ENVIRONMENTAL PARTNERS INC

1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Revised Cleanup Action Report

Lot 4 Chromium Site
Former Mutual Materials Brick Plant Property
Newcastle, Washington

Prepared for:

Newcastle Joint Venture, LLC
600 108th Avenue NE, Suite 840
Bellevue, Washington 98004

August 12, 2020

Prepared by:

Environmental Partners, Inc., a TRC Company
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

State of Washington 2516 Licensed Geologist

ERIC L. CADDEY

Prepared by:
Eric Caddey, L.G.
Senior Geologist

State of Washington 1146 Licensed Geologist

Thomas C. Morin

THOMAS C. MORIN

Reviewed and accepted by:
Thomas C. Morin, L.G.
Principal Geologist/PNW Area Leader

TRC Project Number: 015325.0.0

QR _____ TR tcm

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE IDENTIFICATION AND DESCRIPTION 2

2.1 Site Discovery and Regulatory Status 2
2.2 Property and Site Location 2
2.3 Site Setting 3
2.4 Physiographic Setting 3

3.0 HISTORY AND USES OF SITE 3

3.1 Past Site Uses and Facilities 3
3.2 Current and Future Site Use and Facilities 4
3.3 Zoning 4
3.4 Transportation and Roads 4
3.5 Utilities and Water Supply 4
3.6 Potential Sources of Contamination, Identification of Release 4

4.0 NATURAL CONDITIONS 5

4.1 Soil 5
4.2 Groundwater 5
4.3 Surface Water 5
4.4 Natural Resources and Ecological Receptors 6

5.0 ENVIRONMENTAL INVESTIGATION/REMEDIAL ACTION SUMMARY 6

5.1 Subsurface Investigation 6
5.2 Terrestrial Ecological Evaluation 7

6.0 CONTAMINANT OCCURRENCE AND MOVEMENT 7

7.0 CONCEPTUAL SITE MODEL 7

8.0 CLEANUP STANDARDS 8

8.1 Soil 8
8.2 Groundwater 9
8.3 Surface Water 9
8.4 Indoor Air 9

9.0 FEASIBILITY STUDY 9

9.1 Remedial Action Objectives 9
9.2 Selection of Cleanup Action 9

10.0 IMPLEMENTATION OF THE CLEANUP ACTION 10

10.1 Permitting and Site Preparation 10
10.2 Waste Designation 11
10.3 Health and Safety 11

11.0 CONCLUSIONS 12

12.0 LIMITATIONS 12

TABLES

Table 1 Test Pit Soil Analytical Results (mg/kg)
Table 2 Confirmation Soil Analytical Results (mg/kg)

FIGURES

Figure 1 General Vicinity Map
Figure 2 Location of Site Relative to BSP Lots
Figure 3 Lot 4 Chromium Site Cross Section A-A'
Figure 4 Test Pit Location and Soil Analytical Results
Figure 5 Conceptual Site Model
Figure 6 Remedial Excavation and Confirmation Samples

ATTACHMENTS

Attachment A Phase I Environmental Site Assessment
Attachment B Laboratory Analytical Reports
Attachment C Terrestrial Ecological Evaluation
Attachment D Disposal Information

ABBREVIATIONS AND ACRONYMS

Abbreviation/ Acronym	Definition
bgs	Below ground surface
BSP	Binding Site Plan
CAR	Cleanup Action Report
COC	Compound of concern
COPC	Compound of potential concern
CSM	Conceptual site model
Ecology	Washington State Department of Ecology
EPI	Environmental Partners, Inc.
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
NJV	Newcastle Joint Venture LLC
OSHA	Occupational Safety and Health Administration
TEE	Terrestrial Ecological Evaluation
VCP	Voluntary Cleanup Program
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

1.0 INTRODUCTION

Environmental Partners, Inc. (EPI), a TRC Company[1], is pleased to present this Revised Cleanup Action Report (CAR) for the Lot 4 Chromium Site in Newcastle, Washington (Site; Figure 1). The Site consists of an isolated area of brick manufacturing debris impacted with generally low concentrations of chromium. The Site is located entirely within a parcel of real property identified as Lot 4 in the Binding Site Plan (BSP 16-001) recorded in the property records of King County on December 28, 2016, under Recording No. 20161228000613 (Lot 4). Lot 4 is identified in the property records of King County as Tax Parcel Number 6061250050.

Newcastle Joint Venture, LLC (NJV), the owner of Lot 4, completed a cleanup action at the Site in accordance with the requirements of the Model Toxics Control Act (Chapter 70.105D Revised Code of Washington [RCW]) and its implementing regulations (Chapter 173-340 Washington Administrative Code [WAC]), which together are referred to as MTCA. The cleanup action consisted of the excavation and removal of all hazardous substances at concentrations exceeding cleanup levels developed for the Site, resulting in a final, permanent remedy for the Site. No further remedial action is necessary or possible at the Site.

Key information about the Site is as follows:

- Site Name: Mutual Materials Newcastle Lot 4 Cr Site.
- Ecology Facility Site ID Number: 50608.
- Ecology Cleanup ID Number: 15081.
- Voluntary Cleanup Program (VCP) Number: NW3248.
- Project Consultant for the Site:

  Environmental Partners, Inc., A TRC Company
  1180 NW Maple Street, Suite 310
  Issaquah, Washington 98027
  425-395-0010
  Attn: Thomas Morin

- Party Performing Cleanup Action:

  Newcastle Joint Venture, LLC
  600 108th Avenue NE, Suite 840
  Bellevue, Washington 98004
  Attn: Brian Fritz

[1] EPI was acquired by TRC Environmental Corporation (TRC) on December 27, 2019. For the purposes of this revised CAR, EPI and TRC may be used synonymously.

This revised CAR was prepared in response to an opinion letter from Ecology dated February 19, 2020. The letter requested additional information and clarification of some of the remedial action conducted at the Site. This Revised CAR was prepared in accordance with MTCA and guidance published by Ecology.

2.0 SITE IDENTIFICATION AND DESCRIPTION

This section presents information about the Site and observed impacts in the context of its location.

2.1 Site Discovery and Regulatory Status

In January 2015, NJV acquired a large parcel of property, comprising approximately 54 acres (Property). A brick manufacturing plant formerly operated at the Property. In December 2016, NJV subdivided the Property through recording of a Binding Site Plan (BSP) into three portions: (1) an approximately 27-acre portion that is being developed into apartments, townhomes, retail spaces, parks, and plazas (Developable Portion); (2) an approximately 5-acre portion that was dedicated to the City of Newcastle for public roads (Road Portion); and (3) an approximately 22-acre portion that will remain as open space and critical area tracts (Open Space Portion). The Developable Portion was further subdivided into 11 parcels, known as Lots 1a and 1b and Lots 2 through 10. The Site is located entirely within Lot 4. Figure 2 shows the lots established within the Property through recording of the BSP and the location of the Site within Lot 4.

Before acquiring the Property, NJV performed an environmental assessment of the Property. The environmental assessment identified areas where brick debris had been deposited, including within Lot 4. The nature and extent of the brick debris was further investigated through the excavation of test pits and analysis of soil samples. Analytical results of the soil samples collected from a test pit on Lot 4 indicated total chromium was present at concentrations exceeding the applicable cleanup level for chromium developed for the Site (discussed in Section 8.0) in one location within Lot 4. The lateral and vertical extent of soils that contained total chromium at concentrations exceeding the cleanup level constitutes the “Site” that is the subject of this CAR.

In April 2015, NJV conducted a cleanup action at the Site. The cleanup action consisted of excavation and removal of soil containing total chromium at concentrations exceeding the cleanup level developed for the Site. The cleanup action achieved cleanup standards throughout the Site. Based on the results of the cleanup action, the Site is being enrolled in the VCP and NJV is requesting that Ecology issue a No Further Action (NFA) determination for the Site.

2.2 Property and Site Location

The Site is located entirely within Lot 4, which was created pursuant to the BSP (BSP 16-001) recorded in the property records of King County on December 28, 2016, under Recording No. 20161228000613 (Figure 2). Lot 4 encompasses approximately 110,368 square feet. The legal description of Lot 4 is:

Lot 4, Newcastle Commons Binding Site Plan, according to the Binding Site Plan thereof recorded in Volume 276 of Plats, Pages 1 through 11, inclusive, and is also recorded under recording number 20161228000613, records of King County, Washington.

The geographic coordinates for the Site are 47.544255°north latitude, -122.160189° west longitude. The Site is very small and encompasses only approximately 361 square feet, or less than 0.01 acres. Figure 2 depicts the location of the Site relative to Lot 4.

2.3 Site Setting

The Site is located within the City of Newcastle near the southern boundary of the City of Bellevue. The Site and surrounding area are currently being developed into apartments, townhomes, retail spaces, parks, and plazas. Lot 4 is being redeveloped with residential townhomes and is bordered by critical areas and open space consisting of steep slopes and woodland to the north and east. Newcastle Commons Drive abuts Lot 4 to the south and Lot 3, also developed with apartments and townhomes, abuts Lot 4 to the west.

2.4 Physiographic Setting

The Site is at an elevation of approximately 390 feet above mean sea level (AMSL) and slopes south to north. There are currently steep slopes to the north and east of Lot 4 downward to Coal Creek.

The Site and surrounding area are currently undergoing development with a multi-story townhouse complex.

3.0 HISTORY AND USES OF SITE

This section summarizes previous uses of the Site and provides information regarding the source of the hazardous substances at the Site. Lot 4 and the Site are the focus of this section. A detailed history of the brick plant that formerly operated on the Property is presented in the Phase I Environmental Site Assessment Report (Attachment A).

3.1 Past Site Uses and Facilities

The central portion of the Property was developed in approximately 1957 as a brick manufacturing plant. The plant included two kiln buildings, maintenance and storage buildings, a scale house, and raw material storage sheds. The Site appears to have been used primarily for storage of remnant brick manufacturing debris.

3.2 Current and Future Site Use and Facilities

All historical structures and pavement associated with the former brick plant have been demolished and removed. The initial surface of Lot 4 has been excavated downward by approximately 15 feet below original elevation of 390 feet AMSL. A multi-story townhome structure with a parking garage is currently being constructed on Lot 4, approximately 50 feet south of the location of Test Pit 32. The boundaries and orientation of Lot 4 and Test Pit 32 within the Property are shown on Figure 2.

3.3 Zoning

According to the City of Newcastle Zoning Map and Comprehensive Plan, the Property is zoned as a combination of Mixed Use (MU) Residential and MU Commercial. The current and planned development of the Property is consistent with this zoning and has been approved by the City of Newcastle and all other agencies with regulatory authority.

3.4 Transportation and Roads

Access to the Site is from Newcastle Commons Drive, which runs through the Property and connects Coal Creek Parkway with Newcastle Golf Club Road.

3.5 Utilities and Water Supply

Potable water is supplied by the City of Bellevue municipal system. There are no water supply wells on the Property or Lot 4. Water, sanitary sewer, storm sewer, gas, and electricity will be available throughout the Property after it is developed.

3.6 Potential Sources of Contamination, Identification of Release

The brick debris was accumulated in certain areas of the developable portions of Lot 4. The brick debris accumulated over the operational life of the former brick plant and consisted of off-specification brick and broken bricks not suitable for wholesale or retail sales. The presence of hazardous substances at the Site was assessed through the advancement of one test pit and sampling and analysis of one composite l sample of the broken brick debris collected from this test pit. Analysis of this sample identified total chromium at a concentration exceeding the cleanup level developed for the Site. Section 5.0 below presents additional detail regarding the investigation of the Site.

4.0 NATURAL CONDITIONS

The natural conditions of the Site are described in the following sections.

4.1 Soil

The native soil material for the area is a recessional glacial outwash of varying density and composition, which ranges from 5 to 10 feet in thickness. At the Site a mixture of broken brick debris and poorly-graded sand observed between the surface and about 1 foot below grade underlain by unconsolidated sandy and gravelly soil.

It is anticipated that these native unconsolidated soils continue down to the depth of a native siltstone bedrock that is present beneath all areas of the Property, outcroppings of which are visible on Lot 10. The siltstone bedrock is anticipated at an elevation of between 350 and 340 feet AMSL, or about 50 to 60 feet below grade.

4.2 Groundwater

EPI did not encounter groundwater during the test pit excavation at the Site, which reached a depth of approximately 12 feet below ground surface (bgs).

A water table aquifer at the Property, where present, may be perched on the siltstone bedrock. The elevation of Lot 4 prior to mass excavation was approximately 390 feet AMSL. A water table aquifer was first encountered on the adjacent Lot 3 to the west at an elevation of about 360 feet AMSL, or about 30 feet below grade. Groundwater was encountered in a newly installed well, BLK-4-MW-5, located approximately 180 feet southeast of Test Pit 32. The top of this well was surveyed by a licensed surveyor with an elevation of approximately 380 AMSL. The depth to groundwater in this well is approximately 20 feet bgs, indicating that the elevation of the groundwater in the area of the well and Test Pi 32 is approximately 360 feet AMSL. EPI also installed two other groundwater monitoring wells and the survey data from all three wells indicates a groundwater flow direction to the northeast. These data are documented in EPI's *Cleanup Action Report Model Remedy 1, Lot 4 Former Drywell Site*, and dated October 1, 2019. Figure 3 presents an interpretive cross-section of the Site.

A regional aquifer may be present deeper within the siltstone bedrock and is anticipated to be at depths greater than 200 feet below grade.

4.3 Surface Water

There is no surface water on Lot 4 or the Site. A Category 3, non-fish-bearing stream, identified as Brickyard Stream, is located within the open space tract to the east of Lot 4 (Figure 2) at the base of a steep slope. Brickyard Stream originates at a stormwater culvert on the north side of Newcastle Golf Club Road. Brickyard Stream is primarily an extension of surface water drainage from the road and is dry between precipitation events. When water is present, Brickyard Stream flows to the north. There is no surface water or street flow from Lot 4 to Brickyard Stream.

Coal Creek is located approximately 350 feet northeast of the Site. The creek is at the base of the steep slope that begins at the edge of Lot 4. The steep slope is heavily wooded and rocky.

4.4 Natural Resources and Ecological Receptors

The areas to the west and south of Lot 4 contain existing residential and commercial buildings. Areas to the north and east contain woodlands with Coal Creek to the north and Brickyard Stream to the east.

The potential receptors of concern at the Site and surrounding areas may include vascular vegetation, soil biota, ground-feeding birds, ground-feeding small mammalian predators, and small herbivorous mammals. These are categorized into the following three basic categories:

- Plants
- Soil Biota; and
- Wildlife.

5.0 ENVIRONMENTAL INVESTIGATION/REMEDIAL ACTION SUMMARY

EPI conducted a subsurface investigation and terrestrial ecological evaluation to assess the potential environmental impacts at the Site. The results of those investigations and evaluations are described below.

5.1 Subsurface Investigation

EPI conducted a subsurface investigation of the Property in the third quarter of 2012. The objective of the investigation was to evaluate the presence of potential environmental impacts associated with historical operation of the former brick plant in Lot 4. This section presents the findings of the investigation pertinent to the Site.

On October 25, 2012, EPI observed the excavation of one test pit (TP-32) in Lot 4, in a small area where brick debris was observed. The test pit location is indicated on Figure 4. The test pit was excavated under the direction of Terra Associates, Inc. (Terra) as a component of the geotechnical investigation for the Property, but EPI collected the soil sample.

The test pit was excavated until native soils were encountered. Lithology included a mixture of sand and broken bricks from 0 to 5 feet bgs, and native poorly-graded sand from 5 feet to 8 feet bgs at the bottom of the excavation. The cross-section inset on Figure 3 presents the lithologic information for TP-32. One continuous composite sample, TP-32, was collected by scraping the material from the sidewall and placing it into a plastic bag. The material was then mixed inside the bag and a portion of the composited material was placed into an 8-ounce glass jar, labeled, and placed into a cooler with ice. The sample was transported under standard chain-of-custody procedures and submitted for laboratory analysis of priority pollutant metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, zinc, and total mercury. The analytical results indicated that the composite sample collected from TP-32 contained detectable concentrations of arsenic, chromium, copper, lead,

mercury, and nickel. Chromium was detected at a concentration of 98 milligrams per kilogram (mg/kg), which exceeded the Site-specific terrestrial ecological evaluation (TEE) cleanup level of 42 mg/kg. The sample results are summarized in Table 1 and Figure 4. The laboratory analytical reports are included in Attachment B.

After sample collection, the test pit was immediately backfilled with the excavated material.

5.2 Terrestrial Ecological Evaluation

EPI completed a Site-specific terrestrial ecological evaluation (TEE) for the Property consistent with the requirements of WAC 173-340-7490 and -7493 (Attachment C). A Site-specific TEE was conducted because of the shallow nature of the soil impacts, the uncapped nature of the Property, and the large area of contiguous undeveloped land adjacent to the Property. The TEE was used to develop cleanup levels protective of terrestrial and ecological exposures. Section 8.0 discusses the TEE cleanup levels and presents the cleanup levels developed for the Site.

6.0 CONTAMINANT OCCURRENCE AND MOVEMENT

The test pit investigation identified chromium in a mixture of soil and brick debris extending down to a depth of -5 feet bgs in Lot 4. Chromium is not mobile in the conditions present at the Site. Chromium appears to have originated from the brick debris piled on the ground surface. Sample results combined with the extent of brick debris indicates that the Site was wholly confined within Lot 4.

7.0 CONCEPTUAL SITE MODEL

The following conceptual site model (CSM) is based on data collected during the subsurface investigation of the Site. The CSM identifies potential human and ecologic exposure pathways. The CSM is presented in Figure 5 and is discussed below:

- The Site and surrounding land is zoned as Mixed Use Residential (MU-R) and Mixed Use Commercial (MU-C). The Site consists of approximately 361 square feet.
- After remediation, Lot 4 was redeveloped with residential townhomes.
- There is no surface water on Lot 4 or the Site.
- Subsurface conditions at the Site are generally composed of fill material overlying recessional outwash (where present) and native bedrock. Denser soils may be encountered below the outwash, directly overlying the sedimentary bedrock. Sedimentary sequences are comprised of sandstone, siltstone, and shale that are weathered at their upper contact and become more cemented with depth.

- Groundwater has been encountered in the network of groundwater monitoring wells installed to the east-southeast on Lot 4 . Monitoring data from these wells indicate that groundwater is approximately 20 feet bgs at the Site with a flow direction to the northeast.

- Total chromium is the only compound of potential concern (COPC) for the Site.

- The environmental medium where the COPC was detected is shallow soil. Groundwater was not encountered in the test pit excavated at the Site and is greater than 15 feet bgs below the excavation. The apparent source of the COPC is brick manufacturing debris that was placed on the ground within Lot 4.

- No volatile compounds have been detected in soil at the Site. Therefore, indoor air is not a medium of concern for future buildings constructed on Lot 4 or the Site.

- Ingestion and direct contact are the only potential human exposure pathways to the COPC at the Site.

- There are potential terrestrial and ecological exposures to the COPC at the Site.

8.0 CLEANUP STANDARDS

EPI established cleanup standards for the Site, which consist of cleanup levels and points of compliance at which those cleanup levels must be achieved. In selecting the cleanup levels, EPI considered the exposure pathways and potential receptors identified in the CSM (Section 7.0). As required by MTCA, the selected cleanup levels are protective of human health and the environment based upon the exposure pathways that remain after completion of the cleanup action.

8.1 Soil

EPI selected cleanup levels for the Site after comparing MTCA Method A soil cleanup levels for unrestricted land uses, MTCA Method B soil cleanup levels protective of direct contact, and the Site-specific cleanup levels developed in the TEE. The cleanup level selected for each COPC is the most stringent of those evaluated for each compound and is identified in Table 1.

The compounds of concern (COCs) for the Site consist of those hazardous substances that have been detected at concentrations exceeding the selected cleanup levels. Total chromium is the only COC for the Site. The cleanup level for chromium is 42 mg/kg. However, the MTCA Method A Cleanup Level protective of groundwater is 2,000 mg/kg. The highest concentration of chromium at the Site was 98 mg/kg. Therefore, the concentrations of chromium found at the Site are protective of groundwater.

The point of compliance for the cleanup level is all soil within 15 feet of the ground surface. This point of compliance is protective of all potential human, terrestrial, and ecological exposures at the Site (WAC 173-340-740(6)(d)).

8.2 Groundwater

Groundwater is not an affected medium at the Site and cleanup levels were therefore not developed.

8.3 Surface Water

Surface water is not an affected medium at the Site and cleanup levels were therefore not developed.

8.4 Indoor Air

No volatile compounds have been detected in soil at the Site. Therefore, indoor air is not a medium of concern and cleanup levels were not developed.

9.0 FEASIBILITY STUDY

9.1 Remedial Action Objectives

The primary remedial action objective (RAO) was to remove by excavation all soil from the Site containing total chromium at concentrations exceeding the cleanup levels developed for the Site.

9.2 Selection of Cleanup Action

A permanent remedy was selected for the Site based on best professional judgment and past experience with similar sites where only soil was impacted. The cleanup action selected for the Site consisted of excavation and off-Site disposal of all soil containing total chromium at concentrations exceeding the cleanup levels developed for the Site. This cleanup action was selected because it would be highly effective, quick to implement, and would constitute a final, permanent solution for the Site.

The selected cleanup action met the requirements of MTCA and, as described in detail below, resulted in a permanent cleanup of the Site. The selected cleanup action was evaluated against the threshold requirements in WAC 173-340-360(2)(a) and the other requirements in WAC 173-340-360(2)(b). The threshold requirements include:

- Protect human health and the environment;
- Comply with cleanup standards;
- Comply with applicable state and federal laws; and
- Provide for compliance monitoring.

The other requirements include:

- Use permanent solutions to the maximum extent practicable;
- Provide for a reasonable restoration time frame; and
- Consider public concerns.

The selected cleanup action was determined to meet the "minimum requirements for cleanup actions" specified in WAC 173-340-360(2).

10.0 IMPLEMENTATION OF THE CLEANUP ACTION

In April 2015, NJV's excavation subcontractor (J.R. Hayes), conducted a remedial excavation at the Site. The remedial action was square, approximately 19 feet long and 19 feet wide and 6 feet deep. The extent of the remedial excavation is depicted on Figure 6. The lithology of the excavation consisted of broken brick and sand from surface to 5 feet bgs in the center of the excavation, and approximately 0 to 3 feet progressively out from the center. The final limits consisted of traces of broken brick and sand from 0 to 2 feet, and poorly graded sand from 2 feet to the bottom of the excavation at 6 feet bgs. A cross-section through the excavation is provided in the inset on Figure 3.

Performance samples were collected as the remedial excavation progressed to guide the excavation. The performance samples were collected from native soils after the overlying brick fill was removed. A performance sample was deemed a confirmation sample when laboratory analysis of the sample indicated it did not contain COCs at concentrations exceeding the cleanup levels developed for the Site. Upon completion of the remedial excavation, no visible brick fill debris remained, and the sidewalls and bottom of the remedial excavation consisted of native soil.

A total of four sidewall samples and one bottom soil sample were collected from the lateral limits and bottom of the excavation. All five samples were designated as confirmation samples and consisted of poorly graded sand. The locations of the soil samples are depicted on Figure 6. The soil samples were placed into laboratory-supplied containers, then transported and submitted under standard chain-of-custody protocols to Friedman and Bruya, Inc., of Seattle, Washington, for laboratory analysis. Soil samples were analyzed for total chromium by U.S. Environmental Protection Agency (EPA) Method 200.8. The analytical results for the soil samples are presented in Table 2. Total chromium was not detected in any of the confirmation samples at concentrations exceeding the cleanup level of 42 mg/kg.

The remedial excavation encompassed approximately 361 square feet. A total of 141.87 tons of brick debris and impacted soil were transported from the Site for disposal at the Roosevelt Regional Landfill in Roosevelt, Washington. The excavation was backfilled with clean crushed brick from the on-Site crushing unit.

The completed cleanup action has achieved the cleanup standards throughout the Site. No further remedial action is necessary or possible at the Site.

10.1 Permitting and Site Preparation

No permits were required for the cleanup action. The cleanup action was incorporated in the development and grading permits for NJV's development project.

While no permits were required for worker health and safety issues, the cleanup action complied with the provisions of the Washington Industrial Safety and Health Act (WISHA) and the Code of Federal

Regulations (CFR) subpart 1910.120 that governs Hazardous Waste Operations and Emergency Response (HAZWOPER).

Before commencement of the cleanup action, it was confirmed that there were no underground utilities in the area of the remedial excavation.

10.2 Waste Designation

Brick debris and soil excavated from the Site was transported under a profile as non-hazardous material. The interim destination was the Regional Disposal Intermodal facility in Seattle, Washington. The final destination was the Roosevelt Regional Landfill in Roosevelt, Washington. Laboratory analytical results for samples used for waste profiling are provided in Table 1. The weight disposal information is included as Attachment D.

10.3 Health and Safety

The cleanup action was conducted in accordance with a Site-specific Health and Safety Plan (HASP) and applicable state and federal regulations governing worker health and safety. EPI prepared the HASP in accordance with the requirements of the Occupational Safety and Health Administration (OSHA) and the WISHA standards for hazardous waste site operations (29 CFR 1910.120 and WAC 296-62 Part P). The HASP established the general health and safety practices for EPI personnel performing the cleanup action. Implementation of this level of on-Site health and safety monitoring is considered adequate to meet the requirements of WAC 173-340-410(1)(a) for the following reasons:

- Access to the remedial excavation was limited to authorized personnel. Personnel participating in remedial activities were required to be 40-hour HAZWOPER certified.
- The field monitoring and mitigation measures called for in the HASP were protective of on-site worker health and were adequate to protect the health of construction workers on other portions of the Property.
- The remedial work was conducted in accordance with applicable OSHA and WISHA regulations.
- Health risks associated with long-term exposures to relatively low concentrations of COCs at the Site were not a significant concern.

EPI conducted protection monitoring during implementation of the cleanup action, in accordance with WAC 173-340-410(1)(a) and the HASP, to ensure worker safety and to confirm that human health was adequately protected.

11.0 CONCLUSIONS

The following conclusions are supported by the results of the completed cleanup action:

- The nature and extent of the total chromium at the Site was fully characterized through environmental investigations and additional sampling conducted during the cleanup action.

- The apparent source of the total chromium was brick debris associated with long-term brick-making operations.

- Soil is the only medium of concern at the Site. Groundwater is approximately 20 feet bgs at the Site and the Site has no potential to impact groundwater in the future.

- The highest concentration of Chromium in soil at the Site was 98 mg/kg. The Site-Specific TEE Cleanup Level determined for this site is 42 mg/kg. This TEE CUL relates to protecting the terrestrial ecological environment found living at the surface down to 15 feet bgs. The 42 mg/kg concentration is not appropriate for the protection of groundwater. The Method A Cleanup Level of 2,000 mg/kg is the concentration used for the protection of groundwater (stated on page 5 of Ecology's comment letter). Therefore, with groundwater at least 20 feet bgs, it is believed that the concentrations of chromium found at the Site are clearly protective of groundwater, and no further groundwater assessment is necessary.

- Approximately 141.87 tons of brick debris and soil were excavated and transported off-Site for final disposal at the Roosevelt Regional Landfill in Roosevelt, Washington.

- The cleanup action constitutes a permanent solution for the Site because no COC remains in soil at the Site at concentrations exceeding the cleanup levels. The cleanup action has achieved cleanup standards throughout the Site.

- No further remedial action is necessary or possible at the Site.

12.0 LIMITATIONS

To the extent that preparation of this CAR has required the application of best professional judgment and the employment of scientific principles, certain results of this work have been based on subjective interpretation. TRC makes no warranties, express or implied including and without limitation warranties as to merchantability or fitness for a particular purpose. The information provided in this CAR is not to be construed as legal advice.

This CAR was prepared solely for NJV and its affiliates, partners, and advisors, and the contents of this CAR may not be used or relied upon by any other person without the express written consent and authorization of TRC.

Tables

Table 1
Test Pit Soil Analytical Results (mg/kg)
Cleanup Action Report
Lot 4 Chromium Site
Former Mutual Materials Property, Newcastle, Washington

Sample ID	Sample Date	Detected Metals[b]						
		Arsenic	Beryllium	Chromium	Copper	Lead	Nickel	Zinc
TP-32	10/25/2012	**7.6**	**0.62**	**98**	**16**	**17**	**29**	**28**
MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses[c]		**20**	**NVE**	**2,000**	**NVE**	**250**	**NVE**	**NVE**
MTCA Method B Soil Cleanup Levels[d]		**NA**	**160**	**NA**	**3,200**	**NA**	**160**	**24,000**
Site-Specific TEE Cleanup Level[e]		**17.6**	**NA**	**42**	**50**	**50**	**NA**	**NA**

Notes:

All results presented in milligrams/kilogram (mg/kg).

Bold Bold results indicate that the compound was detected.

Shaded cells indicate that the compound was detected at a concentration greater than the cleanup level.

Established cleanup level.

a Analyzed by EPA Method 1631E.

b Analyzed by EPA Method 200.8 except where indicated.

c Model Toxics Control Act (MTCA) Table 740-1, Chapter 173-340-900.

d MTCA Method B soil cleanup level for direct contact, unrestricted land uses from Cleanup Level and Risk Calculations (CLARC) Master Spreadsheet.

e Site-specific terrestrial and ecological cleanup levels based on the *Site Specific Terrestrial Ecological Evaluation* included as Attachment C.

NVE No cleanup value established for this compound.

NA Not applicable.

Table 2
Confirmation Soil Analytical Results (mg/kg)
Cleanup Action Report
Lot 4 Chromium Site
Former Mutual Materials Property, Newcastle, Washington

Sample Name	Sample Depth (feet)	Sample Date	Metals[a]
			Chromium
A2-B1:6	6	4/6/2015	**7.46**
A2-SW1:3	3	4/6/2015	**4.95**
A2-SW2:4	4	4/6/2015	**10.1**
A2-SW3:3	3	4/6/2015	**9.4**
A2-SW4:4	4	4/6/2015	**7.96**
MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses[b]			**2,000**
MTCA Method B Soil Cleanup Levels[c]			**NA**
Site-Specific TEE Cleanup Level[d]			**42**

Notes:
All results presented in milligrams/kilogram (mg/kg).

Bold Bold results indicate that the compound was detected,

Cells shaded gray indicate that the compound was detected at a concentration greater than a cleanup level.

Selected cleanup level.

a Total Chromium analyzed by EPA Method 200.8.

b Model Toxics Control Act (MTCA) Table 740-1, Chapter 173-340-900.

c MTCA Method B soil cleanup level for direct contact, unrestricted land uses from Cleanup Level and Risk Calculation (CLARC) Master Spreadsheet.

d Site-specific terrestrial and ecological cleanup levels based on the *Site-Specific Terrestrial Ecological Evaluation* included as Attachment C.

NA Not applicable.

Figures

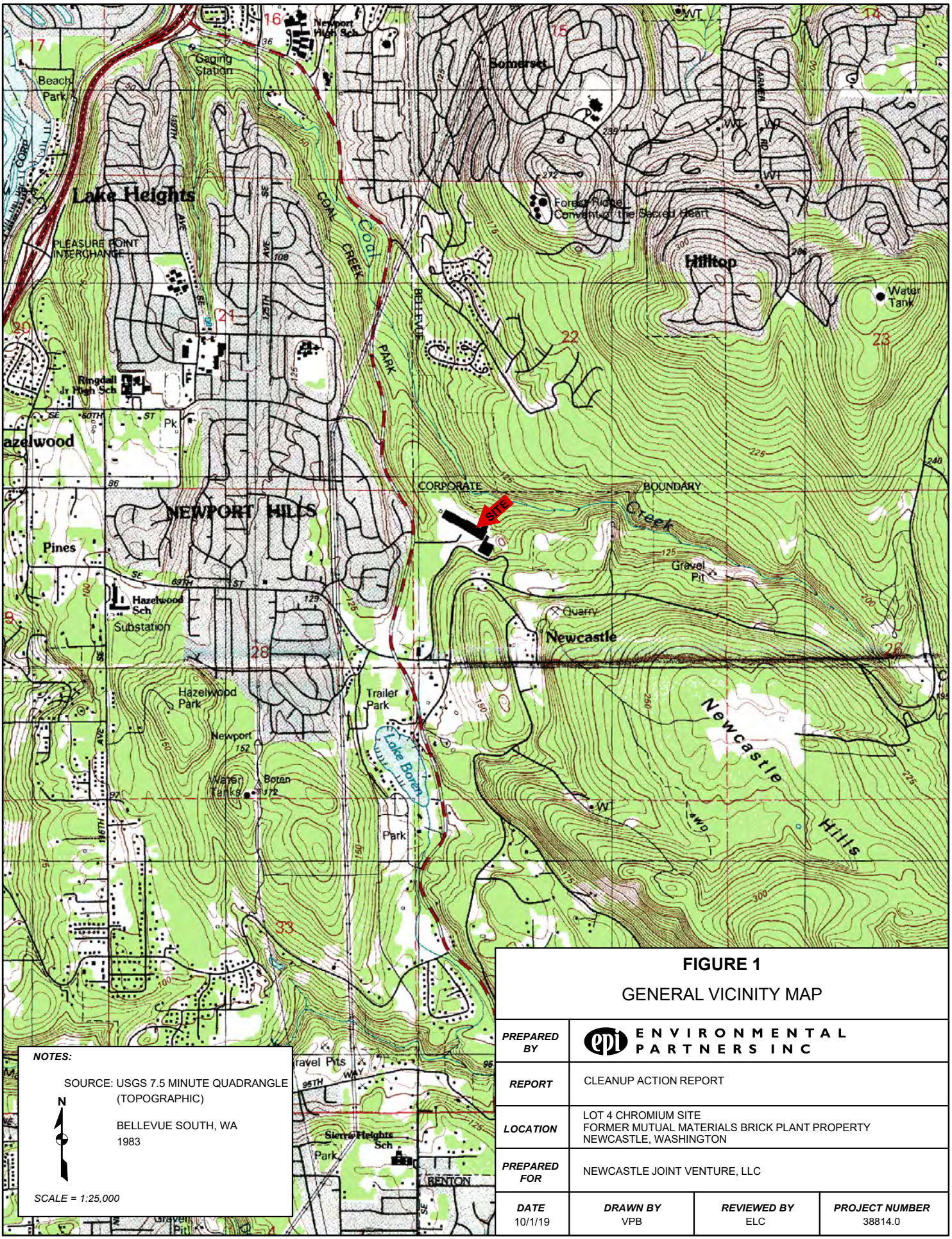
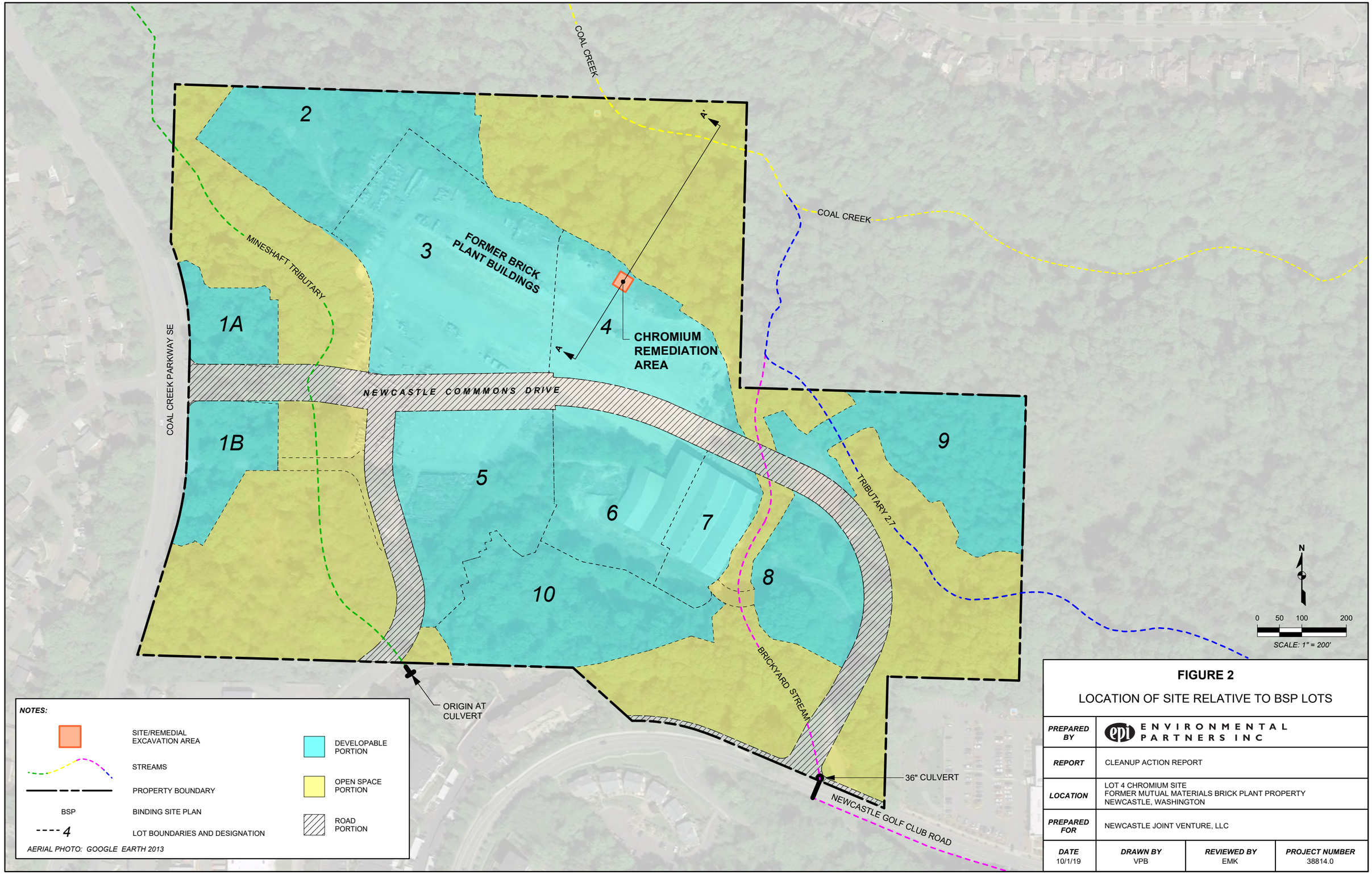


FIGURE 1

GENERAL VICINITY MAP

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON		
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC		
DATE 10/1/19	***DRAWN BY*** VPB	***REVIEWED BY*** ELC	***PROJECT NUMBER*** 38814.0



NOTES:

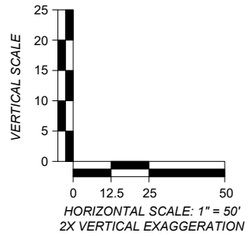
- SITE/REMEDIAL EXCAVATION AREA
- STREAMS
- PROPERTY BOUNDARY
- BSP — BINDING SITE PLAN
- 4 — LOT BOUNDARIES AND DESIGNATION
- DEVELOPABLE PORTION
- OPEN SPACE PORTION
- ROAD PORTION

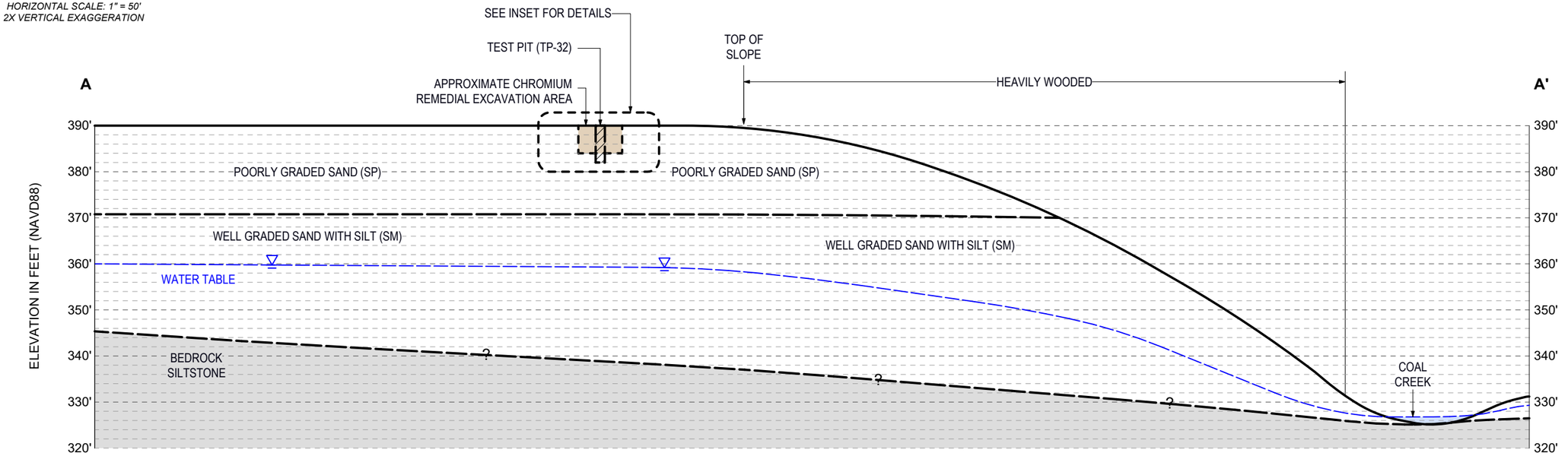
AERIAL PHOTO: GOOGLE EARTH 2013

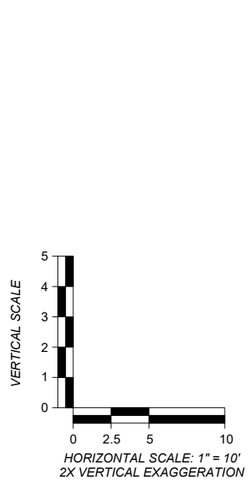
FIGURE 2

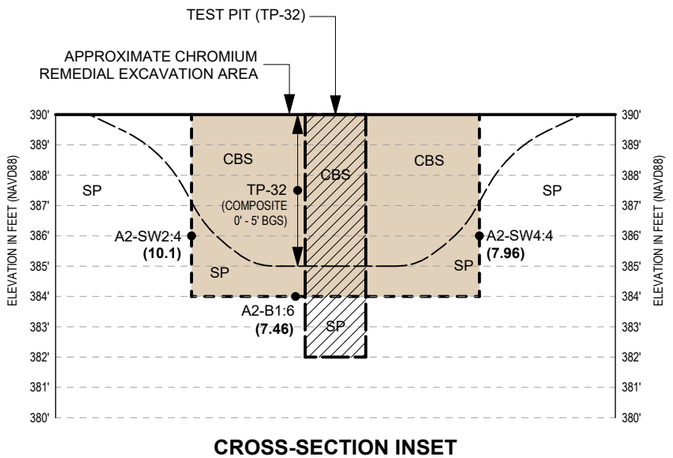
LOCATION OF SITE RELATIVE TO BSP LOTS

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON		
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC		
DATE 10/1/19	**DRAWN BY** VPB	**REVIEWED BY** EMK	**PROJECT NUMBER** 38814.0









CROSS-SECTION INSET

NOTES:

SP	POORLY GRADED SAND
CBS	CRUSHED BRICK AND SAND
SM	WELL GRADED SAND WITH SILT
BGS	BELOW GROUND SURFACE
● A2-SW2:4 **(10.1)**	SOIL SAMPLE LOCATION WITH CHROMIUM CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)
TP-32	COMPOSITE SOIL SAMPLE
▽	WATER LEVEL INDICATOR

FIGURE 3

LOT 4 CHROMIUM SITE CROSS-SECTION A-A'

PREPARED BY	ENVIRONMENTAL PARTNERS INC
REPORT	CLEANUP ACTION REPORT
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC

DATE	***DRAWN BY***	***REVIEWED BY***	***PROJECT NUMBER***
4/9/20	VPB	TCM	015325.0003.0000

TP-32	COMPOSITE SAMPLE RESULTS IN MILIGRAMS PER KILOGRAM (mg/kg)
ARSENIC	**7.6**
BERYLLIUM	**0.62**
CHROMIUM	**98**
COPPER	**16**
LEAD	**17**
NICKEL	**29**
ZINC	**28**

BOLD VALUES REPRESENT A DETECTABLE CONCENTRATION, BOLD VALUES WITH GRAY BACKGROUND REPRESENT A CONCENTRATION DETECTED ABOVE CLEANUP LEVELS

3

FORMER BRICK PLANT BUILDINGS

4

CHROMIUM REMEDIATION AREA

COAL CREEK

NEWCASTLE COMMMONS DRIVE

5

6

7

8

9

N

0 25 50 100

SCALE: 1" = 100'

NOTES:

REMEDIATION AREA

STREAMS

PROPERTY BOUNDARY

4 BLOCK BOUNDARIES AND DESIGNATION

TEST PIT LOCATION

DEVELOPABLE PORTION

OPEN SPACE PORTION

ROAD PORTION

AERIAL PHOTO: GOOGLE EARTH 2013

FIGURE 4

TEST PIT LOCATION AND SOIL ANALYTICAL RESULTS

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON		
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC		
DATE 10/1/19	***DRAWN BY*** VPB	***REVIEWED BY*** EMK	***PROJECT NUMBER*** 38814.0

Primary Sources	Contaminants of Potential Concern	Media of Concern	Transport Mechanisms
Brick Debris Fill	Chromium	[x] Surface Soil (0–2 feet bgs)	[x] Direct release to soil [x] Migration to subsurface soil [ ] Migration to groundwater [ ] Volatilization [x] Runoff or erosion [x] Uptake by plant or animal [ ] Other (list) _____
		[x] Soil (> 2 feet bgs)	[x] Direct release to soil [ ] Migration to groundwater [ ] Volatilization [ ] Other (list) _____
		[ ] Groundwater	[ ] Release to groundwater [ ] Volatilization [ ] Future migration to surface water [ ] Future migration to sediment [ ] Uptake by plant or animal [ ] Other (list) _____
	[x] Adsorbed onto soil [ ] Dissolved in water [ ] Non-aqueous phase	[ ] Surface Water	[x] Release to surface water [ ] Volatilization [ ] Sedimentation [x] Uptake by plant or animal [ ] Other (list) _____
		[ ] Sediment	[ ] Release to surface water [ ] Resuspension or erosion [ ] Uptake by plant or animal [ ] Other (list) _____

Exposure Media	Exposure Pathway	Current (C) and Potential Future (F) Receptors: Commercial Industrial	Construction Worker	Residential/ Recreational	TEE Receptors
[x] Soil	[x] Ingestion	C	C	C	C
	[x] Dermal Exposure	C	C	C	C
[ ] Groundwater	[ ] Ingestion				
	[ ] Dermal Exposure				
[ ] Air	[ ] Inhalation				
[ ] Surface Water	[ ] Ingestion				
	[ ] Dermal Contact				
[ ] Sediment	[ ] Ingestion				
	[ ] Dermal Contact				
[ ] Indoor Air	[ ] Inhalation				

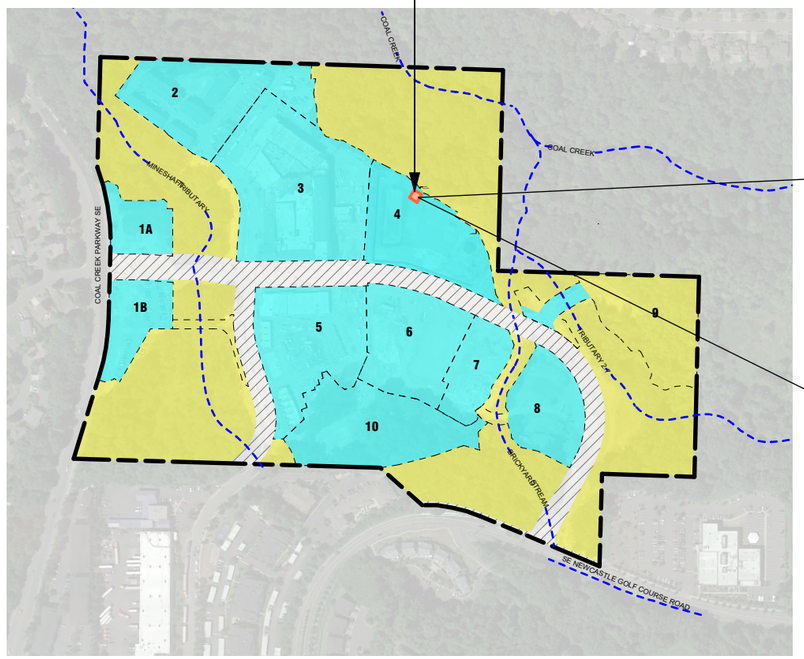
NOTES:
bgs = below ground surface

FIGURE 5
CONCEPTUAL SITE MODEL

PREPARED BY	ENVIRONMENTAL PARTNERS INC
REPORT	CLEANUP ACTION REPORT
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC

DATE	***DRAWN BY***	***REVIEWED BY***	***PROJECT NUMBER***
10/1/19	VPB	TCM	38814.0

BLOCK 4
CHROMIUM



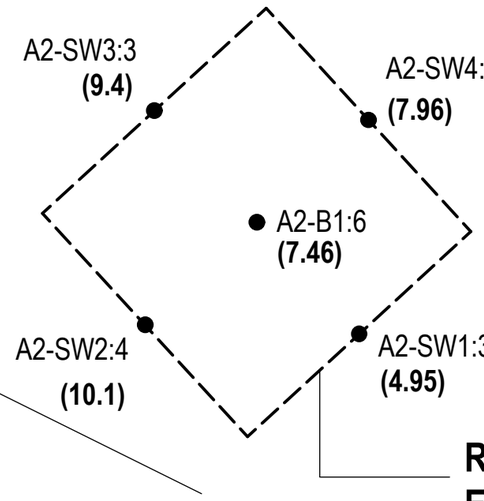
N

0 125 250 500

SCALE: 1" = 500'

KEY MAP

BOUNDARY
TOP OF SLOPE



REMEDIAL EXCAVATION BOUNDARY (CHROMIUM)

N

0 2.5 5 10

SCALE: 1" = 10'

NOTES:

- A2-SW1:3 **(4.95)** — CONFIRMATION SAMPLE WITH CHROMIUM RESULTS IN MILLIGRAMS PER KILOGRAM (mg/kg), BOLD RESULTS INDICATE COMPOUND WAS DETECTED
- REMEDIATION AREA
- STREAMS
- PROPERTY BOUNDARY
- 4 — BLOCK BOUNDARIES AND DESIGNATION
- DEVELOPABLE PORTION
- OPEN SPACE PORTION
- ROAD PORTION

AERIAL PHOTO: GOOGLE EARTH 2013

FIGURE 5
REMEDIAL EXCAVATION LIMITS AND CONFIRMATION SAMPLES

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC
REPORT	CLEANUP ACTION REPORT
LOCATION	LOT 4 CHROMIUM SITE FORMER MUTUAL MATERIALS BRICK PLANT PROPERTY NEWCASTLE, WASHINGTON
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC

DATE	***DRAWN BY***	***REVIEWED BY***	***PROJECT NUMBER***
10/1/19	VPB	EMK	38814.0

Attachment A
Phase I Environmental Site Assessment Report

ENVIRONMENTAL PARTNERS INC
1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Phase I Environmental Site Assessment

Former Mutual Materials Brick Plant
6620 Coal Creek Parkway Southeast
Newcastle, Washington 98059

Prepared For:

AvalonBay Communities, Inc.
600 108th Avenue NE, Suite 840
Bellevue, Washington 98004

January 7, 2015

Prepared By:

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

State of Washington
1148
Licensed Geologist

Thomas C. Morin

Thomas C. Morin, LG
President/Principal Geologist

The above signature denotes that, "I declare to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in §312.10 of 40 CFR 312 and I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed the all appropriate inquires in conformance with the standards and practices set forth in 40 CFR Part 312."

EPI Project Number: 38814.0

QR TM TR TM

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Purpose 1
1.2 Scope-of-Services 1
1.3 Significant Assumptions 2
1.4 Limitations and Exceptions 2
1.5 Special Terms and Conditions 2
1.6 User Reliance 2
1.7 User Provided Information 2
1.7.1 Title Records 3
1.7.2 Environmental Liens or Activity and Use Limitations 3
1.7.3 Specialized Knowledge 3
1.7.4 Valuation Reduction for Environmental Issues 3
1.7.5 Obvious or Commonly Known Site Information 3

2.0 SUBJECT PROPERTY DESCRIPTION 4

2.1 Location and Legal Description 4
2.2 Site and Vicinity General Characteristics 5
2.3 General Site Description and Improvements 5
2.4 Physical Setting 6
2.4.1 Topography 6
2.4.2 Soil 6
2.4.3 Groundwater 7
2.4.4 Surface Water 7

3.0 HISTORICAL RECORDS REVIEW 8

3.1 Historical Use of the Subject Property 9
3.2 Historical Use of Adjoining Properties 10

4.0 SUBJECT PROPERTY RECONNAISSANCE 10

4.1 Methodology and Limiting Conditions 10
4.2 Observations 11
4.2.1 Exterior Observations 14
4.2.2 Interior Observations 14
4.3 Vicinity Land Use and Observations 15

5.0 RECORDS REVIEW 15

5.1 Standard Environmental Record Sources 15

5.1.1 Subject Property 17

5.1.2 Surrounding Properties 19

5.2 Additional Environmental Record Sources 20

6.0 INTERVIEW 20

7.0 FINDINGS AND CONCLUSIONS 21

8.0 DEVIATIONS AND DATA GAPS 22

TABLES (EMBEDDED)

Table 1 Reconnaissance Checklist Summary 11
Table 2 Regulatory Review Information Summary 16

FIGURES

Figure 1 General Vicinity Map
Figure 2 Site Representation

ATTACHMENTS

Attachment A UST Closure & Site Assessment Report
Attachment B Transformer Area Soil Sampling Report
Attachment C Aerial Photographs
Attachment D Regulatory Database Report
Attachment E City Directory Abstract
Attachment F Sanborn Map Report
Attachment G Topographic Map Report
Attachment H Site Photographs
Attachment I Storm Water Pollution Prevention Plan
Attachment J Archived Tax Assessor Information
Attachment K ASTM Questionnaire
Attachment L Qualifications of Environmental Professional

1.0 INTRODUCTION

Environmental Partners, Inc. (EPI) completed a Phase I Environmental Site Assessment (ESA) of the former Mutual Materials brick plant located at 6620 Coal Creek Parkway SE in Newcastle, Washington (the "subject property"). The subject property consists of three adjoining tax parcels that total 52.68 acres. The subject property was occupied by the Mutual Materials brick plant from approximately 1957 until June 2011, when operations ceased. The plant buildings and most of the storage structures have since been demolished and the debris has been removed from the subject property.

EPI's services were performed on behalf of AvalonBay Communities, Inc. (AvalonBay), who requested this Phase I ESA as a component of due diligence in support of a potential purchase of the subject property.

A Phase II ESA of the subject property was performed concurrent with and following the Phase I ESA described herein. The results of that Phase II ESA are presented under separate cover. Where appropriate, some of the findings of that Phase II ESA are incorporated herein and reiterated within the Phase II ESA report.

1.1 Purpose

The purpose of this Phase I ESA is to permit a user to qualify for one or more liability defenses available under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Model Toxics Control Act (MTCA) by conducting all appropriate inquiry into the previous ownership and uses of the subject property consistent with good commercial or customary practice as defined by 42 U.S.C. §9601 (35)(B). The goal of this environmental site assessment is to identify recognized environmental conditions using the level of care that is standard in the environmental industry today.

The term *recognized environmental conditions (RECs),* as defined by American Society for Testing and Materials (ASTM), is the presence or likely presence of any *hazardous substances* or *petroleum products* on a *property* under conditions that indicate an existing release, a past release, or a material threat of a release of any *hazardous substances* or *petroleum products* into structures on the *property* or into the ground, groundwater, or surface water of the property. The term includes *hazardous substances* or *petroleum products* even under conditions in compliance with laws. The term is not intended to include *de minimis* conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies.

1.2 Scope-of-Services

This Phase I ESA was performed in general accordance with ASTM Practice E 1527-13, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM, 2013). The Phase I ESA also meets 40 CFR Part 312, Standards and Practices for All Appropriate Inquiries (AAI).

In should be noted that, consistent with ASTM standards, this assessment did not include investigations related to asbestos, lead-based paint, radon, regulatory compliance, mold or ecological resources.

1.3 Significant Assumptions

The conclusions of this Phase I ESA are based on research of readily available current and historical information sources, subject property and local agency personnel interviews, review of previous environmental investigations, and a site visit. Whenever possible, more than one source of information was researched in order to substantiate our findings and conclusions. Whether we relied on one or multiple information sources, we must assume that the available information source(s) are correct.

1.4 Limitations and Exceptions

The conclusions are based on information described herein and our experience and professional judgment. The information was either made available to EPI or reasonably obtained within the practical constraints of our scope of services. It is not possible to eliminate all uncertainties; however, steps can be taken to reduce their impact. If you become aware of information we did not consider, or have any questions concerning our conclusions and recommendations, please advise us immediately.

No practical study or procedure can or should be expected to discover all potential contamination. However, we believe this environmental assessment, in conjunction with any recommended additional studies, does represent due diligence as determined in accordance with the professional standard of care. This standard is the current level of care and skill ordinarily exercised by members of the engineering profession practicing under similar conditions in the project area. EPI cannot be responsible if due diligence standards change or if you are required to meet a higher standard.

1.5 Special Terms and Conditions

There are no special terms or conditions associated with this Phase I ESA.

1.6 User Reliance

This report was prepared for exclusive use by AvalonBay and its investors, lenders, partners, and affiliates for this project only. Providing the report to others not party to agreement between AvalonBay and EPI, or using it for other projects or purposes can result in misunderstandings or incorrect conclusions. EPI cannot be responsible for the interpretation or extrapolation of the data contained herein, except as stated in our conclusions or recommendations.

1.7 User Provided Information

The ASTM User Questionnaire was completed by Mr. Jeff Linstad, Manufacturing Engineer for Mutual Materials to meet the requirements of Section 6 of the ASTM standard. Mr. Linstad has been associated with the subject property for approximately 33 years. EPI conducted an interview with Mr. Linstad during the walkthrough of the facility and this information is incorporated into the appropriate sections of the report.

Additionally, EPI reviewed the EMG Corporation *Phase I Environmental Site Assessment* for the Mutual Materials Newcastle Brick Plant dated May 1, 2009.

1.7.1 Title Records

A Title Report dated November 28, 2011 and prepared by First American Title Insurance Company, was provided to EPI for review as part of this assessment. The legal owner of the subject property at the time of this Phase I ESA was Mutual Materials Company, a Nevada Corporation. EPI understands there have been no conveyances of title since the date of the Title Report. The lack of a more recent title report is not a data gap that affects the conclusions in this report.

1.7.2 Environmental Liens or Activity and Use Limitations

No records of environmental liens or activity and use limitations were identified in connection with the subject property according to the above-referenced title information or King County Tax Assessor information.

1.7.3 Specialized Knowledge

Mutual Materials is the prospective seller of the subject property and Mr. Linstad indicated that he has no specialized knowledge of the prospective purchaser's business or former occupants of the subject property.

1.7.4 Valuation Reduction for Environmental Issues

A valuation reduction occurs when the value of the property has been reduced below comparable properties due at least in part to environmental conditions associated with the property. Mr. Linstad indicated that to his knowledge the purchase price of the subject property has not been discounted due to existing environmental conditions.

1.7.5 Obvious or Commonly Known Site Information

Mr. Linstad indicated that he has been involved with on-site operations since 1970 and knows of previous environmental investigations. Mr. Linstad indicated that an 8,000-gallon UST was removed from the north side of the Keller Kiln building in October 1994. Mr. Linstad indicated that soil sampling was conducted and petroleum-impacted soil was identified on the south end of the UST. Accessible impacted soil was removed, however, a small volume of impacted soil was left in place beneath the kiln building. Mr. Linstad provided a copy of the *UST Closure & Site Assessment Report* dated December 27, 1994. This report is included in Attachment A.

Mr. Linstad indicated that additional soil sampling was conducted at the subject property in November 2011 in the vicinity of three pad-mounted electrical transformers located near the northeastern corner of the Keller Kiln building. Four composite soil samples were collected within 10 feet of the transformer units. None of the samples were reported to contain detectable concentrations of polychlorinated biphenyls (PCBs). Mr. Linstad provided a copy of a letter report for that sampling dated December 8, 2011, which is included as Attachment B.

2.0 SUBJECT PROPERTY DESCRIPTION

2.1 Location and Legal Description

The subject property is comprised of three tax parcels; King County Parcel Nos. 2724059006 2724059040, and 2724059099 located at 6620 Coal Creek Parkway SE in Newcastle, King County, Washington. Information obtained from the November 28, 2011 title report includes the following legal description:

> THE NORTHWEST QUARTER OF THE NORTHWEST QUARTER; AND SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER, ALL IN SECTION 27 TOWNSHIP 24 NORTH, RANGE 5 EAST, W.M, IN KING COUNTY, WASHINGTON;
>
> EXCEPT THAT PORTION LYING WTHIN RIGHT OF WAY CONVEYED TO COLUMBIA AND PUGET SOUND RAILWAY COMPNAY BT DEED RECORDED IN VOLUME 22 OF DEEDS, PAGE 71, UNDER KING COUNTY RECRDING NO. 651;
>
> ALSO THE WEST 360 FEET OF THE NORTHWEST QUARTER OF THE SOUTHEAST QUARTER OF THE NORTHWEST QUARTER LYING NORTHERLY OF COUNTY ROAD 193; EXCEPT THAT PORTION LYING WEST OF A LINE DESCRIBED AS FOLLOWS;
>
> COMMENCING AT THE NORTHWEST CORNER OF THE SOUTH HALF OF THE NORTHWEST QUARTER OF SAID SECTION 27, TOWNSHIP 24 NORTH, RANGE 5 EAST, W.M., IN KING COUNTY, WASHINGTON;
>
> THENCE SOUTH 88 DEGREES, 20 MINUTES, 58 SECONDS EAST ALONG THE NORTH LINE OF SAID SUBDIVISION 1,334.52 FEET TO THE TRUE POINT OF BEGINNING OF SAID LINE; AND
>
> THENCE SOUTH 22 DEGREES, 33 MINUTES, 42 SECONDS EAST 220.64 FEET TO THE NORTHERLY RIGHT OF WAY MARGIN OF NEWCASTLE-COAL CREAK ROAD, THE CENTERLINE OF WHICH IS SHOWN ON THE RECORD OF SURVEY PREPARED FOR THE CITY OF BELLEVUE, AS RECORDED IN VOLUME 107 OF SURVEYS, PAGES 39 AND 39A, RECORDS OF SAID COUNTY, AND THE TERMINUS OF SAID LINE; AND EXCEPT ANY PORTION LYING WIHIN COAL CREEK LAKE BOREN ROAD.

According to King County Assessor information, the subject property consists of 52.68 acres. A letter dated April 23, 2012 from the City of Newcastle indicates that of the 52.68 acres, the Net Developable Area is 31.84 acres. This is based upon findings regarding the "locations of identified wetlands, streams, geologically hazardous areas, and their respective buffers" discussed in the *Critical Areas Report* (CAR) for the subject property dated February 6, 2012 and the *Supplement* to the CAR dated March 30, 2012. Both reports were prepared for the City of Newcastle by DJB & Associates NW, LLC.

2.2 Site and Vicinity General Characteristics

The subject property location and surrounding areas are shown in Figure 1. Access to the subject property is from a single lane access road off Coal Creek Parkway and from smaller gated access roads off of 132nd Place SE to the southwest and Newcastle Golf Club Road to the southeast.

The subject property is located at the northern boundary between the City of Newcastle and the City of Bellevue. According to the City of Newcastle Zoning Map and Comprehensive Plan the subject property is zoned a combination of Mixed Use (MU) - Residential and MU – Commercial. The central portion of the subject property is generally flat and is the only portion to have been developed. The surrounding areas appear to be second growth forest with incised streams and significant topography, generally sloping to the north and west. Critical areas are identified in the CAR and the Supplement to the CAR.

The subject property is bounded to the west by Coal Creek Parkway with residential development beyond. The subject property is bounded to the north by forest and Coal Creek with single-family homes to the north and northeast across Coal Creek. The subject property is bounded to the east by Tributary 2.7 with forest beyond. The subject property is bounded on the southeast by the Newcastle YMCA and Newcastle Golf Club Road. The subject property is bounded to the south by the Approach Apartments along 132nd Place SE and commercial buildings to the southwest.

The Central Business District for the City of Newcastle is located approximately 0.25 mile southwest of the subject property, at the intersection of Coal Creek Parkway and Newcastle Way.

2.3 General Site Description and Improvements

The subject property was occupied by a brick manufacturing facility from 1957 until June 2011, at which time operations were permanently shut down. During an initial site visit in October 2012 demolition crews were in the final stages of razing the former brick plant buildings. The two kiln buildings and support structures in the central part of the subject property had been removed and the debris was being loaded into trucks for transport and off-site disposal. At the time of the site visit, the following buildings were still present at the subject property:

- The maintenance and storage building west of the kiln buildings;
- The steel canopies over the clay storage area;
- One canopy over the brick storage area; and

- The scale house south of the main plant.

Numerous stacks of unused brick on pallets remained in various locations in the western portion of the subject property.

Several site visits and inspections have been performed since October 2012. During the most recent site visit, September 10, 2014 conducted by Mr. Thomas Morin of EPI and several members of AVB, the subject property remained unchanged from October 2012, with exception of the removal of additional stacks of unused bricks.

Figure 2 depicts the brick plant prior to demolition of the main buildings.

EPI was able to conduct a full reconnaissance of the exterior areas of the subject property including the concrete slab foundations of the buildings, fenced enclosure for a 500-gallon aboveground storage tank (AST) south of the brick storage canopies, scale house, former transformer area, the former 8,000-gallon UST area, propane tank area, and several areas of brick debris throughout the subject property.

Subject property inspections since the time of the original walkthrough indicate that the demolition and cleanup of the subject property have been completed and only the steel canopies over the clay storage remain.

2.4 Physical Setting

2.4.1 Topography

To evaluate the physical setting of the subject property, EPI used the United States Geological Survey (USGS) 7.5' X 15' Bellevue South Quadrangle map revised to 1983. A review of the map shows that the subject property lies at an elevation between 125 and 185 feet above mean sea level and slopes south to north from the area of Newcastle Golf Club Road toward Coal Creek. Topography in the vicinity of the subject property is shown on Figure 1.

The central area of the subject property where the brick plant was located is generally flat. Areas surrounding the central flat area are wooded with steep slopes down to Coal Creek to the north and Tributary 2.7 to the east. The western portion of the subject property contains a wetland between the central flat area and Coal Creek Parkway. A small stream named Mineshaft Tributary, originates off-property to the south and flows into the western wetland. The topography to the south slopes upward to Newcastle Golf Club Road. A culvert, which contains apparent drainage from Newcastle Golf Course Road, the adjacent golf course and other areas to the south and west enters the subject property on the south and becomes a Category 3 (i.e., non-fish bearing) stream which flows to the north through the eastern portion of the subject property and enters Tributary 2.7.

2.4.2 Soil

According to the Geology Map of Washington published by the Department of Natural Resources (1992), the subject property is located within the Puget Sound Lowlands physiographic province of

Washington. This area is characterized as primarily unconsolidated materials deposited by glaciation and may contain glacially-derived sediments up to 500 feet thick.

According to the United States Department of Agriculture's (USDA) Soil Conservation Service (SCS), soils in the subject property area are classified as the Alderwood Gravelly Sandy Loam and the Beausite Gravelly Sandy Loam. Alderwood soils are characterized as being very slowly draining soils with moderately fine to fine textures. Beausite soils are primarily well-drained soils with moderate fine to fine textures. Typically these soils have a surface layer of gravelly sandy loam with fines and gravel to a depth of approximately 11 inches. This layer is underlain by very gravelly sandy loam with fewer fines and more gravel to a depth of approximately 26 inches. This layer is underlain by a denser layer of silty gravel with more fines and slow infiltration rates to approximately 60 inches.

The southern portion of the subject property contains an apparent bedrock outcropping of undetermined rock type. The CAR and Supplement to the CAR indicate the presence of historic coal mine tailings in the southeastern portion of the subject property and historic coal workings on the subject property. The coal mine tailings are the result of historic hard rock mining that occurred throughout this area of Newcastle at depths of greater than 400 feet.

2.4.3 Groundwater

Potable water at the subject property is supplied by the City of Bellevue municipal system. According to subject property personnel, there are no water supply or monitoring wells on the subject property. No evidence of wells was observed around the perimeter of the building foundations on the day of the site visit.

Shallow groundwater flow in the vicinity of the subject property is interpreted to follow surface topography and flow directly toward regional surface water bodies. Based upon the local topographic relief, and direction of regional surface water flow, the groundwater is interpreted to flow generally north toward Coal Creek located along the northern portion of the subject property.

The depth to a regional source of groundwater or aquifer could not be determined based on the available data but is interpreted to be within the underlying bedrock materials.

2.4.4 Surface Water

The subject property is located within the Coal Creek Basin, which is part of the larger Cedar River watershed. The Cedar River Watershed is part of the City of Seattle's regional water supply system along with the Tolt River watershed.

According to the CAR, there are a total of five streams located on the subject property.

Coal Creek is the largest and cuts across the northern part of the subject property north and northwest of the former brick plant.

Mineshaft Tributary is located on the west side of the subject property generally along Coal Creek Parkway and flows into Coal Creek. Mineshaft Tributary emerges from the hillside along 132nd Place SE near the Approach Apartments. Available information indicates that the most likely primary source of this tributary is drainage from an abandoned mine located beyond the southern boundary of the subject property but may also receive some drainage from properties to the south of the subject property. The CAR referred to a wetland delineation report for the subject property prepared by Wetland Resources, Inc. and dated December 12, 2011. The wetland report identified a Category III wetland at the southwestern portion of the subject property along Mineshaft Tributary.

Tributary 2.7 is located on the southeast side of the subject property and flows directly into Coal Creek. There are two tributaries to Tributary 2.7, one of which reportedly discharges from the former area of the brick plant but which could not be located during field observation. The other is a small stream that enters the subject property from a 36-inch concrete culvert beneath Golf Course Road, flows through the subject property and is a tributary to Tributary 2.7.

3.0 HISTORICAL RECORDS REVIEW

The history of land use for the subject property and its vicinity was evaluated to identify past uses that might have had adverse effects on the environmental conditions, primarily through the use of potentially hazardous materials. The following history is based on a compilation of information obtained from the following resources:

- Aerial photographs from 1965, 1977, 1985, 1990, 2005, 2006, and 2011. Copies of these aerial photographs are included in Attachment C. The 2011 aerial photograph was used as the base map for Figure 2: Site Representation.

- Regulatory database information for the subject property and properties located within one mile of the subject property boundary. A copy of the regulatory database information is included in Attachment D.

- City directory information from 1964, 1970, 1975, 1980, 1985, and 1996. This information is summarized in Attachment E.

- No Sanborn Fire Insurance Maps were available for the subject property. The Sanborn Map Report is included as Attachment F.

- Historical topographic maps from 1895, 1897, 1950, 1968, 1973, and 1983. Copies of these maps are included in Attachment G.

- *Critical Areas Report* - Mutual Materials Newcastle Property, prepared by DJB & Associates NW, LLC, dated February 6, 2012.

3.1 Historical Use of the Subject Property

Based on above-referenced historical information, coal mining began in the area referred to as the Newcastle Mining District in the 1880s. The subject property is located on the western end of the Newcastle Mining District, which extends several miles to the east. The subject property reportedly contained several coal seams that were mined until the early 1910s. However, there are no indications of previous coal mine operations at the subject property on either the historical aerial photographs or historical topographic maps.

Two exploratory (prospect) tunnels have been identified on the subject property. The Newcastle Municipal Code has classified two severe coal mine hazards, one moderate coal mine hazard, and a large declassified coal mine hazard on the subject property. The Critical Area Evaluation also identified a “limited area of mine rock fill” at the southeastern portion of the subject property.

Historic coal mining has resulted in an area of accumulated mine tailings on the southeastern portion of the subject property. These mine tailings extend well beyond the subject property and are located throughout this area of Newcastle. It has reportedly been estimated that the mine tailings have a volume of about 75,000 cubic yards and thicknesses of up to 15 feet.

The subject property appears to have been unoccupied between approximately 1920 and the mid-1950s. A 1938 King County Historical Atlas reviewed at Puget Sound Regional Archives shows the subject property owned by Northwestern Continental Company. A 1948 aerial photograph of the subject property area shows the subject property and surrounding areas to be wooded and undeveloped. A 1958 King County Historical Atlas and 1960 Polk Directory shows the subject property owned and occupied by Buildings Brick Company. The 1965 and all subsequent aerial photographs show the former brick plant surrounded by wooded areas.

Construction of the original Dressler Kiln located on the east side of the brick plant near the present clay storage canopies, appears to have begun in about 1956. The plant was expanded to the west with the construction of the larger Keller Kiln in 1970. In full production, the plant operated 24-hours a day and employed over 60 people. The plant produced a large variety of brick products.

The plant was reportedly closed permanently in June 2011. Demolition of the plant buildings and support structures began in 2012. By the time of the site visit in mid-October 2012, most of the larger plant buildings, including each of the kiln buildings, had been razed and building debris was being removed from the subject property. During subsequent site visits, the most recent being September 10, 2014 conducted by Mr. Morin of EPI, the subject property remained unchanged, with exception of the removal of additional brick product.

Because of the historically rural nature of the subject property area, there is no Sanborn Map coverage for the subject property or the surrounding area.

3.2 Historical Use of Adjoining Properties

Historical aerial photographs and topographic maps of the subject property and surrounding areas indicate that the subject property was located in a wooded and isolated area northwest of the then small settlement of Newcastle located approximately 0.25 miles from the subject property. The 1938 King County Historical Atlas shows the area to the north and east of the subject property to be owned by Northwestern Continental Company. The area to the south is owned by Pacific Coast Coal Company and the area to the west is owned by Yesler Estate, Inc.

The 1958 King County Historical Atlas shows the area to the north and east of the subject property to be owned by Tony Scalzo. The area to the south is owned by King County and the area to the west is owned by Roland Burrows.

Aerial photographs show very little development in the surrounding vicinity of the subject property until the 1970s when the area west of Coal Creek Parkway was developed with single-family homes. Commercial development at the northeast corner of the intersection of Coal Creek Parkway and Newcastle Way immediately southwest of the subject property began in the mid-1980s. Residential development to the northeast of the subject property across Coal Creek began in the late 1980s. Commercial and multi-family residential development to the southwest increased to the southwest in the 1990s. The Newcastle YMCA facility was constructed to the southeast of the subject property within the past four years. Mine tailings are known to exist beneath the YMCA property. Moreover, mine tailings are evident in off-property areas to the east through casual visual inspection of the surface.

This area of Newcastle was historically a coal mining district within Washington state and has an extensive history of deep shaft coal mining. Numerous historical documents describe large an extensive piles of coal mine tailings along Newcastle Golf Club Road with heights in excess of 30 feet. The coal mine tailings noted on the subject property are the result of historical operations common to this area and should be considered a background condition for a historic coal mining district.

4.0 SUBJECT PROPERTY RECONNAISSANCE

4.1 Methodology and Limiting Conditions

Mr. Greg McCormick, Senior Geologist and Mr. Thomas Morin, L.G. Principal Geologist, conducted an initial subject property reconnaissance on October 11, 2012. Several other site visits were conducted by Ms. Kris Addis of EPI and Mr. Morin. The most recent site reconnaissance was conducted by Mr. Morin on September 10, 2014 along with representatives of AVB, the City of Newcastle, and the Washington Department of Fish and Wildlife. Mr. Jeff Linstad, Manufacturing Engineer with Mutual Materials served as escort during the initial site reconnaissance on several other occasions.

The weather was cloudy and cool at the time of the reconnaissance and conditions did not limit a thorough examination of exterior subject property features. The purpose of the subject property visit was to identify visible indications of the use or release of hazardous or potentially hazardous substances or petroleum products that were historically used or were currently used, generated, stored,

or disposed on the subject property. Photographs taken during the subject property reconnaissance are included in Attachment H.

4.2 Observations

Table 1 identifies general observations and specific conditions that may or may not result in the presence of RECs for the subject property.

Table 1
Reconnaissance Checklist Summary

Item	Observation/Comment
Current Site Land Use (zoning, more-specific use, construction dates)	The former brick plant and supporting structures were in the process of being demolished. The observations were consistent with the use of the property for brick manufacturing and storage of brick product. The subject property is reportedly zoned MU-C for Mixed-Use Commercial and MU-R for Mixed-Use Residential.
General Description of Site and Area	The subject property is located approximately 0.25 mile north of the central business district of Newcastle. The subject property is primarily accessed by a single-lane road off Coal Creek Parkway. The subject property contains four streams and a wetland. There is multi-family development to the southeast and single-family development visible across Coal Creek. A YMCA building is present immediately to the southeast. The area immediately to the northeast is undeveloped, forested land.
Exterior Observations	Most of the plant buildings had been demolished and the debris hauled off site for disposal. The four clay storage canopies and the adjoining grinding room located southeast of the former plant were still standing. The maintenance and storage building located on the west side of the plant and the scale house located south of the plant were also standing. A 1,000-gallon propane tank was observed on the north side of the former Keller Kiln building. A cradle for a 30,000-gallon propane tank was also observed in this area. According to Mr. Linstad, the 30,000-gallon propane tank was removed in 2008. The former location of three pad-mounted electric transformers was noted in the former location of the northeastern corner of the brick plant. These transformers were reportedly removed from the subject property in September 2012. Several areas of brick debris fill were noted around the perimeter of the former brick plant. Unused brick product was observed in numerous areas of the subject property. The brick product was stored on wooden pallets up to 4 high. There are several locations throughout the subject property that had accumulated significant brick debris. The origin of this debris is reportedly off-specification product that was spread at the subject property over the operational life of the brick plant.

Item	Observation/Comment
Petroleum Products	According to Mr. Linstad, small amounts of machine oil, grease, used oil, and other lubricants were stored in the maintenance building when the plant was in operation. Used oil and antifreeze were generated during machine maintenance activities and picked up periodically for off-site disposal. Some evidence of oil staining was observed in the maintenance building during the subject property visit but there was no indication of floor drains or significant cracks in the floor. The previous Phase I ESA identified used oil and waste antifreeze generation and storage in the maintenance building. The used oil was stored in four approximately 200-gallon ASTs and the used antifreeze was stored in a 55-gallon drum. That report indicates, "that there was no evidence of spills or staining in the area of waste generation or pre-disposal storage. Review of the facility waste management program indicated that the waste disposal operations appear to be performed in accordance with regulatory requirements". No stored petroleum products or other wastes were observed.
Hazardous Substances	According to the previous Phase I ESA, hazardous materials used as part of plant operations included routine janitorial and maintenance supplies, engine oil, grease, diesel fuel, propane, barium carbonate (in sacks), magnesium dioxide (in sacks), and Chromox 71901 (in sacks). The report indicated, "the identified chemicals, materials, and products were observed in their sealed, original containers and in designated storage area. Materials appeared to be properly stored. No evidence of spills or staining was observed in the area of product storage/usage". Mr. Linstad indicated that these materials were historically used a decorative elements of ornamental brick. No such materials were observed during the subject property visit
Hazardous Waste	According to Mr. Linstad, used oil and antifreeze generated during maintenance activities were stored in ASTs and drums respectively and picked up periodically for off-site disposal by Evergreen, a licensed waste transporter. No such materials were observed during the subject property reconnaissance.
Landfills, Dumps	No landfills or dumps were observed on the subject property. EPI did observe areas of on-property disposal of reportedly off-specification brick product in several areas. The maximum thickness, full extent, and volume of these materials were not determined and was beyond the scope of this assessment.
Burial Sites or Solid Waste Disposal	According to Mr. Lindstad, solid waste generated at the subject property was disposed of in standard dumpsters maintained by Waste Management. EPI did not observe any areas of solid waste burial. The previous Phase I ESA, indicated there was "no excessive odors or overflowing/excessive ground trash were noted in the vicinity of the dumpsters. No hazardous, regulated, or medical wastes were noted in the dumpsters".

Item	Observation/Comment
Aboveground Storage Tanks (ASTs)	A 1,000-gallon propane AST was observed on the north side of the former Keller Kiln building. The AST is located over an asphalt surface and appeared to be in good condition. Mr. Linstad indicated that a 30,000-gallon AST was removed from the same area in 2008. The cradle for this former propane AST was observed beside the 1,000-gallon AST. The former 30,000-gallon AST appears to also have been located over an asphalt surface and no concerns were noted. An empty 500-gallon diesel fuel AST was observed in the asphalt-paved area south of the former brick storage canopies. This unit had formerly been located inside the fenced enclosure in a paved area on the south side of the plant and the fuel was removed several months ago according to Mr. Linstad. No concerns were noted in either area on the day of the site visit. Mr. Linstad indicated that the AST was permanently removed from the subject property on October 31, 2012.
Underground Storage Tanks (USTs)	No evidence of USTs was observed on the subject property. An 8,000-gallon diesel fuel UST was removed form the subject property in 1994. The *UST Closure and Site Assessment Report* is included as Attachment A.
Drums	No 55-gallon drums were observed on the subject property.
Potential PCB-Containing Equipment	Mr. Linstad provided documentation regarding the removal and disposal of three pad-mounted electrical transformers in September 2012. The transformers were located in a fenced enclosure at the northeast corner of the Dressler Kiln building. The transformers were removed on September 5, 2012 and transported to Transformer Technologies in Salem, Oregon for destruction. The transformer fluid was tested for polychlorinated biphenyls (PCBs) and one of the units had a concentration of 1.1 parts per million (ppm). On November 3, 2011, Kane Environmental collected four shallow soil samples from an area outside the fenced enclosure within 10 feet of the transformer units. PCBs were not detected in any of the samples collected. The transformer disposal and sampling documentation is provided in Attachment B. Based on a review of this report, the samples do not appear to have been appropriately located to adequately assess potential impacts from these transformers.
HVAC System and Fuel Source	Mr. Linstad indicated that the kiln buildings were unheated other than with residual heat provided by the kiln units. The office building was historically heated with electric baseboard heaters. At the time of the subject property visit, all buildings had been razed.
Drains, Sumps, Pits, Cisterns, Cesspools	No evidence of drains, sumps, pits, cisterns or cesspools was observed on the subject property on the day of the site visit. The subject property is not connected to a municipal sewer system. An inactive septic system is located on the north side of the former Keller Kiln building. Mutual Materials personnel indicated at the time of the previous Phase I ESA that “the septic system is operated in accordance with all applicable codes and regulations”, however, subject property personnel were not aware of any maintenance or upgrades to the system since its installation in 1959. According to Mr. Linstad, the septic system was decommissioned within the past three months prior to demolition of the subject property buildings.
Pits, Ponds, or Lagoons	No pits, pond or lagoons were observed on the subject property

Item	Observation/Comment
Pavement or Soil Stains	The central portion of the subject property was covered with concrete floors for the former buildings and surrounding asphalt. The remainder of the subject property was unpaved and bare soils with the exception of some roadways. No pavement or soil staining was observed.
Structural Corrosion	No significant structural corrosion was observed to any of the remaining structures at the subject property.
Stressed Vegetation	No stressed vegetation was observed
Fill or Grading	As noted above, several areas of brick debris fill were noted on the subject property. The area in the southeastern portion of the property noted in the CAR as containing extensive coal mine tailing was also observed. The coal mine tailings were observed to be in excess of 10 feet thick in some areas.
Chemical/TPH/ Swamp-Gas Odors	No gas odors were evident at the subject property on the day of the site visit.
Storm Water or Surface Erosion	No significant storm water discharge issues or evidence of surface erosion was observed on the day of the site visit. The subject property does not have any stormwater control structures and stormwater necessarily discharges to nearby surface water. EPI obtained a copy of the Storm Water Pollution Prevention Plan (SWPPP) and National Pollution Discharge Elimination System (NPDES) permit for the former brick plant through the Department of Ecology. The SWPPP contains information on regular visual monitoring of water discharge locations and information regarding methods used to limit turbidity and sedimentation into nearby streams with containment berms. A letter from the Ecology Water Quality Inspector dated April 1992, identifies several issues requiring attention. These issues included: preventing sediment entering drainage channels along haul roads, seeding steep slopes to minimize erosion, improved control of sheet flow from runoff from the containment berm and installation of a curb around the waste oil AST and drums. A copy of the SWPPP and Ecology correspondence is included in Attachment I.
Wells and Potable Water	No wells or potable water sources were observed on the subject property.

4.2.1 Exterior Observations

Few structures associated with the former brick plant were still standing at the time of the subject property reconnaissance. The concrete slab foundations for the main kiln buildings and office building were visible in the central portion of the subject property. Numerous pallets of finished brick products were stacked around the perimeter of the former buildings primarily on the north and west sides of the former Dressler Kiln building. Several piles of discarded brick and brick fill were observed around the perimeter of the plant. Areas of the subject property outside the former brick plant itself were heavily wooded with steep slopes down to Coal Creek and its tributaries.

4.2.2 Interior Observations

As noted the larger buildings on the subject property had been demolished. The maintenance and storage building located on the western end of the former Dressler Kiln building was still present and

was accessible during the site visit. The building was constructed of brick and used as a maintenance shop and storage building. A wooden table was observed inside the building and there were wooden shelves along the walls. There was no evidence of floor drains, ASTs, 55-gallon drums of waste materials, in-ground hydraulic lifts, or other potential hazardous equipment within the building.

The scale house located on the south side of the former plant was not accessed during the assessment. According to the site escort, the truck scale located beside the scale house was in good working order when plant operations ceased in June 2011.

The open air clay storage canopies were still present and contained a large quantity of clay raw material. No concerns were noted.

4.3 Vicinity Land Use and Observations

EPI conducted a general visual reconnaissance of adjoining properties during this site visit, but the reconnaissance was restricted to what could be observed from public areas. The following adjoining property uses were observed during the site reconnaissance:

- The subject property is bounded on the west and northwest by a wooded wetland and a stream and on the north, northeast, and east by wooded slopes, streams and undeveloped land.

- The subject property is bounded on the southeast by the Newcastle YMCA facility and parking lot as well as by Golf Club Road with a golf course beyond.

- The subject property is bounded on the south and southeast by The Approach apartments and the Coal Creek Utility District office building on 132nd Place SE.

5.0 RECORDS REVIEW

5.1 Standard Environmental Record Sources

Facilities that generate, transport, store, or dispose of hazardous materials—or that have known or potentially identified contamination that could adversely impact the site—were identified using federal, state, and local databases. Environmental Data Resources, Inc. (EDR) conducted the database search. The EDR report in Attachment D provides a listing and description of the databases reviewed, search distances, and a map showing the approximate locations of listed sites and information contained within each database for each listed site. Some facilities appear on more than one database.

The EDR report also identified seven “orphan” sites. Orphan sites are those that were not mapped or “geocoded” due to inadequate address information. Orphan sites are listed in the Executive Summary of the EDR report. EPI reviewed the orphan list to identify sites that may be within the ASTM-prescribed search distances. Based on our review, six of the listed orphan sites could refer to the Mutual Materials brick plant site. The Site Names refer to the Newcastle coal mine or mine air vent.

The southeast adjoining Newcastle YMCA is also listed as an orphan site. These sites have been incorporated into the discussion below.

EDR conducted a search of federal and state regulatory agency database information about sites within the ASTM Standard E 1527-13 search distances from the subject property. The databases searched, the corresponding search distance, and the number of sites found within the search distance for each database, are summarized in the following Table 2:

Table 2
Regulatory Review Information Summary

Source of Regulatory Information	Acronym	Search Distance	Sites within Search Distance
Federal Databases:			
National Priorities List	NPL	1.0 mile	0
National Priorities List Deletions	Delisted NPL	1.0 mile	0
Comprehensive Environmental Response, Compensation, and Liability Information System; also CERCLIS No Further Remedial Action Planned	CERCLIS and CERCLIS-NFRAP	0.5 mile 0.5 mile	0 2
Resource Conservation & Recovery Act Information-Treatment, Storage, and Disp. Facil.; RCRIS Corrective Action Sites	RCRA TSDF and CORRACTS	0.5 mile 1.0 mile	0 0
Resource Conservation and Recovery Act Hazardous Waste Generators	RCRA LQG RCRA SQG RCRA CESQG	0.25 mile 0.25 mile 0.25 mile	0 0 0
RCRA Non Generator	RCRA NON GEN	0.25 mile	5
Emergency Response Notification System	ERNS	Subject property	0
CERCLA Consent Decree Sites	CONSENT	1.0 mile	0
Records of Decisions	ROD	1.0 mile	0
US Brownfields	Brownfields	0.5 mile	0
Oil and Chemical Spill Database	SPILLS	Subject property	0
Toxics Release Inventory	TRIS	Subject property	0
US Mine Sites	US MINES	0.25 mile	1
State Databases:			
State Solid Waste Disposal/Landfill Sites	SWF/LF	0.5 mile	0
Closed Landfill Inventory Hazardous Waste Sites	CLI	0.5 mile	0
State Hazardous Waste Sites	HSL	1.0 mile	0
Confirmed or Suspected Contaminated Sites List	CSCSL	1.0 mile	4

Source of Regulatory Information	Acronym	Search Distance	Sites within Search Distance
Leaking Underground Storage Tanks	LUST	0.5 mile	2
Registered Underground Storage Tanks	UST	0.25 mile	2
Marine Terminals and Tank Information	AST	0.25 mile	0
Voluntary Cleanup Reports	VCP	0.5 mile	2
Independent Cleanup Report	ICR	0.5 mile	3
Facility Index System	FINDS	Subject property	3
National Pollution Discharge System (Wastewater Permitting)	NPDES	Subject property	0
Engineering & Institutional Controls	ENG/INST CONTROL	0.5 mile	0
Permitted Air Source Listing	AIRS	Subject property	0
Confirmed or Suspected Contaminated Sites - NFA	CSCSL-NFA	0.50 mile	1
Facility/Site Identification System	ALLSITES	0.5 mile	23
Manifest Records	MANIFEST	0.25 mile	1
Inactive Drycleaners	None	0.25 mile	2
Toxic Chemicals Release Inventory	TRIS	Subject property	1
Washington Emissions Data System	AIRS (EMI)	Subject property	1
PCB Transformer	None	Subject property	0
EDR Proprietary Records:			
EDR Manufactured Gas Plants	None	1.0 mile	0
EDR Historical Auto Stations	None	0.25 mile	1
EDR Historical Cleaners	None	0.25 mile	2

5.1.1 Subject Property

The subject property is listed on several of the regulatory databases reviewed as part of this assessment including: Facility Index System (FINDS), Facility/Site Identification System (ALLSITES), Underground Storage Tank (UST), Leaking Underground Storage Tank (LUST), Independent Cleanup Report (ICR), Toxic Chemicals Release Inventory System (TRIS), and Washington Emissions Data System (AIRS-EMI) databases. The FINDS database is maintained by the U.S. Environmental Protection Agency (EPA) and is a database of all facilities with a Site or Facility Identification Number. It is a “database” of databases with pointers to on-line sources for more detailed information. The

FINDS database is maintained by the Washington State Department of Ecology (Ecology) and serves the same purpose for state databases.

The inclusion of the subject property on the UST, LUST, and ICR regulatory listings appears to be for the former 8,000-gallon diesel fuel UST and associated soil remediation. The AIRS-EMI regulatory listing appear to be for the annual Tier II air emission reporting, and National Pollution Discharge Elimination System (NPDES) permitting. The subject property does not appear on the MINES Master Index File of current and former mining sites.

8,000-gallon UST

According to the *UST Closure & Site Assessment Report* (provided in Attachment A), an 8,000-gallon diesel fuel UST and associated product lines were removed from the north side of the Keller Kiln building on October 24, 1994. The UST was reported to be in "moderately poor condition" with significant rust. There were reportedly no noticeable holes or pitting on the tank or piping but there was an indication of a leaking pipe connection where the piping entered the building. Soil samples were collected and two to four cubic yards of petroleum-contaminated soil (PCS) were removed from the UST excavation. A small amount of PCS reportedly located under the footing of the building was inaccessible and was left in place. Information in the LUST and ICR databases indicate that the UST was removed and that a Final Cleanup Report was received by Ecology on December 29, 1994. The UST removal was not issued final closure through the Voluntary Cleanup Program (VCP), or its predecessor programs at Ecology.

Tier II Emissions Reporting

The earliest Tier II emissions reporting information date was 1977 and reporting appears to continue through at least 2005 indicating long-term regulatory oversight for air emissions from the two kilns. Mutual Materials indicated that annual Tier II reporting had been conducted continuously for at least 30 years. The kiln units were also subject to regulation and inspection by the Puget Sound Clean Air Agency (PSCAA). There was no indication of air emissions violations or fines in the database information.

NPDES Permitting

EPI obtained a copy of the Storm Water Pollution Prevention Plan (SWPPP) and NPDES permit through the Department of Ecology Central Files. The SWPPP contains information on regular visual monitoring of water discharge locations and information regarding methods used to limit turbidity and sedimentation into nearby streams with containment berms. A letter from the Ecology Water Quality Inspector dated April 1992 identifies several issues requiring attention. These issues included: preventing sediment entering drainage channels along haul roads, seeding steep slopes to minimize erosion, improved control of sheet flow runoff from the containment berm and installation of a curb around a waste oil AST and drums. There is no indication of storm water discharge violations in the database information.

5.1.2 Surrounding Properties

The Newcastle Coal Mine was geocoded on the adjacent property to the southeast of the subject property. The mine was listed on the FINDS, ALLSITES, CERC-NFRAP, and Confirmed and Suspected Contaminated Sites List – No Further Action (CSCSL-NFA) databases. The property was identified with suspected organic and inorganic conventional contaminant contamination to soil and air, but was listed with a no further action designation in 1997. As mentioned above, the area of the subject property was a historical coal mining district as reflected by this site. The presence of coal mine tailings is considered a background condition within this region.

The AT&T Wireless facility located at 6860 Coal Creek Parkway, approximately 0.25 mile southwest of the subject property, is listed on the FINDS and ALLSITEs databases for Tier II emissions reporting. There are no indications of violations of releases that could affect the subject property.

Bakkers Cleaners located at 6920 Coal Creek Parkway SE, approximately 0.25 mile southwest of the subject property, is listed on the Resource Conservation and Recovery Act (RCRA) Non-Generators databases and also on the FINDS, ALLSITES, and Inactive Drycleaners databases. The last listing date is May 1997. There are no indications of waste handling violations, releases of dry cleaning solvents, or on-going monitoring at this facility. Given the distance of this site from the subject property and the lack of reported releases, the potential for this site to adversely affect the subject property appears limited.

Daniel's Drycleaners located at 6923 Coal Creek Parkway SE, approximately 0.25 mile southwest of the subject property, is listed on several databases including, RCRA Non-Generators, ICR, VCP, Inactive Drycleaners, CSCSL as well as FINDS and ALLSITES databases. This facility is a former drycleaner with a past release of dry cleaning solvents affecting soil and groundwater. The ICR databases indicated that Ecology received an Interim Cleanup Report in December 1996. The status of the release is currently "Cleanup Started" but there is no information indicating that the release has received an NFA determination through the VCP. The release has been monitored by Ecology since 1996. Based on the distance and topographic relationship to the subject property the potential for this site to adversely affect the subject property appears limited.

The ARCO service station (Velocity Investments) site located at 6966 Coal Creek Parkway SE, approximately 0.30 mile southwest of the subject property, is listed on the CSCSL-NFA, VCP, ALLSITES, and Financial Assurance databases. This facility had an apparent fuel release, which was remediated and closed through the VCP. According to the database information the facility received an NFA determination in October 2011. Based upon the distance and topographic relationship of this site to the subject property, and the regulatory status of this site, its potential to adversely affect the subject property appears limited.

The other listed sites do not represent RECs for the subject property for one or more of the following reasons:

- The facility is located over 0.25-mile and downgradient of the subject property.
- The facility is not listed on any databases as having a release to the environment.
- The facility is listed in a database of known or suspected contaminated sites, but received an NFA determination.
- The facility is listed on the LUST database or other databases but no longer an active site.
- The facility is listed in a database of known or suspected contaminated sites, but the potential for adverse impacts is reduced due to the distance and topographic relationship to the subject property.

5.2 Additional Environmental Record Sources

Mutual Materials personnel provided various prior reports for the subject property. Information from a previous Phase I ESA has been incorporated into the appropriate sections of this report. The prior Phase I ESA identified no RECs associated with the history, operations, or waste generation or disposal at the subject property, however, the report concluded that the former 8,000-gallon diesel fuel UST and associated soil impacts represented a historical REC. The report indicated, “contaminated soil was identified and removed during tank closure. The case was issued ‘closure’ status in 1996 and no further action was deemed necessary”. This does not appear fully correct because Ecology did not actually provide an actual No Further Action (NFA) determination or other form of regulatory closure for the UST release.

EPI reviewed online information on the subject property available from the King County Tax Assessors Department. Archived tax assessment information was reviewed at the Puget Sound Regional Archives in Bellevue Washington. Copies of the archived tax assessment records are included in Attachment J.

Information regarding the SWPPP and NPDES permit, and water quality issues were reviewed at the Washington Department of Ecology Northwest Regional Office in Bellevue, Washington.

6.0 INTERVIEW

Mr. Jeff Linstad, Manufacturing Engineer with Mutual Materials served as the escort during the subject property walkthrough on October 11, 2012 and in several subsequent site visits and inspections. Mr. Linstad was designated as the owners representative for the purposes of the Phase I ESA interview. Mr. Linstad indicated that he has been employed by Mutual Materials at the Newcastle facility since 1971. He indicated that he was familiar with most of the on-site processes, waste handling and disposal, and previous environmental investigations conducted at facility. Mr. Linstad provided EPI with several of the previous environmental reports including the 2009 Phase I ESA, CAR and CAR Supplement, UST Closure and Site Assessment Report, transformer area soil sampling report, and geotechnical report. Mr. Linstad provided information regarding use of the Dressler and Keller kilns, UST removal, asbestos abatement, storm water and Tier II permitting. Mr. Linstad also completed the

ASTM 1527-05 questionnaire included in Attachment K. The information provided by Mr. Linstad has been incorporated throughout the body of this report.

7.0 FINDINGS AND CONCLUSIONS

EPI performed this Phase I ESA of the former Mutual Materials brick plant located at 6620 Coal Creek Parkway SE in Newcastle, Washington. The assessment was conducted in general conformance with the scope and limitations of ASTM Practice E 1527-13. Any exceptions to, or deviations from, this practice are described in Section 9.0 of this report.

The qualifications of Environmental Professional who prepared this assessment are included in Attachment L.

This Phase I ESA identified the following RECs at the subject property:

- The area of Newcastle in which the subject property lies was historically used for coal mining. Coal mine tailings are located extensively throughout this area of Newcastle and originate from numerous different mining operations. The subject property contains an estimated accumulation of about 75,000 cubic yards of coal mine tailings in the southeastern portion of the subject property. It cannot be known to what extent those tailings originate from beneath the subject property or from other exploratory or production mines in the area. Within this area of Newcastle coal mine tailings should be considered a background condition resulting from historical operations. Some of those operations may pre-date statehood for the State of Washington.

- The subject property was occupied continuously by a brick manufacturing from 1957 until June 2011. The subject property contains significant accumulations of brick debris. The origin of this debris is reportedly primarily off-specification product that has accumulated over the operational life of the brick plant. The exact volume, location, and contents of the brick debris are not known. The potential constituents of the brick debris represent a REC for the subject property.

- There appears to be residual diesel fuel impacts to soil on the north side of the former brick plant building. The source of the release is a former 8,000-gallon diesel fuel UST removed from the north side of the Keller Kiln building in 1994. The residual PCS is reportedly located beneath the foundation of the building and was not accessible at the time of UST removal. The apparent residual PCS represents a REC for the subject property

- Three pad-mounted electrical transformers which appear to have historically contained PCB-containing oils were located near the northeastern side of the former brick plant building. Prior soil samples in this area were not appropriately sited to assess the potential presence or absence of a release of PCBs to shallow soils. The presence of these historic PCB-containing transformers represents a REC for the subject property.

- There are four streams located on or immediately adjacent to the subject property. These streams primarily receive surface water runoff from off-property sources. The subject property is primarily uncapped and most on-property precipitation infiltrates directly to soil. It is likely that any impacts to surface water are likely primarily the result of off-property sources and background conditions. The potential for surface water quality impacts may represents a REC for the subject property.

On behalf of AvalonBay Communities, Inc. each of these RECs has subsequently been further assessed through the performance of a *Focused Subsurface Investigation* (FSA). That FSA is presented under separate cover.

8.0 DEVIATIONS AND DATA GAPS

EPI has made an appropriate inquiry into the commonly known and reasonably ascertainable resources concerning the historical ownership and use of the subject property. No significant deviations or data gaps occurred from the ASTM Practice E 1527-13, *Standard Practice for Environmental Site Assessments; Phase I Environmental Site Assessment Process,* or 40 CFR Part 312.

9.0 REFERENCES

Published Sources

American Society for Testing and Materials. 2013. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process ASTM E 1527-13. West Conshohocken, Pennsylvania.

Environmental Protection Agency. 2005. 40 CFR Part 312. Standards and Practices for All Appropriate Inquiries; Final Rule. November 1, 2006.

Environmental Data Resources, Inc. Summary Radius Map. Inquiry Number 4171904.2s dated January 5, 2015.

Aerial photographs from Environmental Data Resources Inc., Inquiry Number 3444311.5 dated November 1, 2012.

Historical Topographic Map Report, Environmental Data Resources, Inc., Inquiry Number 3444311.4 dated October 31, 2012.

City Directory Image Report, Environmental Data Resources, Inc., Inquiry Number 3444311.6 dated November 6, 2012.

Sanborn Fire Insurance Maps from Environmental Data Resources, Inc., Inquiry Number 3444311.3 dated October 30, 2012.

U.S. Geological Survey (USGS) Topographic Map 1983, Bellevue South, Washington Quadrangle.

United States Department of Agriculture (USDA) Soil Conservation Services (SCS) Soil Survey of King County, Washington.

Other Sources

City of Newcastle, Mr. David Lee, Associate Planner, (425) 649-4444 Ext. 127.

City of Newcastle Zoning and Critical Area online information.

Title Report prepared by First American Title Insurance Company, dated November 28, 2011.

Archived Tax Assessor Information obtained from Puget Sound Regional Archives, Bellevue, Washington.

Washington Department of Ecology File Information, Northwest Regional Office, Bellevue, Washington.

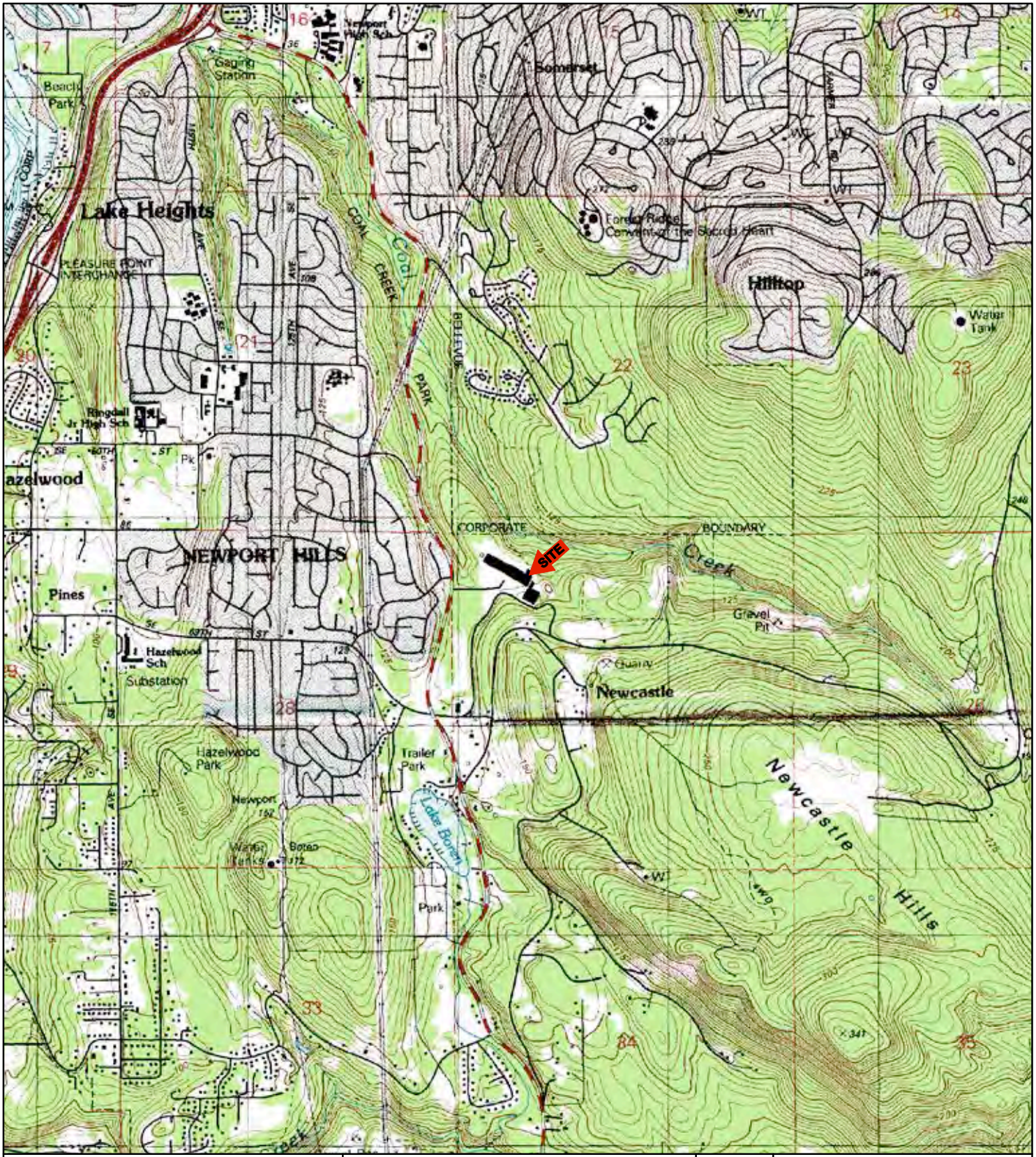
Phase I Environmental Site Assessment, Mutual Materials Newcastle Brick Plant, prepared by EMG Corporation, dated May 1, 2009.

City of Newcastle Critical Areas Report, Mutual Materials Newcastle Property, prepared by DJB & Associates NW, LLC, dated February 6, 2012.

Supplement to City of Newcastle Critical Areas Report, Mutual Materials Newcastle Property, prepared by DJB & Associates NW, LLC, dated March 30, 2012.

Mutual Materials Property – Soil Sampling Results, Pad Mounted Transformer Location, prepared by Kane Environmental, Inc., dated December 8, 2011.

Figures



KEY:

SOURCE: USGS 7.5 MINUTE QUADRANGLE (TOPOGRAPHIC)

BELLEVUE SOUTH, WA
1983

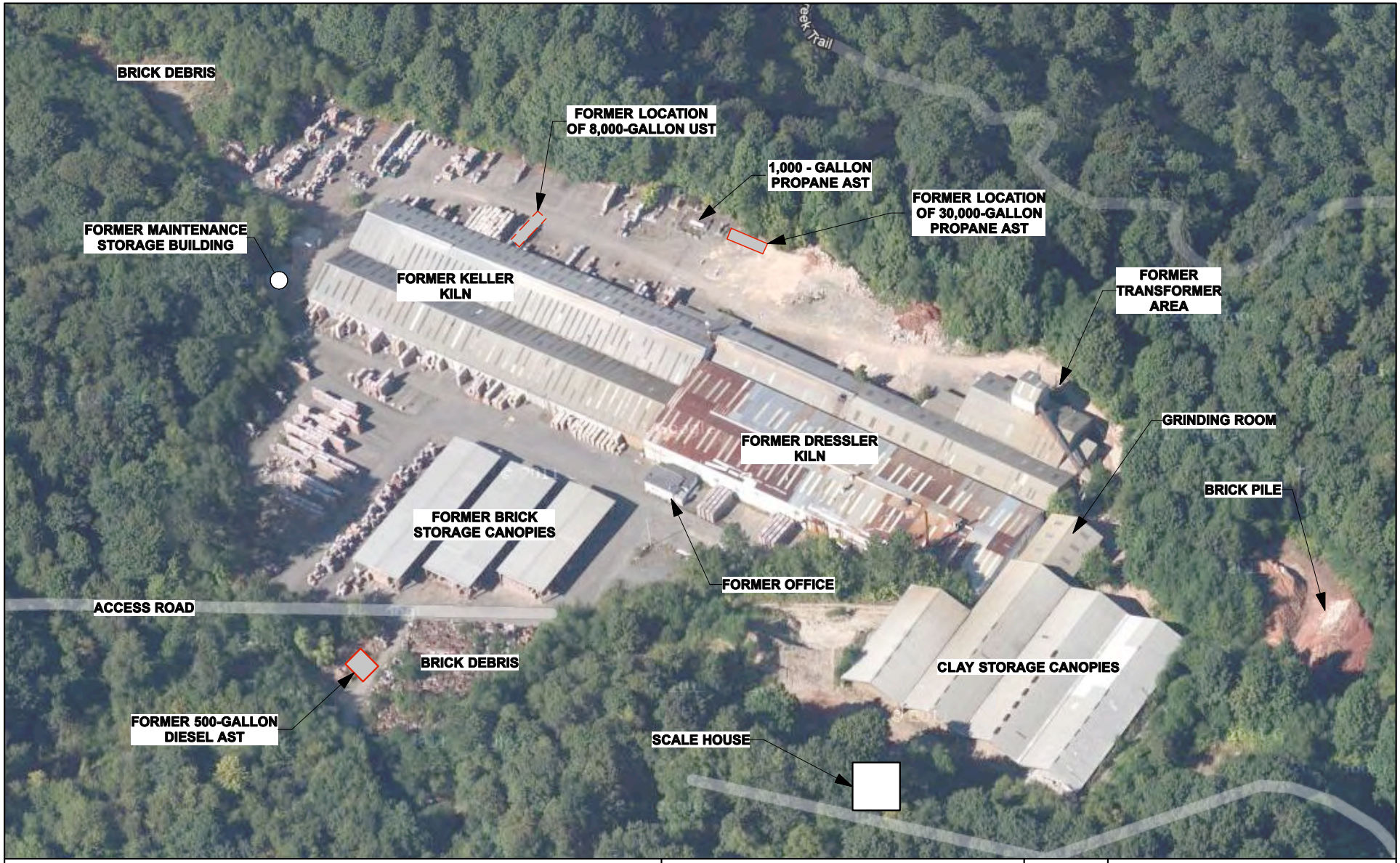
SCALE = 1:25,000

ENVIRONMENTAL PARTNERS INC
295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 1

GENERAL VICINITY MAP

PROJECT	38814.0		
PREPARED FOR	AVALON BAY		
LOCATION	6620 COAL CREEK PKWY SE NEWCASTLE, WASHINGTON		
SHEET 1 of 1	DRAWN BY ALW	REVIEWED BY GAM	DATE 10/31/12



KEY:

UST LOCATION

AST LOCATION

0 37.5 75 150

APPROXIMATE SCALE: 1" = 150'

ENVIRONMENTAL PARTNERS INC

295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 2

SITE REPRESENTATION

PROJECT	38814.0		
PREPARED FOR	AVALON BAY		
LOCATION	6620 COAL CREEK PKWY SE NEWCASTLE, WASHINGTON		
SHEET 1 of 1	DRAWN BY ALW	REVIEWED BY GAM	DATE 11/21/12

Attachment A
UST Closure & Site Assessment Report

O'Sullivan Omega

December 27, 1994

Mr. Jeff Linstad
Mutual Materials
605 119th N.E.
P.O. Box 2009
Bellevue, WA 98009

RE: UST Closure & Site Assessment Report
Mutual Materials, Newcastle
6620 Coal Creek Parkway
Renton, Washington

Dear Mr. Linstad:

Enclosed are two bound copies of the Underground Storage Tank Closure and Site Assessment Report for the above referenced subject property. One copy has also been sent to the Washington Department of Ecology.

If you have any questions regarding this report or need additional information please call me at (206) 682-2440.

Sincerely,
O'Sullivan Omega, Inc.

Paul Riley,
Environmental Services Manager

Enclosure

PR/de

cc: Ms. Karen Say
O'Sullivan Omega, Seattle

O'Sullivan Omega, Inc.
The Total Compliance Company

Main Office
3214 16th Ave. SW
Seattle. WA 98134
Phone 206.682.2440
Fax 206.621.8568

Portland Office
28395 SW Boberg Rd.
Wilsonville. OR 97070
Phone 503.682.0275
Fax 503.682.3607

Spokane Office
6012 East Valley Way
Spokane, WA 99212
Phone 509.534.3040
Fax 509.534.9434

Mutual Materials
Newcastle Brick Plant
Site Plan

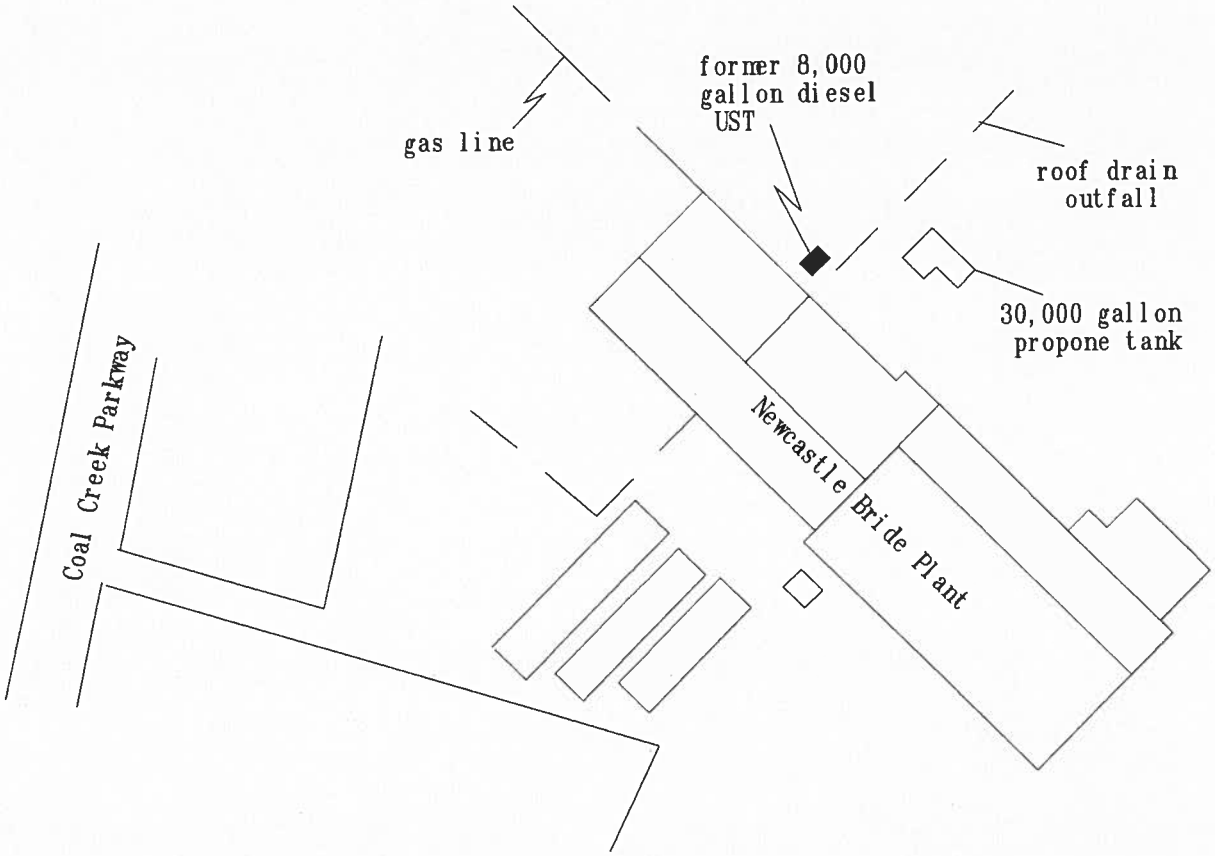


figure modified from site plan supplied by Mutual Materials

N

O'Sullivan Omega, Inc.
Geologists, Environmental
Specialists & General Contractor
3214 - 16th Avenue SW
Seattle, WA 98134

not to scale	site address: 6620 Coal Creek Parkway, Renton, Wa	date: 12/07/94	Figure 2

O'Sullivan Omega

December 23, 1994

Jeff Linstad
Manufacturing Engineer
605 119th NE Street
P.O. Box 2009
Bellevue, Washington 98009
Phone (206) 637-0500 ext. 362
Fax (206) 454-7732

RE: Mutual Materials-Newcastle Brick Plant
UST Closure and Site Assessment Report
6620 Coal Creek Parkway
Renton, Washington 98006
Ecology Site Number # 102343

Dear Mr. Linstad:

This report presents O'Sullivan Omega Inc. (O'Sullivan Omega) findings regarding the removal of one (1) 8,000 gallon diesel underground storage tank (UST) at the Mutual Materials-Newcastle Plant, Renton, Washington (Figure 1). The UST was decommissioned and removed by O'Sullivan Omega of Seattle, Washington. In addition, O'Sullivan Omega performed the UST Site Assessment for the project following Washington State Department of Ecology's (Ecology) document *Guidelines for Site Checks and Site Assessments for UST* (Revised, October 1992).

The objectives of this project were to:

- Remove and decommission one 8,000 gallon diesel fuel UST;
- Excavate petroleum contaminated soil (PCS) with the intent of bringing the site soils into compliance with the Washington State Department of Ecology (Ecology) MTCA Method A Soil Cleanup Guidelines (WAC 173-340);
- Determine concentrations of total petroleum hydrocarbons (TPHs) in soil samples collected adjacent to/and underlying the UST and from associated soil stockpiles;
- Compare TPH concentrations detected in soil to the applicable MTCA Method A Soil Cleanup Guidelines;
- Prepare a final UST Closure & Site Assessment report (following Ecology's *Guidance for Site Checks and Site Assessment for UST*) which documents the tank decommissioning activities, field observations, soil sampling locations, analytical results, conclusions and recommendations.

SITE & UST DESCRIPTIONS

The site is located at 6620 Coal Creek Parkway in Renton, Washington (Figure 1). The facility is currently a processing and storage facility for bricks.

The 8,000 gallon diesel fuel UST was reportedly installed in 1957 to provide fuel for a brick kiln. The tank was later used to fuel equipment at the facility. The UST was located adjacent to, and north of, the Plant building (Figure 2; Photo 1/Appendix A). The UST's dispenser was located just inside the facility. The UST was oriented northeast-southwest and had a diameter of 8 foot and length of 23 feet.

UST DECOMMISSIONING & REMOVAL ACTIVITIES

Copies of the Ecology UST 30 Day Notice of Intent to Close, UST Temporary/Permanent Closure and Site Assessment Notice, and the UST Site Check/Site Assessment Checklist are provided in Appendix B.

The 30 day intent to Close notification was submitted to Ecology by O'Sullivan Omega. The tank was pumped of product and triple rinsed by Coastal Tank Cleaning (CTC) of Seattle, Washington on October 24, 1994 (Appendix C). All product and rinsate were disposed by CTC in accordance with all applicable local, state, and federal regulations.

On October 24, 1994, O'Sullivan Omega inerted with dry ice, exposed, and removed the 8,000 gallon diesel UST. Soil immediately adjacent to the UST fill pipe and piping system was separately stockpiled since field screening evidence suggested the presence of petroleum hydrocarbons. Suspect clean tank overburden material was also stockpiled separately. On October 24, 1994 The diesel UST was transported by O'Sullivan Omega to CTC for final cleaning and disposal as scrap metal (Appendix C).

CONDITION OF THE UST AND PIPING SYSTEM

The 8,000 gallon fuel oil UST was in moderately-poor condition, with areas of moderate to heavy rust (Photo 2). There were no holes or noticeable pitting detected on the UST walls. The piping was in moderate to poor condition, also with areas of rust. There were no obvious corrosion holes seen in the piping, however there was evidence that fuel had leaked at a piping connection, where the product piping entered the building. There did not appear to be significant spillage of fuel near the fill pipe.

PETROLEUM CONTAMINATED SOIL REMOVAL

Field observations indicated that soil along the south sidewall, where the underground distribution piping entered the building, was impacted by a petroleum release. Mutual Materials requested that O'Sullivan Omega excavate the PCS, without undercutting the buildings footings. O'Sullivan Omega removed the PCS up to the buildings footings with a backhoe and hand shovels (Photo 3). The excavation under the piping had a final dimension of 5'l x 8'w x 4'd. Field observations and field screening results indicated that the piping excavation floor and sidewalls (under the former piping location) was clean. Approximately 2 to 4 cubic yards of PCS was removed.

SOIL SAMPLING ACTIVITIES

Samples were screened in the field for volatile organic compounds (VOCs) using a *Mini-Rae* photo-ionization detector (PID) with a 10.2 eV lamp, calibrated with 100 parts per million (ppm) isobutylene and zero air. Sample locations were chosen following Ecology's guidelines for UST Site Assessments. Soil samples collected for analysis were placed in clean, borosilicate sample jars with Teflon lined lids, placed in a cooler with bagged ice, and transported to American Analytical Services, Inc. of Redmond, Washington. Soil samples were collected using O'Sullivan Omega's standard decontamination and sampling protocols (Appendix D).

On October 24, 1994, a total of 5 discrete soil samples where collected from the excavation (Figure 3). Discrete sample B1-13 was collected from the excavation floor at a depth of 13 feet BGS. One discrete sample was collected from each sidewall at a depth of approximately 13 feet BGS. Adjacent sidewall samples were composited together into one sample for analysis by the laboratory chemist. The north sidewall (NSW-13) and east sidewall (ESW-13) samples were composited together for analysis. The south sidewall (SSW-13) and west sidewall (WSW-13) samples were composited together for analysis.

On October 24, 1994 a total of five discrete samples were collected from soil stockpile material. Sample RES-1 was collected from approximately 2 to 4 cubic yards of petroleum contaminated soil impacted by leakage from the piping/dispenser system. Four samples were collected from the suspect clean tank overburden material (samples OB1-C1, OB1-C2, OB2-C1, and OB2-C2). Samples OB1-C1 and OB1-C2 were composited together for analysis. Samples OB2-C1 and OB2-C2 were composited together for analysis.

SITE SOIL CONDITIONS

Soil encountered in the UST excavation was generally moderately compact, moderate-yellowish brown, slightly silty, gravely sand. Groundwater was not encountered in the UST excavation.

LABORATORY ANALYSIS

The laboratory analyses selected for this project were based upon the Washington State Department of Ecology Site Assessment requirements. All samples (two discrete and four composite) were analyzed to determine the diesel total petroleum hydrocarbon (TPH) concentrations using Washington State Test Method WTPH-D. Copies of analytical report and associated chain of custody are included in Appendix E.

ANALYTICAL RESULTS

All analytical results and Ecology's MTCA Method A Soil Cleanup Guidelines are given in Table 1 and discussed below.

Samples collected from the excavation floor and sidewalls had non-detectable diesel TPH concentrations (i.e., below the analytical detection limit of 25 parts per million, ppm). Sample RES-1, collected from the PCS overburden material, had a diesel TPH concentration of 4,300 ppm. Suspect clean tank overburden composite samples (OB1-C1/OB1-C2 and OB2-C1/OB2-C2) had non-detectable diesel TPH concentrations.

DISCUSSION AND CONCLUSIONS

On October 24, 1994, O'Sullivan Omega removed one (1) 8,000 gallon diesel UST and associated piping at the Mutual Materials - Newcastle Bride Plant, located in Renton, Washington. The UST was in moderate to poor condition, with no visual indications of leakage from the UST. However, a small volume of PCS was encountered along the south sidewall and underlying the UST piping system where it entered the building. O'Sullivan Omega excavated approximately 2 to 4 cubic yards of PCS from this impacted area (up to the buildings footings). A small volume of PCS was left in-place, under the building footings (Photo 3), since additional excavation might of jeopardized the buildings footings.

A total of 10 samples were collected from the excavation and associated soil stockpile. All samples collected from the excavation floor and sidewalls, and tank overburden soil stockpile, had non-detectable concentrations of diesel TPH. One sample collected from approximately 2 to 4 cubic yards of diesel impacted soil had a diesel TPH concentration of 4,300 ppm. The 2 to 4 cubic yards of diesel impacted soil was transported by O'Sullivan Omega to Associated Sand and Gravel of Everett, Washington for treatment/disposal. Copies of PCS disposal documentation is provided in Appendix F.

Analytical results indicated that, in general, the excavation *in-situ* soil and tank overburden material (re-used as backfill) were in compliance with applicable local, state, and federal environmental regulations at time of UST closure. However, an apparent small volume of PCS

was left in-place under the building at time of closure. Although the PCS underlying building (and dispenser, located just inside the building) is most likely of insignificant volume, the actual volume cannot be determined without additional subsurface investigation.

The excavation was backfilled by O'Sullivan Omega to sub-grade with the original, clean tank overburden material and clean imported fill. The excavation was then finished to-grade with asphalt.

RECOMMENDATIONS

At this time, O'Sullivan Omega does not recommend any additional subsurface investigation in the project area.

LIMITATIONS

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature of the work and conditions of the work completed in the same or similar locations at the time the work was performed. O'Sullivan Omega results and findings from the select area do not necessarily reflect soil or ground water conditions underlying other areas of the site not investigated. This report is not meant to represent a legal opinion. No other warranty, expressed or implied, is made.

Any questions regarding our work or this report, the presentation of the information, and the interpretation of the data are welcome and should be referred to the undersigned.

Sincerely,
O'Sullivan Omega, Inc.

Richard Simpson
Project Geologist

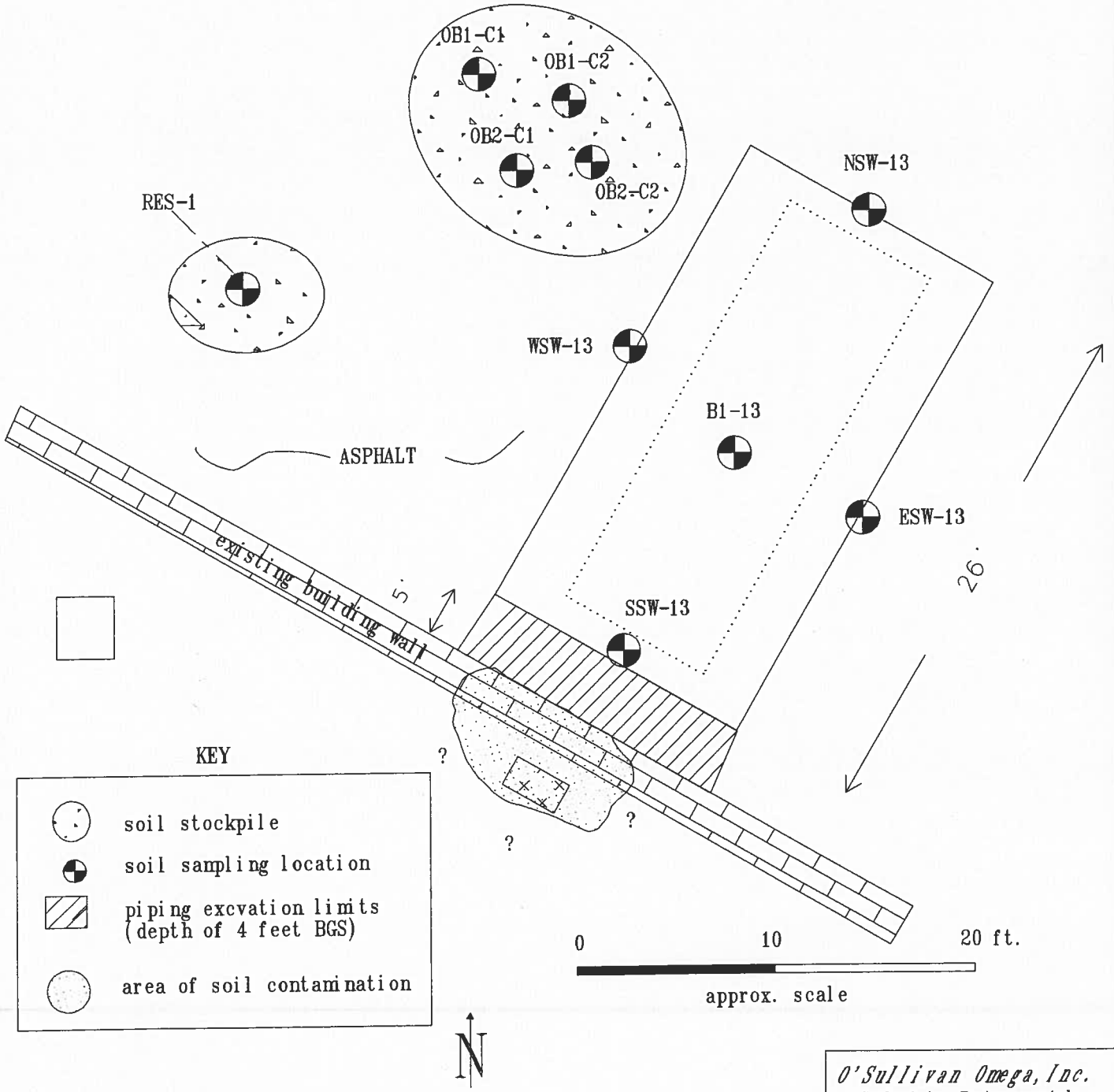
Paul Riley
Manager, Environmental Services

Attachments

cc: Washington State Department of Ecology
Underground Storage Tank Division
PO Box 47655
Olympia, Washington 98504-7655

Ms. Karen Say
O'Sullivan Omega, Inc.

Mutual Materials
Newcastle Brick Plant
Sampling Plan



samples collected by O'Sullivan Omega on October 24, 1994. Sample depth indicated by sample ID suffix.

O'Sullivan Omega, Inc.
Geologists, Environmental Specialists & General Contractor
3214 - 16th Avenue SW
Seattle, WA 98134

approx. scale as shown	site address: 6620 Coal Creek Parkway, Renton, Wa	date: 10/20/94	Figure 3

Photo 3. View of south sidewall after excavating approximately 4 cubic yards of petroleum contaminated soil (PCS). Impacted soil located under the building's footing was left in-place at time of site closure.

Attachment B
Transformer Area Soil Sampling Report

APPENDIX D

KANE ENVIRONMENTAL INC

MEMORANDUM

DATE: December 8, 2011

TO: Mr. Ben Pariser
BP Squared, LLC

FROM: John Kane
Principal
Kane Environmental, Inc.

RE: Mutual Materials Property
Soil Sampling Results
Pad-Mounted Transformer Location
6620 Coal Creek Parkway
Newcastle, WA

State of Washington
1193
Licensed Geologist
JOHN R. KANE

Kane Environmental conducted near-surface soil sampling at the Mutual Materials property located at 6620 Coal Creek Parkway in Newcastle, Washington (Figure 1). The near-surface soil sampling was conducted at the location of three pad-mounted aboveground electrical transformers at the northwest corner of the Property manufacturing building (Figure 2). The active transformers were enclosed by a locked cyclone security fence. The soil samples were collected within ten feet of the transformers, in proximity to detect a past release from the transformers, and for health and safety concerns.

On November 3, 2011, Kane Environmental used a post-hole digger and hand shovel to collect soil composite samples approximately 0.5 to 1.5 feet below ground surface (bgs) for analysis of Polychlorinated Biphenyls (PCBs). PCBs were commonly used in old electrical transformers prior to the 1980s. The soil analytical results revealed non-detectable concentrations of PCBs in all four soil samples. Based on the soil analytical data, no further investigation is warranted.

When the electrical transformers are decommissioned, Kane Environmental recommends that oil inside the transformers be analyzed to determine the presence or absence of PCBs.

Kane Environmental review the report titled, "*Phase I Environmental Site Assessment of Mutual Materials Newcastle Brick Plant*" prepared by EMG and dated May 6, 2009. The report identified the past presence of a 8,000-gallon diesel fuel underground storage tank (UST), but also noted that the UST had been removed along with some diesel contaminated soil, and was issued a closed status in 1996 (we assume by the Washington State Department of Ecology) and "*no further action was deemed necessary*". The

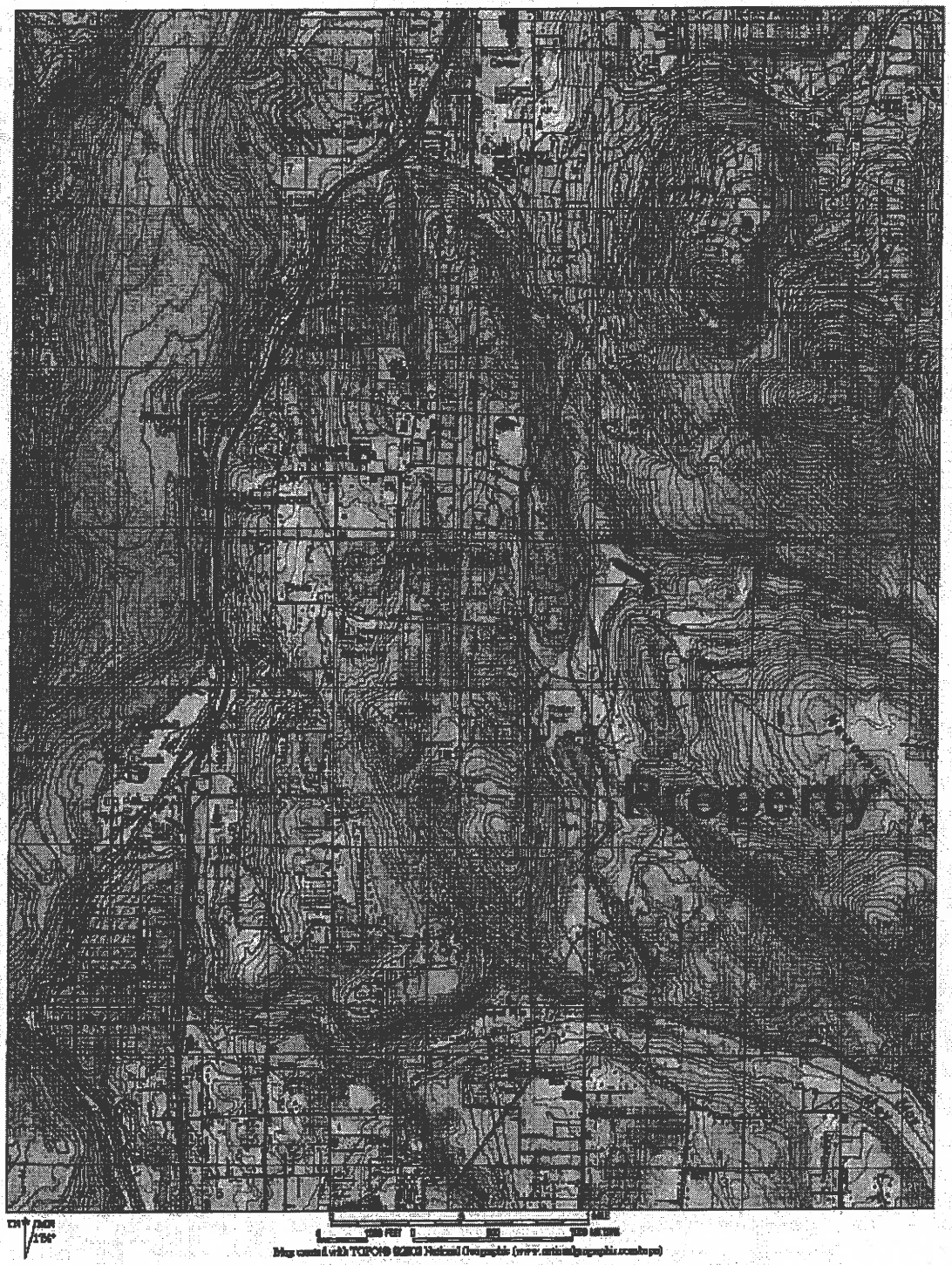
APPENDIX D

Phase I ESA also reported that the was no record of any spills or releases, except for the diesel UST; no obvious staining inside or outside the buildings associated with the chemicals and oils used at the Property; and the septic system was only connected to bathrooms. Some suspect asbestos-containing materials (ACM) was noted in their Phase I ESA report.

Based on our review of the Phase I ESA report, the report states that no recognized environmental conditions are present at the Property that would warrant additional assessment, except for the presence of the suspect ACM.

Thank you and please call me at (206) 691-0476 if you have any questions.

APPENDIX D



KANE ENVIRONMENTAL INC

Near Surface Soil Samples
6620 Coal Creek Parkway
Newcastle, Washington

Figure 1
Vicinity Map

APPENDIX D

N

LEGEND

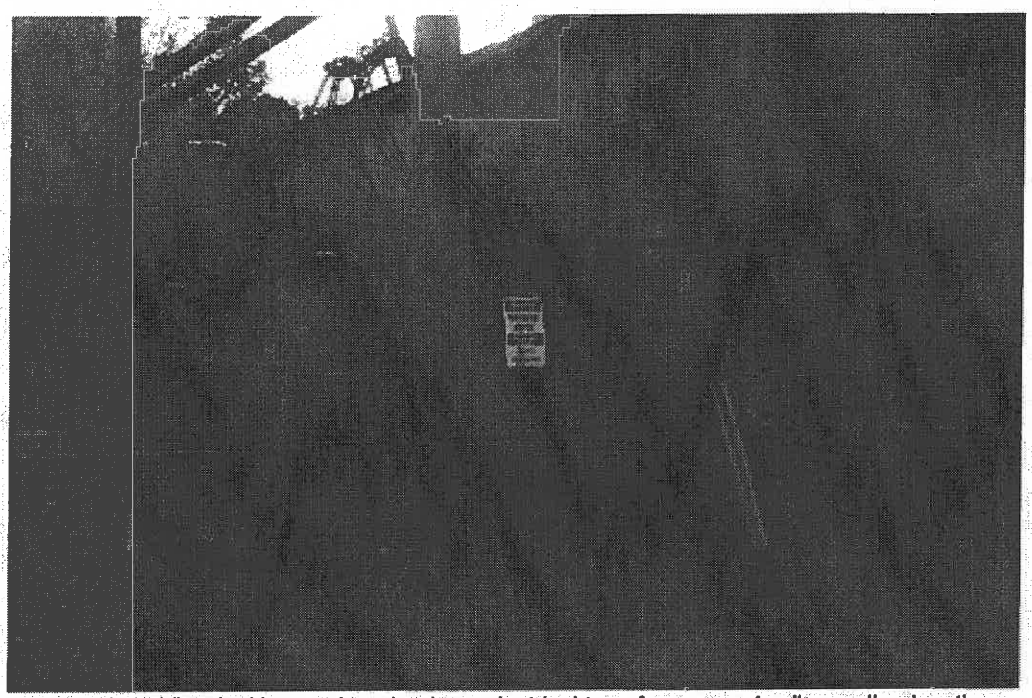
——————— BUILDING LINE

○ TRANSFORMERS

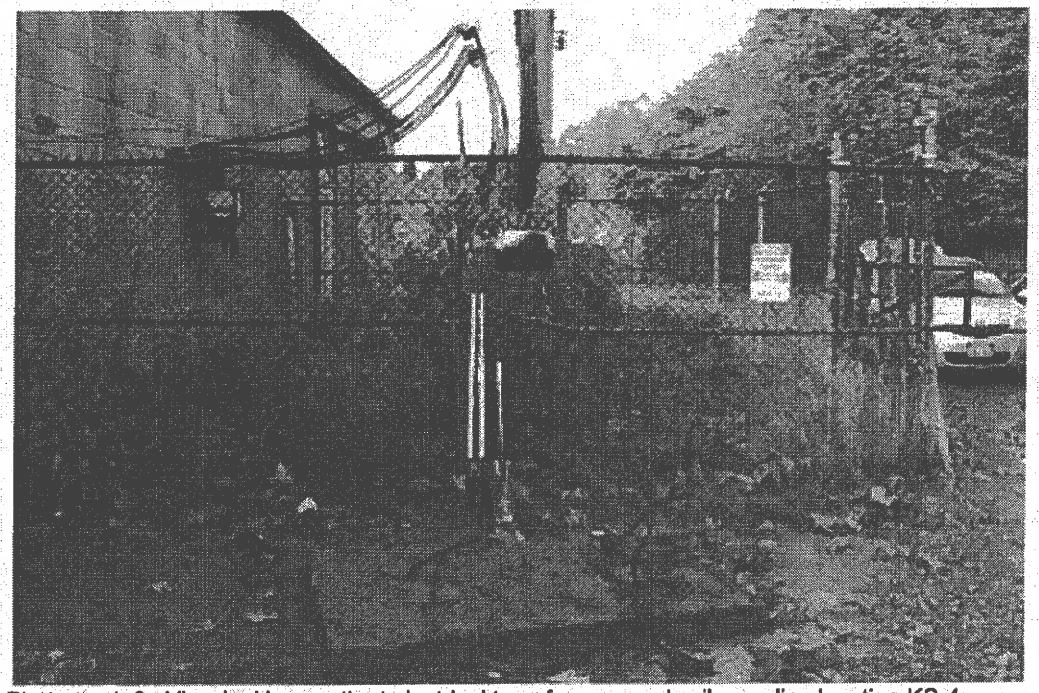
SS-1 NEAR SURFACE SOIL SAMPLE LOCATION AND IDENTIFICATION

KANE ENVIRONMENTAL INC	Near Surface Soil Samples 6620 Coal Creek Parkway Newcastle, Washington	Figure 2 Soil Sampling Locations

APPENDIX D



Photograph 1. View looking north at the three electrical transformers and soil sampling location KS-2.



Photograph 2. View looking south at electrical transformers and soil sampling location KS-4.

Transformer Technologies LLC

4709 Turner Rd. SE
Salem OR 97317
503-364-5476 Phone

Purchase Ticket

Purchase Ticket # **12358**
Purchase Date **09/28/12**
Currency **US Dollar**

Customer:
Mutual Materials
PO Box 2009
Bellevue WA 98009

Account Rep
ocoleman

Terms Net 30 Days
Payment Due 10/28/12

Item Name	Order #	Gross	Tare	Net	Price	Tota
Rec: **9/10/12** WT Ticket #**S 16754**						
Polemount Transformers	10735	10,950.000	0.000	10,950.000 LB	$0.200000 LB	$2,190.0
External Detail ID:	9/7/12					
Container Num	3 Units			Chasis/Trailer #	12-08-155-XFR	
	Totals:	10,950.000	0.000	10,950.000		**$2,190.0**

Notes:

WTN 12-08-155-XFR
PUD 9/5/12
UNITS 3

9/5
3units (transformers)
Jeff L.

Payment Information

Date	Check / Ref	Check	Cash /EFT	Total Appl
10/05/12	50362	$2,190.00	$0.00	$2,190.00

RECEIVED BY: _____

Prepared By OShields 10/5/2012 1:15:32PM

powered by www.21stCenturyProgramming.com

Transformer Technologies, LLC.

A G&S – Coleman/Calbag Company

EPA ID Number: ORQ000026715 **Date:** *9/13/2012*

CERTIFICATE OF DESTRUCTION

TRANSPORTABLE EQUIPMENT WORK ORDER:

12-08-155-XFR

THIS IS TO CERTIFY THAT THE LISTED EQUIPMENT RECEIVED AT TRANSFORMER TECHNOLOGIES, SALEM, OREGON ON **September 7, 2012** WAS DESTRUCTED BY **September 12, 2012** IN ACCORDANCE WITH 40 CFR 761 AND ALL APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS.
SEE ATTACHED LISTING FOR EQUIPMENT DESIGNATION

GENERATOR: **Mutual Materials**
ADDRESS: PO Box 2009
Bellevue WA 98009

Les Joel General Manager

4709 TURNER ROAD SALEM, OREGON 97317
(503)364-5476 FAX (503)364-3339 www.transformertechnologies.com

Transformer Technologies, LLC.

A G&S – Coleman/Calbag Company

Customer:	Mutual Material
Arrival Date:	9/7/2012
Destruction Date:	9/12/2012
Record of Destruction:	12-08-155-XFR
Total No. of Units	3
Total Weight	10950

Unit ID	Serial Number	Equipment Type	PCB ppm	KVA	Weight
Newcastle Plant	No nameplate	Polemount	1.1	Unkwn	3650
Newcastle Plant	No nameplate	Polemount	<1	Unkwn	3650
Newcastle Plant	No nameplate	Polemount	<1	Unkwn	3650

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
40CFRPART761	1	800-424-9300	12-08-155-XFR

GENERATOR

5. Generator's Name and Mailing Address
Mutual Materials
PO Box 2009
Bellevue, WA 98009
Generator's Phone: 206-920-3711

Generator's Site Address (if different than mailing address)
6620 Coal Creek Parkway SE
Newcastle, WA 98059

6. Transporter 1 Company Name: Transformer Technologies — U.S. EPA ID Number: ORQ000026715

7. Transporter 2 Company Name — U.S. EPA ID Number:

8. Designated Facility Name and Site Address
Transformer Technologies
4709 Turner Rd SE
Salem, OR 97317
Facility's Phone: 503-364-5476

U.S. EPA ID Number: ORQ000026715

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	Non DOT/ Non PCB Regulated Electrical Equipment.	3	CM	10950	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Non PCB Manifest. In case of spill notify Jeff Linstad 206-920-3711
See attached equipment list for further unit indentification.
PO 10735

14. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: JEFF LINSTAD — Signature: Jeff Linstad — Month / Day / Year:

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Alan Nisly — Signature: Alan Nisly — Month / Day / Year:

Transporter 2 Printed/Typed Name — Signature — Month / Day / Year: 9 5 12

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number:
Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month / Day / Year:

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: William Bailey — Signature: W. Bailey — Month / Day / Year: 9 7 12

169-BLC-O 5 11977 (Rev. 9/09)

DESIGNATED FACILITY TO GENERATOR

SPECTRA Laboratories

2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

06/26/2012

Mutual Materials
PO Box 2009
Bellevue, WA 98009
Attn: Jeff Linstad

P.O.#:	497621
Project:	Newcastle Plant
Client ID:	Transformer Oil 1
Sample Matrix:	Oil
Date Sampled:	06/20/2012
Date Received:	06/21/2012
Spectra Project:	2012060520
Spectra Number:	1
	Rush

Analyte	Result	Units	Method
PCB AR1260	1.1	mg/Kg	SW846 8082A

Surrogate	% Recovery	Method
Decachlorobiphenyl	81	SW846 8082A

SPECTRA LABORATORIES

Steve Hibbs, Laboratory Manager
a5/sgh

SPECTRA Laboratories

2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

06/26/2012

Mutual Materials
PO Box 2009
Bellevue, WA 98009
Attn: Jeff Linstad

P.O.#:	497621
Project:	Newcastle Plant
Client ID:	Transformer Oil 2
Sample Matrix:	Oil
Date Sampled:	06/20/2012
Date Received:	06/21/2012
Spectra Project:	2012060520
Spectra Number:	2
	Rush

Analyte	Result	Units	Method
PCB	<1.0	mg/Kg	SW846 8082A

Surrogate	% Recovery	Method
Decachlorobiphenyl	84	SW846 8082A

SPECTRA LABORATORIES

Steve Hibbs, Laboratory Manager
a5/sgh

SPECTRA Laboratories

2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

06/26/2012

Mutual Materials
PO Box 2009
Bellevue, WA 98009
Attn: Jeff Linstad

P.O.#: 497621
Project: Newcastle Plant
Client ID: Transformer Oil 3
Sample Matrix: Oil
Date Sampled: 06/20/2012
Date Received: 06/21/2012
Spectra Project: 2012060520
Spectra Number: 3
Rush

Analyte	Result	Units	Method
PCB	<1.0	mg/Kg	SW846 8082A

Surrogate	% Recovery	Method
Decachlorobiphenyl	79	SW846 8082A

SPECTRA LABORATORIES

Steve Hibbs, Laboratory Manager
a5/sgh

Attachment C
Aerial Photographs

Former Mutual Materials Site
6620 COAL CREEK PKWY SE
Renton, WA 98059

Inquiry Number: 3444311.5
November 01, 2012

The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report AS IS. Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2012 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

Date EDR Searched Historical Sources:

Aerial Photography November 01, 2012

Target Property:

6620 COAL CREEK PKWY SE

Renton, WA 98059

Year	***Scale***	***Details***	***Source***
1965	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Flight Date: July 06, 1965	EDR
1977	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Flight Date: September 13, 1977	EDR
1985	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Flight Date: June 25, 1985	EDR
1990	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Composite DOQQ - acquisition dates: July 18, 1990	EDR
2005	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Flight Year: 2005	EDR
2006	Aerial Photograph. Scale: 1"=500'	Panel #: 47122-E2, Mercer Island, WA;/Flight Year: 2006	EDR

INQUIRY #: 3444311.5

YEAR: 1965

= 500'

N

INQUIRY #: 3444311.5
YEAR: 1977
= 500'
N

INQUIRY #: 3444311.5

YEAR: 1985

= 500'

N

INQUIRY #: 3444311.5
YEAR: 1990
= 500'
N

INQUIRY #: 3444311.5
YEAR: 2005
= 500'
N

INQUIRY #: 3444311.5
YEAR: 2006
= 500'
N

Attachment D
Regulatory Database Report

Former Mutual Materials Site
6620 COAL CREEK PKWY SE
Renton, WA 98059

Inquiry Number: 3444311.6
November 06, 2012

The EDR-City Directory Image Report

Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION

Executive Summary

Findings

City Directory Images

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OR DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction orforecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2012 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc. or its affiliates is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available city directory data at 5 year intervals.

RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. A check mark indicates where information was identified in the source and provided in this report.

Year	Target Street	Cross Street	Source
1996	☑	☐	Polk's City Directory
1985	☐	☐	Polk's City Directory
1980	☐	☐	Polk's City Directory
1975	☐	☐	Polk's City Directory
1970	☐	☐	Polk's City Directory
1964	☐	☐	Polk's City Directory

RECORD SOURCES

EDR is licensed to reproduce certain City Directory works by the copyright holders of those works. The purchaser of this EDR City Directory Report may include it in report(s) delivered to a customer. Reproduction of City Directories without permission of the publisher or licensed vendor may be a violation of copyright.

FINDINGS

TARGET PROPERTY STREET

6620 COAL CREEK PKWY SE
Renton, WA 98059

Year	*CD Image*	*Source*	
COAL CREEK PKWY SE			
1996	pg A1	Polk's City Directory	
1985	-	Polk's City Directory	Street not listed in Source
1980	-	Polk's City Directory	Street not listed in Source
1975	-	Polk's City Directory	Street not listed in Source
1970	-	Polk's City Directory	Street not listed in Source
1964	-	Polk's City Directory	Street not listed in Source

FINDINGS

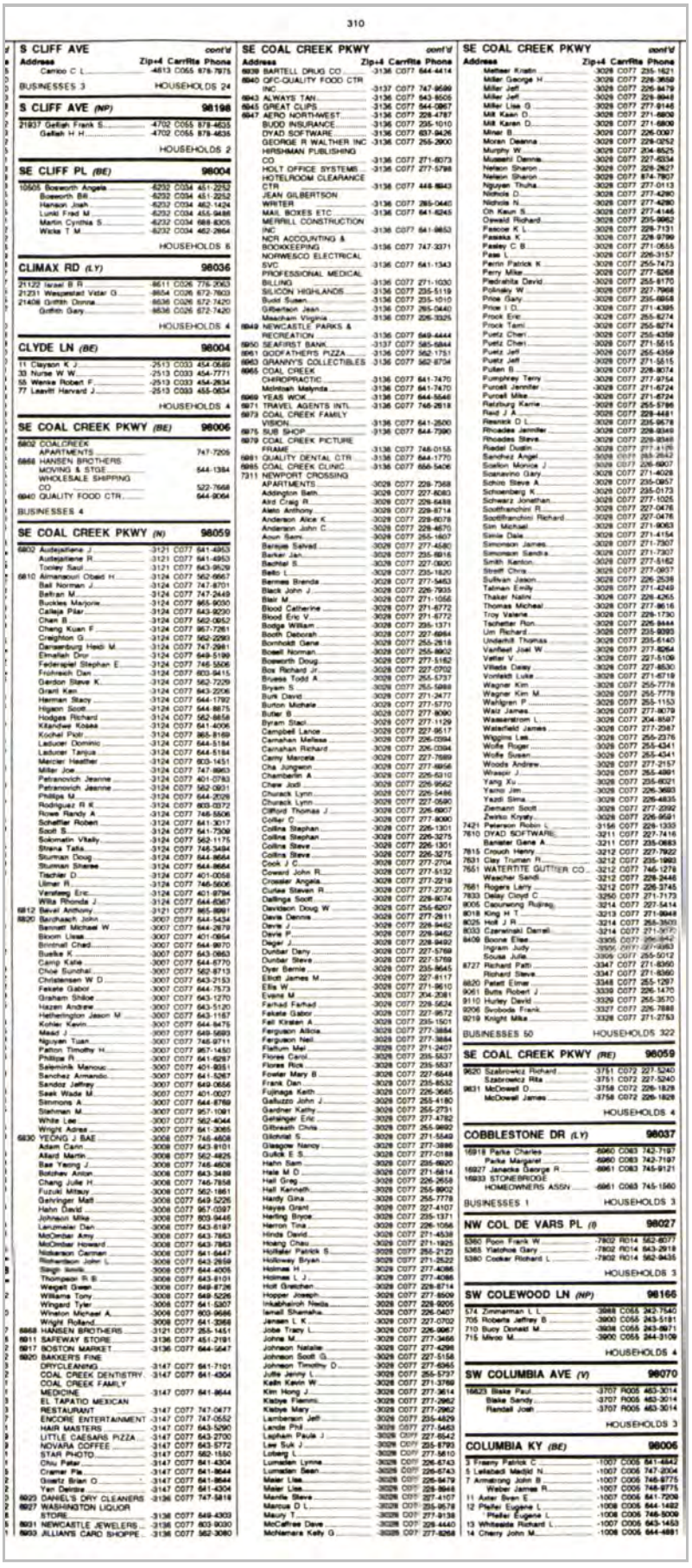
CROSS STREETS

No Cross Streets Identified

City Directory Images

Target Street	Cross Street	Source
✓	-	Polk's City Directory

COAL CREEK PKWY SE 1996



S CLIFF AVE cont'd

Address	Zip+4	Carrlte	Phone
Carroo C L	-4813	C055	878-7975
BUSINESSES 3		HOUSEHOLDS 24	

S CLIFF AVE (NP) 98198

21937 Gellish Frank S	-4702	C055	878-4635
Gellish H H	-4702	C055	878-4635
HOUSEHOLDS 2			

SE CLIFF PL (BE) 98004

10505 Bosworth Angela	-6232	C034	451-2252
Bosworth Bill	-6232	C034	451-2252
Hanson Josh	-6232	C034	462-1424
Lunkl Fred M	-6232	C034	455-9488
Martin Cynthia S	-6232	C034	688-8305
Wicks T M	-6232	C034	462-2664
HOUSEHOLDS 6			

CLIMAX RD (LY) 98036

21122 Israel B R	-8611	C026	776-2063
21231 Wesgestad Vidar G	-8654	C026	672-7603
21406 Griffith Donna	-8636	C026	672-7420
Griffith Gary	-8636	C026	672-7420
HOUSEHOLDS 4			

CLYDE LN (BE) 98004

11 Clayson K J	-2513	C033	454-0689
33 Nurse W W	-2513	C033	454-7771
55 Wenke Robert F	-2513	C033	454-2634
77 Leavitt Harvard J	-2513	C033	455-0634
HOUSEHOLDS 4			

SE COAL CREEK PKWY (BE) 98006

6802 COALCREEK APARTMENTS			747-7205
6866 HANSEN BROTHERS MOVING & STOR			644-1384
WHOLESALE SHIPPING CO			522-7668
6940 QUALITY FOOD CTR			644-9064
BUSINESSES 4			

SE COAL CREEK PKWY (N) 98059

6802 Audejatiene J	-3121	C077	641-4953
Audejatiene R	-3121	C077	641-4953
Tooley Saul	-3121	C077	643-9539
6810 Almansouri Obaid H	-3124	C077	562-6667
Ball Norman J	-3124	C077	747-8701
Beltran M	-3124	C077	747-3449
Buckles Marjorie	-3124	C077	865-9050
Calleja Pilar	-3124	C077	643-9230
Chan B	-3124	C077	562-0952
Chang Kuan F	-3124	C077	867-7261
Creighton G	-3124	C077	562-2293
Darsenburg Heidi M	-3124	C077	747-2981
Elmallah Dror	-3124	C077	649-5199
Federspiel Stephan E	-3124	C077	746-5506
Frohreich Dan	-3124	C077	603-9415
Gerdon Steve K	-3124	C077	562-7229
Grant Ken	-3124	C077	643-2206
Herman Stacy	-3124	C077	644-1792
Higson Scott	-3124	C077	644-8675
Hodges Richard	-3124	C077	562-6858
Kifandwe Kobea	-3124	C077	641-4206
Kochel Piotr	-3124	C077	865-8169
Laducer Dominic	-3124	C077	644-5184
Laducer Tanjua	-3124	C077	644-5184
Mercier Heather	-3124	C077	603-1451
Miller Joe	-3124	C077	747-8963
Petranovich Jeanne	-3124	C077	401-0783
Petranovich Jeanne	-3124	C077	562-0931
Phillips M	-3124	C077	644-2028
Rodriguez R K	-3124	C077	603-0372
Rowe Randy A	-3124	C077	746-5506
Schaffer Robert	-3124	C077	641-3017
Scott S	-3124	C077	641-7309
Sokomatin Vitaliy	-3124	C077	562-1175
Shiena Talla	-3124	C077	746-3484
Sturman Doug	-3124	C077	644-8664
Sturman Sheree	-3124	C077	644-8664
Tischler D	-3124	C077	401-0058
Ulmer R	-3124	C077	746-5606
Vansteeg Eric	-3124	C077	401-9794
Wills Rhonda J	-3124	C077	644-6367
6812 Bevel Anthony	-3121	C077	865-8991
6820 Birchbach John	-3007	C077	644-5434
Bennett Michael W	-3007	C077	644-2679
Bloom Lissa	-3007	C077	401-0864
Brintnall Chad	-3007	C077	644-9870
Buelke K	-3007	C077	643-0863
Camp Katie	-3007	C077	644-6770
Choe Sunchai	-3007	C077	562-8713
Christensen W D	-3007	C077	643-2153
Fekete Gabor	-3007	C077	644-7573
Graham Shiloe	-3007	C077	643-1270
Hazen Andrew	-3007	C077	643-5120
Hetherington Jason M	-3007	C077	643-1167
Kohler Kevin	-3007	C077	644-8475
Mead J	-3007	C077	649-5693
Nguyen Tuan	-3007	C077	562-9711
Patton Timothy H	-3007	C077	957-1450
Phillips R	-3007	C077	641-6287
Selemink Manouc	-3007	C077	401-9351
Sanchez Amando	-3007	C077	641-5267
Sandoz Jeffrey	-3007	C077	649-0656
Seek Wade M	-3007	C077	401-0027
Simmons A	-3007	C077	644-8769
Starkman M	-3007	C077	957-1091
White Lee	-3007	C077	562-4044
Wright Adrea	-3007	C077	641-3065
6830 YEONG J BAE	-3008	C077	746-4608
Adam Carin	-3008	C077	643-9101
Allard Martin	-3008	C077	562-4825
Bae Yeong J	-3008	C077	746-4608
Botchev Aman	-3008	C077	643-3489
Chang Julie H	-3008	C077	746-7858
Fuzuki Mitsuy	-3008	C077	562-1861
Gehringer Matt	-3008	C077	649-5226
Hahn David	-3008	C077	957-0097
Johnson Mike	-3008	C077	603-9446
Lenzmeier Dan	-3008	C077	643-8197
McClendan Amy	-3008	C077	643-7863
McClendan Howard	-3008	C077	643-7863
Niskanen Carmen	-3008	C077	641-5447
Richardson John L	-3008	C077	643-2659
Singh Sharik	-3008	C077	644-4005
Thompson R S	-3008	C077	643-8101
Weigelt Gwen	-3008	C077	649-8726
Williams Tony	-3008	C077	649-5295
Wingard Tyler	-3008	C077	641-5307
Winston Michael A	-3008	C077	603-9686
Wright Rolland	-3008	C077	641-3368
6868 HANSEN BROTHERS	-3121	C077	254-4451
6911 SAFEWAY STORE	-3136	C077	451-2191
6917 BOSTON MARKET	-3136	C077	644-5647
6920 BAKKER'S FINE DRYCLEANING	-3147	C077	641-7101
COAL CREEK DENTISTRY	-3147	C077	641-4304
COAL CREEK FAMILY MEDICINE	-3147	C077	641-9644
EL TAPATIO MEXICAN RESTAURANT	-3147	C077	747-0477
ENCORE ENTERTAINMENT	-3147	C077	747-0552
HAIR MASTERS	-3147	C077	643-5290
LITTLE CAESARS PIZZA	-3147	C077	643-2700
NOVARA COFFEE	-3147	C077	643-5772
STAR PHOTO	-3147	C077	562-1550
Chiu Peter	-3147	C077	641-4304
Cramer Pla	-3147	C077	641-9644
Goertz Brian O	-3147	C077	641-9644
Yen Deirdre	-3147	C077	641-4304
6923 DANIEL'S DRY CLEANERS	-3136	C077	747-5818
6927 WASHINGTON LIQUOR STORE	-3138	C077	649-4303
6931 NEWCASTLE JEWELERS	-3136	C077	603-9030
6933 JILLIAN'S CARD SHOPPE	-3136	C077	562-3080

SE COAL CREEK PKWY cont'd

Address	Zip+4	Carrlte	Phone
6938 BARTELL DRUG CO	-3136	C077	644-4414
6940 OFC-QUALITY FOOD CTR INC	-3137	C077	747-9586
6943 ALWAYS TAN	-3136	C077	643-8505
6945 GREAT CLIPS	-3136	C077	644-0867
6947 AERO NORTHWEST	-3136	C077	228-4787
BUDD INSURANCE	-3136	C077	235-1010
DYAD SOFTWARE	-3136	C077	637-8426
GEORGE R WALTHER INC	-3136	C077	255-2900
HIRSHMAN PUBLISHING CO	-3135	C077	271-6073
HOLT OFFICE SYSTEMS	-3135	C077	277-5798
HOTELROOM CLEARANCE CTR	-3136	C077	448-8843
JEAN GILBERTSON WRITER	-3136	C077	255-0440
MAIL BOXES ETC	-3136	C077	641-6245
MERRILL CONSTRUCTION INC	-3136	C077	641-8653
NCR ACCOUNTING & BOOKKEEPING	-3136	C077	747-3371
NORWESCO ELECTRICAL SVC	-3136	C077	641-1343
PROFESSIONAL MEDICAL BILLING	-3136	C077	271-1030
SILICON HIGHLANDS	-3136	C077	235-5119
Budd Susan	-3136	C077	235-1010
Gilbertson Jean	-3136	C077	255-0440
Meacham Virginia	-3136	C077	226-3325
6949 NEWCASTLE PARKS & RECREATION	-3136	C077	649-4444
6950 SEAFIRST BANK	-3137	C077	585-6844
6961 GODFATHERS PIZZA	-3136	C077	562-1751
6963 GRANNY'S COLLECTIBLES	-3136	C077	562-8704
6965 COAL CREEK CHIROPRACTIC	-3136	C077	641-7470
Mcintosh Melynda	-3136	C077	641-7470
6969 YEAS WOK	-3136	C077	644-5646
6971 TRAVEL AGENTS INTL	-3136	C077	746-2818
6973 COAL CREEK FAMILY VISION	-3136	C077	641-2500
6975 SUB SHOP	-3136	C077	644-7390
6979 COAL CREEK PICTURE FRAME	-3136	C077	746-0155
6981 QUALITY DENTAL CTR	-3136	C077	644-1770
6985 COAL CREEK CLINIC	-3136	C077	656-5406
7311 NEWPORT CROSSING APARTMENTS	-3029	C077	228-7368
Addington Beth	-3029	C077	227-8083
Aird Craig R	-3029	C077	226-6488
Aiello Anthony	-3029	C077	229-8714
Anderson Alice K	-3029	C077	229-8078
Anderson John C	-3029	C077	228-4670
Aoun Sami	-3029	C077	255-1607
Barraza Salvad	-3029	C077	277-4585
Barker Jan	-3029	C077	235-8918
Bechtel S	-3029	C077	227-0920
Bello L	-3029	C077	235-1820
Barnes Brenda	-3029	C077	277-5463
Black John J	-3029	C077	226-7935
Blair M	-3029	C077	271-1056
Blood Catherine	-3029	C077	271-6772
Blood Eric V	-3029	C077	271-6772
Bodge William	-3029	C077	235-1371
Booth Deborah	-3029	C077	227-6984
Bornhold Gene	-3029	C077	255-2818
Bosell Norman	-3029	C077	255-8902
Bosworth Doug	-3029	C077	277-5152
Box Richard Jr	-3029	C077	227-0702
Bryasa Todd A	-3029	C077	255-1737
Bryam S	-3029	C077	255-5988
Burk David	-3029	C077	271-2477
Burton Michele	-3029	C077	277-5770
Butler B	-3029	C077	277-8090
Byram Staci	-3029	C077	277-1129
Campbell Lance	-3029	C077	227-9517
Carnahan Melissa	-3029	C077	226-0394
Carnahan Richard	-3029	C077	226-0394
Carny Marcela	-3029	C077	227-7589
Cha Jongwon	-3029	C077	277-8956
Chamberlin A	-3029	C077	235-5310
Chew Jodi	-3029	C077	226-9562
Churack Lynn	-3029	C077	226-5486
Churack Lynn	-3029	C077	227-0590
Clifford Thomas J	-3029	C077	226-8907
Colter C	-3029	C077	277-8090
Collins Stephan	-3029	C077	226-1301
Collins Stephan	-3029	C077	226-3275
Collins Steve	-3029	C077	226-1301
Collins Steve	-3029	C077	226-3275
Cook J C	-3029	C077	277-2704
Coward John R	-3029	C077	277-5132
Crossler Angela	-3029	C077	277-2218
Curlee Steven R	-3029	C077	277-2730
Dallinga Scott	-3029	C077	229-8074
Davidson Doug W	-3029	C077	256-5207
Davis Dennis	-3029	C077	277-2911
Davis J	-3029	C077	229-9462
Davis P	-3029	C077	229-9462
Deger J	-3029	C077	229-9492
Dunbar Dany	-3029	C077	227-5769
Dunbar Steve	-3029	C077	227-5769
Dyer Bernie	-3029	C077	235-9645
Elliott James M	-3029	C077	227-6117
Ellis W	-3029	C077	271-9610
Evans M	-3029	C077	204-2081
Farhad Farhad	-3029	C077	229-5624
Fekete Gabor	-3029	C077	227-9572
Fell Kirsten A	-3029	C077	235-1501
Ferguson Alicia	-3029	C077	277-3884
Ferguson Neil	-3029	C077	277-3884
Flatlum Mel	-3029	C077	271-2407
Flores Carol	-3029	C077	235-5537
Flores Rick	-3029	C077	235-5537
Fowler Mary B	-3029	C077	227-6548
Frank Dan	-3029	C077	235-8532
Fujinaga Keith	-3029	C077	226-3665
Gallucio John J	-3029	C077	255-4184
Gardner Kathy	-3029	C077	255-2731
Gelsinger Eric	-3029	C077	277-4782
Gibreath Chris	-3029	C077	255-9692
Gilchrist S	-3029	C077	271-5349
Glasgow Nancy	-3029	C077	277-3886
Gulick E S	-3029	C077	277-0188
Hahn Sam	-3029	C077	255-9820
Hale M D	-3029	C077	271-6914
Hall Greg	-3029	C077	226-2658
Hall Kenneth	-3029	C077	255-8902
Hardy Gina	-3029	C077	255-7778
Hayes Grant	-3029	C077	227-4107
Herling Bryce	-3029	C077	235-1371
Herron Tina	-3029	C077	226-1056
Hinds David	-3029	C077	271-4539
Hoang Chau	-3029	C077	271-1925
Holtfater Patrick S	-3029	C077	255-2123
Holloway Bryan	-3029	C077	271-2522
Holmes H	-3029	C077	277-4085
Holmes L J	-3029	C077	277-4086
Holt Gretchen	-3029	C077	229-8714
Hopper Joseph	-3029	C077	277-8509
Inkabhairoh Nedia	-3029	C077	229-9205
Ismail Shamaha	-3029	C077	226-0407
Jensen L K	-3029	C077	227-0702
Jobe Trany L	-3029	C077	226-0667
Johns M	-3029	C077	277-3466
Johnson Natalie	-3029	C077	277-4296
Johnson Scott G	-3029	C077	227-5158
Johnson Timothy D	-3029	C077	277-8365
Jolle Jenny L	-3029	C077	255-5737
Kadn Kevin W	-3029	C077	271-3789
Kim Hong J	-3029	C077	277-3614
Klabye Flennic	-3029	C077	277-2962
Klabye Mary	-3029	C077	277-2962
Lambenson Jeff	-3029	C077	235-4629
Lande Phil	-3029	C077	271-5463
Lapham Paula J	-3029	C077	227-6542
Lee Suki J	-3029	C077	255-8793
Lofberg L	-3029	C077	277-5810
Lumsden Lynne	-3029	C077	226-6743
Lumsden Sean	-3029	C077	226-6743
Maier Lisa	-3029	C077	226-8479
Maier Lisa	-3029	C077	229-8948
Manlla Steve	-3029	C077	227-4107
Marcus D L	-3029	C077	235-9578
Maury T	-3029	C077	277-9138
McCaffree Dave	-3029	C077	229-4440
McNamara Kelly G	-3029	C077	277-8268

SE COAL CREEK PKWY cont'd

Address	Zip+4	Carrlte	Phone
Meltser Kristin	-3029	C077	235-1621
Miller George H	-3029	C077	226-3650
Miller Jeff	-3029	C077	226-8479
Miller Jeff	-3029	C077	229-9948
Miller Lisa G	-3029	C077	277-9146
Mill Kawn D	-3029	C077	271-6809
Mill Karen D	-3029	C077	271-6809
Miner B	-3029	C077	226-0087
Moran Deanna	-3029	C077	229-0252
Murphy W	-3029	C077	204-8525
Musselli Danna	-3029	C077	227-9334
Nelson Sharon	-3029	C077	229-2627
Nelson Sharon	-3029	C077	674-7807
Nguyen Thuha	-3029	C077	277-0113
Nithola D	-3029	C077	277-4290
Nichola N	-3029	C077	277-4290
Oh Kwun S	-3029	C077	277-4146
Oswald Richard	-3029	C077	255-9902
Pascoe K L	-3029	C077	229-7131
Paseka K	-3029	C077	226-9799
Pasley C B	-3029	C077	271-0555
Pass L	-3029	C077	226-3157
Perrin Patrick K	-3029	C077	255-7473
Perry Mike	-3029	C077	277-5268
Piedrahita David	-3029	C077	255-6170
Polinsky W	-3029	C077	271-7968
Price Gary	-3029	C077	235-6958
Price I D	-3029	C077	271-4395
Prock Eric	-3029	C077	255-8274
Prock Terri	-3029	C077	255-8274
Puetz Cheri	-3029	C077	255-4359
Puetz Cheri	-3029	C077	271-5515
Puetz Jeff	-3029	C077	255-4359
Puetz Jeff	-3029	C077	271-5515
Pullen B	-3029	C077	226-8074
Pumphrey Terry	-3029	C077	277-9754
Purcell Jennifer	-3029	C077	271-5724
Purcell Mike	-3029	C077	271-5724
Ratzburg Kerrie	-3029	C077	255-5786
Reid J A	-3029	C077	229-4481
Resnick D L	-3029	C077	235-9578
Rhoades Jennifer	-3029	C077	228-9349
Rhoades Steve	-3029	C077	228-9348
Riedel Dustin	-3029	C077	277-4186
Sanchez Angel	-3029	C077	283-2642
Scelton Monica J	-3029	C077	226-6907
Scenavino Gary	-3029	C077	271-4028
Schilo Steve A	-3029	C077	235-0957
Schoenberg K	-3029	C077	235-0173
Schwarz Jonathan	-3029	C077	277-1025
Scotthanchini R	-3029	C077	227-0476
Scotthanchini Richard	-3029	C077	227-0476
Sim Michael	-3029	C077	271-9063
Simile Dale	-3029	C077	271-4154
Simonson James	-3029	C077	271-7307
Simonson Sandra	-3029	C077	271-7307
Smith Kenton	-3029	C077	277-5162
Streiff Chris	-3029	C077	277-0907
Sullivan Jason	-3029	C077	226-2538
Tatman Emily	-3029	C077	271-4249
Thaker Nalini	-3029	C077	226-4265
Thomas Michael	-3029	C077	277-9516
Troy Valerie	-3029	C077	229-1730
Tschetter Ron	-3029	C077	226-9444
Um Richard	-3029	C077	235-9283
Underhill Thomas	-3029	C077	235-5140
Vanfleet Joel W	-3029	C077	277-8264
Vetter V	-3029	C077	227-5109
Villada Daisy	-3029	C077	227-8530
Vontesh Luke	-3029	C077	227-6719
Wagner Kim	-3029	C077	255-7778
Wagner Kim M	-3029	C077	255-7778
Wahlgren P	-3029	C077	255-1163
Walz James	-3029	C077	277-8079
Wassenstrom L	-3029	C077	204-8597
Waterfield James	-3029	C077	277-2587
Wiggins Lee	-3029	C077	235-2376
Wolfe Roger	-3029	C077	255-4341
Wolfe Susan	-3029	C077	255-4341
Woods Andrew	-3029	C077	277-2157
Wheasir J	-3029	C077	283-4991
Yang Xu	-3029	C077	235-8021
Yanno Jim	-3029	C077	226-3693
Yazdi Sima	-3029	C077	226-6835
Ziemann Scott	-3029	C077	277-2392
Zwirko Kristy	-3029	C077	226-9591
7421 Peterson Robin L	-3156	C077	229-1333
7610 DYAD SOFTWARE	-3211	C077	227-7416
Banister Gene A	-3211	C077	235-0883
7815 Crouch Henry	-3212	C077	227-7922
7631 Clay Truman R	-3212	C077	235-1983
7651 WATERTITE GUTTER CO	-3212	C077	746-1278
Weacher Sandi	-3212	C077	228-2446
7661 Rogers Larry	-3212	C077	226-3745
7833 Delay Cloyd C	-3250	C077	271-7173
9005 Caouneung Rujirag	-3214	C077	227-5414
8018 King H T	-3213	C077	271-9048
8025 Holt J R	-3214	C077	255-3503
8033 Czerwinski Darrell	-3214	C077	271-2670
8409 Boone Elise	-3305	C077	226-8942
Ingram Judy	-3305	C077	227-9083
Sousa Julie	-3305	C077	255-5012
8727 Richard Patti	-3347	C077	271-8360
Richard Steve	-3347	C077	271-8360
8820 Petett Elmer	-3348	C077	255-1267
9061 Butts Robert J	-3339	C077	226-1470
9110 Hurley David	-3329	C077	255-3570
9206 Svoboda Frank	-3327	C077	226-7888
9219 Knight Mike	-3328	C077	271-2753
BUSINESSES 50		HOUSEHOLDS 322	

SE COAL CREEK PKWY (RE) 98059

9620 Szabrowicz Richard	-3751	C072	227-5240
Szabrowicz Rita	-3751	C072	227-5240
9631 McDowell D	-3758	C072	226-1829
McDowell James	-3758	C072	226-1829
HOUSEHOLDS 4			

COBBLESTONE DR (LY) 98037

16918 Parke Charles	-6960	C083	742-7197
Parke Margaret	-6960	C083	742-7197
16927 Janacke George R	-6961	C083	745-9121
16933 STONEBRIDGE HOMEOWNERS ASSN	-6961	C083	745-1560
BUSINESSES 1		HOUSEHOLDS 3	

NW COL DE VARS PL (I) 98027

5360 Poon Frank W	-7802	R014	562-8077
5365 Yatchke Gary	-7802	R014	643-2918
5380 Cosker Richard L	-7802	R014	562-9435
HOUSEHOLDS 3			

SW COLEWOOD LN (NP) 98166

574 Zimmerman L L	-3968	C055	242-7540
705 Roberts Jeffrey B	-3900	C055	243-5181
710 Bury Donnell M	-3938	C055	243-9971
715 Mirco M	-3900	C055	244-3109
HOUSEHOLDS 4			

SW COLUMBIA AVE (V) 98070

16625 Blake Paul	-3707	R005	463-3014
Blake Sandy	-3707	R005	463-3014
Randall Josh	-3707	R005	463-3014
HOUSEHOLDS 3			

COLUMBIA KY (BE) 98006

3 Freany Patrick C	-1007	C005	641-4842
5 Lellabadi Medid N	-1007	C005	747-2004
7 Armstrong John B	-1007	C005	746-9775
Weber James R	-1007	C005	746-9775
11 Aster Sven E	-1007	C005	641-7208
12 Pfeifer Eugene L	-1008	C005	644-1482
Pfeifer Eugene L	-1008	C005	746-9009
13 Whiteside Richard L	-1007	C005	643-1453
14 Cherry John M	-1008	C005	644-4691

Attachment E
City Directory Abstract

Newcastle
6620 Coal Creek Parkway SE
Renton, WA 98059

Inquiry Number: 4171904.2s
January 05, 2015

The EDR Radius Map™ Report with GeoCheck®

Environmental Data Resources Inc

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION	PAGE
Executive Summary	ES1
Overview Map	2
Detail Map	3
Map Findings Summary	4
Map Findings	8
Orphan Summary	138
Government Records Searched/Data Currency Tracking	GR-1

GEOCHECK ADDENDUM

Physical Setting Source Addendum	A-1
Physical Setting Source Summary	A-2
Physical Setting SSURGO Soil Map	A-5
Physical Setting Source Map	A-13
Physical Setting Source Map Findings	A-15
Physical Setting Source Records Searched	PSGR-1

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2014 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

6620 COAL CREEK PARKWAY SE
KING County, WA 98059

COORDINATES

Latitude (North):	47.5436000 - 47° 32' 36.96''
Longitude (West):	122.1612000 - 122° 9' 40.32''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	563122.4
UTM Y (Meters):	5265697.5
Elevation:	375 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	47122-E2 MERCER ISLAND, WA
Most Recent Revision:	1983

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20110826
Source:	USDA

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 8 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
NEWCASTLE BRICK PLANT 6620 COALCREEK PKWY SE RENTON, WA 98055	TRIS	98055NWCST6805C
MUTUAL MATERIALS CO NEWCASTLE PLA 6620 COALCREEK PARKWAY SE RENTON, WA 98059	WA CSCSL WA ALLSITES WA LUST WA UST	N/A
MUTUAL MATERIALS CO, NEWCASTLE 6620 COAL CREEK PKWY NEWCASTLE, WA 98059	FINDS	N/A
MUTUAL MATERIALS CO (NEWCASTLE) 6620 COAL CRK PKWY RENTON, WA 98059	WA AIRS	N/A

MUTUAL MATERIALS CO, NEWCASTLE 6620 COAL CREEK PKWY NEWCASTLE, WA 98055	WA AIRS	N/A
MUTUAL MATERIALS CO NEWCASTLE PLA 6620 COALCREEK PARKWAY SE RENTON, WA	WA RGA LUST	N/A
MUTUAL MATERIALS 6620 COAL CREEK PARKWAY SE BELLEVUE, WA 98006	WA ICR	N/A
MUTUAL MATERIALS 6620 COAL CREEK PARKWAY SE RENTON, WA	WA RGA LUST	N/A

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY ---------- Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

EXECUTIVE SUMMARY

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROL ---------- Sites with Institutional Controls
LUCIS ---------- Land Use Control Information System

Federal ERNS list

ERNS ---------- Emergency Response Notification System

State- and tribal - equivalent NPL

WA HSL ---------- Hazardous Sites List

State and tribal landfill and/or solid waste disposal site lists

WA SWF/LF ---------- Solid Waste Facility Database

State and tribal leaking storage tank lists

INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

WA AST ---------- Aboveground Storage Tank Locations
INDIAN UST ---------- Underground Storage Tanks on Indian Land
FEMA UST ---------- Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

WA INST CONTROL ---------- Institutional Control Site List

State and tribal voluntary cleanup sites

INDIAN VCP ---------- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

WA BROWNFIELDS ---------- Brownfields Sites Listing

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

EXECUTIVE SUMMARY

Local Lists of Landfill / Solid Waste Disposal Sites

ODI	Open Dump Inventory
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
WA SWTIRE	Solid Waste Tire Facilities
WA SWRCY	Recycling Facility List
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL	Clandestine Drug Labs
WA CDL	Clandestine Drug Lab Contaminated Site List
WA HIST CDL	List of Sites Contaminated by Clandestine Drug Labs
US HIST CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
WA SPILLS 90	SPILLS 90 data from FirstSearch

Other Ascertainable Records

DOT OPS	Incident and Accident Data
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
RADINFO	Radiation Information Database
RAATS	RCRA Administrative Action Tracking System
RMP	Risk Management Plans
WA UIC	Underground Injection Wells Listing
WA DRYCLEANERS	Drycleaner List
INDIAN RESERV	Indian Reservations
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
WA COAL ASH	Coal Ash Disposal Site Listing
PCB TRANSFORMER	PCB Transformer Registration Database
US FIN ASSUR	Financial Assurance Information
EPA WATCH LIST	EPA WATCH LIST
LEAD SMELTERS	Lead Smelter Sites
US AIRS	Aerometric Information Retrieval System Facility Subsystem
PRP	Potentially Responsible Parties

EXECUTIVE SUMMARY

2020 COR ACTION..... 2020 Corrective Action Program List
COAL ASH DOE..... Steam-Electric Plant Operation Data
COAL ASH EPA..... Coal Combustion Residues Surface Impoundments List

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP..... EDR Proprietary Manufactured Gas Plants

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

WA RGA LF..... Recovered Government Archive Solid Waste Facilities List
WA RGA HWS..... Recovered Government Archive State Hazardous Waste Facilities List

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

State- and tribal - equivalent CERCLIS

WA CSCSL: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. The data come from the Department of Ecology's Confirmed & Suspected Contaminated Sites List.

A review of the WA CSCSL list, as provided by EDR, and dated 10/21/2014 has revealed that there are 3 WA CSCSL sites within approximately 1 mile of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***
BELLEVUE FIRE STATION # 9	***12412 SE 69TH WAY***	***WSW 1/4 - 1/2 (0.469 mi.)***	***E36***	***120***
Lower Elevation	**Address**	**Direction / Distance**	**Map ID**	**Page**
BGN PROPERTIES INC	***5629 119TH AVE SE***	***NW 1/2 - 1 (0.816 mi.)***	***38***	***128***

EXECUTIVE SUMMARY

State and tribal leaking storage tank lists

WA LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Ecology's Leaking Underground Storage Tanks Site List.

A review of the WA LUST list, as provided by EDR, and dated 08/18/2014 has revealed that there is 1 WA LUST site within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
BELLEVUE FIRE STATION # 9	***12412 SE 69TH WAY***	***WSW 1/4 - 1/2 (0.469 mi.)***	***E36***	***120***

State and tribal registered storage tank lists

WA UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Ecology's Statewide UST Site/Tank Report.

A review of the WA UST list, as provided by EDR, and dated 11/25/2014 has revealed that there is 1 WA UST site within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
ARCO AM PM	6966 COAL CREEK PKWY SE	SW 0 - 1/8 (0.121 mi.)	C20	82

State and tribal voluntary cleanup sites

WA ICR: These are remedial action reports Ecology has received from either the owner or operator of the site. These actions have been conducted without department oversight or approval and are not under an order or decree.

A review of the WA ICR list, as provided by EDR, and dated 12/01/2002 has revealed that there are 2 WA ICR sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***
KING CO. FIRE DIST. #24 STN #2	12412 SE 69TH WAY	WSW 1/4 - 1/2 (0.469 mi.)	E35	118

WA VCP: Sites that have entered either the Voluntary Cleanup Program or its predecessor Independent Remedial Action Program.

A review of the WA VCP list, as provided by EDR, and dated 10/21/2014 has revealed that there are 2 WA VCP sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***
VELOCITY INVESTMENTS INC ARCO	***6966 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.124 mi.)***	***C23***	***85***

EXECUTIVE SUMMARY

ADDITIONAL ENVIRONMENTAL RECORDS

Local Lists of Hazardous waste / Contaminated Sites

Information on facilities and sites of interest to the Department of Ecology.

A review of the WA ALLSITES list, as provided by EDR, and dated 11/05/2014 has revealed that there are 22 WA ALLSITES sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NEWCASTLE KING 4 COAL CO MINE	***SE NEWCASTLE COAL CR***	***S 0 - 1/8 (0.019 mi.)***	***10***	***47***
AT&T WIRELESS NEWCASTLE	***6860 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.050 mi.)***	***B11***	***47***
NEWCASTLE YMCA	SE NEWCASTLE COAL CREEK	SE 0 - 1/8 (0.073 mi.)	12	48
BAKKERS CLEANERS	***6920 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.090 mi.)***	***B14***	***49***
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***
COAL CREEK VILLAGE SHOPPING CE	***6925 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.093 mi.)***	***B17***	***74***
BARTELLS 30	***6939 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.102 mi.)***	***C18***	***75***
VELOCITY INVESTMENTS INC ARCO	***6966 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.124 mi.)***	***C23***	***85***
NEWCASTLE DRUMS	NEWCASTLE COAL CREEK RD	ESE 1/8 - 1/4 (0.142 mi.)	24	97
VIEW POINTE TOWNHOMES	133RD AVE SE & SE 68TH	S 1/8 - 1/4 (0.179 mi.)	25	97
SAFEWAY STORE 558	***6911 COAL CREEK PARKWAY***	***SW 1/8 - 1/4 (0.217 mi.)***	***26***	***97***
ACORN CUSTOM CABINETRY	7211 132ND PL SE	SSW 1/8 - 1/4 (0.248 mi.)	27	98
NEWCASTLE VISTA POND 3	12835 NEWCASTLE WAY	SW 1/4 - 1/2 (0.279 mi.)	28	99
NEWCASTLE TRANSIT CENTER PROJE	NEWCASTLE WY 129TH AVE	SSW 1/4 - 1/2 (0.280 mi.)	D29	100
NEWCASTLE CITY	***13020 SE 72ND PL***	***SSW 1/4 - 1/2 (0.283 mi.)***	***D30***	***100***
PRECISION AUTOCRAFT INC	***13032 SE 72ND PL FRONT***	***SSW 1/4 - 1/2 (0.284 mi.)***	***D31***	***101***
STRESS TEK INC	***13032 SE 72ND PL N END***	***SSW 1/4 - 1/2 (0.284 mi.)***	***D32***	***116***
COAL CREEK RETENTION BASINS DA		ENE 1/4 - 1/2 (0.314 mi.)	33	117
COAL CREEK RETENTION BASINS DA		ENE 1/4 - 1/2 (0.446 mi.)	34	118
BELLEVUE FIRE STATION # 9	***12412 SE 69TH WAY***	***WSW 1/4 - 1/2 (0.469 mi.)***	***E36***	***120***
KING CNTY WATER DIST 107	***7415 129TH AVE SE***	***SSW 1/4 - 1/2 (0.482 mi.)***	***37***	***125***

Lower Elevation	Address	Direction / Distance	Map ID	Page
UPPER COAL CREEK BANK STABILIZ		NNW 0 - 1/8 (0.119 mi.)	19	77

WA CSCSL NFA: The data set contains information about sites previously on the Confirmed and Suspected Contaminated Sites list that have received a No Further Action (NFA) determination. Because it is necessary to maintain historical records of sites that have been investigated and cleaned up, sites are not deleted from the database when cleanup activities are completed. Instead a No Further Action code is entered based upon the type of NFA determination the site received.

A review of the WA CSCSL NFA list, as provided by EDR, and dated 10/21/2014 has revealed that there are 2 WA CSCSL NFA sites within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
NEWCASTLE KING 4 COAL CO MINE	***SE NEWCASTLE COAL CR***	***S 0 - 1/8 (0.019 mi.)***	***10***	***47***
VELOCITY INVESTMENTS INC ARCO	***6966 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.124 mi.)***	***C23***	***85***

Other Ascertainable Records

RCRA NonGen / NLR: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

A review of the RCRA NonGen / NLR list, as provided by EDR, and dated 06/10/2014 has revealed that there are 5 RCRA NonGen / NLR sites within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
BAKKERS CLEANERS	***6920 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.090 mi.)***	***B14***	***49***
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***
COAL CREEK VILLAGE SHOPPING CE	***6925 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.093 mi.)***	***B17***	***74***
BARTELLS 30	***6939 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.102 mi.)***	***C18***	***75***
VELOCITY INVESTMENTS INC	6966 COAL CREEK PKWY SE	SW 0 - 1/8 (0.121 mi.)	C21	84

US MINES: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration.

A review of the US MINES list, as provided by EDR, and dated 08/05/2014 has revealed that there is 1 US MINES site within approximately 0.25 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
MUTUAL MATERIALS COMPANY		0 - 1/8 (0.000 mi.)	A9	46

WA MANIFEST: Hazardous waste manifest information.

A review of the WA MANIFEST list, as provided by EDR, and dated 12/31/2013 has revealed that there is 1 WA MANIFEST site within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***

WA Inactive Drycleaners: A listing of inactive drycleaner facility locations.

A review of the WA Inactive Drycleaners list, as provided by EDR, and dated 12/31/2013 has revealed that there are 2 WA Inactive Drycleaners sites within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
BAKKERS CLEANERS	***6920 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.090 mi.)***	***B14***	***49***
DANIELS DRYCLEANERS COAL CREEK	***6923 COAL CREEK PKWY SE***	***SW 0 - 1/8 (0.092 mi.)***	***B16***	***54***

EXECUTIVE SUMMARY

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR US Hist Auto Stat: EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

A review of the EDR US Hist Auto Stat list, as provided by EDR, has revealed that there is 1 EDR US Hist Auto Stat site within approximately 0.25 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
Not reported	6966 COAL CREEK PKWY S	SW 0 - 1/8 (0.124 mi.)	C22	85

EDR US Hist Cleaners: EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

A review of the EDR US Hist Cleaners list, as provided by EDR, has revealed that there are 2 EDR US Hist Cleaners sites within approximately 0.25 miles of the target property.

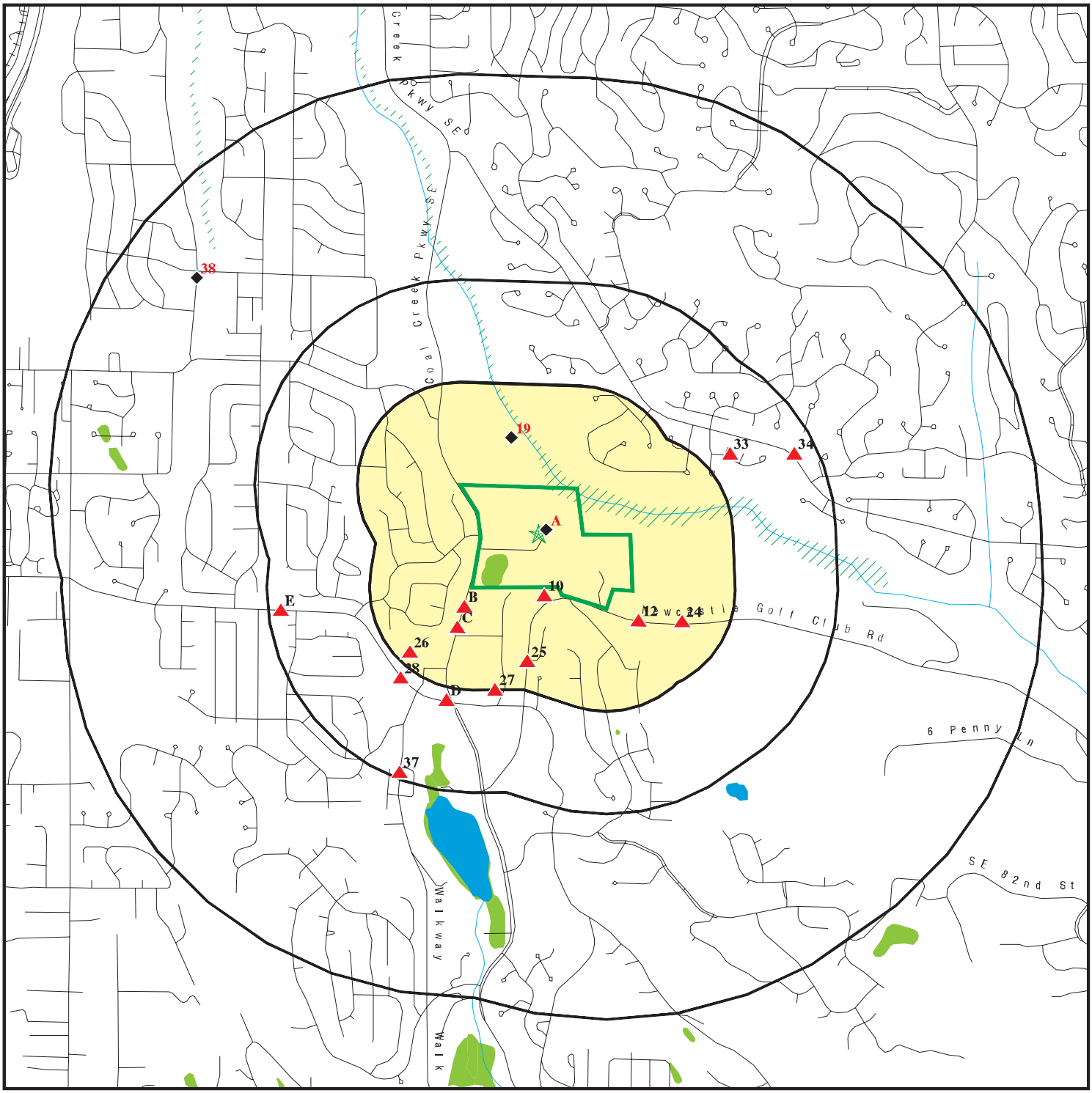
Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
Not reported	6920 COAL CREEK PKWY S	SW 0 - 1/8 (0.090 mi.)	B13	49
Not reported	6923 COAL CREEK PKWY S	SW 0 - 1/8 (0.092 mi.)	B15	53

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 15 records.

Site Name	Database(s)
NEWCASTLE AM PM	WA RGA LUST
NEWCASTLE MINE-AIR VENT	WA RGA HWS
NEWCASTLE MINE TIMBER SHOOT	WA RGA HWS
NEWCASTLE/COAL CREEK LANDFILL	WA RGA HWS
NEWCASTLE AM PM	WA RGA HWS
NEWCASTLE MINE - AIR VENT	CERC-NFRAP
NEWCASTLE MINE TIMBER SHOOT	CERC-NFRAP
KING 4 COAL CO. MINE, A	CERC-NFRAP
NEWCASTLE DRUMS	FINDS
NEWCASTLE KING 4 COAL CO MINE A	FINDS
NEWCASTLE YMCA	FINDS
SUNSET RIDGE CORPORATE CAMPUS	WA ICR
CHEVRON	WA ICR
WEST FUEL COMPANY	WA ICR
MIDWAY AUTO	WA ICR

OVERVIEW MAP - 4171904.2S



0 1/4 1/2 1 Miles

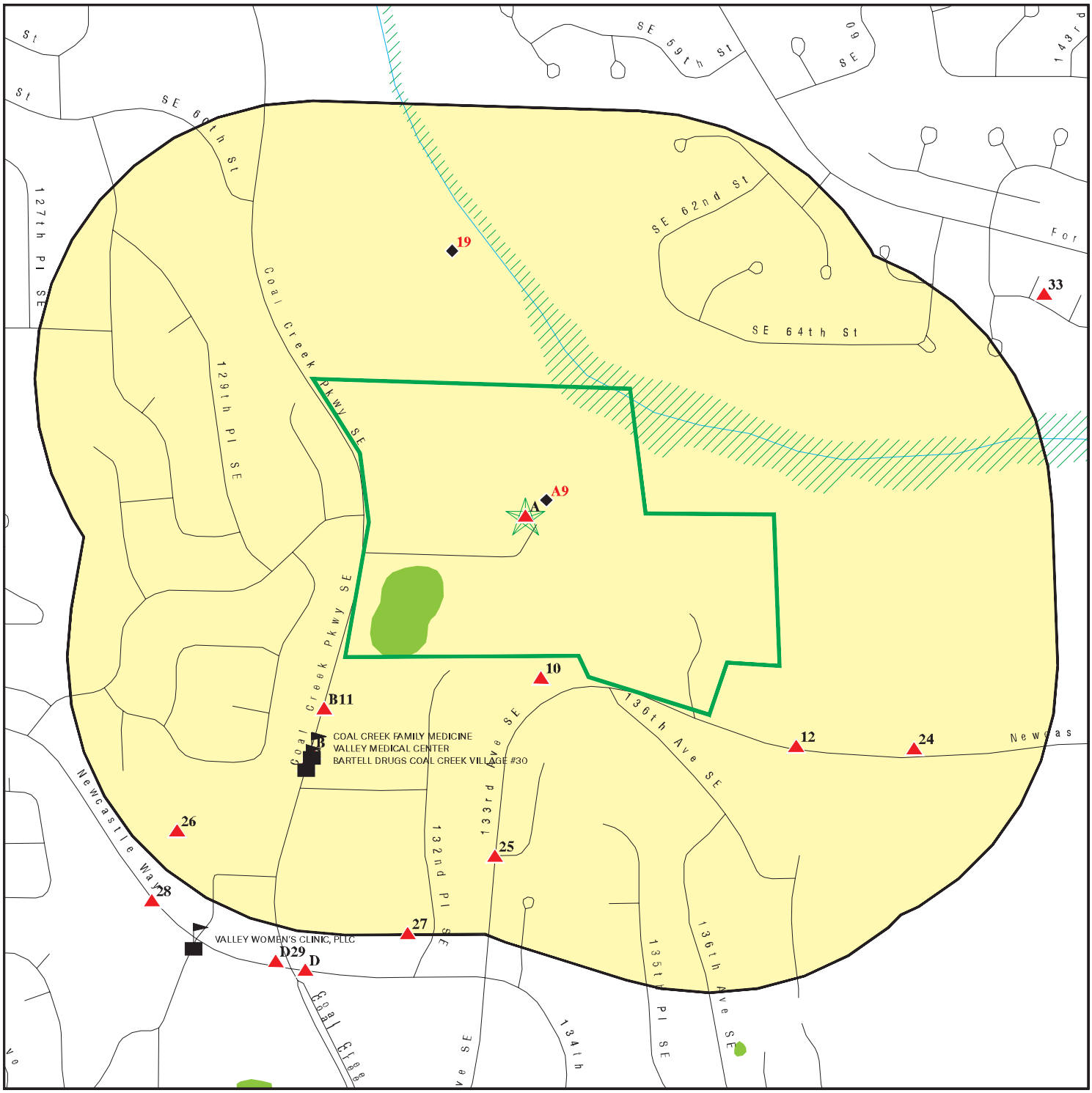
- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Newcastle ADDRESS: 6620 Coal Creek Parkway SE Renton WA 98059 LAT/LONG: 47.5436 / 122.1612	CLIENT: Environmental Partners CONTACT: Monica Mogg INQUIRY #: 4171904.2s DATE: January 05, 2015 9:10 am

Copyright © 2015 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

DETAIL MAP - 4171904.2S



0 1/16 1/8 1/4 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Newcastle	CLIENT:	Environmental Partners
ADDRESS:	6620 Coal Creek Parkway SE Renton WA 98059	CONTACT:	Monica Mogg
LAT/LONG:	47.5436 / 122.1612	INQUIRY #:	4171904.2s
		DATE:	January 05, 2015 9:12 am

Copyright © 2015 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	0.001		0	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
CERCLIS	0.500		0	0	0	NR	NR	0
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-CESQG	0.250		0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROL	0.500		0	0	0	NR	NR	0
LUCIS	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	0.001		0	NR	NR	NR	NR	0
State- and tribal - equivalent NPL								
WA HSL	1.000		0	0	0	0	NR	0
State- and tribal - equivalent CERCLIS								
WA CSCSL	1.000	1	1	0	1	1	NR	4
State and tribal landfill and/or solid waste disposal site lists								
WA SWF/LF	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
WA LUST	0.500	1	0	0	1	NR	NR	2

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
WA UST	0.250	1	1	0	NR	NR	NR	2
WA AST	0.250		0	0	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
FEMA UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
WA INST CONTROL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
WA ICR	0.500	1	1	0	1	NR	NR	3
WA VCP	0.500		2	0	0	NR	NR	2
INDIAN VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
WA BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
WA SWTIRE	0.500		0	0	0	NR	NR	0
WA SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL	0.001		0	NR	NR	NR	NR	0
WA ALLSITES	0.500	1	9	4	9	NR	NR	23
WA CSCSL NFA	0.500		2	0	0	NR	NR	2
WA CDL	0.001		0	NR	NR	NR	NR	0
WA HIST CDL	0.001		0	NR	NR	NR	NR	0
US HIST CDL	0.001		0	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	0.001		0	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	0.001		0	NR	NR	NR	NR	0
WA SPILLS	0.001		0	NR	NR	NR	NR	0
WA SPILLS 90	0.001		0	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		5	0	NR	NR	NR	5

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
DOT OPS	0.001		0	NR	NR	NR	NR	0
DOD	1.000		0	0	0	0	NR	0
FUDS	1.000		0	0	0	0	NR	0
CONSENT	1.000		0	0	0	0	NR	0
ROD	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
US MINES	0.250		1	0	NR	NR	NR	1
TRIS	0.001	1	0	NR	NR	NR	NR	1
TSCA	0.001		0	NR	NR	NR	NR	0
FTTS	0.001		0	NR	NR	NR	NR	0
HIST FTTS	0.001		0	NR	NR	NR	NR	0
SSTS	0.001		0	NR	NR	NR	NR	0
ICIS	0.001		0	NR	NR	NR	NR	0
PADS	0.001		0	NR	NR	NR	NR	0
MLTS	0.001		0	NR	NR	NR	NR	0
RADINFO	0.001		0	NR	NR	NR	NR	0
FINDS	0.001	1	0	NR	NR	NR	NR	1
RAATS	0.001		0	NR	NR	NR	NR	0
RMP	0.001		0	NR	NR	NR	NR	0
WA UIC	0.001		0	NR	NR	NR	NR	0
WA MANIFEST	0.250		1	0	NR	NR	NR	1
WA DRYCLEANERS	0.250		0	0	NR	NR	NR	0
CA HAZNET	TP		NR	NR	NR	NR	NR	0
WA NPDES	0.001		0	NR	NR	NR	NR	0
WA AIRS	0.001	2	0	NR	NR	NR	NR	2
WA Inactive Drycleaners	0.250		2	0	NR	NR	NR	2
INDIAN RESERV	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
WA Financial Assurance	0.001		0	NR	NR	NR	NR	0
WA COAL ASH	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	0.001		0	NR	NR	NR	NR	0
US FIN ASSUR	0.001		0	NR	NR	NR	NR	0
EPA WATCH LIST	0.001		0	NR	NR	NR	NR	0
LEAD SMELTERS	0.001		0	NR	NR	NR	NR	0
US AIRS	0.001		0	NR	NR	NR	NR	0
PRP	0.001		0	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
COAL ASH DOE	0.001		0	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR US Hist Auto Stat	0.250		1	0	NR	NR	NR	1
EDR US Hist Cleaners	0.250		2	0	NR	NR	NR	2
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
WA RGA LF	0.001		0	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
WA RGA LUST	0.001	2	0	NR	NR	NR	NR	2
WA RGA HWS	0.001		0	NR	NR	NR	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1 **NEWCASTLE BRICK PLANT** **TRIS** **1005452414**
Target **6620 COALCREEK PKWY SE** **98055NWCST6805C**
Property **RENTON, WA 98055**

Site 1 of 9 in cluster A

Actual: 375 ft.

TRIS:

Click this hyperlink while viewing on your computer to access
2 additional US_TRIS: record(s) in the EDR Site Report.

A2 **MUTUAL MATERIALS CO NEWCASTLE PLANT** **WA CSCSL** **U000797828**
Target **6620 COALCREEK PARKWAY SE** **WA ALLSITES** **N/A**
Property **RENTON, WA 98059** **WA LUST**
WA UST

Site 2 of 9 in cluster A

Actual: 375 ft.

CSCSL:

Facility ID:	63651713
Region:	Northwest
Lat/Long:	47.549988 / -122.166427
Brownfield Status:	Not reported
Rank Status:	N
Clean Up Siteid:	9974
Site Status:	Cleanup Started
PSI?:	Not reported
Contaminant Name:	Petroleum-Diesel
Ground Water:	Not reported
Surface Water:	Not reported
Soil:	Confirmed Above Cleanup Level
Sediment:	Not reported
Air:	Not reported
Bedrock:	Not reported
Responsible Unit:	Northwest

ALLSITES:

Facility Id:	63651713
Latitude:	47.549988
Longitude:	-122.16642
Ecology Interest Type Code:	AQOPS
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	AQOPS
Interaction 2:	Air Qual Oper Permit Source
Ecology Program:	AIRQUAL
Program Data:	AIRSIS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1977-01-01 00:00:00
Date Interaction 3:	Not reported

Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TRI
Interaction 2:	Toxics Release Inventory
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Program ID:	Not reported
Date Interaction:	1987-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TIER2
Interaction 2:	Emergency/Haz Chem Rpt TIER2
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1990-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-12-29 00:00:00
Date Interaction 3:	1995-06-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	HWP
Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1998-01-01 00:00:00
Date Interaction 3:	1999-09-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-06-16 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	INDSWGP
Interaction 2:	Industrial SW GP

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Ecology Program: WATQUAL
Program Data: PARIS
Facility Alt.: MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID: WAR000362
Date Interaction: 1993-01-19 00:00:00
Date Interaction 3: 2011-06-13 00:00:00

Facility Id: 63651713
Latitude: 47.549988
Longitude: -122.16642
Ecology Interest Type Code: HWP
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL
Program Data: AIRSIS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1977-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1987-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000008670
Date Interaction: 1990-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: LUST
Interaction 2: LUST Facility
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Not reported
Program ID: 102343

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Date Interaction: 1994-12-29 00:00:00
Date Interaction 3: 1995-06-01 00:00:00

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: CRK000008670
Date Interaction: 1998-01-01 00:00:00
Date Interaction 3: 1999-09-01 00:00:00

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 102343
Date Interaction: 1994-06-16 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: INDSWGP
Interaction 2: Industrial SW GP
Ecology Program: WATQUAL
Program Data: PARIS
Facility Alt.: MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID: WAR000362
Date Interaction: 1993-01-19 00:00:00
Date Interaction 3: 2011-06-13 00:00:00

Facility Id: 63651713
Latitude: 47.549988
Longitude: -122.16642
Ecology Interest Type Code: INDSWGP
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL
Program Data: AIRSIS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1977-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TRI
Interaction 2:	Toxics Release Inventory
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1987-01-01 00:00:00
Date Interaction 3:	Not reported

Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TIER2
Interaction 2:	Emergency/Haz Chem Rpt TIER2
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1990-01-01 00:00:00
Date Interaction 3:	Not reported

Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-12-29 00:00:00
Date Interaction 3:	1995-06-01 00:00:00

Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	HWP
Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1998-01-01 00:00:00
Date Interaction 3:	1999-09-01 00:00:00

Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-06-16 00:00:00

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: INDSWGP
Interaction 2: Industrial SW GP
Ecology Program: WATQUAL
Program Data: PARIS
Facility Alt.: MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID: WAR000362
Date Interaction: 1993-01-19 00:00:00
Date Interaction 3: 2011-06-13 00:00:00

Facility Id: 63651713
Latitude: 47.549988
Longitude: -122.16642
Ecology Interest Type Code: LUST
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL
Program Data: AIRSIS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1977-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1987-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000008670
Date Interaction: 1990-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Interaction: I
Interaction 1: LUST
Interaction 2: LUST Facility
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Not reported
Program ID: 102343
Date Interaction: 1994-12-29 00:00:00
Date Interaction 3: 1995-06-01 00:00:00

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: CRK000008670
Date Interaction: 1998-01-01 00:00:00
Date Interaction 3: 1999-09-01 00:00:00

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 102343
Date Interaction: 1994-06-16 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: INDSWGP
Interaction 2: Industrial SW GP
Ecology Program: WATQUAL
Program Data: PARIS
Facility Alt.: MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID: WAR000362
Date Interaction: 1993-01-19 00:00:00
Date Interaction 3: 2011-06-13 00:00:00

Facility Id: 63651713
Latitude: 47.549988
Longitude: -122.16642
Ecology Interest Type Code: TIER2
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Program Data:	AIRSIS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1977-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TRI
Interaction 2:	Toxics Release Inventory
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1987-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	TIER2
Interaction 2:	Emergency/Haz Chem Rpt TIER2
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1990-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-12-29 00:00:00
Date Interaction 3:	1995-06-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	HWP
Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1998-01-01 00:00:00
Date Interaction 3:	1999-09-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 102343
Date Interaction: 1994-06-16 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: INDSWGP
Interaction 2: Industrial SW GP
Ecology Program: WATQUAL
Program Data: PARIS
Facility Alt.: MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID: WAR000362
Date Interaction: 1993-01-19 00:00:00
Date Interaction 3: 2011-06-13 00:00:00

Facility Id: 63651713
Latitude: 47.549988
Longitude: -122.16642
Ecology Interest Type Code: TRI
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL
Program Data: AIRSIS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1977-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1987-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1990-01-01 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-12-29 00:00:00
Date Interaction 3:	1995-06-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	HWP
Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	CRK000008670
Date Interaction:	1998-01-01 00:00:00
Date Interaction 3:	1999-09-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-06-16 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	INDSWGP
Interaction 2:	Industrial SW GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID:	WAR000362
Date Interaction:	1993-01-19 00:00:00
Date Interaction 3:	2011-06-13 00:00:00

Facility Id:	63651713
Latitude:	47.549988
Longitude:	-122.16642

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Ecology Interest Type Code: UST
Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: AQOPS
Interaction 2: Air Qual Oper Permit Source
Ecology Program: AIRQUAL
Program Data: AIRSIS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1977-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1987-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000008670
Date Interaction: 1990-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: LUST
Interaction 2: LUST Facility
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Not reported
Program ID: 102343
Date Interaction: 1994-12-29 00:00:00
Date Interaction 3: 1995-06-01 00:00:00

Facility ID: 63651713
Facility Company: MUTUAL MATERIALS CO NEWCASTLE
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Program ID:	CRK000008670
Date Interaction:	1998-01-01 00:00:00
Date Interaction 3:	1999-09-01 00:00:00
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	Not reported
Program ID:	102343
Date Interaction:	1994-06-16 00:00:00
Date Interaction 3:	Not reported
Facility ID:	63651713
Facility Company:	MUTUAL MATERIALS CO NEWCASTLE
Interaction:	I
Interaction 1:	INDSWGP
Interaction 2:	Industrial SW GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	MUTUAL MATERIAL NEW CASTLE BRICK PL
Program ID:	WAR000362
Date Interaction:	1993-01-19 00:00:00
Date Interaction 3:	2011-06-13 00:00:00

LUST:

Facility ID:	63651713
Facility Status:	RCU
Cleanup Site ID:	9974
Cleanup Unit Type:	Upland
Process Type:	Independent Action
Alternate Name:	MUTUAL MATERIALS
Release Status Date:	01/03/1995
Site Response Unit Code:	Northwest
Lat/Long:	47.549988 / -122.16642
Facility ID:	63651713
Facility Status:	Cleanup Started
Cleanup Site ID:	9974
Cleanup Unit Type:	Upland
Process Type:	Independent Action
Alternate Name:	MUTUAL MATERIALS
Release Status Date:	07/01/2011
Site Response Unit Code:	Northwest
Lat/Long:	47.549988 / -122.16642
Facility ID:	63651713
Facility Status:	Cleanup Started
Cleanup Site ID:	9974
Cleanup Unit Type:	Upland
Process Type:	Independent Action
Alternate Name:	MUTUAL MATERIALS
Release Status Date:	12/29/1994

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **U000797828**

Site Response Unit Code: Northwest
Lat/Long: 47.549988 / -122.16642

UST:
Facility ID: 63651713
Site Id: 2139
UBI: 1780016170010002
Phone Number: 2062551101
Decimal Latitude: 47.549988
Decimal Longitude: -122.166427

Tank Name: #1 DIESEL
Tag Number: Not reported
Tank Status: Removed
Tank Status Date: 08/06/1996
Tank Install Date: 00/15/1958
Tank Closure Date: Not reported
Capacity Range: Not reported
Tank Permit Expiration Date: 07/01/1995
Tank Upgrade Date: Not reported
Tank Spill Prevention: None
Tank Overfill Prevention: None
Tank Material: Not reported
Tank Construction: Single Wall Tank
Tank Tightness Test: Not reported
Tank Corrosion Protection: None
Tank Manifold: Not reported
Tank Release Detection: Not reported
Tank SFC Type: Not reported
Pipe Material: Not reported
Pipe Construction: Single Wall Pipe
Pipe Primary Release Detection: Not reported
Pipe Second Release Detection: Not reported
Pipe Corrosion Protection: None
Pipe Pumping System: Not reported
Responsible Unit: NORTHWEST
Dispencer/Pump SFC Type: Not reported

A3 **MUTUAL MATERIALS CO, NEWCASTLE** **FINDS** **1014851853**
Target **6620 COAL CREEK PKWY** **N/A**
Property **NEWCASTLE, WA 98059**

Site 3 of 9 in cluster A

Actual: 375 ft.

FINDS:

Registry ID: 110041599605

Environmental Interest/Information System
CRITERIA AND HAZARDOUS AIR POLLUTANT INVENTORY

A4 **MUTUAL MATERIALS CO (NEWCASTLE)** **WA AIRS** **S102456351**
Target **6620 COAL CRK PKWY** **N/A**
Property **RENTON, WA 98059**

Site 4 of 9 in cluster A

Actual:
375 ft.

AIRS (EMI):

Year Of Info:	96
Facility ID:	0039
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	Not reported
Point NAICS:	Not reported
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	Not reported
Point Comments:	Not reported
Local ID:	C
Local Air Agency ID:	Not reported
Fed County Code:	Not reported
Source Number:	Not reported
Process ID:	Not reported
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	44
% Control Of Sulfur Dioxide Emissions:	16
NO2 Chemical:	19
% Cntrl Of Volatile Organic Compound Emissions:	6
CO Nonattainment Area:	35

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	Not reported
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	Not reported
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	Not reported
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	Not reported
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	Not reported
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	Not reported
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	Not reported
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	Not reported
Latitude/Longitude:	Not reported
Whether Source Is An AOP(Title V) Source:	Not reported
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	MUTUAL MATERIALS CO (NEWCASTLE)
Mailing Address:	6620 COAL CRK PKWY
Mailing City,St,Zip:	RENTON, 53 98059
Year Of Info:	Not reported
Facility ID:	Not reported
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	Not reported
Point NAICS:	Not reported
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	Not reported
Point Comments:	Not reported
Local ID:	Not reported
Local Air Agency ID:	Not reported
Fed County Code:	Not reported
Source Number:	Not reported
Process ID:	Not reported
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	Not reported
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	Not reported
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	Not reported
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	Not reported
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	Not reported
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	Not reported
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	Not reported
Latitude/Longitude:	Not reported
Whether Source Is An AOP(Title V) Source:	Not reported
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	MUTUAL MATERIALS CO (NEWCASTLE)
Mailing Address:	6620 COAL CRK PKWY
Mailing City,St,Zip:	RENTON, 53
Year Of Info:	Not reported
Facility ID:	0039
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	Not reported
Point NAICS:	Not reported
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	Not reported
Point Comments:	Not reported
Local ID:	C
Local Air Agency ID:	Not reported
Fed County Code:	Not reported
Source Number:	Not reported
Process ID:	Not reported
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	44.0000
% Control Of Sulfur Dioxide Emissions:	16.0000
NO2 Chemical:	19.0000
% Cntrl Of Volatile Organic Compound Emissions:	6.0000
CO Nonattainment Area:	35.0000
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	Not reported
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	Not reported
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	Not reported
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	Not reported
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	Not reported
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	Not reported
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	Not reported
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	Not reported
Latitude/Longitude:	Not reported
Whether Source Is An AOP(Title V) Source:	Not reported
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported

MUTUAL MATERIALS CO (NEWCASTLE) (Continued) **S102456351**

User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	MUTUAL MATERIALS CO (NEWCASTLE)
Mailing Address:	6620 COAL CRK PKWY
Mailing City,St,Zip:	RENTON, 53 98059

A5 **MUTUAL MATERIALS CO, NEWCASTLE** **WA AIRS** **S108276832**
Target **6620 COAL CREEK PKWY** **N/A**
Property **NEWCASTLE, WA 98055**

Site 5 of 9 in cluster A

Actual:
375 ft.

AIRS (EMI):

Year Of Info:	2005
Facility ID:	327121
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	1
Point NAICS:	327121
Lat/Long:	47.54164036 / 122.1614273
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	FUEL COMBUSTION KILNS DRYERS
Point Comments:	Not reported
Local ID:	Not reported
Local Air Agency ID:	C
Fed County Code:	033
Source Number:	11568
Process ID:	1
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	10200602
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	0
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	0
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	0
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	0
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	0
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	0
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	FALSE
Latitude/Longitude:	47.54164036 / 122.1614273
Whether Source Is An AOP(Title V) Source:	TRUE
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	Not reported
Mailing Address:	Not reported
Mailing City,St,Zip:	Not reported
Year Of Info:	2005
Facility ID:	327121
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	2
Point NAICS:	327121
Lat/Long:	47.54164036 / 122.1614273
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	COMBUSTION TUNNEL KILN & DRYERS
Point Comments:	Not reported
Local ID:	Not reported
Local Air Agency ID:	C
Fed County Code:	033
Source Number:	11568
Process ID:	1
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	435
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	30500311
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	25

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	4
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	17
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	9
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	1
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	31
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	Not reported
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	FALSE
Latitude/Longitude:	47.54164036 / 122.1614273
Whether Source Is An AOP(Title V) Source:	TRUE
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	Not reported
Mailing Address:	Not reported
Mailing City,St,Zip:	Not reported
Year Of Info:	2007
Facility ID:	Not reported
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	327121
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	2
Point NAICS:	327121
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	COMBUSTION TUNNEL KILN & DRYERS
Point Comments:	Not reported
Local ID:	Not reported
Local Air Agency ID:	C
Fed County Code:	Not reported
Source Number:	11568
Process ID:	1
Release Point Id:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	435
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	30500311
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	22
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	4
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	17
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	9
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	1
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	31
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	Not reported
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	False
Latitude/Longitude:	47.541640355699997 / 122.16142732900001
Whether Source Is An AOP(Title V) Source:	True
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	Not reported
Mailing Address:	Not reported
Mailing City,St,Zip:	Not reported
Year Of Info:	2007
Facility ID:	Not reported
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	327121
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	1
Point NAICS:	327121
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	FUEL COMBUSTION KILNS DRYERS
Point Comments:	Not reported
Local ID:	Not reported
Local Air Agency ID:	C
Fed County Code:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Source Number:	11568
Process ID:	1
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	10200602
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported
% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	0
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	0
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	0
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	0
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	0
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	0
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	False
Latitude/Longitude:	47.541640355699997 / 122.16142732900001
Whether Source Is An AOP(Title V) Source:	True
Control Code1:	Not reported
Control Code2:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	Not reported
Mailing Address:	Not reported
Mailing City,St,Zip:	Not reported
Year Of Info:	2006
Facility ID:	327121
Facility Type:	Not reported
Facility Category Short Name:	Not reported
Facility Site Status Description:	Not reported
Ecolgy Fac ID:	Not reported
Plant Name:	Not reported
Plant SIC Code:	Not reported
Plant NAICS:	Not reported
NAICS Code:	Not reported
Plant Lat/Long:	Not reported
Plant Lat/Long (dms):	Not reported
Plant UTM East:	Not reported
Plant UTM North:	Not reported
Plant UTM Zone:	Not reported
Point Process SIC:	Not reported
Point Num:	1
Point NAICS:	327121
Lat/Long:	Not reported
Lat/Long (dms):	Not reported
Point UTM East:	Not reported
Point UTM North:	Not reported
Point UTM Zone:	Not reported
Point Desc:	FUEL COMBUSTION KILNS DRYERS
Point Comments:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Local ID:	Not reported
Local Air Agency ID:	C
Fed County Code:	033
Source Number:	11568
Process ID:	1
Release Point Id:	Not reported
Release Point Description:	Not reported
Emissions Unit Id:	Not reported
Emissions Unit Design Capacity Quantity:	Not reported
Emissions Unit Design Capacity UOM Code:	Not reported
Emissions Unit Process Id:	Not reported
Insignificant Emissions Unit Flag:	Not reported
Calculation Material Code Description:	Not reported
Calculation Parameter Quantity:	Not reported
Calculation Parameter UOM Code:	Not reported
Percent Sulfur Content:	Not reported
Percent Ash Content:	Not reported
Heat Content:	Not reported
Heat Content Numerator UOM Code:	Not reported
Heat Content Denominator UOM Code:	Not reported
PM-CON:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
PM10 Nonattainment Area:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
NO2 Chemical:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
CO Nonattainment Area:	Not reported
Univsl Business ID:	Not reported
Boilers Design Capacity At A Point:	Not reported
% Of Ops Occuring During Qtr Jan-Mar:	Not reported
% Of Ops Occuring During Qtr Dec-Feb:	Not reported
% Of Ops Occuring During Qtr Apr-Jun:	Not reported
% Of Ops Occuring During Qtr Mar-May:	Not reported
% Of Ops Occuring During Qtr Jun-Aug:	Not reported
% Of Ops Occuring During Qtr Jul-Sep:	Not reported
% Of Ops Occuring During Qtr Sep-Nov:	Not reported
% Of Ops Occuring During Qtr Oct-Dec:	Not reported
# Of Hours Facility Operates Each Day:	Not reported
# Of Days Facility Operates Each Week:	Not reported
# Of Weeks Facility Operates Each Year:	Not reported
Exit Temp Of A Stack Or Vent:	Not reported
% Wtr In Stack / Vent Exhaust:	Not reported
Height Of Stack:	Not reported
Diameter Of Stack:	Not reported
Air Flow From A Vent Or Stack:	Not reported
% Oxygen In Stack / Vent Exhaust:	Not reported
Flow Rate:	Not reported
Flow Unit:	Not reported
Vertical Dist Exhaust Travels From Stack/vent Outlet:	Not reported
SCC Process Desc:	10200602
EPA Code For Throughput Unit Of Measure:	Not reported
EPA Mat Code For Throughput At Each Process:	Not reported
EPA Code For Mat Thruput Fate Desc/input/output/existing:	Not reported
Description Of Material:	Not reported
Annual Qty Of Throughput Mat:	Not reported
Maximum Rate/Amount Of Annual Throughput:	Not reported
% Of Sulfur In Fuels:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

% Of Ash In Fuels:	Not reported
Emission Unit Output Threshhold:	Not reported
Facility's Throughput Data Confidential:	Not reported
Tot Suspended Partclt Emissn Tons/Year:	Not reported
Tot Suspended Partclte Emissions Estmn Code:	Not reported
Pri Particulate Matter Cntrl Tech Code At Point/Segment:	Not reported
Sec Partciulate Matter Cntrl Tech Code At Point/segment:	Not reported
% Control Of Particulate Matter Emissions:	Not reported
Particulate Matter Emission (?10microns) Tons/Year:	0
Partclte Matter Emission (?10microns) Est Code:	Not reported
Pri Prtclte Matter (?10microns) Cntrl Tech Code At Pt/Seg:	Not reported
Sec Prtclte Matter (?10microns) Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Prtclte Matter (? 10microns) Emisns:	Not reported
Prticlte Matter (?2.5microns)emisins In Tons/Yr:	Not reported
Prticlte Matter Emisn (?2.5microns) Est Code:	Not reported
Pri Ptculate Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
Sec Prticlte Matter (?2.5microns) Ctl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Particulate Matter (?2.5microns) Emissions:	Not reported
Sulfur Dioxide Emissions Tons/Year:	0
Sulfur Dioxide Emission Estimation Code:	Not reported
Pri Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
Secondary Sulfur Dioxide Cntrl Tech Code At Pt/Seg:	Not reported
% Control Of Sulfur Dioxide Emissions:	Not reported
Nitrous Oxides Emissions In Tons/Yr:	0
Nitrous Oxides Emission Estimation Code:	Not reported
Pri Nitrous Oxides Cntrl Tech Code At Point/Segment:	Not reported
Sec Nitrous Oxide Control Tech Code At Point Segment:	Not reported
% Control Of Nitrous Oxides Emissions:	Not reported
Volatile Organic Compound Emitted Desc:	Not reported
Volatile Organic Compound Emissions In Tons/Year:	0
Voltl Organic Compound Emissions Est Code:	Not reported
Pri Voltl Organic Compound Cntl Tech Code At Pt/seg:	Not reported
Sec Voltle Organic Compound Cntl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Volatile Organic Compound Emissions:	Not reported
Carbon Monoxide Emissions In Tons/Year:	0
Carbon Monoxide Emission Est Code:	Not reported
Pri Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
Sec Carbon Monoxide Cntrl Tech Code At Pt/Seg:	Not reported
% Cntrl Of Carbon Monoxide Emissions:	Not reported
Lead Emissions In Tons/Year:	Not reported
Lead Emission Estimation Code:	Not reported
PM10 Nonattainment Area:	Not reported
Ozone Nonattainment Area:	Not reported
CO Nonattainment Area:	Not reported
UTM East:	Not reported
UTM North:	Not reported
UTM Zone:	Not reported
P NH3 Control:	Not reported
NH3 tpy:	0
S NH3 ctrl:	Not reported
NH3 % ctrl:	Not reported
STK ACFS:	Not reported
SCC Process Desc:	Not reported
Primary Control Device Code for SO2:	Not reported
Secondary Control Device Code for SO2:	Not reported
Insignificant Emissions Unit:	FALSE
Latitude/Longitude:	Not reported

MUTUAL MATERIALS CO, NEWCASTLE (Continued) **S108276832**

Whether Source Is An AOP(Title V) Source:	TRUE
Control Code1:	Not reported
Control Code2:	Not reported
Control Code3:	Not reported
Control Code4:	Not reported
Control Code5:	Not reported
Control Code6:	Not reported
Facility Site Supplemental Address:	Not reported
User Defined Site Code:	Not reported
User Defined RP Identifier Code:	Not reported
Release Point Status Code Description:	Not reported
Release Point Exit Gas Velocity Measure Quantity:	Not reported
Release Point Gas Velocity UOMCode:	Not reported
Release Point Exit Gas Flow Rate Measure Quantity:	Not reported
Release Point Gas Flow Rate UOM Code:	Not reported
Release Point Exit Gas Temperature Measure Quantity:	Not reported
Water Vapor Percent Quantity:	Not reported
Oxygen Percent Quantity:	Not reported
User Defined Unit Identifier Code:	Not reported
Emissions Unit Description:	Not reported
Unit Status Code Description:	Not reported
User Defined Process Identifier Code:	Not reported
Emission Unit Process Description:	Not reported
Short Name Description:	Not reported
Actual Hours Per Period Quantity:	Not reported
Pollutant Type Code:	Not reported
Average Percent Emissions Quantity:	Not reported
Contact Name:	Not reported
Contact Phone:	Not reported
Contact Fax:	Not reported
Contact E-mail:	Not reported
Mailing Name:	Not reported
Mailing Address:	Not reported
Mailing City,St,Zip:	Not reported

Click this hyperlink while viewing on your computer to access
3 additional WA AIR_EMISSIONS: record(s) in the EDR Site Report.

A6
Target Property

MUTUAL MATERIALS CO NEWCASTLE PLANT **WA RGA LUST** **S115439513**
6620 COALCREEK PARKWAY SE **N/A**
RENTON, WA

Site 6 of 9 in cluster A

Actual: 375 ft.

RGA LUST:

2010 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2009 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2008 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2007 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2006 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2005 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK PARKWAY SE
2004 MUTUAL MATERIALS CO NEWCASTLE PLANT 6620 COALCREEK

MUTUAL MATERIALS CO NEWCASTLE PLANT (Continued) **S115439513**

PARKWAY SE

A7 **MUTUAL MATERIALS** **WA ICR** **U003025300**
Target **6620 COAL CREEK PARKWAY SE** **N/A**
Property **BELLEVUE, WA 98006**

Site 7 of 9 in cluster A

Actual:
375 ft.

ICR:

Date Ecology Received Report:	12/29/94
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Soil
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Final cleanup report
Site Register Issue:	93-44
County Code:	17
Contact:	Not reported
Report Title:	Not reported

A8 **MUTUAL MATERIALS** **WA RGA LUST** **S115439526**
Target **6620 COAL CREEK PARKWAY SE** **N/A**
Property **RENTON, WA**

Site 8 of 9 in cluster A

Actual:
375 ft.

RGA LUST:

2003	MUTUAL MATERIALS	6620 COAL CREEK PARKWAY SE
2002	MUTUAL MATERIALS	6620 COAL CREEK PARKWAY SE

A9 **MUTUAL MATERIALS COMPANY** **US MINES** **1014851463**
N/A

< 1/8
1 ft.

KING (County), WA

Site 9 of 9 in cluster A

Relative:
Lower

Actual:
371 ft.

US MINES:

Mine ID:	4502191
SIC code(s):	145904 000000 000000 000000 000000 000000
Entity name:	NEWCASTLE BRICK PLANT MILL
Company:	MUTUAL MATERIALS COMPANY
State FIPS code:	WA
County FIPS code:	KING
Status:	4
Status date:	19790621
Operation Class:	non-Coal Mining
Number of shops:	0
Number of plants:	0
Latitude:	00 00 00
Longitude:	000 00 00

10
South
< 1/8
0.019 mi.
102 ft.

NEWCASTLE KING 4 COAL CO MINE A
SE NEWCASTLE COAL CR
NEWCASTLE, WA 98056

WA ALLSITES **S104971713**
WA CSCSL NFA **N/A**

Relative:
Higher

Actual:
456 ft.

ALLSITES:

Facility Id:	2138
Latitude:	47.54149
Longitude:	-122.1609
Ecology Interest Type Code:	SCS
Facility ID:	2138
Facility Company:	NEWCASTLE KING 4 COAL CO MINE A
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	NEWCASTLE KING 4 COAL CO MINE A
Program ID:	Not reported
Date Interaction:	1988-03-01 00:00:00
Date Interaction 3:	1997-07-02 00:00:00
Facility/Site Interaction T:	3643
Geographic Location Identifier (Alias Facid):	2138
Interaction (Aka Env Int) Type Code:	SCS
Interaction (Aka Env Int) Description:	State Cleanup Site
Interaction Status:	I
Federal Program Indentifier:	Not reported
Interaction Start Date:	03/01/1988
Interaction End Date:	07/02/1997
prgm_facil:	NEWCASTLE KING 4 COAL CO MINE A
cur_sys_pr:	TOXICS
cur_sys_nm:	ISIS

CSCSL NFA:

Facility/Site Id:	2138
CS Id:	38
NFA Date:	07/02/1997
Rank:	Not reported
VCP:	No
Latitude:	47.54149
Longitude:	-122.1609

B11
SW
< 1/8
0.050 mi.
263 ft.

Site 1 of 6 in cluster B

AT&T WIRELESS NEWCASTLE
6860 COAL CREEK PKWY SE
RENTON, WA 98059

FINDS **1008906597**
WA ALLSITES **N/A**

Relative:
Higher

Actual:
386 ft.

FINDS:

Registry ID: 110022930925

Environmental Interest/Information System

Washington Facility / Site Identification System (WA-FSIS) provides a means to query and display data maintained by the Washington Department of Ecology. This system contains key information for each

AT&T WIRELESS NEWCASTLE (Continued) **1008906597**

facility/site that is currently, or has been, of interest to the Air Quality, Dam Safety, Hazardous Waste, Toxics Cleanup, and Water Quality Programs.

ALLSITES:

Facility Id:	8532725
Latitude:	47.5382240
Longitude:	-122.16685
Ecology Interest Type Code:	TIER2
Facility ID:	8532725
Facility Company:	AT&T WIRELESS NEWCASTLE
Interaction:	I
Interaction 1:	TIER2
Interaction 2:	Emergency/Haz Chem Rpt TIER2
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	CRK000055040
Date Interaction:	2003-09-15 00:00:00
Date Interaction 3:	2003-09-16 00:00:00

---

12 **NEWCASTLE YMCA** **WA ALLSITES** **S110038327**
SE **SE NEWCASTLE COAL CREEK RD & 136TH** **N/A**
< 1/8 **NEWCASTLE, WA 98059**
0.073 mi.
388 ft.

Relative:
Higher

Actual:
502 ft.

ALLSITES:

Facility Id:	6186
Latitude:	47.5406
Longitude:	-122.156
Ecology Interest Type Code:	CONSTSWGP
Facility ID:	6186
Facility Company:	NEWCASTLE YMCA
Interaction:	I
Interaction 1:	CONSTSWGP
Interaction 2:	Construction SW GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	NEWCASTLE YMCA
Program ID:	WAR010380
Date Interaction:	2008-06-20 00:00:00
Date Interaction 3:	2010-03-19 00:00:00
Facility/Site Interaction T:	85493
Geographic Location Identifier (Alias Facid):	6186
Interaction (Aka Env Int) Type Code:	CONSTGP
Interaction (Aka Env Int) Description:	Construction SW GP
Interaction Status:	A
Federal Program Indentifier:	WAR010380
Interaction Start Date:	06/20/2008
Interaction End Date:	Not reported
prgm_facil:	NEWCASTLE YMCA
cur_sys_pr:	WATQUAL
cur_sys_nm:	PARIS

B13
SW
< 1/8
0.090 mi.
476 ft.

6920 COAL CREEK PKWY SE
RENTON, WA 98059

Site 2 of 6 in cluster B

EDR US Hist Cleaners **1015087736**
N/A

Relative:
Higher

Actual:
387 ft.

EDR Historical Cleaners:

Name:	BAKKERS FINE DRY CLEANING
Year:	2001
Address:	6920 COAL CREEK PKWY SE
Name:	BAKKERS FINE DRY CLEANING
Year:	2004
Address:	6920 COAL CREEK PKWY SE
Name:	BAKKERS FINE DRY CLEANING
Year:	2010
Address:	6920 COAL CREEK PKWY SE
Name:	NEWCASTLE CLEANERS
Year:	2011
Address:	6920 COAL CREEK PKWY SE
Name:	NEWCASTLE CLEANERS
Year:	2012
Address:	6920 COAL CREEK PKWY SE

B14
SW
< 1/8
0.090 mi.
476 ft.

BAKKERS CLEANERS
6920 COAL CREEK PKWY SE
RENTON, WA 98059

Site 3 of 6 in cluster B

RCRA NonGen / NLR **1004793147**
FINDS **WA0000062364**
WA ALLSITES
WA Inactive Drycleaners

Relative:
Higher

Actual:
387 ft.

RCRA NonGen / NLR:

Date form received by agency:	08/16/2004
Facility name:	BAKKERS CLEANERS
Facility address:	6920 COAL CREEK PKWY SE RENTON, WA 98059
EPA ID:	WA0000062364
Contact:	BAKKERS CLEANER BAKKERS CLEANER
Contact address:	6920 COAL CREEK PKWY SE RENTON, WA 98059
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:

Owner/operator name:	FAYE N
Owner/operator address:	6920 COAL CREEK PKWY SE RENTON, WA 98059
Owner/operator country:	US
Owner/operator telephone:	(425)641-7101
Legal status:	Private
Owner/Operator Type:	Operator
Owner/Op start date:	05/13/1997
Owner/Op end date:	Not reported

BAKKERS CLEANERS (Continued) **1004793147**

Owner/operator name: BAKKERS CLEANER B
Owner/operator address: 6920 COAL CREEK PKWY SE
RENTON, WA 98059
Owner/operator country: US
Owner/operator telephone: (425)641-7101
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 05/01/1996
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Historical Generators:
Date form received by agency: 12/31/2003
Site name: BAKKERS CLEANERS
Classification: Not a generator, verified

Violation Status: No violations found

FINDS:

Registry ID: 110005302038

Environmental Interest/Information System
Washington Facility / Site Identification System (WA-FSIS) provides a means to query and display data maintained by the Washington Department of Ecology. This system contains key information for each facility/site that is currently, or has been, of interest to the Air Quality, Dam Safety, Hazardous Waste, Toxics Cleanup, and Water Quality Programs.

RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

HAZARDOUS WASTE BIENNIAL REPORTER

BAKKERS CLEANERS (Continued) **1004793147**

ALLSITES:

Facility Id:	31639748
Latitude:	47.5408
Longitude:	-122.16499
Ecology Interest Type Code:	HWG
Facility ID:	31639748
Facility Company:	Bakkers Cleaners
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WA0000062364
Date Interaction:	1993-11-23 00:00:00
Date Interaction 3:	2003-12-31 00:00:00

Inactive Drycleaners:

EPA I:	WA0000062364
FS Id:	3806
Facility ID:	WA0000062364
NAICS Code:	81232
Fed Waste Code Desc:	Not reported
State Waste Code Desc:	Not reported
TAX REG NBR:	Not reported
BUSINESS TYPE:	Not reported
MAIL NAME:	Not reported
MAIL LINE1:	Not reported
MAIL LINE2:	Not reported
MAIL CITY:	Not reported
MAIL STATE:	Not reported
MAIL ZIP:	Not reported
MAIL COUNTRY:	Not reported
LEGAL ORG NAME:	Not reported
LEGAL PERSON FIRST NAME:	Not reported
LEGAL PERSON MIDDLE INIT:	Not reported
LEGAL PERSON LAST NAME:	Not reported
LEGAL LINE1:	Not reported
LEGAL LINE2:	Not reported
LEGAL CITY:	Not reported
LEGAL STATE:	Not reported
LEGAL ZIP:	Not reported
LEGAL COUNTRY:	Not reported
LEGAL PHONE NBR:	Not reported
LEGAL EFFECTIVE DATE:	Not reported
LEGAL ORGANIZATION TYPE:	Not reported
LAND ORG NAME:	Not reported
LAND PERSON FIRST NAME:	Not reported
LAND PERSON MIDDLE INIT:	Not reported
LAND PERSON LAST NAME:	Not reported
LAND LINE1:	Not reported
LAND LINE2:	Not reported
LAND CITY:	Not reported
LAND STATE:	Not reported
LAND ZIP:	Not reported

BAKKERS CLEANERS (Continued) **1004793147**

LAND COUNTRY:	Not reported
LAND PHONE NBR:	Not reported
LAND ORGANIZATION TYPE:	Not reported
OPERATOR ORG NAME:	Not reported
OPERATOR PERSON FIRST NAME:	Not reported
OPERATOR PERSON MIDDLE INIT:	Not reported
OPERATOR PERSON LAST NAME:	Not reported
OPERATOR LINE1:	Not reported
OPERATOR LINE2:	Not reported
OPERATOR CITY:	Not reported
OPERATOR STATE:	Not reported
OPERATOR ZIP:	Not reported
OPERATOR COUNTRY:	Not reported
OPERATOR PHONE NBR:	Not reported
OPERATOR EFFECTIVE DATE:	Not reported
OPERATOR ORGANIZATION TYPE:	Not reported
SITE CONTACT FIRST NAME:	Not reported
SITE CONTACT MIDDLE INIT:	Not reported
SITE CONTACT LAST NAME:	Not reported
SITE CONTACT LINE1:	Not reported
SITE CONTACT LINE2:	Not reported
SITE CONTACT CITY:	Not reported
SITE CONTACT STATE:	Not reported
SITE CONTACT ZIP:	Not reported
SITE CONTACT COUNTRY:	Not reported
SITE CONTACT PHONE NBR:	Not reported
SITE CONTACT EMAIL:	Not reported
FORM CONTACT FIRST NAME:	Not reported
FORM CONTACT MIDDLE INIT:	Not reported
FORM CONTACT LAST NAME:	Not reported
FORM CONTACT LINE1:	Not reported
FORM CONTACT LINE2:	Not reported
FORM CONTACT CITY:	Not reported
FORM CONTACT STATE:	Not reported
FORM CONTACT ZIP:	Not reported
FORM CONTACT COUNTRY:	Not reported
FORM CONTACT PHONE NBR:	Not reported
FORM CONTACT EMAIL:	Not reported
GEN STATUS CD:	Not reported
MONTHLY GENERATION:	Not reported
BATCH GENERATION:	Not reported
ONE TIME GENERATION:	Not reported
TRANSPORTS OWN WASTE:	Not reported
TRANSPORTS OTHERS WASTE:	Not reported
RECYCLER ONSITE:	Not reported
TRANSFER FACILITY:	Not reported
PBR:	Not reported
TBG:	Not reported
MIXED RADIOACTIVE:	Not reported
IMPORTER:	Not reported
TSDR FACILITY:	Not reported
IMMEDIATE RECYCLER:	Not reported
GEN DANG FUEL:	Not reported
GEN MARKET TO BURNER:	Not reported
GEN OTHER MARKETERS:	Not reported
UTILITY BOILER BURNER:	Not reported
INDUSTRY BOILER BURNER:	Not reported

BAKKERS CLEANERS (Continued) **1004793147**

FURNACE BURNER:	Not reported
SMELTER DEFERRAL:	Not reported
SMALL QTY EXEMPTION:	Not reported
OTHER EXEMPTION:	Not reported
UW BATTERY GEN:	Not reported
UW THERMOSTATS GEN:	Not reported
UW MERCURY GEN:	Not reported
UW LAMPS GEN:	Not reported
UW BATTERY ACCUM:	Not reported
UW THERMOSTATS ACCUM:	Not reported
UW MERCURY ACCUM:	Not reported
UW LAMPS ACCUM:	Not reported
UW DESTINATION FACILITY:	Not reported
OFF SPEC UTILITY BOILER:	Not reported
OFF SPEC INDUSTRY BOILER:	Not reported
OFF SPEC FURNACE:	Not reported
USED OIL TRANSPORTER:	Not reported
USED OIL TRANSFER FACILITY:	Not reported
USED OIL PROCESSOR:	Not reported
USED OIL REREFINER:	Not reported
USED OIL FUEL MARKETER DIR SHIPMENTS:	Not reported
USED OIL FUEL MARKETER MEETS SPECS:	Not reported
Comments:	Not reported

B15 **EDR US Hist Cleaners** **1015087754**
SW **6923 COAL CREEK PKWY SE** **N/A**
< 1/8 **RENTON, WA 98059**
0.092 mi.
484 ft. **Site 4 of 6 in cluster B**

Relative:
Higher

Actual:
388 ft.

EDR Historical Cleaners:

Name:	DANIELS DRY CLEANERS
Year:	2001
Address:	6923 COAL CREEK PKWY SE
Name:	DANIELS DRY CLEANERS
Year:	2002
Address:	6923 COAL CREEK PKWY SE
Name:	DANIELS DRY CLEANERS
Year:	2004
Address:	6923 COAL CREEK PKWY SE
Name:	CUSTOM CLEANERS
Year:	2011
Address:	6923 COAL CREEK PKWY SE
Name:	CUSTOM CLEANERS
Year:	2012
Address:	6923 COAL CREEK PKWY SE

B16
SW
< 1/8
0.092 mi.
484 ft.

Relative:
Higher

Actual:
388 ft.

DANIELS DRYCLEANERS COAL CREEK
6923 COAL CREEK PKWY SE
NEWCASTLE, WA 98059

Site 5 of 6 in cluster B

Database(s): RCRA NonGen / NLR, FINDS, WA CSCSL, WA ALLSITES, WA MANIFEST, WA VCP, WA ICR, CA HAZNET, WA Inactive Drycleaners

EDR ID Number: 1000885302
EPA ID Number: WAD988471843

RCRA NonGen / NLR:

Date form received by agency:	06/18/2009
Facility name:	DANIELS DRYCLEANERS COAL CREEK
Facility address:	6923 COAL CREEK PKWY SE NEWCASTLE, WA 98059
EPA ID:	WAD988471843
Mailing address:	105 S WACKER DR # 2800 CHICAGO, IL 60606
Contact:	DAN PREZEMBEL
Contact address:	105 S WACKER DR # 2800 CHICAGO, IL 60606
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Land type:	Private
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:

Owner/operator name:	DANIELS DRY CLE D
Owner/operator address:	6923 COAL CREEK PKWY SE NEWCASTLE, WA 98059
Owner/operator country:	US
Owner/operator telephone:	(425)747-5818
Legal status:	Private
Owner/Operator Type:	Operator
Owner/Op start date:	01/01/1900
Owner/Op end date:	Not reported

Owner/operator name:	FRANCIS A
Owner/operator address:	14335 NE 24TH STE 202 BELLEVUE, WA 98007
Owner/operator country:	US
Owner/operator telephone:	(425)747-1825
Legal status:	Private
Owner/Operator Type:	Owner
Owner/Op start date:	09/11/1996
Owner/Op end date:	Not reported

Handler Activities Summary:

U.S. importer of hazardous waste:	No
Mixed waste (haz. and radioactive):	No
Recycler of hazardous waste:	No
Transporter of hazardous waste:	No
Treater, storer or disposer of HW:	No
Underground injection activity:	No
On-site burner exemption:	No

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Furnace exemption:	No
Used oil fuel burner:	No
Used oil processor:	No
User oil refiner:	No
Used oil fuel marketer to burner:	No
Used oil Specification marketer:	No
Used oil transfer facility:	No
Used oil transporter:	No

Historical Generators:

Date form received by agency:	12/31/2007
Site name:	DANIELS DRYCLEANERS COAL CREEK
Classification:	Not a generator, verified

Hazardous Waste Summary:

Waste code:	F002
Waste name:	THE FOLLOWING SPENT HALOGENATED SOLVENTS: TETRACHLOROETHYLENE, METHYLENE CHLORIDE, TRICHLOROETHYLENE, 1,1,1-TRICHLOROETHANE, CHLOROBENZENE, 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE, ORTHO-DICHLOROBENZENE, TRICHLOROFLUOROMETHANE, AND 1,1,2-TRICHLOROETHANE; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE HALOGENATED SOLVENTS OR THOSE LISTED IN F001, F004, OR F005, AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
Violation Status:	No violations found

Evaluation Action Summary:

Evaluation date:	08/29/2007
Evaluation:	COMPLIANCE ASSISTANCE VISIT
Area of violation:	Not reported
Date achieved compliance:	Not reported
Evaluation lead agency:	State

FINDS:

Registry ID: 110005352117

Environmental Interest/Information System

Washington Facility / Site Identification System (WA-FSIS) provides a means to query and display data maintained by the Washington Department of Ecology. This system contains key information for each facility/site that is currently, or has been, of interest to the Air Quality, Dam Safety, Hazardous Waste, Toxics Cleanup, and Water Quality Programs.

RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

HAZARDOUS WASTE BIENNIAL REPORTER

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

CSCSL:
Facility ID: 10627385
Region: Northwest
Lat/Long: 47.54078 / -122.16504
Brownfield Status: Not reported
Rank Status: N
Clean Up Siteid: 629
Site Status: Cleanup Started
PSI?: Not reported
Contaminant Name: Halogenated Organics
Ground Water: Confirmed Above Cleanup Level
Surface Water: Not reported
Soil: Confirmed Above Cleanup Level
Sediment: Not reported
Air: Not reported
Bedrock: Not reported
Responsible Unit: Northwest

ALLSITES:
Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: HWG
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1990-02-28 00:00:00
Date Interaction 3: 1998-05-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1993-01-01 00:00:00
Date Interaction 3: 1993-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: Not reported

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Date Interaction:	1998-09-10 00:00:00
Date Interaction 3:	2002-06-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW0915
Date Interaction:	2002-06-05 00:00:00
Date Interaction 3:	2006-10-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	2006-06-21 00:00:00
Date Interaction 3:	2006-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	A
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW1678
Date Interaction:	2006-10-05 00:00:00
Date Interaction 3:	Not reported
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWOTHER
Interaction 2:	Haz Waste Management Activity
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	DANIELS DRYCLEANERS COAL CREEK
Program ID:	WAD988471843
Date Interaction:	2006-12-31 00:00:00
Date Interaction 3:	2008-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	LSC
Interaction 2:	Local Source Control
Ecology Program:	HAZWASTE

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Program Data: LSC
Facility Alt.: Newcastle Cleaners
Program ID: Not reported
Date Interaction: 2009-02-03 00:00:00
Date Interaction 3: 2010-04-29 00:00:00

Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: HWOTHER
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1990-02-28 00:00:00
Date Interaction 3: 1998-05-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1993-01-01 00:00:00
Date Interaction 3: 1993-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: Not reported
Date Interaction: 1998-09-10 00:00:00
Date Interaction 3: 2002-06-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: NW0915
Date Interaction: 2002-06-05 00:00:00

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Date Interaction 3: 2006-10-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 2006-06-21 00:00:00
Date Interaction 3: 2006-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: A
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: NW1678
Date Interaction: 2006-10-05 00:00:00
Date Interaction 3: Not reported

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWOTHER
Interaction 2: Haz Waste Management Activity
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: DANIELS DRYCLEANERS COAL CREEK
Program ID: WAD988471843
Date Interaction: 2006-12-31 00:00:00
Date Interaction 3: 2008-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: LSC
Interaction 2: Local Source Control
Ecology Program: HAZWASTE
Program Data: LSC
Facility Alt.: Newcastle Cleaners
Program ID: Not reported
Date Interaction: 2009-02-03 00:00:00
Date Interaction 3: 2010-04-29 00:00:00

Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: HWP
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	1990-02-28 00:00:00
Date Interaction 3:	1998-05-05 00:00:00

Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWP
Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	1993-01-01 00:00:00
Date Interaction 3:	1993-12-31 00:00:00

Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	Not reported
Date Interaction:	1998-09-10 00:00:00
Date Interaction 3:	2002-06-05 00:00:00

Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW0915
Date Interaction:	2002-06-05 00:00:00
Date Interaction 3:	2006-10-05 00:00:00

Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	2006-06-21 00:00:00
Date Interaction 3:	2006-12-31 00:00:00

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: A
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: NW1678
Date Interaction: 2006-10-05 00:00:00
Date Interaction 3: Not reported

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWOTHER
Interaction 2: Haz Waste Management Activity
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: DANIELS DRYCLEANERS COAL CREEK
Program ID: WAD988471843
Date Interaction: 2006-12-31 00:00:00
Date Interaction 3: 2008-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: LSC
Interaction 2: Local Source Control
Ecology Program: HAZWASTE
Program Data: LSC
Facility Alt.: Newcastle Cleaners
Program ID: Not reported
Date Interaction: 2009-02-03 00:00:00
Date Interaction 3: 2010-04-29 00:00:00

Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: LSC
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1990-02-28 00:00:00
Date Interaction 3: 1998-05-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWP

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Interaction 2:	Hazardous Waste Planner
Ecology Program:	HAZWASTE
Program Data:	HWPPRT
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	1993-01-01 00:00:00
Date Interaction 3:	1993-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	Not reported
Date Interaction:	1998-09-10 00:00:00
Date Interaction 3:	2002-06-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW0915
Date Interaction:	2002-06-05 00:00:00
Date Interaction 3:	2006-10-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	2006-06-21 00:00:00
Date Interaction 3:	2006-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	A
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW1678
Date Interaction:	2006-10-05 00:00:00
Date Interaction 3:	Not reported
Facility ID:	10627385

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWOTHER
Interaction 2: Haz Waste Management Activity
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: DANIELS DRYCLEANERS COAL CREEK
Program ID: WAD988471843
Date Interaction: 2006-12-31 00:00:00
Date Interaction 3: 2008-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: LSC
Interaction 2: Local Source Control
Ecology Program: HAZWASTE
Program Data: LSC
Facility Alt.: Newcastle Cleaners
Program ID: Not reported
Date Interaction: 2009-02-03 00:00:00
Date Interaction 3: 2010-04-29 00:00:00

Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: SCS
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1990-02-28 00:00:00
Date Interaction 3: 1998-05-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1993-01-01 00:00:00
Date Interaction 3: 1993-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: SCS
Interaction 2: State Cleanup Site

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	Not reported
Date Interaction:	1998-09-10 00:00:00
Date Interaction 3:	2002-06-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW0915
Date Interaction:	2002-06-05 00:00:00
Date Interaction 3:	2006-10-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	2006-06-21 00:00:00
Date Interaction 3:	2006-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	A
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW1678
Date Interaction:	2006-10-05 00:00:00
Date Interaction 3:	Not reported
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWOTHER
Interaction 2:	Haz Waste Management Activity
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	DANIELS DRYCLEANERS COAL CREEK
Program ID:	WAD988471843
Date Interaction:	2006-12-31 00:00:00
Date Interaction 3:	2008-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Interaction: I
Interaction 1: LSC
Interaction 2: Local Source Control
Ecology Program: HAZWASTE
Program Data: LSC
Facility Alt.: Newcastle Cleaners
Program ID: Not reported
Date Interaction: 2009-02-03 00:00:00
Date Interaction 3: 2010-04-29 00:00:00

Facility Id: 10627385
Latitude: 47.54078
Longitude: -122.16504
Ecology Interest Type Code: VOLCLNST
Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1990-02-28 00:00:00
Date Interaction 3: 1998-05-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: WAD988471843
Date Interaction: 1993-01-01 00:00:00
Date Interaction 3: 1993-12-31 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Daniels Drycleaners Coal Creek
Program ID: Not reported
Date Interaction: 1998-09-10 00:00:00
Date Interaction 3: 2002-06-05 00:00:00

Facility ID: 10627385
Facility Company: Daniels Drycleaners Coal Creek
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW0915
Date Interaction:	2002-06-05 00:00:00
Date Interaction 3:	2006-10-05 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988471843
Date Interaction:	2006-06-21 00:00:00
Date Interaction 3:	2006-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	A
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Daniels Drycleaners Coal Creek
Program ID:	NW1678
Date Interaction:	2006-10-05 00:00:00
Date Interaction 3:	Not reported
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	HWOTHER
Interaction 2:	Haz Waste Management Activity
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	DANIELS DRYCLEANERS COAL CREEK
Program ID:	WAD988471843
Date Interaction:	2006-12-31 00:00:00
Date Interaction 3:	2008-12-31 00:00:00
Facility ID:	10627385
Facility Company:	Daniels Drycleaners Coal Creek
Interaction:	I
Interaction 1:	LSC
Interaction 2:	Local Source Control
Ecology Program:	HAZWASTE
Program Data:	LSC
Facility Alt.:	Newcastle Cleaners
Program ID:	Not reported
Date Interaction:	2009-02-03 00:00:00
Date Interaction 3:	2010-04-29 00:00:00

WA MANIFEST:
Facility Site ID Number: 10627385

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

EPA ID:	WAD988471843
NAICS:	812320
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	Not reported
Permit by Rule:	False
Treatment by Generator:	False
Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	600550005
Business Type:	Not reported
Mail Name:	Not reported
Mail addr line1:	10115 214th Ave NE
Mail city,st,zip:	Redmond, WA 98053
Mail country:	UNITED STATES
Legal org name:	Not reported
Legal org type:	Private
Legal addr line1:	10115 214th Ave NE
Legal city,st,zip:	Redmond, WA 98053
Legal country:	UNITED STATES
Legal phone nbr:	(425)868-8528
Legal effective date:	09/11/1996
Land org name:	JSH Properties Inc
Land org type:	Private
Land person name:	Not reported
Land addr line1:	14335 NE 24th Ste 202
Land city,st,zip:	Bellevue, WA 98007
Land country:	UNITED STATES
Land phone nbr:	(425)747-1825
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	10115 214th Ave NE
Operator city,st,zip:	Redmond, WA 98053-7647
Operator country:	UNITED STATES
Operator phone nbr:	(425)868-8528

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Operator effective date:	09/11/1996
Site contact name:	Helen Ferrelli
Site contact addr line1:	6923 Coal Creek Pkwy SE
Site Contact City/State/ Zip:	NewCastle, WA 98059-3136
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)271-9447
Site Contact EMail:	Not reported
Form Contact NAME:	Maureen Sanchez
Form Contact ADDR LINE1:	2405 140th Avenue NE
Form Contact ADDR LINE2:	Suite A-101
Form Contact City,ST,Zip:	Bellevue, WA 98005
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)5624200
Form Contact EMail:	msanchez@kleinfelder.com
Gen Status CD:	XQG
Monthly Generation:	False
Batch Generation:	False
One Time Generation:	False
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	False
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

VCP:

edr_fstat:	WA
edr_fzip:	98059
edr_fcnty:	KING
edr_zip:	Not reported
Facility ID:	10627385
VCP Status:	Yes
VCP:	Not reported
Ecology Status:	Not reported
NFA Type:	Not reported
Date NFA:	Not reported
Rank:	N
Cleanup Siteid:	629

ICR:

Date Ecology Received Report:	12/16/96
Contaminants Found at Site:	Halogenated Solvents
Media Contaminated:	Groundwater, Soil

HAZNET:

envid:	1000885302
Year:	1994
GEPAID:	WAD988471843
Contact:	DAN & HELEN FERRELLI
Telephone:	2068688528

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

Mailing Name: Not reported
Mailing Address: 6923 COAL CREEK PKWY SE
Mailing City,St,Zip: NEWCASTLE, WA 980590000
Gen County: Not reported
TSD EPA ID: CAD009452657
TSD County: Not reported
Waste Category: Liquids with halogenated organic compounds >= 1,000 Mg./L
Disposal Method: Disposal, Other
Tons: .3543
Facility County: 99

envid: 1000885302
Year: 1993
GEPAID: WAD988471843
Contact: DAN & HELEN FERRELLI
Telephone: 2068688528
Mailing Name: Not reported
Mailing Address: 6923 COAL CREEK PKWY SE
Mailing City,St,Zip: NEWCASTLE, WA 980590000
Gen County: Not reported
TSD EPA ID: CAD009452657
TSD County: Not reported
Waste Category: Liquids with halogenated organic compounds >= 1,000 Mg./L
Disposal Method: Disposal, Other
Tons: 0.81299999999
Facility County: 99

envid: 1000885302
Year: 1993
GEPAID: WAD988471843
Contact: DAN & HELEN FERRELLI
Telephone: 2068688528
Mailing Name: Not reported
Mailing Address: 6923 COAL CREEK PKWY SE
Mailing City,St,Zip: NEWCASTLE, WA 980590000
Gen County: Not reported
TSD EPA ID: CAD009452657
TSD County: Not reported
Waste Category: Still bottoms with halogenated organics
Disposal Method: Disposal, Other
Tons: 0.37519999999
Facility County: 99

Inactive Drycleaners:
EPA I: WAD988471843
FS Id: 10627385
Facility ID: WAD988471843
NAICS Code: 812320
Fed Waste Code Desc: Not reported
State Waste Code Desc: Not reported
TAX REG NBR: 600550005
BUSINESS TYPE: Not reported
MAIL NAME: Not reported
MAIL LINE1: 10115 214th Ave NE
MAIL LINE2: Not reported
MAIL CITY: Redmond
MAIL STATE: WA

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

MAIL ZIP:	98053
MAIL COUNTRY:	UNITED STATES
LEGAL ORG NAME:	Not reported
LEGAL PERSON FIRST NAME:	Daniel & Helen
LEGAL PERSON MIDDLE INIT:	Not reported
LEGAL PERSON LAST NAME:	Ferrelli
LEGAL LINE1:	10115 214th Ave NE
LEGAL LINE2:	Not reported
LEGAL CITY:	Redmond
LEGAL STATE:	WA
LEGAL ZIP:	98053
LEGAL COUNTRY:	UNITED STATES
LEGAL PHONE NBR:	(425)868-8528
LEGAL EFFECTIVE DATE:	9/11/1996
LEGAL ORGANIZATION TYPE:	Private
LAND ORG NAME:	JSH Properties Inc
LAND PERSON FIRST NAME:	Not reported
LAND PERSON MIDDLE INIT:	Not reported
LAND PERSON LAST NAME:	Not reported
LAND LINE1:	14335 NE 24th Ste 202
LAND LINE2:	Not reported
LAND CITY:	Bellevue
LAND STATE:	WA
LAND ZIP:	98007
LAND COUNTRY:	UNITED STATES
LAND PHONE NBR:	(425)747-1825
LAND ORGANIZATION TYPE:	Private
OPERATOR ORG NAME:	Not reported
OPERATOR PERSON FIRST NAME:	Daniel & Helen
OPERATOR PERSON MIDDLE INIT:	Not reported
OPERATOR PERSON LAST NAME:	Ferrelli
OPERATOR LINE1:	10115 214th Ave NE
OPERATOR LINE2:	Not reported
OPERATOR CITY:	Redmond
OPERATOR STATE:	WA
OPERATOR ZIP:	98053-7647
OPERATOR COUNTRY:	UNITED STATES
OPERATOR PHONE NBR:	(425)868-8528
OPERATOR EFFECTIVE DATE:	09/11/96
OPERATOR ORGANIZATION TYPE:	Private
SITE CONTACT FIRST NAME:	Helen
SITE CONTACT MIDDLE INIT:	Not reported
SITE CONTACT LAST NAME:	Ferrelli
SITE CONTACT LINE1:	6923 Coal Creek Pkwy SE
SITE CONTACT LINE2:	Not reported
SITE CONTACT CITY:	NewCastle
SITE CONTACT STATE:	WA
SITE CONTACT ZIP:	98059-3136
SITE CONTACT COUNTRY:	UNITED STATES
SITE CONTACT PHONE NBR:	(425)271-9447
SITE CONTACT EMAIL:	Not reported
FORM CONTACT FIRST NAME:	Maureen
FORM CONTACT MIDDLE INIT:	Not reported
FORM CONTACT LAST NAME:	Sanchez
FORM CONTACT LINE1:	2405 140th Avenue NE
FORM CONTACT LINE2:	Suite A-101
FORM CONTACT CITY:	Bellevue

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

FORM CONTACT STATE:	WA
FORM CONTACT ZIP:	98005
FORM CONTACT COUNTRY:	UNITED STATES
FORM CONTACT PHONE NBR:	(425)5624200
FORM CONTACT EMAIL:	msanchez@kleinfelder.com
GEN STATUS CD:	XQG
MONTHLY GENERATION:	F
BATCH GENERATION:	F
ONE TIME GENERATION:	F
TRANSPORTS OWN WASTE:	F
TRANSPORTS OTHERS WASTE:	F
RECYCLER ONSITE:	F
TRANSFER FACILITY:	F
PBR:	F
TBG:	F
MIXED RADIOACTIVE:	F
IMPORTER:	F
TSDR FACILITY:	F
IMMEDIATE RECYCLER:	F
GEN DANG FUEL:	F
GEN MARKET TO BURNER:	F
GEN OTHER MARKETERS:	F
UTILITY BOILER BURNER:	F
INDUSTRY BOILER BURNER:	F
FURNACE BURNER:	F
SMELTER DEFERRAL:	F
SMALL QTY EXEMPTION:	F
OTHER EXEMPTION:	Not reported
UW BATTERY GEN:	F
UW THERMOSTATS GEN:	F
UW MERCURY GEN:	F
UW LAMPS GEN:	F
UW BATTERY ACCUM:	F
UW THERMOSTATS ACCUM:	F
UW MERCURY ACCUM:	F
UW LAMPS ACCUM:	F
UW DESTINATION FACILITY:	F
OFF SPEC UTILITY BOILER:	F
OFF SPEC INDUSTRY BOILER:	F
OFF SPEC FURNACE:	F
USED OIL TRANSPORTER:	F
USED OIL TRANSFER FACILITY:	F
USED OIL PROCESSOR:	F
USED OIL REREFINER:	F
USED OIL FUEL MARKETER DIR SHIPMENTS:	F
USED OIL FUEL MARKETER MEETS SPECS:	F
Comments:	Not reported
EPA I:	WAD988471843
FS Id:	1614
Facility ID:	WAD988471843
NAICS Code:	81232
Fed Waste Code Desc:	Not reported
State Waste Code Desc:	Not reported
TAX REG NBR:	Not reported
BUSINESS TYPE:	Not reported
MAIL NAME:	Not reported
MAIL LINE1:	Not reported

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

MAIL LINE2:	Not reported
MAIL CITY:	Not reported
MAIL STATE:	Not reported
MAIL ZIP:	Not reported
MAIL COUNTRY:	Not reported
LEGAL ORG NAME:	Not reported
LEGAL PERSON FIRST NAME:	Not reported
LEGAL PERSON MIDDLE INIT:	Not reported
LEGAL PERSON LAST NAME:	Not reported
LEGAL LINE1:	Not reported
LEGAL LINE2:	Not reported
LEGAL CITY:	Not reported
LEGAL STATE:	Not reported
LEGAL ZIP:	Not reported
LEGAL COUNTRY:	Not reported
LEGAL PHONE NBR:	Not reported
LEGAL EFFECTIVE DATE:	Not reported
LEGAL ORGANIZATION TYPE:	Not reported
LAND ORG NAME:	Not reported
LAND PERSON FIRST NAME:	Not reported
LAND PERSON MIDDLE INIT:	Not reported
LAND PERSON LAST NAME:	Not reported
LAND LINE1:	Not reported
LAND LINE2:	Not reported
LAND CITY:	Not reported
LAND STATE:	Not reported
LAND ZIP:	Not reported
LAND COUNTRY:	Not reported
LAND PHONE NBR:	Not reported
LAND ORGANIZATION TYPE:	Not reported
OPERATOR ORG NAME:	Not reported
OPERATOR PERSON FIRST NAME:	Not reported
OPERATOR PERSON MIDDLE INIT:	Not reported
OPERATOR PERSON LAST NAME:	Not reported
OPERATOR LINE1:	Not reported
OPERATOR LINE2:	Not reported
OPERATOR CITY:	Not reported
OPERATOR STATE:	Not reported
OPERATOR ZIP:	Not reported
OPERATOR COUNTRY:	Not reported
OPERATOR PHONE NBR:	Not reported
OPERATOR EFFECTIVE DATE:	Not reported
OPERATOR ORGANIZATION TYPE:	Not reported
SITE CONTACT FIRST NAME:	Not reported
SITE CONTACT MIDDLE INIT:	Not reported
SITE CONTACT LAST NAME:	Not reported
SITE CONTACT LINE1:	Not reported
SITE CONTACT LINE2:	Not reported
SITE CONTACT CITY:	Not reported
SITE CONTACT STATE:	Not reported
SITE CONTACT ZIP:	Not reported
SITE CONTACT COUNTRY:	Not reported
SITE CONTACT PHONE NBR:	Not reported
SITE CONTACT EMAIL:	Not reported
FORM CONTACT FIRST NAME:	Not reported
FORM CONTACT MIDDLE INIT:	Not reported
FORM CONTACT LAST NAME:	Not reported

DANIELS DRYCLEANERS COAL CREEK (Continued) **1000885302**

FORM CONTACT LINE1:	Not reported
FORM CONTACT LINE2:	Not reported
FORM CONTACT CITY:	Not reported
FORM CONTACT STATE:	Not reported
FORM CONTACT ZIP:	Not reported
FORM CONTACT COUNTRY:	Not reported
FORM CONTACT PHONE NBR:	Not reported
FORM CONTACT EMAIL:	Not reported
GEN STATUS CD:	Not reported
MONTHLY GENERATION:	Not reported
BATCH GENERATION:	Not reported
ONE TIME GENERATION:	Not reported
TRANSPORTS OWN WASTE:	Not reported
TRANSPORTS OTHERS WASTE:	Not reported
RECYCLER ONSITE:	Not reported
TRANSFER FACILITY:	Not reported
PBR:	Not reported
TBG:	Not reported
MIXED RADIOACTIVE:	Not reported
IMPORTER:	Not reported
TSDR FACILITY:	Not reported
IMMEDIATE RECYCLER:	Not reported
GEN DANG FUEL:	Not reported
GEN MARKET TO BURNER:	Not reported
GEN OTHER MARKETERS:	Not reported
UTILITY BOILER BURNER:	Not reported
INDUSTRY BOILER BURNER:	Not reported
FURNACE BURNER:	Not reported
SMELTER DEFERRAL:	Not reported
SMALL QTY EXEMPTION:	Not reported
OTHER EXEMPTION:	Not reported
UW BATTERY GEN:	Not reported
UW THERMOSTATS GEN:	Not reported
UW MERCURY GEN:	Not reported
UW LAMPS GEN:	Not reported
UW BATTERY ACCUM:	Not reported
UW THERMOSTATS ACCUM:	Not reported
UW MERCURY ACCUM:	Not reported
UW LAMPS ACCUM:	Not reported
UW DESTINATION FACILITY:	Not reported
OFF SPEC UTILITY BOILER:	Not reported
OFF SPEC INDUSTRY BOILER:	Not reported
OFF SPEC FURNACE:	Not reported
USED OIL TRANSPORTER:	Not reported
USED OIL TRANSFER FACILITY:	Not reported
USED OIL PROCESSOR:	Not reported
USED OIL REREFINER:	Not reported
USED OIL FUEL MARKETER DIR SHIPMENTS:	Not reported
USED OIL FUEL MARKETER MEETS SPECS:	Not reported
Comments:	Not reported

B17 **COAL CREEK VILLAGE SHOPPING CENTER** **RCRA NonGen / NLR** **1001126034**
SW **6925 COAL CREEK PKWY SE** **FINDS** **WAR000011098**
< 1/8 **NEWCASTLE, WA 98059** **WA ALLSITES**
0.093 mi.
491 ft. **Site 6 of 6 in cluster B**

Relative:
Higher

Actual:
389 ft.

RCRA NonGen / NLR:

Date form received by agency:	05/03/2000
Facility name:	COAL CREEK VILLAGE SHOPPING CENTER
Facility address:	6925 COAL CREEK PKWY SE NEWCASTLE, WA 98059
EPA ID:	WAR000011098
Contact:	COAL CREEK VILL COAL CREEK VILL
Contact address:	6925 COAL CREEK PKWY SE NEW CASTLE, WA 98059
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:

Owner/operator name:	RREEF WEST FIVE R
Owner/operator address:	1301 DOVE ST #460 NEWPORT BEACH, CA 92660
Owner/operator country:	US
Owner/operator telephone:	(714)851-6200
Legal status:	Private
Owner/Operator Type:	Owner
Owner/Op start date:	11/12/1996
Owner/Op end date:	Not reported

Owner/operator name:	LARRY C
Owner/operator address:	1301 DOVE ST #460 NEWPORT BEACH, CA 92660
Owner/operator country:	US
Owner/operator telephone:	(714)851-6200
Legal status:	Private
Owner/Operator Type:	Operator
Owner/Op start date:	11/12/1996
Owner/Op end date:	Not reported

Handler Activities Summary:

U.S. importer of hazardous waste:	No
Mixed waste (haz. and radioactive):	No
Recycler of hazardous waste:	No
Transporter of hazardous waste:	No
Treater, storer or disposer of HW:	No
Underground injection activity:	No
On-site burner exemption:	No
Furnace exemption:	No
Used oil fuel burner:	No
Used oil processor:	No
User oil refiner:	No
Used oil fuel marketer to burner:	No
Used oil Specification marketer:	No
Used oil transfer facility:	No

COAL CREEK VILLAGE SHOPPING CENTER (Continued) **1001126034**

Used oil transporter: No

Violation Status: No violations found

FINDS:

Registry ID: 110005406122

Environmental Interest/Information System
RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

ALLSITES:

Facility Id:	57224319
Latitude:	47.536293
Longitude:	-122.16639
Ecology Interest Type Code:	HWG
Facility ID:	57224319
Facility Company:	Coal Creek Village Shopping Center
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAR000011098
Date Interaction:	1996-11-12 00:00:00
Date Interaction 3:	1996-12-31 00:00:00

C18 **BARTELLS 30** **RCRA NonGen / NLR** **1001969619**
SW **6939 COAL CREEK PKWY SE** **FINDS** **WAH000009779**
< 1/8 **NEWCASTLE, WA 98059** **WA ALLSITES**
0.102 mi.
540 ft. **Site 1 of 5 in cluster C**

Relative:
Higher

Actual:
388 ft.

RCRA NonGen / NLR:

Date form received by agency:	09/03/2002
Facility name:	BARTELLS 30
Facility address:	6939 COAL CREEK PKWY SE NEWCASTLE, WA 98059
EPA ID:	WAH000009779
Contact:	BARTELLS 30 BARTELLS 30
Contact address:	6939 COAL CREEK PKWY SE NEWCASTLE, WA 98059
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

BARTELLS 30 (Continued) **1001969619**

Owner/Operator Summary:
Owner/operator name: PAT R
Owner/operator address: 6939 COAL CREEK PKWY SE
NEWCASTLE, WA 98059
Owner/operator country: US
Owner/operator telephone: (425)644-4414
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 10/07/1999
Owner/Op end date: Not reported

Owner/operator name: GEORGE B
Owner/operator address: 4727 DENVER AVE S
SEATTLE, WA 98134
Owner/operator country: US
Owner/operator telephone: (206)763-2626
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 10/07/1999
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Violation Status: No violations found

FINDS:

Registry ID: 110005396231

Environmental Interest/Information System
RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

ALLSITES:
Facility Id: 99686752
Latitude: 47.5368211

BARTELLS 30 (Continued) **1001969619**

Longitude:	-122.16689
Ecology Interest Type Code:	HWG
Facility ID:	99686752
Facility Company:	Bartells 30
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAH000009779
Date Interaction:	1999-10-07 00:00:00
Date Interaction 3:	2001-12-31 00:00:00

---

19 **UPPER COAL CREEK BANK STABILIZATION** **WA ALLSITES** **S110626493**
NNW **N/A**
< 1/8 **, WA**
0.119 mi.
628 ft.

Relative:
Lower

Actual:
300 ft.

ALLSITES:

Facility Id:	4339727
Latitude:	47.5470462
Longitude:	-122.16261
Ecology Interest Type Code:	401PROJ
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	401PROJ
Interaction 2:	401CZM Project Site
Ecology Program:	SEA
Program Data:	AQUATICS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported

Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported

Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported

UPPER COAL CREEK BANK STABILIZATION (Continued) **S110626493**

Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final

UPPER COAL CREEK BANK STABILIZATION (Continued) **S110626493**

Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported

Facility Id: 4339727

UPPER COAL CREEK BANK STABILIZATION (Continued) **S110626493**

Latitude: 47.5470462
Longitude: -122.16261
Ecology Interest Type Code: NONENFNL
Facility ID: 4339727
Facility Company: Upper Coal Creek Bank Stabilization
Interaction: A
Interaction 1: 401PROJ
Interaction 2: 401CZM Project Site
Ecology Program: SEA
Program Data: AQUATICS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 2008-07-22 00:00:00
Date Interaction 3: Not reported

Facility ID: 4339727
Facility Company: Upper Coal Creek Bank Stabilization
Interaction: A
Interaction 1: NONENFNL
Interaction 2: Non Enforcement Final
Ecology Program: SEA
Program Data: DMS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 2008-07-22 00:00:00
Date Interaction 3: Not reported

Facility ID: 4339727
Facility Company: Upper Coal Creek Bank Stabilization
Interaction: A
Interaction 1: NONENFNL
Interaction 2: Non Enforcement Final
Ecology Program: SEA
Program Data: DMS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 2008-07-22 00:00:00
Date Interaction 3: Not reported

Facility ID: 4339727
Facility Company: Upper Coal Creek Bank Stabilization
Interaction: A
Interaction 1: NONENFNL
Interaction 2: Non Enforcement Final
Ecology Program: SEA
Program Data: DMS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 2008-07-22 00:00:00
Date Interaction 3: Not reported

Facility ID: 4339727
Facility Company: Upper Coal Creek Bank Stabilization
Interaction: A
Interaction 1: NONENFNL
Interaction 2: Non Enforcement Final
Ecology Program: SEA

UPPER COAL CREEK BANK STABILIZATION (Continued) **S110626493**

Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A

UPPER COAL CREEK BANK STABILIZATION (Continued) **S110626493**

Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported
Facility ID:	4339727
Facility Company:	Upper Coal Creek Bank Stabilization
Interaction:	A
Interaction 1:	NONENFNL
Interaction 2:	Non Enforcement Final
Ecology Program:	SEA
Program Data:	DMS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	2008-07-22 00:00:00
Date Interaction 3:	Not reported

C20 **ARCO AM PM** **WA UST** **U004117997**
SW **6966 COAL CREEK PKWY SE** **N/A**
< 1/8 **NEWCASTLE, WA 98059**
0.121 mi.
639 ft. **Site 2 of 5 in cluster C**

Relative:
Higher

Actual:
387 ft.

UST:

Facility ID:	55853537
Site Id:	97529
UBI:	6019806480010001
Phone Number:	4257465899
Decimal Latitude:	47.53812
Decimal Longitude:	-122.165434
Tank Name:	1. REG
Tag Number:	A0175
Tank Status:	Operational
Tank Status Date:	08/06/1996
Tank Install Date:	00/01/1987
Tank Closure Date:	Not reported
Capacity Range:	10,000 to 19,999 Gallons
Tank Permit Expiration Date:	09/30/2015
Tank Upgrade Date:	03/05/1997
Tank Spill Prevention:	Spill Bucket/Spill Box

ARCO AM PM (Continued) **U004117997**

Tank Overfill Prevention:	Overfill Alarm
Tank Material:	Fiberglass Reinforced Plastic
Tank Construction:	Double Wall Tank
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Corrosion Resistant
Tank Manifold:	Not reported
Tank Release Detection:	Interstitial Monitoring
Tank SFC Type:	Not reported
Pipe Material:	Fiberglass
Pipe Construction:	Single Wall Pipe
Pipe Primary Release Detection:	Automatic Line Leak Detector (ALLD)
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	Corrosion Resistant
Pipe Pumping System:	Pressurized System
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

Tank Name:	2. U/L
Tag Number:	A0175
Tank Status:	Operational
Tank Status Date:	08/06/1996
Tank Install Date:	00/01/1987
Tank Closure Date:	Not reported
Capacity Range:	10,000 to 19,999 Gallons
Tank Permit Expiration Date:	09/30/2015
Tank Upgrade Date:	03/05/1997
Tank Spill Prevention:	Spill Bucket/Spill Box
Tank Overfill Prevention:	Overfill Alarm
Tank Material:	Fiberglass Reinforced Plastic
Tank Construction:	Double Wall Tank
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Corrosion Resistant
Tank Manifold:	Not reported
Tank Release Detection:	Interstitial Monitoring
Tank SFC Type:	Not reported
Pipe Material:	Fiberglass
Pipe Construction:	Single Wall Pipe
Pipe Primary Release Detection:	Automatic Line Leak Detector (ALLD)
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	Corrosion Resistant
Pipe Pumping System:	Pressurized System
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

Tank Name:	3. SUP
Tag Number:	A0175
Tank Status:	Operational
Tank Status Date:	08/06/1996
Tank Install Date:	00/01/1987
Tank Closure Date:	Not reported
Capacity Range:	10,000 to 19,999 Gallons
Tank Permit Expiration Date:	09/30/2015
Tank Upgrade Date:	03/05/1997
Tank Spill Prevention:	Spill Bucket/Spill Box
Tank Overfill Prevention:	Overfill Alarm

ARCO AM PM (Continued) **U004117997**

Tank Material:	Fiberglass Reinforced Plastic
Tank Construction:	Double Wall Tank
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Corrosion Resistant
Tank Manifold:	Not reported
Tank Release Detection:	Interstitial Monitoring
Tank SFC Type:	Not reported
Pipe Material:	Fiberglass
Pipe Construction:	Single Wall Pipe
Pipe Primary Release Detection:	Automatic Line Leak Detector (ALLD)
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	Corrosion Resistant
Pipe Pumping System:	Pressurized System
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

C21 **VELOCITY INVESTMENTS INC** **RCRA NonGen / NLR** **1004794465**
SW **6966 COAL CREEK PKWY SE** **WAD988514907**
< 1/8 **RENTON, WA 98056**
0.121 mi.
639 ft. **Site 3 of 5 in cluster C**

Relative:
Higher

Actual:
387 ft.

RCRA NonGen / NLR:

Date form received by agency:	03/28/2001
Facility name:	VELOCITY INVESTMENTS INC
Facility address:	6966 COAL CREEK PKWY SE RENTON, WA 98056
EPA ID:	WAD988514907
Mailing address:	PO BOX 6038 ARTESIA, CA 90702-6038
Contact:	ARCO ARCO
Contact address:	PO BOX 6038 ARTESIA, CA 90702-6038
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:

Owner/operator name:	ARCO A
Owner/operator address:	PO BOX 6038 ARTESIA, CA 90702
Owner/operator country:	US
Owner/operator telephone:	(714)670-5423
Legal status:	Private
Owner/Operator Type:	Owner
Owner/Op start date:	07/10/1996
Owner/Op end date:	Not reported
Owner/operator name:	DEREK R
Owner/operator address:	PO BOX 6038 ARTESIA, CA 90702
Owner/operator country:	US
Owner/operator telephone:	(714)670-5405
Legal status:	Private

VELOCITY INVESTMENTS INC (Continued) **1004794465**

Owner/Operator Type: Operator
Owner/Op start date: 07/10/1996
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Violation Status: No violations found

C22 **EDR US Hist Auto Stat** **1015602847**
SW **6966 COAL CREEK PKWY SE** **N/A**
< 1/8 **RENTON, WA 98059**
0.124 mi.
655 ft. **Site 4 of 5 in cluster C**

Relative:
Higher

Actual:
387 ft.

EDR Historical Auto Stations:
Name: ARCO AM / PM MINI MARKET 5502
Year: 2005
Address: 6966 COAL CREEK PKWY SE

Name: ARCO AM PM MINI MARKET 5502
Year: 2008
Address: 6966 COAL CREEK PKWY SE

C23 **VELOCITY INVESTMENTS INC ARCO NO 5375** **WA ALLSITES** **S108523105**
SW **6966 COAL CREEK PKWY SE** **WA CSCSL NFA** **N/A**
< 1/8 **NEWCASTLE, WA 98059** **WA VCP**
0.124 mi. **WA Financial Assurance**
655 ft. **Site 5 of 5 in cluster C**

Relative:
Higher

Actual:
387 ft.

ALLSITES:
Facility Id: 55853537
Latitude: 47.53812
Longitude: -122.16543
Ecology Interest Type Code: HWG
Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Program ID:	WAD988514907
Date Interaction:	1988-01-01 00:00:00
Date Interaction 3:	1776-07-04 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988514907
Date Interaction:	1992-12-04 00:00:00
Date Interaction 3:	2000-04-06 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	NW1275
Date Interaction:	2004-06-10 00:00:00
Date Interaction 3:	2006-07-31 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	Not reported
Date Interaction:	2006-07-31 00:00:00
Date Interaction 3:	2011-07-14 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Newcastle AM PM
Program ID: NW2309
Date Interaction: 2010-08-02 00:00:00
Date Interaction 3: 2011-06-30 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Newcastle AM PM
Program ID: NW2461
Date Interaction: 2011-07-14 00:00:00
Date Interaction 3: 2011-10-03 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: ARCO AM PM
Program ID: 97529
Date Interaction: 1987-02-01 00:00:00
Date Interaction 3: Not reported

Facility Id: 55853537
Latitude: 47.53812
Longitude: -122.16543
Ecology Interest Type Code: LUST
Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1988-01-01 00:00:00
Date Interaction 3: 1776-07-04 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988514907

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Date Interaction:	1992-12-04 00:00:00
Date Interaction 3:	2000-04-06 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	NW1275
Date Interaction:	2004-06-10 00:00:00
Date Interaction 3:	2006-07-31 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	Not reported
Date Interaction:	2006-07-31 00:00:00
Date Interaction 3:	2011-07-14 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2309
Date Interaction:	2010-08-02 00:00:00
Date Interaction 3:	2011-06-30 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Program Data: ISIS
Facility Alt.: Newcastle AM PM
Program ID: NW2461
Date Interaction: 2011-07-14 00:00:00
Date Interaction 3: 2011-10-03 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: ARCO AM PM
Program ID: 97529
Date Interaction: 1987-02-01 00:00:00
Date Interaction 3: Not reported

Facility Id: 55853537
Latitude: 47.53812
Longitude: -122.16543
Ecology Interest Type Code: SCS
Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1988-01-01 00:00:00
Date Interaction 3: 1776-07-04 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1992-12-04 00:00:00
Date Interaction 3: 2000-04-06 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID: NW1275
Date Interaction: 2004-06-10 00:00:00

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Date Interaction 3:	2006-07-31 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	Not reported
Date Interaction:	2006-07-31 00:00:00
Date Interaction 3:	2011-07-14 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2309
Date Interaction:	2010-08-02 00:00:00
Date Interaction 3:	2011-06-30 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2461
Date Interaction:	2011-07-14 00:00:00
Date Interaction 3:	2011-10-03 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Facility Alt.: ARCO AM PM
Program ID: 97529
Date Interaction: 1987-02-01 00:00:00
Date Interaction 3: Not reported

Facility Id: 55853537
Latitude: 47.53812
Longitude: -122.16543
Ecology Interest Type Code: TIER2
Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1988-01-01 00:00:00
Date Interaction 3: 1776-07-04 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1992-12-04 00:00:00
Date Interaction 3: 2000-04-06 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID: NW1275
Date Interaction: 2004-06-10 00:00:00
Date Interaction 3: 2006-07-31 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID: Not reported
Date Interaction: 2006-07-31 00:00:00
Date Interaction 3: 2011-07-14 00:00:00

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00

Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2309
Date Interaction:	2010-08-02 00:00:00
Date Interaction 3:	2011-06-30 00:00:00

Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2461
Date Interaction:	2011-07-14 00:00:00
Date Interaction 3:	2011-10-03 00:00:00

Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	ARCO AM PM
Program ID:	97529
Date Interaction:	1987-02-01 00:00:00
Date Interaction 3:	Not reported

Facility Id:	55853537
Latitude:	47.53812
Longitude:	-122.16543
Ecology Interest Type Code:	UST
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	TIER2

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Interaction 2:	Emergency/Haz Chem Rpt TIER2
Ecology Program:	HAZWASTE
Program Data:	EPCRA
Facility Alt.:	Not reported
Program ID:	WAD988514907
Date Interaction:	1988-01-01 00:00:00
Date Interaction 3:	1776-07-04 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988514907
Date Interaction:	1992-12-04 00:00:00
Date Interaction 3:	2000-04-06 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	NW1275
Date Interaction:	2004-06-10 00:00:00
Date Interaction 3:	2006-07-31 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	Not reported
Date Interaction:	2006-07-31 00:00:00
Date Interaction 3:	2011-07-14 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00
Facility ID:	55853537

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Newcastle AM PM
Program ID: NW2309
Date Interaction: 2010-08-02 00:00:00
Date Interaction 3: 2011-06-30 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Newcastle AM PM
Program ID: NW2461
Date Interaction: 2011-07-14 00:00:00
Date Interaction 3: 2011-10-03 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: ARCO AM PM
Program ID: 97529
Date Interaction: 1987-02-01 00:00:00
Date Interaction 3: Not reported

Facility Id: 55853537
Latitude: 47.53812
Longitude: -122.16543
Ecology Interest Type Code: VOLCLNST
Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: WAD988514907
Date Interaction: 1988-01-01 00:00:00
Date Interaction 3: 1776-07-04 00:00:00

Facility ID: 55853537
Facility Company: VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988514907
Date Interaction:	1992-12-04 00:00:00
Date Interaction 3:	2000-04-06 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	NW1275
Date Interaction:	2004-06-10 00:00:00
Date Interaction 3:	2006-07-31 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	SCS
Interaction 2:	State Cleanup Site
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	Not reported
Date Interaction:	2006-07-31 00:00:00
Date Interaction 3:	2011-07-14 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	VELOCITY INVESTMENTS INC ARCO NO 5375
Program ID:	97529
Date Interaction:	2000-05-31 00:00:00
Date Interaction 3:	2004-06-10 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2309
Date Interaction:	2010-08-02 00:00:00
Date Interaction 3:	2011-06-30 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375

VELOCITY INVESTMENTS INC ARCO NO 5375 (Continued) **S108523105**

Interaction:	I
Interaction 1:	VOLCLNST
Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Newcastle AM PM
Program ID:	NW2461
Date Interaction:	2011-07-14 00:00:00
Date Interaction 3:	2011-10-03 00:00:00
Facility ID:	55853537
Facility Company:	VELOCITY INVESTMENTS INC ARCO NO 5375
Interaction:	A
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	ARCO AM PM
Program ID:	97529
Date Interaction:	1987-02-01 00:00:00
Date Interaction 3:	Not reported

CSCSL NFA:

Facility/Site Id:	55853537
CS Id:	6290
NFA Date:	10/03/2011
Rank:	Not reported
VCP:	Yes
Latitude:	47.53812
Longitude:	-122.165434

VCP:

edr_fstat:	WA
edr_fzip:	98059
edr_fcnty:	KING
edr_zip:	Not reported
Facility ID:	55853537
VCP Status:	Not reported
VCP:	Yes
Ecology Status:	Not reported
NFA Type:	Not reported
Date NFA:	10/3/2011
Rank:	Not reported
Cleanup Siteid:	6290

WA Financial Assurance 1:

edr_fstat:	WA
edr_fzip:	98052
edr_fcnty:	Not reported
edr_zip:	Not reported
DOE Site ID:	97529
Site Type:	Other Ins
Financial Resp Type:	Zurich
Inception Date:	04/05/2011
Expiration Date:	04/05/2012

24
ESE
1/8-1/4
0.142 mi.
749 ft.

NEWCASTLE DRUMS
NEWCASTLE COAL CREEK RD T24N R5E
BELLEVUE, WA 98006

WA ALLSITES **S109556803**
N/A

Relative:
Higher

Actual:
512 ft.

ALLSITES:

Facility Id:	42677836
Latitude:	47.54057
Longitude:	-122.15373
Ecology Interest Type Code:	HWG
Facility ID:	42677836
Facility Company:	Newcastle Drums
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD988470696
Date Interaction:	1990-02-28 00:00:00
Date Interaction 3:	1991-12-31 00:00:00

25
South
1/8-1/4
0.179 mi.
947 ft.

VIEW POINTE TOWNHOMES
133RD AVE SE & SE 68TH STREET
NEWCASTLE, WA 98059

WA ALLSITES **S110700620**
N/A

Relative:
Higher

Actual:
459 ft.

ALLSITES:

Facility Id:	22644
Latitude:	47.5393775
Longitude:	-122.16192
Ecology Interest Type Code:	CONSTSWGP
Facility ID:	22644
Facility Company:	View Pointe Townhomes
Interaction:	I
Interaction 1:	CONSTSWGP
Interaction 2:	Construction SW GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	View Pointe Townhomes
Program ID:	WAR124738
Date Interaction:	2010-10-27 00:00:00
Date Interaction 3:	2012-11-02 00:00:00

26
SW
1/8-1/4
0.217 mi.
1147 ft.

SAFEWAY STORE 558
6911 COAL CREEK PARKWAY SE
NEWCASTLE, WA 98059

WA ALLSITES **S105389552**
WA SPILLS **N/A**

Relative:
Higher

Actual:
412 ft.

ALLSITES:

Facility Id:	22336
Latitude:	47.53831
Longitude:	-122.1658

SAFEWAY STORE 558 (Continued) **S105389552**

Ecology Interest Type Code: HWG
Facility ID: 22336
Facility Company: Safeway Store 558
Interaction: A
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Safeway Store 558
Program ID: WAH000045816
Date Interaction: 2014-02-12 00:00:00
Date Interaction 3: Not reported

SPILLS:
Facility ID: 504975
Medium: Not reported
Material Desc: PETROLEUM - DIESEL FUEL
Material Qty: Not reported
Material Units: Not reported
Date Received: 07/01/1999
Contact Name: UNKNOWN
Incident Date: Not reported

27
SSW
1/8-1/4
0.248 mi.
1312 ft.

ACORN CUSTOM CABINETRY **WA ALLSITES** **S109554040**
7211 132ND PL SE **N/A**
RENTON, WA 98056

Relative:
Higher

Actual:
391 ft.

ALLSITES:
Facility Id: 24553921
Latitude: 47.52321
Longitude: -122.1649
Ecology Interest Type Code: HWP
Facility ID: 24553921
Facility Company: Acorn Custom Cabinetry
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000027090
Date Interaction: 1990-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 24553921
Facility Company: Acorn Custom Cabinetry
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: CRK000027090
Date Interaction: 1993-01-01 00:00:00

ACORN CUSTOM CABINETRY (Continued) **S109554040**

Date Interaction 3: 1993-12-31 00:00:00

Facility Id: 24553921
Latitude: 47.52321
Longitude: -122.1649
Ecology Interest Type Code: TRI
Facility ID: 24553921
Facility Company: Acorn Custom Cabinetry
Interaction: A
Interaction 1: TRI
Interaction 2: Toxics Release Inventory
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000027090
Date Interaction: 1990-01-01 00:00:00
Date Interaction 3: Not reported

Facility ID: 24553921
Facility Company: Acorn Custom Cabinetry
Interaction: I
Interaction 1: HWP
Interaction 2: Hazardous Waste Planner
Ecology Program: HAZWASTE
Program Data: HWPPRT
Facility Alt.: Not reported
Program ID: CRK000027090
Date Interaction: 1993-01-01 00:00:00
Date Interaction 3: 1993-12-31 00:00:00

28
SW
1/4-1/2
0.279 mi.
1475 ft.

NEWCASTLE VISTA POND 3 **WA ALLSITES** **S110626138**
12835 NEWCASTLE WAY **N/A**
NEWCASTLE, WA 98056

Relative:
Higher

Actual:
401 ft.

ALLSITES:
Facility Id: 252427
Latitude: 45.1517825
Longitude: -126.86369
Ecology Interest Type Code: DAM
Facility ID: 252427
Facility Company: Newcastle Vista Pond 3
Interaction: A
Interaction 1: DAM
Interaction 2: Dam Site
Ecology Program: WATRES
Program Data: DSS
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 2006-09-08 00:00:00
Date Interaction 3: Not reported

Facility/Site Interaction T: 6479
Geographic Location Identifier (Alias Facid): 252427
Interaction (Aka Env Int) Type Code: DAM

NEWCASTLE VISTA POND 3 (Continued) **S110626138**

Interaction (Aka Env Int) Description:	Dam Site
Interaction Status:	A
Federal Program Indentifier:	Not reported
Interaction Start Date:	09/08/2006
Interaction End Date:	Not reported
prgm_facil:	Not reported
cur_sys_pr:	WATRES
cur_sys_nm:	DSS

D29 **NEWCASTLE TRANSIT CENTER PROJECT** **WA ALLSITES** **S110039645**
SSW **NEWCASTLE WY 129TH AVE SE & 132ND** **N/A**
1/4-1/2 **NEWCASTLE, WA 98059**
0.280 mi.
1480 ft. **Site 1 of 4 in cluster D**

Relative:
Higher

Actual:
385 ft.

ALLSITES:

Facility Id:	18375
Latitude:	47.5378
Longitude:	-122.166
Ecology Interest Type Code:	CONSTSWGP
Facility ID:	18375
Facility Company:	NEWCASTLE TRANSIT CENTER PROJECT
Interaction:	I
Interaction 1:	CONSTSWGP
Interaction 2:	Construction SW GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	NEWCASTLE TRANSIT CENTER PROJECT
Program ID:	WAR011577
Date Interaction:	2009-03-23 00:00:00
Date Interaction 3:	2010-12-20 00:00:00
Facility/Site Interaction T:	85946
Geographic Location Identifier (Alias Facid):	18375
Interaction (Aka Env Int) Type Code:	CONSTGP
Interaction (Aka Env Int) Description:	Construction SW GP
Interaction Status:	A
Federal Program Indentifier:	WAR011577
Interaction Start Date:	03/23/2009
Interaction End Date:	Not reported
prgm_facil:	NEWCASTLE TRANSIT CENTER PROJECT
cur_sys_pr:	WATQUAL
cur_sys_nm:	PARIS

D30 **NEWCASTLE CITY** **WA ALLSITES** **S110036307**
SSW **13020 SE 72ND PL** **WA NPDES** **N/A**
1/4-1/2 **NEWCASTLE, WA 98059**
0.283 mi.
1496 ft. **Site 2 of 4 in cluster D**

Relative:
Higher

Actual:
387 ft.

ALLSITES:

Facility Id:	6183
Latitude:	47.5375
Longitude:	-122.165

NEWCASTLE CITY (Continued) **S110036307**

Ecology Interest Type Code:	MS4P2WESTGP
Facility ID:	6183
Facility Company:	NEWCASTLE CITY OF
Interaction:	A
Interaction 1:	MS4P2WESTGP
Interaction 2:	Municipal SW Phase II Western WA GP
Ecology Program:	WATQUAL
Program Data:	PARIS
Facility Alt.:	NEWCASTLE CITY
Program ID:	WAR045533
Date Interaction:	2007-02-16 00:00:00
Date Interaction 3:	Not reported
Facility/Site Interaction T:	87214
Geographic Location Identifier (Alias Facid):	6183
Interaction (Aka Env Int) Type Code:	MS4P2WESTGP
Interaction (Aka Env Int) Description:	Municipal SW Phase II Western WA GP
Interaction Status:	A
Federal Program Indentifier:	WAR045533
Interaction Start Date:	02/16/2007
Interaction End Date:	Not reported
prgm_facil:	NEWCASTLE CITY
cur_sys_pr:	WATQUAL
cur_sys_nm:	PARIS

NPDES:

Facility ID:	6183
Facility Status:	Active
Facility Type:	Municipal SW Phase II Western WA GP
Admin Region:	Headqarters
Date Issued:	08/01/2012
Latitude:	47.53750000
Longitude:	-122.165000
Permit ID:	WAR045533
Permit Version:	3
Permit Status:	Active
Permit SubStatus:	Coverage Issued
Ecology Contact:	Anne Dettelbach
WRIA:	Cedar-Sammamish
Permit Expiration Date:	07/31/2018
Effective Date:	08/01/2013
Days to Expiration:	1376

D31 **PRECISION AUTOCRAFT INC** **RCRA NonGen / NLR** **1000172424**
SSW **13032 SE 72ND PL FRONT OF BLDG** **FINDS** **WAD988474052**
1/4-1/2 **RENTON, WA 98059** **WA ALLSITES**
0.284 mi. **WA MANIFEST**
1497 ft. **Site 3 of 4 in cluster D**

Relative:
Higher

Actual:
387 ft.

RCRA NonGen / NLR:

Date form received by agency:	05/24/2011
Facility name:	PRECISION AUTOCRAFT INC
Facility address:	13032 SE 72ND PL FRONT OF BLDG RENTON, WA 98059
EPA ID:	WAD988474052
Mailing address:	15215 SE 272ND STREET

PRECISION AUTOCRAFT INC (Continued) **1000172424**

SUITE 201
KENT, WA 98042-4215
Contact: MICHAEL P CHAFFEUR
Contact address: 15215 SE 272ND STREET SUITE 201
KENT, WA 98042-4215
Contact country: US
Contact telephone: (000)000-0000
Contact email: Not reported
EPA Region: 10
Classification: Non-Generator
Description: Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:
Owner/operator name: MICHAEL C
Owner/operator address: 15215 SE 272ND STREET SUITE 201
KENT, WA 98042
Owner/operator country: US
Owner/operator telephone: (425)277-0845
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 01/01/2006
Owner/Op end date: Not reported

Owner/operator name: BRIAN D
Owner/operator address: 15215 SE 272ND STREET SUITE 201
KENT, WA 98042
Owner/operator country: US
Owner/operator telephone: (425)277-0845
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 09/10/1996
Owner/Op end date: Not reported

Owner/operator name: BRIAN DUNCAN
Owner/operator address: PO BOX 2591
RENTON, WA 98056
Owner/operator country: US
Owner/operator telephone: Not reported
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 09/10/1996
Owner/Op end date: Not reported

Owner/operator name: CAD AUTOMOTIVE DBA PRECISION AUTOCRAFT
Owner/operator address: 15215 SE 272ND STREET SUITE 201
KENT, 98042
Owner/operator country: US
Owner/operator telephone: (425)277-0845
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 01/01/2006
Owner/Op end date: Not reported

Owner/operator name: PRECISION AUTOCRAFT INC
Owner/operator address: 13032 SE 72ND PL
NEWCASTLE, WA 98059
Owner/operator country: US

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Owner/operator telephone: Not reported
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 09/10/1996
Owner/Op end date: Not reported

Owner/operator name: PRECISION AUTOCRAFT INC
Owner/operator address: 15215 SE 272ND STREET SUITE 201
KENT, 98042
Owner/operator country: US
Owner/operator telephone: (425)277-0845
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 09/10/1996
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Historical Generators:
Date form received by agency: 05/24/2011
Site name: PRECISION AUTOCRAFT INC
Classification: Not a generator, verified

Date form received by agency: 03/17/2010
Site name: PRECISION AUTOCRAFT INC
Classification: Conditionally Exempt Small Quantity Generator

Date form received by agency: 12/31/2007
Site name: PRECISION AUTOCRAFT INC
Classification: Not a generator, verified

Date form received by agency: 12/31/2005
Site name: PRECISION AUTOCRAFT INC
Classification: Not a generator, verified

Date form received by agency: 12/31/2003
Site name: PRECISION AUTOCRAFT INC
Classification: Not a generator, verified

Hazardous Waste Summary:
Waste code: WSQG

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Waste name: A placeholder to allow BR submission to validate. In WA State, Conditionally Exempt Small Quantity Generators (Called SQG in WA) are not required to report waste streams, so no valid State or Fed codes are available for reporting to BR.

Violation Status: No violations found

FINDS:

Registry ID: 110008221637

Environmental Interest/Information System

Washington Facility / Site Identification System (WA-FSIS) provides a means to query and display data maintained by the Washington Department of Ecology. This system contains key information for each facility/site that is currently, or has been, of interest to the Air Quality, Dam Safety, Hazardous Waste, Toxics Cleanup, and Water Quality Programs.

RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

HAZARDOUS WASTE BIENNIAL REPORTER

ALLSITES:

Facility Id:	96343678
Latitude:	47.53743
Longitude:	-122.16604
Ecology Interest Type Code:	HWG
Facility ID:	96343678
Facility Company:	Precision Autocraft Inc
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Precision Autocraft Inc
Program ID:	WAD988474052
Date Interaction:	1990-05-07 00:00:00
Date Interaction 3:	2011-03-11 00:00:00

WA MANIFEST:

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	2008
Permit by Rule:	False
Treatment by Generator:	False

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	601187040
Business Type:	Not reported
Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG
Monthly Generation:	False
Batch Generation:	False
One Time Generation:	True
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	False
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	Not reported
Permit by Rule:	False
Treatment by Generator:	False
Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	601187040
Business Type:	Not reported

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan
Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG
Monthly Generation:	False
Batch Generation:	True
One Time Generation:	False
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	True
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

Facility Site ID Number:	96343678
EPA ID:	WAD988474052

PRECISION AUTOCRAFT INC (Continued) **1000172424**

NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Sold Business to Kirmac
Data Year:	2011
Permit by Rule:	False
Treatment by Generator:	False
Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	602703981
Business Type:	Not reported
Mail Name:	CAD Automotive dba Precision Autocraft
Mail addr line1:	15215 SE 272nd Street
Mail addr line2:	Suite 201
Mail city,st,zip:	Kent, WA 98042-4215
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	15215 SE 272nd Street
Legal addr line2:	Suite 201
Legal city,st,zip:	Kent, WA 98042-4215
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	CAD Automotive dba Precision Autocraft
Operator org type:	Private
Operator addr line1:	15215 SE 272nd Street
Operator addr line2:	Suite 201
Operator city,st,zip:	Kent, WA 98042-4215

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	01/01/2006
Site contact name:	Michael P Chaffeur
Site contact addr line1:	15215 272nd Street
Site contact addr line2:	Suite 201
Site Contact City/State/ Zip:	Kent, WA 98042-4215
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(206)406-3076
Site Contact EMail:	mikec@eaglecreekland.com
Form Contact NAME:	Michael P Chaffeur
Form Contact ADDR LINE1:	15215 272nd Street
Form Contact ADDR LINE2:	Suite 201
Form Contact City,ST,Zip:	Kent, WA 98042-4215
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(206)406-3076
Form Contact EMail:	mikec@eaglecreekland.com
Gen Status CD:	XQG
Monthly Generation:	False
Batch Generation:	False
One Time Generation:	False
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	False
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	Not reported
Permit by Rule:	No
Treatment by Generator:	No
Mixed radioactive waste:	No
Importer of hazardous waste:	No
Immediate recycler:	No
Treatment/Storage/Disposal/Recycling Facility:	No
Generator of dangerous fuel waste:	No
Generator marketing to burner:	No
Other marketers (i.e., blender, distributor, etc.):	No
Utility boiler burner:	No
Industry boiler burner:	No
Industrial Furnace:	No
Smelter defferal:	No
Universal waste - batteries - generate:	No
Universal waste - thermostats - generate:	No

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Universal waste - mercury - generate:	No
Universal waste - lamps - generate:	No
Universal waste - batteries - accumulate:	No
Universal waste - thermostats - accumulate:	No
Universal waste - mercury - accumulate:	No
Universal waste - lamps - accumulate:	No
Destination Facility for Universal Waste:	No
Off-specification used oil burner - utility boiler:	No
Off-specification used oil burner - industrial boiler:	No
Off-specification used oil burner - industrial furnace:	No
Tax Reg #:	601187040
Business Type:	Not reported
Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan
Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG
Monthly Generation:	No
Batch Generation:	No
One Time Generation:	No
Transport Own Waste:	No
Tranports Other Waste:	No
Recycler Onsite:	Yes
Transfer Facility:	No

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Other Exemption:	Not reported
UW Battery Gen:	No
Used Oil Transporter:	No
Used Oil Transfer Facility:	No
Used Oil Processor:	No
Used Oil Refiner:	No
Used Oil Fuel Marketer Directs Shipments:	No
Used Oil Fuel Marketer Meets Specs:	No

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	2009
Permit by Rule:	False
Treatment by Generator:	False
Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	601187040
Business Type:	Not reported
Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan
Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG
Monthly Generation:	False
Batch Generation:	True
One Time Generation:	False
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	False
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	Not reported
Permit by Rule:	FALSE
Treatment by Generator:	FALSE
Mixed radioactive waste:	FALSE
Importer of hazardous waste:	FALSE
Immediate recycler:	FALSE
Treatment/Storage/Disposal/Recycling Facility:	FALSE
Generator of dangerous fuel waste:	FALSE
Generator marketing to burner:	FALSE

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Other marketers (i.e., blender, distributor, etc.):	FALSE
Utility boiler burner:	FALSE
Industry boiler burner:	FALSE
Industrial Furnace:	FALSE
Smelter defferal:	FALSE
Universal waste - batteries - generate:	FALSE
Universal waste - thermostats - generate:	FALSE
Universal waste - mercury - generate:	FALSE
Universal waste - lamps - generate:	FALSE
Universal waste - batteries - accumulate:	FALSE
Universal waste - thermostats - accumulate:	FALSE
Universal waste - mercury - accumulate:	FALSE
Universal waste - lamps - accumulate:	FALSE
Destination Facility for Universal Waste:	FALSE
Off-specification used oil burner - utility boiler:	FALSE
Off-specification used oil burner - industrial boiler:	FALSE
Off-specification used oil burner - industrial furnace:	FALSE
Tax Reg #:	601187040
Business Type:	Not reported
Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private
Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan
Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Monthly Generation:	FALSE
Batch Generation:	TRUE
One Time Generation:	FALSE
Transport Own Waste:	FALSE
Tranports Other Waste:	FALSE
Recycler Onsite:	TRUE
Transfer Facility:	FALSE
Other Exemption:	Not reported
UW Battery Gen:	FALSE
Used Oil Transporter:	FALSE
Used Oil Transfer Facility:	FALSE
Used Oil Processor:	FALSE
Used Oil Refiner:	FALSE
Used Oil Fuel Marketer Directs Shipments:	FALSE
Used Oil Fuel Marketer Meets Specs:	FALSE

Facility Site ID Number:	96343678
EPA ID:	WAD988474052
NAICS:	811121
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	2010
Permit by Rule:	False
Treatment by Generator:	False
Mixed radioactive waste:	False
Importer of hazardous waste:	False
Immediate recycler:	False
Treatment/Storage/Disposal/Recycling Facility:	False
Generator of dangerous fuel waste:	False
Generator marketing to burner:	False
Other marketers (i.e., blender, distributor, etc.):	False
Utility boiler burner:	False
Industry boiler burner:	False
Industrial Furnace:	False
Smelter defferal:	False
Universal waste - batteries - generate:	False
Universal waste - thermostats - generate:	False
Universal waste - mercury - generate:	False
Universal waste - lamps - generate:	False
Universal waste - batteries - accumulate:	False
Universal waste - thermostats - accumulate:	False
Universal waste - mercury - accumulate:	False
Universal waste - lamps - accumulate:	False
Destination Facility for Universal Waste:	False
Off-specification used oil burner - utility boiler:	False
Off-specification used oil burner - industrial boiler:	False
Off-specification used oil burner - industrial furnace:	False
Tax Reg #:	601187040
Business Type:	Not reported
Mail Name:	Precision Autocraft Inc
Mail addr line1:	13032 SE 72ND PL
Mail city,st,zip:	NEWCASTLE, WA 98059-3002
Mail country:	UNITED STATES
Legal org name:	Precision Autocraft Inc
Legal org type:	Private

PRECISION AUTOCRAFT INC (Continued) **1000172424**

Legal addr line1:	13032 SE 72nd Pl
Legal city,st,zip:	NEWCASTLE, WA 98059
Legal country:	UNITED STATES
Legal phone nbr:	(425)277-0845
Legal effective date:	09/10/1996
Land org name:	Five Star Development
Land org type:	Private
Land person name:	Not reported
Land addr line1:	13024 SE 72ND PL
Land city,st,zip:	NEWCASTLE, WA 98059-3002
Land country:	UNITED STATES
Land phone nbr:	(425)641-6199
Operator org name:	Not reported
Operator org type:	Private
Operator addr line1:	PO Box 2591
Operator city,st,zip:	RENTON, WA 98056-0591
Operator country:	UNITED STATES
Operator phone nbr:	(425)277-0845
Operator effective date:	09/10/1996
Site contact name:	Brian Duncan
Site contact addr line1:	13032 SE 72nd Pl
Site Contact City/State/ Zip:	NEWCASTLE, WA 98059
Site Contact Country:	UNITED STATES
Site Contact Phone #:	(425)277-0845
Site Contact EMail:	Not reported
Form Contact NAME:	Brian Duncan
Form Contact ADDR LINE1:	13032 SE 72nd Pl
Form Contact City,ST,Zip:	NEWCASTLE, WA 98059
Form Contact Country:	UNITED STATES
Form Contact Phone #:	(425)277-0845
Form Contact EMail:	preaut@aol.com
Gen Status CD:	SQG
Monthly Generation:	False
Batch Generation:	True
One Time Generation:	False
Transport Own Waste:	False
Tranports Other Waste:	False
Recycler Onsite:	False
Transfer Facility:	False
Other Exemption:	Not reported
UW Battery Gen:	False
Used Oil Transporter:	False
Used Oil Transfer Facility:	False
Used Oil Processor:	False
Used Oil Refiner:	False
Used Oil Fuel Marketer Directs Shipments:	False
Used Oil Fuel Marketer Meets Specs:	False

D32 STRESS TEK INC — **RCRA NonGen / NLR** — **1000222244**
SSW 13032 SE 72ND PL N END OF BLDG — **FINDS** — **WAD009277716**
1/4-1/2 RENTON, WA 98059 — **WA ALLSITES**
0.284 mi.
1497 ft. Site 4 of 4 in cluster D

Relative: Higher

Actual: 387 ft.

RCRA NonGen / NLR:

Date form received by agency:	03/03/2000
Facility name:	STRESS TEK INC
Facility address:	13032 SE 72ND PL N END OF BLDG RENTON, WA 98059
EPA ID:	WAD009277716
Mailing address:	5920 S 194TH ST KENT, WA 98032-1196
Contact:	STRESS TEK RENT STRESS TEK RENT
Contact address:	5920 S 194TH ST KENT, WA 98032-1196
Contact country:	US
Contact telephone:	(000)000-0000
Contact email:	Not reported
EPA Region:	10
Classification:	Non-Generator
Description:	Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:

Owner/operator name:	KEITH R
Owner/operator address:	5920 S 194TH ST KENT, WA 98032
Owner/operator country:	US
Owner/operator telephone:	(253)872-1910
Legal status:	Private
Owner/Operator Type:	Owner
Owner/Op start date:	06/12/1996
Owner/Op end date:	Not reported

Owner/operator name:	JOHN H
Owner/operator address:	13032 SE 72ND PL RENTON, WA 98059
Owner/operator country:	US
Owner/operator telephone:	(425)641-4230
Legal status:	Private
Owner/Operator Type:	Operator
Owner/Op start date:	06/12/1996
Owner/Op end date:	Not reported

Handler Activities Summary:

U.S. importer of hazardous waste:	No
Mixed waste (haz. and radioactive):	No
Recycler of hazardous waste:	No
Transporter of hazardous waste:	No
Treater, storer or disposer of HW:	No
Underground injection activity:	No
On-site burner exemption:	No
Furnace exemption:	No
Used oil fuel burner:	No
Used oil processor:	No
User oil refiner:	No
Used oil fuel marketer to burner:	No

STRESS TEK INC (Continued) **1000222244**

Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Historical Generators:
Date form received by agency: 03/01/1996
Site name: STRESS TEK - RENTON
Classification: Large Quantity Generator

Violation Status: No violations found

FINDS:

Registry ID: 110006469482

Environmental Interest/Information System
RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

ALLSITES:
Facility Id: 81527882
Latitude: 47.5371
Longitude: -122.16401
Ecology Interest Type Code: HWG
Facility ID: 81527882
Facility Company: Stress Tek Inc
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD009277716
Date Interaction: 1989-04-06 00:00:00
Date Interaction 3: 1999-12-31 00:00:00

---

33 **COAL CREEK RETENTION BASINS DAM NO 2** **WA ALLSITES** **S110626334**
ENE **N/A**
1/4-1/2 **, WA**
0.314 mi.
1657 ft.

Relative:
Higher

Actual:
520 ft.

ALLSITES:
Facility Id: 34659235
Latitude: 47.546488
Longitude: -122.15123
Ecology Interest Type Code: DAM
Facility ID: 34659235
Facility Company: Coal Creek Retention Basins Dam No 2
Interaction: A
Interaction 1: DAM

COAL CREEK RETENTION BASINS DAM NO 2 (Continued) **S110626334**

Interaction 2:	Dam Site
Ecology Program:	WATRES
Program Data:	DSS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1999-05-26 00:00:00
Date Interaction 3:	Not reported

---

34 **COAL CREEK RETENTION BASINS DAM NO 1** **WA ALLSITES** **S110627368**
ENE **N/A**
1/4-1/2 **, WA**
0.446 mi.
2354 ft.

Relative:
Higher

Actual:
563 ft.

ALLSITES:

Facility Id:	8585289
Latitude:	47.546488
Longitude:	-122.14789
Ecology Interest Type Code:	DAM
Facility ID:	8585289
Facility Company:	Coal Creek Retention Basins Dam No 1
Interaction:	A
Interaction 1:	DAM
Interaction 2:	Dam Site
Ecology Program:	WATRES
Program Data:	DSS
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1999-05-26 00:00:00
Date Interaction 3:	Not reported

E35 **KING CO. FIRE DIST. #24 STN #2** **WA ICR** **S104873102**
WSW **12412 SE 69TH WAY** **N/A**
1/4-1/2 **NEWCASTLE, WA 98056**
0.469 mi.
2474 ft. **Site 1 of 2 in cluster E**

Relative:
Higher

Actual:
436 ft.

ICR:

Date Ecology Received Report:	03/21/94
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater, Soil
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	93-21
County Code:	17
Contact:	Not reported
Report Title:	Not reported
Date Ecology Received Report:	12/10/90
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater, Soil
Waste Management:	Tank
Region:	North Western

KING CO. FIRE DIST. #24 STN #2 (Continued) **S104873102**

Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	91-20
County Code:	17
Contact:	Not reported
Report Title:	Not reported
Date Ecology Received Report:	08/07/91
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	92-07
County Code:	17
Contact:	Not reported
Report Title:	Not reported
Date Ecology Received Report:	03/24/92
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	92-20
County Code:	17
Contact:	Not reported
Report Title:	Not reported
Date Ecology Received Report:	04/16/93
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	93-01
County Code:	17
Contact:	Not reported
Report Title:	Not reported
Date Ecology Received Report:	03/12/96
Contaminants Found at Site:	Petroleum products
Media Contaminated:	Groundwater
Waste Management:	Tank
Region:	North Western
Type of Report Ecology Received:	Interim cleanup report
Site Register Issue:	94-24
County Code:	17
Contact:	Not reported
Report Title:	Not reported

E36 **BELLEVUE FIRE STATION # 9** **WA CSCSL** **U000585965**
WSW **12412 SE 69TH WAY** **WA ALLSITES** **N/A**
1/4-1/2 **BELLEVUE, WA 98006** **WA LUST**
0.469 mi. **WA UST**
2474 ft. **Site 2 of 2 in cluster E** **WA Financial Assurance**

Relative:
Higher

Actual:
436 ft.

CSCSL:

Facility ID:	19331436
Region:	Northwest
Lat/Long:	47.541350538 / -122.17461906
Brownfield Status:	Not reported
Rank Status:	N
Clean Up Siteid:	8231
Site Status:	Cleanup Started
PSI?:	Not reported
Contaminant Name:	Benzene
Ground Water:	Confirmed Above Cleanup Level
Surface Water:	Confirmed Above Cleanup Level
Soil:	Confirmed Above Cleanup Level
Sediment:	Not reported
Air:	Not reported
Bedrock:	Not reported
Responsible Unit:	Northwest

Facility ID:	19331436
Region:	Northwest
Lat/Long:	47.541350538 / -122.17461906
Brownfield Status:	Not reported
Rank Status:	N
Clean Up Siteid:	8231
Site Status:	Cleanup Started
PSI?:	Not reported
Contaminant Name:	Petroleum-Gasoline
Ground Water:	Confirmed Above Cleanup Level
Surface Water:	Confirmed Above Cleanup Level
Soil:	Confirmed Above Cleanup Level
Sediment:	Not reported
Air:	Not reported
Bedrock:	Not reported
Responsible Unit:	Northwest

ALLSITES:

Facility Id:	19331436
Latitude:	47.5413505
Longitude:	-122.17461
Ecology Interest Type Code:	LUST
Facility ID:	19331436
Facility Company:	BELLEVUE CITY FIRE DISTRICT 9
Interaction:	A
Interaction 1:	LUST
Interaction 2:	LUST Facility
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	Not reported
Program ID:	343
Date Interaction:	1990-02-12 00:00:00
Date Interaction 3:	Not reported

Facility ID:	19331436

BELLEVUE FIRE STATION # 9 (Continued) **U000585965**

Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000051350
Date Interaction: 2003-09-15 00:00:00
Date Interaction 3: Not reported

Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 343
Date Interaction: 2000-03-20 00:00:00
Date Interaction 3: Not reported

Facility Id: 19331436
Latitude: 47.5413505
Longitude: -122.17461
Ecology Interest Type Code: TIER2
Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: LUST
Interaction 2: LUST Facility
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Not reported
Program ID: 343
Date Interaction: 1990-02-12 00:00:00
Date Interaction 3: Not reported

Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000051350
Date Interaction: 2003-09-15 00:00:00
Date Interaction 3: Not reported

Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank

BELLEVUE FIRE STATION # 9 (Continued) **U000585965**

Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 343
Date Interaction: 2000-03-20 00:00:00
Date Interaction 3: Not reported

Facility Id: 19331436
Latitude: 47.5413505
Longitude: -122.17461
Ecology Interest Type Code: UST
Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: LUST
Interaction 2: LUST Facility
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: Not reported
Program ID: 343
Date Interaction: 1990-02-12 00:00:00
Date Interaction 3: Not reported

Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: TIER2
Interaction 2: Emergency/Haz Chem Rpt TIER2
Ecology Program: HAZWASTE
Program Data: EPCRA
Facility Alt.: Not reported
Program ID: CRK000051350
Date Interaction: 2003-09-15 00:00:00
Date Interaction 3: Not reported

Facility ID: 19331436
Facility Company: BELLEVUE CITY FIRE DISTRICT 9
Interaction: A
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: 343
Date Interaction: 2000-03-20 00:00:00
Date Interaction 3: Not reported

LUST:
Facility ID: 19331436
Facility Status: Cleanup Started
Cleanup Site ID: 8231
Cleanup Unit Type: Upland
Process Type: Independent Action
Alternate Name: KING CO FIRE DIST # 25 STA # 2
Release Status Date: 03/11/1992

BELLEVUE FIRE STATION # 9 (Continued) **U000585965**

Site Response Unit Code: Northwest
Lat/Long: 47.5413505 / -122.17461

Facility ID: 19331436
Facility Status: Monitoring
Cleanup Site ID: 8231
Cleanup Unit Type: Upland
Process Type: Independent Action
Alternate Name: KING CO FIRE DIST # 25 STA # 2
Release Status Date: 06/01/1995
Site Response Unit Code: Northwest
Lat/Long: 47.5413505 / -122.17461

Facility ID: 19331436
Facility Status: Cleanup Started
Cleanup Site ID: 8231
Cleanup Unit Type: Upland
Process Type: Independent Action
Alternate Name: KING CO FIRE DIST # 25 STA # 2
Release Status Date: 02/06/2013
Site Response Unit Code: Northwest
Lat/Long: 47.5413505 / -122.17461

UST:
Facility ID: 19331436
Site Id: 343
UBI: 1790167460010020
Phone Number: 4254526148
Decimal Latitude: 47.54135054
Decimal Longitude: -122.1746191

Tank Name: 1
Tag Number: A5145
Tank Status: Operational
Tank Status Date: 05/23/2001
Tank Install Date: 00/20/2000
Tank Closure Date: Not reported
Capacity Range: Not reported
Tank Permit Expiration Date: 06/30/2015
Tank Upgrade Date: 12/20/2000
Tank Spill Prevention: Spill Bucket/Spill Box
Tank Overfill Prevention: Automatic Shutoff (fill pipe)
Tank Material: Fiberglass Reinforced Plastic
Tank Construction: Double Wall Tank
Tank Tightness Test: Part of Automatic Tank Gauging (ATG) System
Tank Corrosion Protection: Corrosion Resistant
Tank Manifold: Not reported
Tank Release Detection: Interstitial Monitoring
Tank SFC Type: Not reported
Pipe Material: Flexible Piping
Pipe Construction: Double Wall Pipe
Pipe Primary Release Detection: Safe Suction (No Leak Detection)
Pipe Second Release Detection: Interstitial Monitoring (or Sump Sensor)
Pipe Corrosion Protection: Corrosion Resistant
Pipe Pumping System: Safe Suction
Responsible Unit: NORTHWEST
Dispencer/Pump SFC Type: Not reported

BELLEVUE FIRE STATION # 9 (Continued) **U000585965**

Tank Name:	5
Tag Number:	A5145
Tank Status:	Removed
Tank Status Date:	08/06/1996
Tank Install Date:	00/31/1964
Tank Closure Date:	Not reported
Capacity Range:	Not reported
Tank Permit Expiration Date:	Not reported
Tank Upgrade Date:	Not reported
Tank Spill Prevention:	Not reported
Tank Overfill Prevention:	Not reported
Tank Material:	Not reported
Tank Construction:	Not reported
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Not reported
Tank Manifold:	Not reported
Tank Release Detection:	Not reported
Tank SFC Type:	Not reported
Pipe Material:	Not reported
Pipe Construction:	Not reported
Pipe Primary Release Detection:	Not reported
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	Not reported
Pipe Pumping System:	Not reported
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

Tank Name:	6
Tag Number:	A5145
Tank Status:	Removed
Tank Status Date:	08/06/1996
Tank Install Date:	00/31/1964
Tank Closure Date:	Not reported
Capacity Range:	Not reported
Tank Permit Expiration Date:	Not reported
Tank Upgrade Date:	Not reported
Tank Spill Prevention:	Not reported
Tank Overfill Prevention:	Not reported
Tank Material:	Not reported
Tank Construction:	Not reported
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Not reported
Tank Manifold:	Not reported
Tank Release Detection:	Not reported
Tank SFC Type:	Not reported
Pipe Material:	Not reported
Pipe Construction:	Not reported
Pipe Primary Release Detection:	Not reported
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	Not reported
Pipe Pumping System:	Not reported
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

WA Financial Assurance 1:
edr_fstat: WA

BELLEVUE FIRE STATION # 9 (Continued) **U000585965**

edr_fzip: Not reported
edr_fcnty: Not reported
edr_zip: Not reported
DOE Site ID: 343
Site Type: Self Insured
Financial Resp Type: Local Gov Financial Test
Inception Date: 06/08/2011
Expiration Date: 06/08/2012

37
SSW
1/4-1/2
0.482 mi.
2546 ft.

KING CNTY WATER DIST 107
7415 129TH AVE SE
RENTON, WA 98056

RCRA NonGen / NLR **1000231749**
FINDS **WAD173260621**
WA ALLSITES
WA UST

Relative:
Higher

Actual:
398 ft.

RCRA NonGen / NLR:
Date form received by agency: 07/25/1988
Facility name: KING CNTY WATER DIST 107
Facility address: 7415 129TH AVE SE
RENTON, WA 98056
EPA ID: WAD173260621
Contact: KING COUNTY INT KING COUNTY INT
Contact address: 7415 129TH AVE SE
RENTON, WA 98056-1441
Contact country: US
Contact telephone: (000)000-0000
Contact email: Not reported
EPA Region: 10
Classification: Non-Generator
Description: Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:
Owner/operator name: KING COUNTY INT K
Owner/operator address: 7415 129TH AVE SE
RENTON, WA 98056
Owner/operator country: US
Owner/operator telephone: (000)000-0000
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 05/02/1996
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No

KING CNTY WATER DIST 107 (Continued) **1000231749**

Used oil transporter: No

Violation Status: No violations found

FINDS:

Registry ID: 110005333068

Environmental Interest/Information System

Washington Facility / Site Identification System (WA-FSIS) provides a means to query and display data maintained by the Washington Department of Ecology. This system contains key information for each facility/site that is currently, or has been, of interest to the Air Quality, Dam Safety, Hazardous Waste, Toxics Cleanup, and Water Quality Programs.

RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

ALLSITES:

Facility Id: 61428456
Latitude: 47.53637
Longitude: -122.1683
Ecology Interest Type Code: HWG
Facility ID: 61428456
Facility Company: King Cnty Water Dist 107
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAD173260621
Date Interaction: 1988-07-25 00:00:00
Date Interaction 3: 1992-08-26 00:00:00

Facility ID: 61428456
Facility Company: King Cnty Water Dist 107
Interaction: I
Interaction 1: UST
Interaction 2: Underground Storage Tank
Ecology Program: TOXICS
Program Data: UST
Facility Alt.: Not reported
Program ID: Not reported
Date Interaction: 1982-10-01 00:00:00
Date Interaction 3: 2000-05-03 00:00:00

Facility Id: 61428456
Latitude: 47.53637
Longitude: -122.1683

KING CNTY WATER DIST 107 (Continued) **1000231749**

Ecology Interest Type Code:	UST
Facility ID:	61428456
Facility Company:	King Cnty Water Dist 107
Interaction:	I
Interaction 1:	HWG
Interaction 2:	Hazardous Waste Generator
Ecology Program:	HAZWASTE
Program Data:	TURBOWASTE
Facility Alt.:	Not reported
Program ID:	WAD173260621
Date Interaction:	1988-07-25 00:00:00
Date Interaction 3:	1992-08-26 00:00:00

Facility ID:	61428456
Facility Company:	King Cnty Water Dist 107
Interaction:	I
Interaction 1:	UST
Interaction 2:	Underground Storage Tank
Ecology Program:	TOXICS
Program Data:	UST
Facility Alt.:	Not reported
Program ID:	Not reported
Date Interaction:	1982-10-01 00:00:00
Date Interaction 3:	2000-05-03 00:00:00

UST:

Facility ID:	61428456
Site Id:	12534
UBI:	Not reported
Phone Number:	2062359200
Decimal Latitude:	47.53637
Decimal Longitude:	-122.1683

Tank Name:	1.
Tag Number:	Not reported
Tank Status:	Removed
Tank Status Date:	08/06/1996
Tank Install Date:	00/01/1982
Tank Closure Date:	Not reported
Capacity Range:	111 TO 1,100 Gallons
Tank Permit Expiration Date:	03/14/1995
Tank Upgrade Date:	Not reported
Tank Spill Prevention:	None
Tank Overfill Prevention:	None
Tank Material:	Fiberglass Reinforced Plastic
Tank Construction:	Single Wall Tank
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Corrosion Resistant
Tank Manifold:	Not reported
Tank Release Detection:	Statistical Inventory Reconciliation
Tank SFC Type:	Not reported
Pipe Material:	Not reported
Pipe Construction:	Single Wall Pipe
Pipe Primary Release Detection:	Safe Suction (No Leak Detection)
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	None

KING CNTY WATER DIST 107 (Continued) **1000231749**

Pipe Pumping System:	Not reported
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

Tank Name:	4.
Tag Number:	Not reported
Tank Status:	Removed
Tank Status Date:	08/06/1996
Tank Install Date:	00/01/1982
Tank Closure Date:	Not reported
Capacity Range:	111 TO 1,100 Gallons
Tank Permit Expiration Date:	03/14/1995
Tank Upgrade Date:	Not reported
Tank Spill Prevention:	None
Tank Overfill Prevention:	None
Tank Material:	Fiberglass Reinforced Plastic
Tank Construction:	Single Wall Tank
Tank Tightness Test:	Not reported
Tank Corrosion Protection:	Corrosion Resistant
Tank Manifold:	Not reported
Tank Release Detection:	Statistical Inventory Reconciliation
Tank SFC Type:	Not reported
Pipe Material:	Not reported
Pipe Construction:	Single Wall Pipe
Pipe Primary Release Detection:	Safe Suction (No Leak Detection)
Pipe Second Release Detection:	Not reported
Pipe Corrosion Protection:	None
Pipe Pumping System:	Not reported
Responsible Unit:	NORTHWEST
Dispencer/Pump SFC Type:	Not reported

38
NW
1/2-1
0.816 mi.
4306 ft.

BGN PROPERTIES INC
5629 119TH AVE SE
BELLEVUE, WA 98006

WA CSCSL **S107435881**
WA ALLSITES **N/A**
WA MANIFEST
WA VCP
WA Inactive Drycleaners

Relative:
Lower

Actual:
332 ft.

CSCSL:

Facility ID:	1557937
Region:	Northwest
Lat/Long:	47.552613 / -122.179219
Brownfield Status:	Not reported
Rank Status:	N
Clean Up Siteid:	1453
Site Status:	Cleanup Started
PSI?:	Not reported
Contaminant Name:	Halogenated Organics
Ground Water:	Suspected
Surface Water:	Not reported
Soil:	Confirmed Above Cleanup Level
Sediment:	Not reported
Air:	Not reported
Bedrock:	Not reported
Responsible Unit:	Northwest

ALLSITES:

BGN PROPERTIES INC (Continued) **S107435881**

Facility Id: 1557937
Latitude: 47.552613
Longitude: -122.17921
Ecology Interest Type Code: HWG
Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAH000027265
Date Interaction: 2005-09-23 00:00:00
Date Interaction 3: 2005-12-31 00:00:00

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: BGN Properties Inc
Program ID: Not reported
Date Interaction: 2006-06-21 00:00:00
Date Interaction 3: Not reported

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: BGN Properties Inc
Program ID: NW2786
Date Interaction: 2013-10-04 00:00:00
Date Interaction 3: Not reported

Facility Id: 1557937
Latitude: 47.552613
Longitude: -122.17921
Ecology Interest Type Code: SCS
Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAH000027265
Date Interaction: 2005-09-23 00:00:00
Date Interaction 3: 2005-12-31 00:00:00

BGN PROPERTIES INC (Continued) **S107435881**

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: BGN Properties Inc
Program ID: Not reported
Date Interaction: 2006-06-21 00:00:00
Date Interaction 3: Not reported

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: VOLCLNST
Interaction 2: Voluntary Cleanup Sites
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: BGN Properties Inc
Program ID: NW2786
Date Interaction: 2013-10-04 00:00:00
Date Interaction 3: Not reported

Facility Id: 1557937
Latitude: 47.552613
Longitude: -122.17921
Ecology Interest Type Code: VOLCLNST
Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: I
Interaction 1: HWG
Interaction 2: Hazardous Waste Generator
Ecology Program: HAZWASTE
Program Data: TURBOWASTE
Facility Alt.: Not reported
Program ID: WAH000027265
Date Interaction: 2005-09-23 00:00:00
Date Interaction 3: 2005-12-31 00:00:00

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: SCS
Interaction 2: State Cleanup Site
Ecology Program: TOXICS
Program Data: ISIS
Facility Alt.: BGN Properties Inc
Program ID: Not reported
Date Interaction: 2006-06-21 00:00:00
Date Interaction 3: Not reported

Facility ID: 1557937
Facility Company: BGN Properties Inc
Interaction: A
Interaction 1: VOLCLNST

BGN PROPERTIES INC (Continued) **S107435881**

Interaction 2:	Voluntary Cleanup Sites
Ecology Program:	TOXICS
Program Data:	ISIS
Facility Alt.:	BGN Properties Inc
Program ID:	NW2786
Date Interaction:	2013-10-04 00:00:00
Date Interaction 3:	Not reported

WA MANIFEST:

Facility Site ID Number:	1557937
EPA ID:	WAH000027265
NAICS:	812320
SWC Desc:	Not reported
FWC Desc:	Not reported
Form Comm:	Not reported
Data Year:	Not reported
Permit by Rule:	No
Treatment by Generator:	No
Mixed radioactive waste:	No
Importer of hazardous waste:	No
Immediate recycler:	No
Treatment/Storage/Disposal/Recycling Facility:	No
Generator of dangerous fuel waste:	No
Generator marketing to burner:	No
Other marketers (i.e., blender, distributor, etc.):	No
Utility boiler burner:	No
Industry boiler burner:	No
Industrial Furnace:	No
Smelter defferal:	No
Universal waste - batteries - generate:	No
Universal waste - thermostats - generate:	No
Universal waste - mercury - generate:	No
Universal waste - lamps - generate:	No
Universal waste - batteries - accumulate:	No
Universal waste - thermostats - accumulate:	No
Universal waste - mercury - accumulate:	No
Universal waste - lamps - accumulate:	No
Destination Facility for Universal Waste:	No
Off-specification used oil burner - utility boiler:	No
Off-specification used oil burner - industrial boiler:	No
Off-specification used oil burner - industrial furnace:	No
Tax Reg #:	601605800
Business Type:	Former Dry Cleaners
Mail Name:	Western Property Management
Mail addr line1:	8626 Roosevelt Way NE
Mail city,st,zip:	Seattle, WA 98115
Mail country:	UNITED STATES
Legal org name:	BGN Properties Inc
Legal org type:	Private
Legal addr line1:	8626 Roosevelt Way NE
Legal city,st,zip:	Seattle, WA 98115
Legal country:	UNITED STATES
Legal phone nbr:	(206)525-3700
Legal effective date:	08/01/1995
Land org name:	BGN Properties Inc
Land org type:	Private

BGN PROPERTIES INC (Continued) **S107435881**

Land person name:	Not reported
Land addr line1:	8626 Roosevelt Way NE
Land city,st,zip:	Seattle, WA 98115
Land country:	UNITED STATES
Land phone nbr:	(206)525-3700
Operator org name:	BGN Properties Inc
Operator org type:	Private
Operator addr line1:	5629 119th Ave SE
Operator city,st,zip:	Bellevue, WA 98006
Operator country:	UNITED STATES
Operator phone nbr:	((206)525-3700
Operator effective date:	08/01/1995
Site contact name:	Greg Allemeier
Site contact addr line1:	8626 Roosevelt Way NE
Site Contact City/State/ Zip:	Seattle, WA 98115
Site Contact Country:	UNITED STATES
Site Contact Phone #:	206-525-3700
Site Contact EMail:	Not reported
Form Contact NAME:	Greg Allemeier
Form Contact ADDR LINE1:	8626 Roosevelt Way NE
Form Contact City,ST,Zip:	Seattle, WA 98115
Form Contact Country:	UNITED STATES
Form Contact Phone #:	206-525-3700
Form Contact EMail:	Not reported
Gen Status CD:	XQG
Monthly Generation:	No
Batch Generation:	No
One Time Generation:	No
Transport Own Waste:	No
Tranports Other Waste:	No
Recycler Onsite:	No
Transfer Facility:	No
Other Exemption:	Not reported
UW Battery Gen:	No
Used Oil Transporter:	No
Used Oil Transfer Facility:	No
Used Oil Processor:	No
Used Oil Refiner:	No
Used Oil Fuel Marketer Directs Shipments:	No
Used Oil Fuel Marketer Meets Specs:	No

VCP:

edr_fstat:	WA
edr_fzip:	98006
edr_fcnty:	KING
edr_zip:	Not reported
Facility ID:	1557937
VCP Status:	Yes
VCP:	Not reported
Ecology Status:	Not reported
NFA Type:	Not reported
Date NFA:	Not reported
Rank:	N
Cleanup Siteid:	1453

BGN PROPERTIES INC (Continued) **S107435881**

Inactive Drycleaners:

EPA I:	WAH000027265
FS Id:	1557937
Facility ID:	WAH000027265
NAICS Code:	812320
Fed Waste Code Desc:	Not reported
State Waste Code Desc:	Not reported
TAX REG NBR:	601605800
BUSINESS TYPE:	Former Dry Cleaners
MAIL NAME:	Western Property Management
MAIL LINE1:	8626 Roosevelt Way NE
MAIL LINE2:	Not reported
MAIL CITY:	Seattle
MAIL STATE:	WA
MAIL ZIP:	98115
MAIL COUNTRY:	UNITED STATES
LEGAL ORG NAME:	BGN Properties Inc
LEGAL PERSON FIRST NAME:	Not reported
LEGAL PERSON MIDDLE INIT:	Not reported
LEGAL PERSON LAST NAME:	Not reported
LEGAL LINE1:	8626 Roosevelt Way NE
LEGAL LINE2:	Not reported
LEGAL CITY:	Seattle
LEGAL STATE:	WA
LEGAL ZIP:	98115
LEGAL COUNTRY:	UNITED STATES
LEGAL PHONE NBR:	(206)525-3700
LEGAL EFFECTIVE DATE:	8/1/1995
LEGAL ORGANIZATION TYPE:	Private
LAND ORG NAME:	BGN Properties Inc
LAND PERSON FIRST NAME:	Not reported
LAND PERSON MIDDLE INIT:	Not reported
LAND PERSON LAST NAME:	Not reported
LAND LINE1:	8626 Roosevelt Way NE
LAND LINE2:	Not reported
LAND CITY:	Seattle
LAND STATE:	WA
LAND ZIP:	98115
LAND COUNTRY:	UNITED STATES
LAND PHONE NBR:	(206)525-3700
LAND ORGANIZATION TYPE:	Private
OPERATOR ORG NAME:	BGN Properties Inc
OPERATOR PERSON FIRST NAME:	Not reported
OPERATOR PERSON MIDDLE INIT:	Not reported
OPERATOR PERSON LAST NAME:	Not reported
OPERATOR LINE1:	5629 119th Ave SE
OPERATOR LINE2:	Not reported
OPERATOR CITY:	Bellevue
OPERATOR STATE:	WA
OPERATOR ZIP:	98006
OPERATOR COUNTRY:	UNITED STATES
OPERATOR PHONE NBR:	((206)525-3700
OPERATOR EFFECTIVE DATE:	8/1/1995
OPERATOR ORGANIZATION TYPE:	Private
SITE CONTACT FIRST NAME:	Greg
SITE CONTACT MIDDLE INIT:	Not reported
SITE CONTACT LAST NAME:	Allemeier

BGN PROPERTIES INC (Continued) **S107435881**

SITE CONTACT LINE1:	8626 Roosevelt Way NE
SITE CONTACT LINE2:	Not reported
SITE CONTACT CITY:	Seattle
SITE CONTACT STATE:	WA
SITE CONTACT ZIP:	98115
SITE CONTACT COUNTRY:	UNITED STATES
SITE CONTACT PHONE NBR:	206-525-3700
SITE CONTACT EMAIL:	Not reported
FORM CONTACT FIRST NAME:	Greg
FORM CONTACT MIDDLE INIT:	Not reported
FORM CONTACT LAST NAME:	Allemeier
FORM CONTACT LINE1:	8626 Roosevelt Way NE
FORM CONTACT LINE2:	Not reported
FORM CONTACT CITY:	Seattle
FORM CONTACT STATE:	WA
FORM CONTACT ZIP:	98115
FORM CONTACT COUNTRY:	UNITED STATES
FORM CONTACT PHONE NBR:	206-525-3700
FORM CONTACT EMAIL:	Not reported
GEN STATUS CD:	XQG
MONTHLY GENERATION:	No
BATCH GENERATION:	No
ONE TIME GENERATION:	No
TRANSPORTS OWN WASTE:	No
TRANSPORTS OTHERS WASTE:	No
RECYCLER ONSITE:	No
TRANSFER FACILITY:	No
PBR:	No
TBG:	No
MIXED RADIOACTIVE:	No
IMPORTER:	No
TSDR FACILITY:	No
IMMEDIATE RECYCLER:	No
GEN DANG FUEL:	No
GEN MARKET TO BURNER:	No
GEN OTHER MARKETERS:	No
UTILITY BOILER BURNER:	No
INDUSTRY BOILER BURNER:	No
FURNACE BURNER:	No
SMELTER DEFERRAL:	No
SMALL QTY EXEMPTION:	Not reported
OTHER EXEMPTION:	Not reported
UW BATTERY GEN:	No
UW THERMOSTATS GEN:	No
UW MERCURY GEN:	No
UW LAMPS GEN:	No
UW BATTERY ACCUM:	No
UW THERMOSTATS ACCUM:	No
UW MERCURY ACCUM:	No
UW LAMPS ACCUM:	No
UW DESTINATION FACILITY:	No
OFF SPEC UTILITY BOILER:	No
OFF SPEC INDUSTRY BOILER:	No
OFF SPEC FURNACE:	No
USED OIL TRANSPORTER:	No
USED OIL TRANSFER FACILITY:	Not reported
USED OIL PROCESSOR:	No

BGN PROPERTIES INC (Continued) **S107435881**

USED OIL REREFINER:	No
USED OIL FUEL MARKETER DIR SHIPMENTS:	No
USED OIL FUEL MARKETER MEETS SPECS:	No
Comments:	Not reported
EPA I:	WAH000027265
FS Id:	16032
Facility ID:	WAH000027265
NAICS Code:	812320
Fed Waste Code Desc:	Not reported
State Waste Code Desc:	Not reported
TAX REG NBR:	Not reported
BUSINESS TYPE:	Not reported
MAIL NAME:	Not reported
MAIL LINE1:	Not reported
MAIL LINE2:	Not reported
MAIL CITY:	Not reported
MAIL STATE:	Not reported
MAIL ZIP:	Not reported
MAIL COUNTRY:	Not reported
LEGAL ORG NAME:	Not reported
LEGAL PERSON FIRST NAME:	Not reported
LEGAL PERSON MIDDLE INIT:	Not reported
LEGAL PERSON LAST NAME:	Not reported
LEGAL LINE1:	Not reported
LEGAL LINE2:	Not reported
LEGAL CITY:	Not reported
LEGAL STATE:	Not reported
LEGAL ZIP:	Not reported
LEGAL COUNTRY:	Not reported
LEGAL PHONE NBR:	Not reported
LEGAL EFFECTIVE DATE:	Not reported
LEGAL ORGANIZATION TYPE:	Not reported
LAND ORG NAME:	Not reported
LAND PERSON FIRST NAME:	Not reported
LAND PERSON MIDDLE INIT:	Not reported
LAND PERSON LAST NAME:	Not reported
LAND LINE1:	Not reported
LAND LINE2:	Not reported
LAND CITY:	Not reported
LAND STATE:	Not reported
LAND ZIP:	Not reported
LAND COUNTRY:	Not reported
LAND PHONE NBR:	Not reported
LAND ORGANIZATION TYPE:	Not reported
OPERATOR ORG NAME:	Not reported
OPERATOR PERSON FIRST NAME:	Not reported
OPERATOR PERSON MIDDLE INIT:	Not reported
OPERATOR PERSON LAST NAME:	Not reported
OPERATOR LINE1:	Not reported
OPERATOR LINE2:	Not reported
OPERATOR CITY:	Not reported
OPERATOR STATE:	Not reported
OPERATOR ZIP:	Not reported
OPERATOR COUNTRY:	Not reported
OPERATOR PHONE NBR:	Not reported
OPERATOR EFFECTIVE DATE:	Not reported
OPERATOR ORGANIZATION TYPE:	Not reported

BGN PROPERTIES INC (Continued) **S107435881**

SITE CONTACT FIRST NAME:	Not reported
SITE CONTACT MIDDLE INIT:	Not reported
SITE CONTACT LAST NAME:	Not reported
SITE CONTACT LINE1:	Not reported
SITE CONTACT LINE2:	Not reported
SITE CONTACT CITY:	Not reported
SITE CONTACT STATE:	Not reported
SITE CONTACT ZIP:	Not reported
SITE CONTACT COUNTRY:	Not reported
SITE CONTACT PHONE NBR:	Not reported
SITE CONTACT EMAIL:	Not reported
FORM CONTACT FIRST NAME:	Not reported
FORM CONTACT MIDDLE INIT:	Not reported
FORM CONTACT LAST NAME:	Not reported
FORM CONTACT LINE1:	Not reported
FORM CONTACT LINE2:	Not reported
FORM CONTACT CITY:	Not reported
FORM CONTACT STATE:	Not reported
FORM CONTACT ZIP:	Not reported
FORM CONTACT COUNTRY:	Not reported
FORM CONTACT PHONE NBR:	Not reported
FORM CONTACT EMAIL:	Not reported
GEN STATUS CD:	Not reported
MONTHLY GENERATION:	Not reported
BATCH GENERATION:	Not reported
ONE TIME GENERATION:	Not reported
TRANSPORTS OWN WASTE:	Not reported
TRANSPORTS OTHERS WASTE:	Not reported
RECYCLER ONSITE:	Not reported
TRANSFER FACILITY:	Not reported
PBR:	Not reported
TBG:	Not reported
MIXED RADIOACTIVE:	Not reported
IMPORTER:	Not reported
TSDR FACILITY:	Not reported
IMMEDIATE RECYCLER:	Not reported
GEN DANG FUEL:	Not reported
GEN MARKET TO BURNER:	Not reported
GEN OTHER MARKETERS:	Not reported
UTILITY BOILER BURNER:	Not reported
INDUSTRY BOILER BURNER:	Not reported
FURNACE BURNER:	Not reported
SMELTER DEFERRAL:	Not reported
SMALL QTY EXEMPTION:	Not reported
OTHER EXEMPTION:	Not reported
UW BATTERY GEN:	Not reported
UW THERMOSTATS GEN:	Not reported
UW MERCURY GEN:	Not reported
UW LAMPS GEN:	Not reported
UW BATTERY ACCUM:	Not reported
UW THERMOSTATS ACCUM:	Not reported
UW MERCURY ACCUM:	Not reported
UW LAMPS ACCUM:	Not reported
UW DESTINATION FACILITY:	Not reported
OFF SPEC UTILITY BOILER:	Not reported
OFF SPEC INDUSTRY BOILER:	Not reported
OFF SPEC FURNACE:	Not reported

BGN PROPERTIES INC (Continued) **S107435881**

USED OIL TRANSPORTER: Not reported
USED OIL TRANSFER FACILITY: Not reported
USED OIL PROCESSOR: Not reported
USED OIL REREFINER: Not reported
USED OIL FUEL MARKETER DIR SHIPMENTS: Not reported
USED OIL FUEL MARKETER MEETS SPECS: Not reported
Comments: Not reported

Count: 15 records. ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
BELLEVUE	S105454447	SUNSET RIDGE CORPORATE CAMPUS	137TH 139TH AVE. SE & FRONTAGE	98006	WA ICR
BELLEVUE	S103505900	CHEVRON	1919 SE 56TH ST.	98006	WA ICR
BELLEVUE	1016261976	NEWCASTLE DRUMS	NEWCASTLE COAL CREEK RD T24N R	98006	FINDS
ISSAQUAH	S115344346	NEWCASTLE MINE-AIR VENT	NEWCASTLE COAL CR RD, SECT. 26		WA RGA HWS
ISSAQUAH	S115344345	NEWCASTLE MINE TIMBER SHOOT	NEWCASTLE COAL CR RD, SECT. 26		WA RGA HWS
ISSAQUAH	S115344348	NEWCASTLE/COAL CREEK LANDFILL	NEWCASTLE COAL CR RD, SECT. 26		WA RGA HWS
NEWCASTLE	S105063454	WEST FUEL COMPANY	18060 140TH AVE. SE	98056	WA ICR
NEWCASTLE	S115344344	NEWCASTLE AM PM	6966 COAL CREEK PKWY SE		WA RGA HWS
NEWCASTLE	S115439690	NEWCASTLE AM PM	6966 COAL CREEK PKWY SE		WA RGA LUST
NEWCASTLE	S104873110	MIDWAY AUTO	2802 KENT-DES MOINES ROAD	98056	WA ICR
NEWCASTLE	1007080644	NEWCASTLE KING 4 COAL CO MINE A	SE NEWCASTLE COAL CR	98056	FINDS
NEWCASTLE	1016706085	NEWCASTLE YMCA	SE NEWCASTLE COAL CREEK RD & 1	98059	FINDS
NEWCASTLE	1003880505	NEWCASTLE MINE - AIR VENT	SE NEWCASTLE - COAL CR RD	98006	CERC-NFRAP
NEWCASTLE	1003880501	NEWCASTLE MINE TIMBER SHOOT	SE NEWCASTLE-COAL CREEK ROAD	98006	CERC-NFRAP
NEWCASTLE	1003880503	KING 4 COAL CO. MINE, A	SE NEWCASTLE-COAL CREEK ROAD	98006	CERC-NFRAP

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 09/29/2014
Date Data Arrived at EDR: 10/08/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 40

Source: EPA
Telephone: N/A
Last EDR Contact: 10/08/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 09/29/2014
Date Data Arrived at EDR: 10/08/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 40

Source: EPA
Telephone: N/A
Last EDR Contact: 10/08/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 09/29/2014
Date Data Arrived at EDR: 10/08/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 40

Source: EPA
Telephone: N/A
Last EDR Contact: 10/08/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Quarterly

Federal CERCLIS list

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 10/25/2013
Date Data Arrived at EDR: 11/11/2013
Date Made Active in Reports: 02/13/2014
Number of Days to Update: 94

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/24/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Quarterly

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 07/21/2014
Date Data Arrived at EDR: 10/07/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 10/07/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Varies

Federal CERCLIS NFRAP site List

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 10/25/2013
Date Data Arrived at EDR: 11/11/2013
Date Made Active in Reports: 02/13/2014
Number of Days to Update: 94

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 11/24/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Varies

Federal institutional controls / engineering controls registries

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 09/18/2014
Date Data Arrived at EDR: 09/19/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 31

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/03/2014
Next Scheduled EDR Contact: 03/16/2015
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 09/18/2014
Date Data Arrived at EDR: 09/19/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 31

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 12/03/2014
Next Scheduled EDR Contact: 03/16/2015
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 08/29/2014
Date Data Arrived at EDR: 10/09/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 11

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 11/17/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 09/29/2014
Date Data Arrived at EDR: 09/30/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 37

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Annually

State- and tribal - equivalent NPL

HSL: Hazardous Sites List

The Hazardous Sites List is a subset of the CSCSL Report. It includes sites which have been assessed and ranked using the Washington Ranking Method (WARM).

Date of Government Version: 08/27/2014
Date Data Arrived at EDR: 09/16/2014
Date Made Active in Reports: 10/13/2014
Number of Days to Update: 27

Source: Department of Ecology
Telephone: 360-407-7200
Last EDR Contact: 12/09/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Semi-Annually

State- and tribal - equivalent CERCLIS

CSCSL: Confirmed and Suspected Contaminated Sites List

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/27/2014
Number of Days to Update: 4

Source: Department of Ecology
Telephone: 360-407-7200
Last EDR Contact: 10/23/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Semi-Annually

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: Solid Waste Facility Database

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 12/01/2014
Date Data Arrived at EDR: 12/12/2014
Date Made Active in Reports: 12/22/2014
Number of Days to Update: 10

Source: Department of Ecology
Telephone: 360-407-6132
Last EDR Contact: 12/08/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Annually

State and tribal leaking storage tank lists

LUST: Leaking Underground Storage Tanks Site List

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 08/18/2014
Date Data Arrived at EDR: 08/22/2014
Date Made Active in Reports: 08/29/2014
Number of Days to Update: 7

Source: Department of Ecology
Telephone: 360-407-7183
Last EDR Contact: 11/20/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Quarterly

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land

A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 02/01/2013
Date Data Arrived at EDR: 05/01/2013
Date Made Active in Reports: 11/01/2013
Number of Days to Update: 184

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 10/31/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 07/30/2014
Date Data Arrived at EDR: 08/12/2014
Date Made Active in Reports: 08/22/2014
Number of Days to Update: 10

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Semi-Annually

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 10/06/2014
Date Data Arrived at EDR: 10/29/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 19
Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 05/20/2014
Date Data Arrived at EDR: 06/10/2014
Date Made Active in Reports: 08/22/2014
Number of Days to Update: 73
Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 05/22/2014
Date Data Arrived at EDR: 08/22/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 27
Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 11/04/2014
Date Data Arrived at EDR: 11/07/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 10
Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 03/01/2013
Date Data Arrived at EDR: 03/01/2013
Date Made Active in Reports: 04/12/2013
Number of Days to Update: 42
Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN LUST R5: Leaking Underground Storage Tanks on Indian Land
Leaking underground storage tanks located on Indian Land in Michigan, Minnesota and Wisconsin.

Date of Government Version: 11/03/2014
Date Data Arrived at EDR: 11/05/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 12
Source: EPA, Region 5
Telephone: 312-886-7439
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

State and tribal registered storage tank lists

UST: Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/25/2014
Date Data Arrived at EDR: 11/26/2014
Date Made Active in Reports: 12/23/2014
Number of Days to Update: 27
Source: Department of Ecology
Telephone: 360-407-7183
Last EDR Contact: 11/14/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Quarterly

AST: Aboveground Storage Tank Locations

A listing of aboveground storage tank locations regulated by the Department of Ecology's Spill Prevention, Preparedness and Response Program.

Date of Government Version: 04/01/2014
Date Data Arrived at EDR: 05/06/2014
Date Made Active in Reports: 06/04/2014
Number of Days to Update: 29

Source: Department of Ecology
Telephone: 360-407-7562
Last EDR Contact: 11/03/2014
Next Scheduled EDR Contact: 02/16/2015
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 11/03/2014
Date Data Arrived at EDR: 11/05/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 12

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 10/06/2014
Date Data Arrived at EDR: 10/29/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 8

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Semi-Annually

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 05/20/2014
Date Data Arrived at EDR: 06/10/2014
Date Made Active in Reports: 08/15/2014
Number of Days to Update: 66

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 02/01/2013
Date Data Arrived at EDR: 05/01/2013
Date Made Active in Reports: 01/27/2014
Number of Days to Update: 271

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 10/31/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 08/20/2014
Date Data Arrived at EDR: 08/22/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 27

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

INDIAN UST R9: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 08/14/2014
Date Data Arrived at EDR: 08/15/2014
Date Made Active in Reports: 08/22/2014
Number of Days to Update: 7
Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 11/04/2014
Date Data Arrived at EDR: 11/07/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 10
Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Quarterly

INDIAN UST R4: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 07/30/2014
Date Data Arrived at EDR: 08/12/2014
Date Made Active in Reports: 08/22/2014
Number of Days to Update: 10
Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Semi-Annually

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55
Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 10/10/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

INST CONTROL: Institutional Control Site List
Sites that have institutional controls.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/27/2014
Number of Days to Update: 4
Source: Department of Ecology
Telephone: 360-407-7170
Last EDR Contact: 10/23/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

ICR: Independent Cleanup Reports
These are remedial action reports Ecology has received from either the owner or operator of the sites. These actions have been conducted without department oversight or approval and are not under an order or decree. This database is no longer updated by the Department of Ecology.

Date of Government Version: 12/01/2002
Date Data Arrived at EDR: 01/03/2003
Date Made Active in Reports: 01/22/2003
Number of Days to Update: 19
Source: Department of Ecology
Telephone: 360-407-7200
Last EDR Contact: 08/10/2009
Next Scheduled EDR Contact: 11/09/2009
Data Release Frequency: No Update Planned

VCP: Voluntary Cleanup Program Sites
Sites that have entered either the Voluntary Cleanup Program or its predecessor Independent Remedial Action Program.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/27/2014
Number of Days to Update: 4
Source: Department of Ecology
Telephone: 360-407-7200
Last EDR Contact: 10/23/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27
Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 09/29/2014
Date Data Arrived at EDR: 10/01/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 36
Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 12/31/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Varies

State and tribal Brownfields sites

BROWNFIELDS: Brownfields Sites Listing
A listing of brownfields sites included in the Confirmed & Suspected Sites Listing. Brownfields are abandoned, idle or underused commercial or industrial properties, where the expansion or redevelopment is hindered by real or perceived contamination. Brownfields vary in size, location, age, and past use -- they can be anything from a five-hundred acre automobile assembly plant to a small, abandoned corner gas station.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/27/2014
Number of Days to Update: 4
Source: Department of Ecology
Telephone: 360-725-4030
Last EDR Contact: 10/23/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites
Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 09/22/2014
Date Data Arrived at EDR: 09/23/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 27
Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 12/22/2014
Next Scheduled EDR Contact: 04/06/2015
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137
Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 10/24/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: No Update Planned

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39
Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SWRCY: Recycling Facility List
A llisting of recycling center locations.

Date of Government Version: 10/31/2014
Date Data Arrived at EDR: 10/31/2014
Date Made Active in Reports: 12/23/2014
Number of Days to Update: 53
Source: Department of Ecology
Telephone: 360-407-6105
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

SWTIRE: Solid Waste Tire Facilities
This study identified sites statewide with unauthorized accumulations of scrap tires.

Date of Government Version: 11/01/2005
Date Data Arrived at EDR: 03/16/2006
Date Made Active in Reports: 04/13/2006
Number of Days to Update: 28
Source: Department of Ecology
Telephone: N/A
Last EDR Contact: 12/08/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52
Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 10/29/2014
Next Scheduled EDR Contact: 02/16/2015
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US CDL: Clandestine Drug Labs
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 07/25/2014
Date Data Arrived at EDR: 09/09/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 41
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 11/25/2014
Next Scheduled EDR Contact: 03/16/2015
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

ALLSITES: Facility/Site Identification System Listing
Information on facilities and sites of interest to the Department of Ecology.

Date of Government Version: 11/05/2014
Date Data Arrived at EDR: 11/07/2014
Date Made Active in Reports: 12/29/2014
Number of Days to Update: 52

Source: Department of Ecology
Telephone: 360-407-6423
Last EDR Contact: 11/03/2014
Next Scheduled EDR Contact: 02/16/2015
Data Release Frequency: Quarterly

CSCSL NFA: Confirmed and Contaminated Sites - No Further Action
This report contains information about sites that are undergoing cleanup and sites that are awaiting further investigation and/or cleanup. Sites on the Hazardous Sites List (see above) are included in this data set.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/27/2014
Number of Days to Update: 4

Source: Department of Ecology
Telephone: 360-407-7170
Last EDR Contact: 10/21/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Semi-Annually

CDL: Clandestine Drug Lab Contaminated Site List
Illegal methamphetamine labs use hazardous chemicals that create public health hazards. Chemicals and residues can cause burns, respiratory and neurological damage, and death. Biological hazards associated with intravenous needles, feces, and blood also pose health risks.

Date of Government Version: 11/09/2014
Date Data Arrived at EDR: 11/24/2014
Date Made Active in Reports: 12/22/2014
Number of Days to Update: 28

Source: Department of Health
Telephone: 360-236-3380
Last EDR Contact: 11/10/2014
Next Scheduled EDR Contact: 02/23/2015
Data Release Frequency: Varies

HIST CDL: List of Sites Contaminated by Clandestine Drug Labs
This listing of contaminated sites by Clandestine Drug Labs includes non-remediated properties. The current CDL listing does not. This listing is no longer updated by the state agency.

Date of Government Version: 02/08/2007
Date Data Arrived at EDR: 06/26/2007
Date Made Active in Reports: 07/19/2007
Number of Days to Update: 23

Source: Department of Health
Telephone: 360-236-3381
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 07/25/2014
Date Data Arrived at EDR: 09/09/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 41

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 11/25/2014
Next Scheduled EDR Contact: 03/16/2015
Data Release Frequency: No Update Planned

Local Land Records

LIENS 2: CERCLA Lien Information
A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 02/18/2014
Date Data Arrived at EDR: 03/18/2014
Date Made Active in Reports: 04/24/2014
Number of Days to Update: 37

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/30/2014
Date Data Arrived at EDR: 10/01/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 36

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 12/30/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Annually

SPILLS: Reported Spills
Spills reported to the Spill Prevention, Preparedness and Response Division.

Date of Government Version: 09/15/2014
Date Data Arrived at EDR: 09/18/2014
Date Made Active in Reports: 10/13/2014
Number of Days to Update: 25

Source: Department of Ecology
Telephone: 360-407-6950
Last EDR Contact: 12/08/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Semi-Annually

SPILLS 90: SPILLS90 data from FirstSearch
Spills 90 includes those spill and release records available exclusively from FirstSearch databases. Typically, they may include chemical, oil and/or hazardous substance spills recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.

Date of Government Version: 05/23/2006
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 03/06/2013
Number of Days to Update: 62

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 06/10/2014
Date Data Arrived at EDR: 07/02/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: (206) 553-1200
Last EDR Contact: 12/29/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Varies

DOT OPS: Incident and Accident Data
Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 08/07/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 42

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 11/04/2014
Next Scheduled EDR Contact: 02/16/2015
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 11/07/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 06/06/2014
Date Data Arrived at EDR: 09/10/2014
Date Made Active in Reports: 09/18/2014
Number of Days to Update: 8

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 01/24/2014
Date Made Active in Reports: 02/24/2014
Number of Days to Update: 31

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 12/24/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 11/25/2013
Date Data Arrived at EDR: 12/12/2013
Date Made Active in Reports: 02/24/2014
Number of Days to Update: 74

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 09/14/2010
Date Data Arrived at EDR: 10/07/2011
Date Made Active in Reports: 03/01/2012
Number of Days to Update: 146

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 11/26/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Varies

US MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/05/2014
Date Data Arrived at EDR: 09/04/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 74

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 12/30/2014
Next Scheduled EDR Contact: 03/16/2015
Data Release Frequency: Semi-Annually

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 07/31/2013
Date Made Active in Reports: 09/13/2013
Number of Days to Update: 44

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 11/26/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 64

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/22/2014
Next Scheduled EDR Contact: 04/06/2015
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 11/19/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 11/19/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 07/31/2014
Date Data Arrived at EDR: 10/29/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 8

Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 10/10/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 07/01/2014
Date Data Arrived at EDR: 10/15/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 33

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 10/15/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 07/22/2013
Date Data Arrived at EDR: 08/02/2013
Date Made Active in Reports: 11/01/2013
Number of Days to Update: 91

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 12/04/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 10/07/2014
Date Data Arrived at EDR: 10/08/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 12

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 10/08/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 08/16/2014
Date Data Arrived at EDR: 09/10/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 40

Source: EPA
Telephone: (206) 553-1200
Last EDR Contact: 12/09/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

RMP: Risk Management Plans

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 08/01/2014
Date Data Arrived at EDR: 08/12/2014
Date Made Active in Reports: 11/06/2014
Number of Days to Update: 86

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 10/27/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2011
Date Data Arrived at EDR: 02/26/2013
Date Made Active in Reports: 04/19/2013
Number of Days to Update: 52

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 11/26/2014
Next Scheduled EDR Contact: 03/09/2015
Data Release Frequency: Biennially

UIC: Underground Injection Wells Listing

A listing of underground injection wells.

Date of Government Version: 11/18/2014
Date Data Arrived at EDR: 11/21/2014
Date Made Active in Reports: 12/23/2014
Number of Days to Update: 32

Source: Department of Ecology
Telephone: 360-407-6143
Last EDR Contact: 11/21/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Varies

WA MANIFEST: Hazardous Waste Manifest Data
Hazardous waste manifest information.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 05/23/2014
Date Made Active in Reports: 06/04/2014
Number of Days to Update: 12
Source: Department of Ecology
Telephone: N/A
Last EDR Contact: 10/17/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Annually

DRYCLEANERS: Drycleaner List
A listing of registered drycleaners who registered with the Department of Ecology (using the SIC code of 7215 and 7216) as hazardous waste generators.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 05/23/2014
Date Made Active in Reports: 06/04/2014
Number of Days to Update: 12
Source: Department of Ecology
Telephone: 360-407-6732
Last EDR Contact: 10/17/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Varies

NPDES: Water Quality Permit System Data
A listing of permitted wastewater facilities.

Date of Government Version: 10/21/2014
Date Data Arrived at EDR: 10/23/2014
Date Made Active in Reports: 10/28/2014
Number of Days to Update: 5
Source: Department of Ecology
Telephone: 360-407-6073
Last EDR Contact: 10/23/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Quarterly

AIRS (EMI): Washington Emissions Data System
Emissions inventory data.

Date of Government Version: 12/31/2012
Date Data Arrived at EDR: 03/28/2014
Date Made Active in Reports: 04/22/2014
Number of Days to Update: 25
Source: Department of Ecology
Telephone: 360-407-6040
Last EDR Contact: 12/19/2014
Next Scheduled EDR Contact: 04/06/2015
Data Release Frequency: Annually

INACTIVE DRYCLEANERS: Inactive Drycleaners
A listing of inactive drycleaner facility locations.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 05/23/2014
Date Made Active in Reports: 06/04/2014
Number of Days to Update: 12
Source: Department of Ecology
Telephone: 360-407-6732
Last EDR Contact: 10/17/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Annually

INDIAN RESERV: Indian Reservations
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34
Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 11/07/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Semi-Annually

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing
The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 03/07/2011
Date Data Arrived at EDR: 03/09/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 54
Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 11/18/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Varies

FEDLAND: Federal and Indian Lands

Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339
Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 11/07/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: N/A

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 11/11/2011
Date Data Arrived at EDR: 05/18/2012
Date Made Active in Reports: 05/25/2012
Number of Days to Update: 7
Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 11/14/2014
Next Scheduled EDR Contact: 02/23/2015
Data Release Frequency: Varies

PRP: Potentially Responsible Parties

A listing of verified Potentially Responsible Parties

Date of Government Version: 10/25/2013
Date Data Arrived at EDR: 10/17/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 3
Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 12/29/2015
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Quarterly

LEAD SMELTER 2: Lead Smelter Sites

A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36
Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Financial Assurance 1: Financial Assurance Information Listing

A listing of financial assurance information for underground storage tank facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 02/24/2012
Date Data Arrived at EDR: 02/24/2012
Date Made Active in Reports: 03/27/2012
Number of Days to Update: 32
Source: Department of Ecology
Telephone: 360-586-1060
Last EDR Contact: 11/17/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

LEAD SMELTER 1: Lead Smelter Sites
A listing of former lead smelter site locations.

Date of Government Version: 06/04/2014
Date Data Arrived at EDR: 06/12/2014
Date Made Active in Reports: 07/28/2014
Number of Days to Update: 46

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 10/06/2014
Next Scheduled EDR Contact: 01/19/2015
Data Release Frequency: Varies

Financial Assurance 3: Financial Assurance Information Listing
A listing of financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 02/01/2001
Date Data Arrived at EDR: 03/06/2007
Date Made Active in Reports: 04/19/2007
Number of Days to Update: 44

Source: Department of Ecology
Telephone: 360-407-6136
Last EDR Contact: 11/18/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Varies

Financial Assurance 2: Financial Assurance Information Listing
A listing of financial assurance information for hazardous waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 05/23/2011
Date Data Arrived at EDR: 05/26/2011
Date Made Active in Reports: 06/27/2011
Number of Days to Update: 32

Source: Department of Ecology
Telephone: 360-407-6754
Last EDR Contact: 11/17/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Varies

EPA WATCH LIST: EPA WATCH LIST
EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

Date of Government Version: 08/30/2013
Date Data Arrived at EDR: 03/21/2014
Date Made Active in Reports: 06/17/2014
Number of Days to Update: 88

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 11/14/2014
Next Scheduled EDR Contact: 02/23/2015
Data Release Frequency: Quarterly

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 02/01/2011
Date Data Arrived at EDR: 10/19/2011
Date Made Active in Reports: 01/10/2012
Number of Days to Update: 83

Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 10/31/2014
Next Scheduled EDR Contact: 02/09/2015
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information
All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 09/04/2014
Date Data Arrived at EDR: 09/04/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 46

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 11/11/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: Quarterly

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 07/01/2014
Date Data Arrived at EDR: 09/10/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

COAL ASH: Coal Ash Disposal Site Listing
A listing of coal ash disposal site locations.

Date of Government Version: 09/10/2014
Date Data Arrived at EDR: 09/11/2014
Date Made Active in Reports: 10/15/2014
Number of Days to Update: 34

Source: Department of Ecology
Telephone: 360-407-6933
Last EDR Contact: 12/08/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

COAL ASH DOE: Sleam-Electric Plan Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 10/17/2014
Next Scheduled EDR Contact: 01/26/2015
Data Release Frequency: Varies

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)
The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 10/16/2014
Date Data Arrived at EDR: 10/31/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 17

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 12/23/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Annually

US AIRS MINOR: Air Facility System Data
A listing of minor source facilities.

Date of Government Version: 10/16/2014
Date Data Arrived at EDR: 10/31/2014
Date Made Active in Reports: 11/17/2014
Number of Days to Update: 17

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 12/23/2014
Next Scheduled EDR Contact: 04/13/2015
Data Release Frequency: Annually

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR US Hist Auto Stat: EDR Exclusive Historic Gas Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR US Hist Cleaners: EDR Exclusive Historic Dry Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Ecology in Washington.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/10/2014
Number of Days to Update: 193

Source: Department of Ecology
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Ecology in Washington.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Ecology
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA LUST: Recovered Government Archive Leaking Underground Storage Tank

The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Ecology in Washington.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Ecology
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

COUNTY RECORDS

KING COUNTY:

Abandoned Landfill Study in King County

The King County Abandoned Landfill Survey was conducted from October through December 1984 by the Health Department's Environmental Health Division at the request of the King County Council. The primary objective of the survey was to determine if any public health problems existed at the predetermined 24 sites.

Date of Government Version: 04/30/1985
Date Data Arrived at EDR: 11/07/1994
Date Made Active in Reports: N/A
Number of Days to Update: 0

Source: Seattle-King County Department of Public Health
Telephone: 206-296-4785
Last EDR Contact: 10/21/1994
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SEATTLE COUNTY:

Abandoned Landfill Study in the City of Seattle

The Seattle Abandoned Landfill Survey was conducted in June and July of 1984 by the Health Department's Environmental Health Division at the request of the Mayor's Office. The primary objective of the survey was to determine if any public health problems existed at the predetermined 12 sites.

Date of Government Version: 07/30/1984
Date Data Arrived at EDR: 11/07/1994
Date Made Active in Reports: N/A
Number of Days to Update: 0

Source: Seattle - King County Department of Public Health
Telephone: 206-296-4785
Last EDR Contact: 10/21/1994
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SEATTLE/KING COUNTY:

Seattle - King County Abandoned Landfill Toxicity / Hazard Assessment Project

This report presents the Seattle-King County Health Department's follow-up investigation of two city owned and four county owned abandoned landfills which was conducted from February to December 1986.

Date of Government Version: 12/31/1986
Date Data Arrived at EDR: 08/18/1995
Date Made Active in Reports: 09/20/1995
Number of Days to Update: 33

Source: Department of Public Health
Telephone: 206-296-4785
Last EDR Contact: 08/14/1995
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SNOHOMISH COUNTY:

Solid Waste Sites of Record at Snohomish Health District
Solid waste disposal and/or utilization sites in Snohomish County.

Date of Government Version: 11/16/2011
Date Data Arrived at EDR: 03/29/2012
Date Made Active in Reports: 05/03/2012
Number of Days to Update: 35

Source: Snohomish Health District
Telephone: 206-339-5250
Last EDR Contact: 12/22/2014
Next Scheduled EDR Contact: 04/06/2015
Data Release Frequency: Semi-Annually

TACOMA/PIERCE COUNTY:

Closed Landfill Survey
Following numerous requests for information about closed dumpsites and landfills in Pierce County, the Tacoma-Pierce County Health Department decided to conduct a study on the matter. The aim of the study was to evaluate public health risks associated with the closed dumpsites and landfills, and to determine the need, if any, for further investigations of a more detailed nature. The sites represent all of the known dumpsites and landfills closed after 1950.

Date of Government Version: 09/01/2002
Date Data Arrived at EDR: 03/24/2003
Date Made Active in Reports: 05/14/2003
Number of Days to Update: 51

Source: Tacoma-Pierce County Health Department
Telephone: 206-591-6500
Last EDR Contact: 03/19/2003
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data
Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 07/30/2013
Date Data Arrived at EDR: 08/19/2013
Date Made Active in Reports: 10/03/2013
Number of Days to Update: 45

Source: Department of Energy & Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 11/17/2014
Next Scheduled EDR Contact: 03/02/2015
Data Release Frequency: No Update Planned

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 11/01/2014
Date Data Arrived at EDR: 11/05/2014
Date Made Active in Reports: 11/24/2014
Number of Days to Update: 19

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 11/05/2014
Next Scheduled EDR Contact: 02/16/2015
Data Release Frequency: Annually

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 07/21/2014
Date Made Active in Reports: 08/25/2014
Number of Days to Update: 35

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 10/20/2014
Next Scheduled EDR Contact: 02/02/2015
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 06/20/2014
Date Made Active in Reports: 08/07/2014
Number of Days to Update: 48

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/30/2015
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Daycare Center Listing
Source: Department of Social & Health Services
Telephone: 253-383-1735

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

NEWCASTLE
6620 COAL CREEK PARKWAY SE
RENTON, WA 98059

TARGET PROPERTY COORDINATES

Latitude (North):	47.5436 - 47° 32' 36.96''
Longitude (West):	122.1612 - 122° 9' 40.32''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	563122.4
UTM Y (Meters):	5265697.5
Elevation:	375 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	47122-E2 MERCER ISLAND, WA
Most Recent Revision:	1983

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

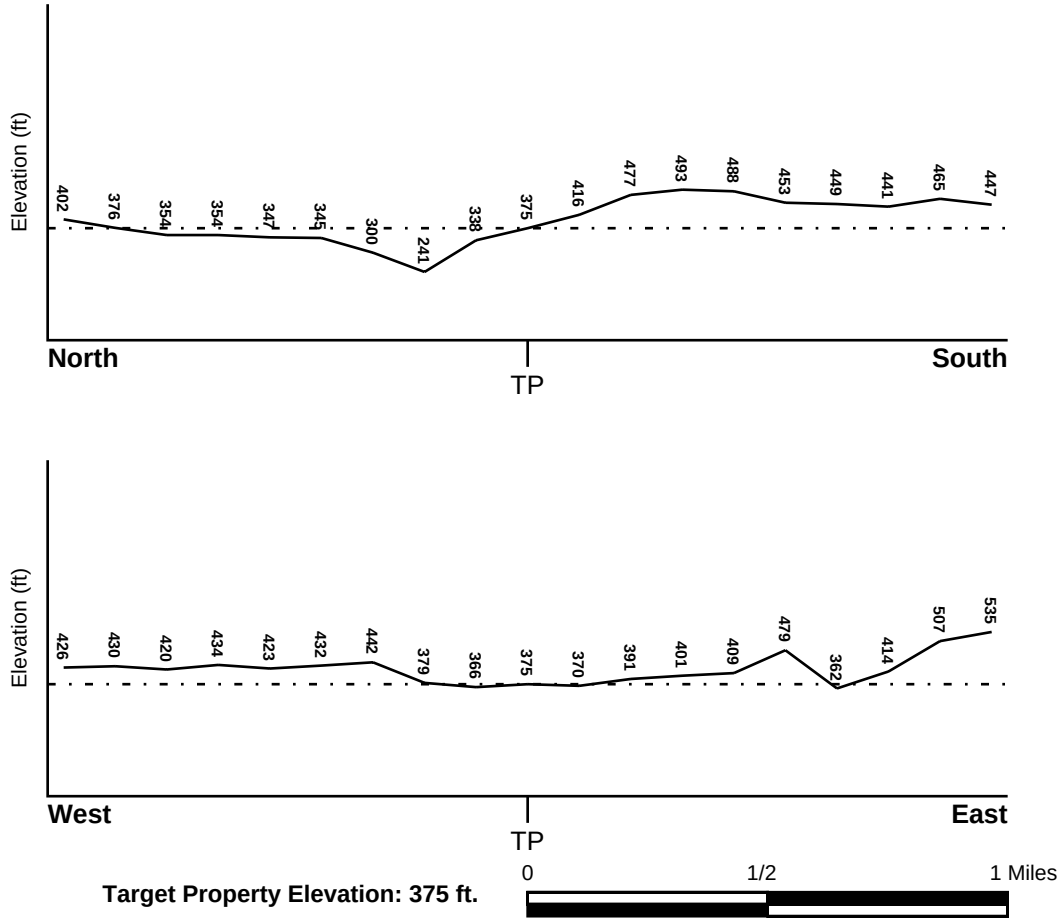
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General North

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
KING, WA	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property:	53033C0666F - FEMA Q3 Flood data
Additional Panels in search area:	53033C0667F - FEMA Q3 Flood data 53033C0669F - FEMA Q3 Flood data 53033C0668F - FEMA Q3 Flood data

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
MERCER ISLAND	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Site-Specific Hydrogeological Data*:

Search Radius:	1.25 miles
Status:	Not found

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
3	1/2 - 1 Mile WSW	W

For additional site information, refer to Physical Setting Source Map Findings.

* ©1996 Site−specific hydrogeological data gathered by CERCLIS Alerts, Inc., Bainbridge Island, WA. All rights reserved. All of the information and opinions presented are those of the cited EPA report(s), which were completed under a Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) investigation.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

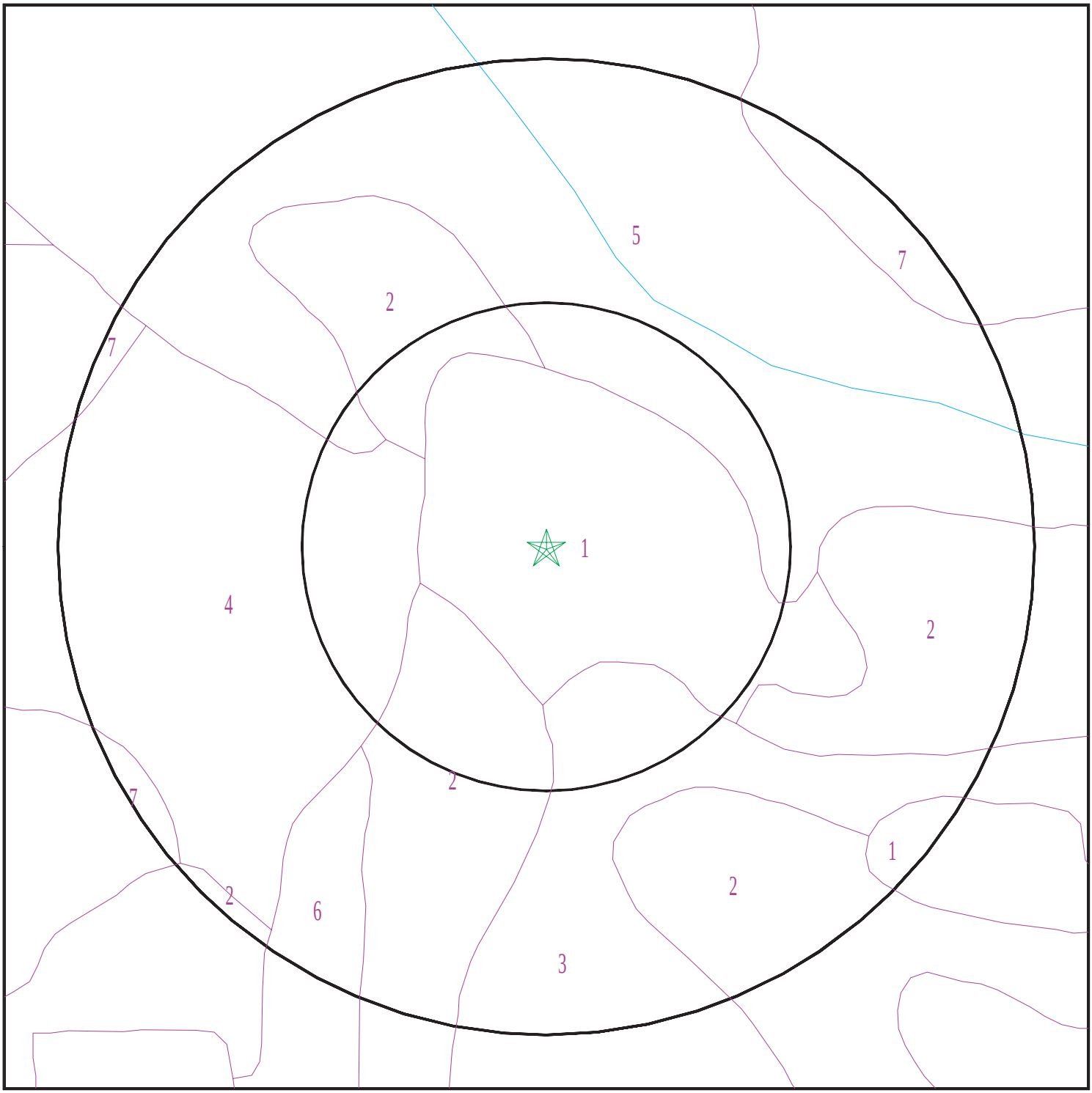
Era:	Cenozoic
System:	Tertiary
Series:	Eocene
Code:	Te *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratifed Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

SSURGO SOIL MAP - 4171904.2s



SITE NAME:	Newcastle	CLIENT:	Environmental Partners
ADDRESS:	6620 Coal Creek Parkway SE Renton WA 98059	CONTACT:	Monica Mogg
LAT/LONG:	47.5436 / 122.1612	INQUIRY #:	4171904.2s
		DATE:	January 05, 2015 9:12 am

Copyright © 2015 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. The following information is based on Soil Conservation Service SSURGO data.

Soil Map ID: 1

Soil Component Name:	Urban land
Soil Surface Texture:	
Hydrologic Group:	Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Soil Drainage Class:	
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	Not Reported
Depth to Bedrock Min:	> 0 inches
Depth to Watertable Min:	> 0 inches

No Layer Information available.

Soil Map ID: 2

Soil Component Name:	Beausite
Soil Surface Texture:	gravelly sandy loam
Hydrologic Group:	Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.
Soil Drainage Class:	Well drained
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	Moderate
Depth to Bedrock Min:	> 97 inches
Depth to Watertable Min:	> 0 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 14 Min: 4	Max: 6.5 Min: 5.6
2	5 inches	18 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 14 Min: 4	Max: 6.5 Min: 5.6
3	18 inches	37 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 14 Min: 4	Max: 6 Min: 5.6
4	37 inches	42 inches		Not reported	Not reported	Max: Min:	Max: Min:

Soil Map ID: 3

Soil Component Name: Beausite

Soil Surface Texture: gravelly sandy loam

Hydrologic Group: Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.

Soil Drainage Class: Well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 97 inches

Depth to Watertable Min: > 0 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 14 Min: 4	Max: 6.5 Min: 5.6
2	5 inches	18 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 14 Min: 4	Max: 6.5 Min: 5.6
3	18 inches	37 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 14 Min: 4	Max: 6 Min: 5.6
4	37 inches	42 inches		Not reported	Not reported	Max: Min:	Max: Min:

Soil Map ID: 4

Soil Component Name: Alderwood

Soil Surface Texture: gravelly sandy loam

Hydrologic Group: Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.

Soil Drainage Class: Moderately well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 84 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	11 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1
2	11 inches	40 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1
3	40 inches	59 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 0.42 Min: 0.01	Max: 6 Min: 5.1

Soil Map ID: 5

Soil Component Name: Alderwood

Soil Surface Texture: gravelly sandy loam

Hydrologic Group: Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.

Soil Drainage Class: Moderately well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 69 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	11 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1
2	11 inches	26 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1
3	26 inches	59 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 0.42 Min: 0.01	Max: 6 Min: 5.1

Soil Map ID: 6

Soil Component Name: Seattle

Soil Surface Texture: muck

Hydrologic Group: Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.

Soil Drainage Class: Very poorly drained

Hydric Status: All hydric

Corrosion Potential - Uncoated Steel: High

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	11 inches	muck	A-8	Highly organic soils, Peat.	Max: 14 Min: 4	Max: Min:
2	11 inches	59 inches	stratified mucky peat to muck	A-8	Highly organic soils, Peat.	Max: 14 Min: 4	Max: Min:

Soil Map ID: 7

Soil Component Name: Alderwood

Soil Surface Texture: gravelly sandy loam

Hydrologic Group: Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.

Soil Drainage Class: Moderately well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 84 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	11 inches	gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1
2	11 inches	26 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 42 Min: 14	Max: 6 Min: 5.1

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
3	26 inches	59 inches	very gravelly sandy loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 0.42 Min: 0.01	Max: 6 Min: 5.1

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 0.001 miles
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
A1	USGS40001261694	1/4 - 1/2 Mile WSW
A2	USGS40001261691	1/4 - 1/2 Mile SW
4	USGS40001261712	1/2 - 1 Mile WSW
5	USGS40001262154	1/2 - 1 Mile NW
6	USGS40001261771	1/2 - 1 Mile West

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

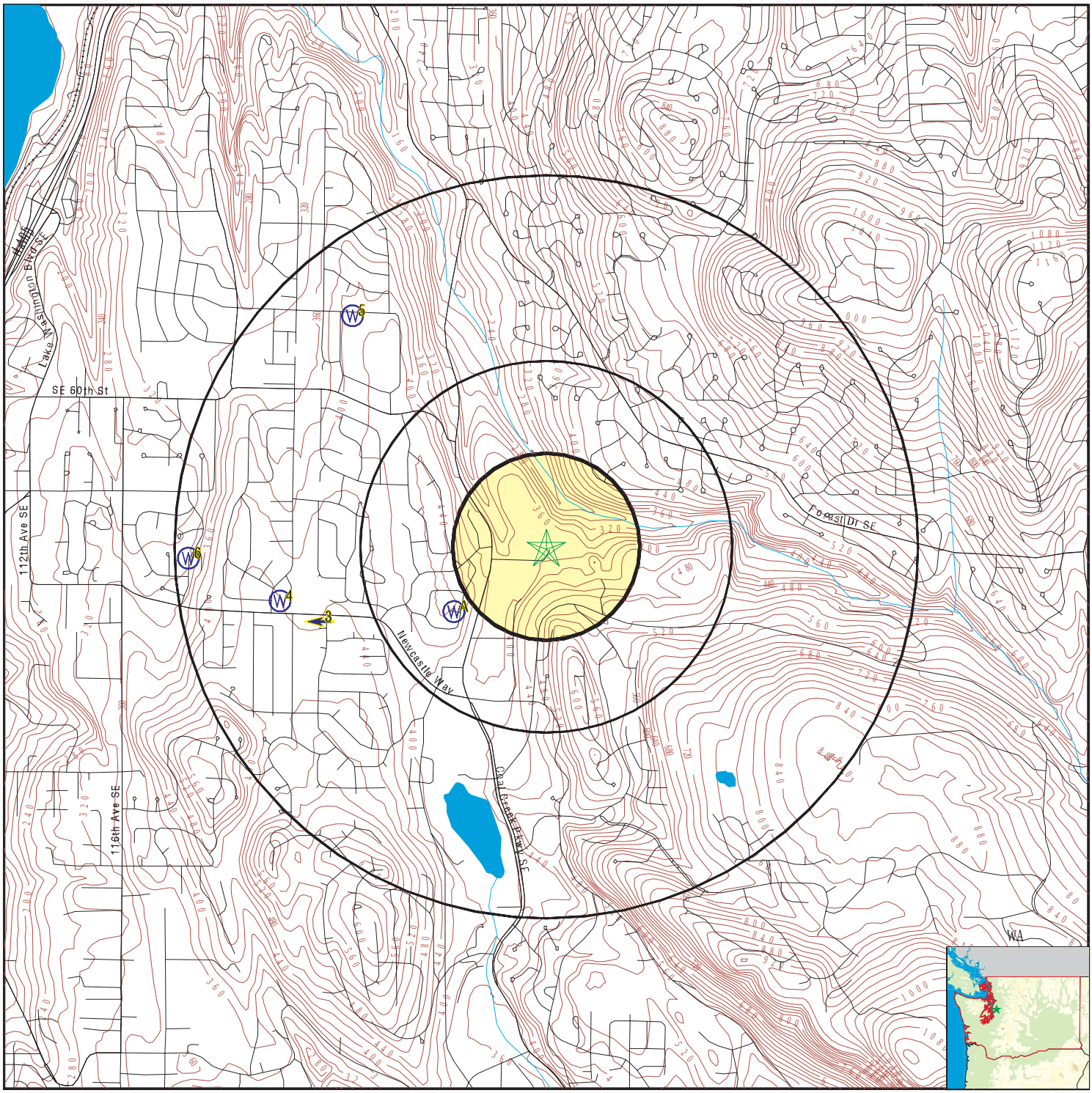
Note: PWS System location is not always the same as well location.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 4171904.2s



0 1/4 1/2 1 Miles

- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location
- HD Closest Hydrogeological Data

N

SITE NAME:	Newcastle	CLIENT:	Environmental Partners
ADDRESS:	6620 Coal Creek Parkway SE Renton WA 98059	CONTACT:	Monica Mogg
LAT/LONG:	47.5436 / 122.1612	INQUIRY #:	4171904.2s
		DATE:	January 05, 2015 9:12 am

Copyright © 2015 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation | Database | EDR ID Number

A1
WSW **FED USGS** **USGS40001261694**
1/4 - 1/2 Mile
Higher

Org. Identifier:	USGS-WA		
Formal name:	USGS Washington Water Science Center		
Monloc Identifier:	USGS-473229122334501		
Monloc name:	24N/05E-16R01		
Monloc type:	Well		
Monloc desc:	Not Reported		
Huc code:	17110012	Drainagearea value:	Not Reported
Drainagearea Units:	Not Reported	Contrib drainagearea:	Not Reported
Contrib drainagearea units:	Not Reported	Latitude:	47.541211
Longitude:	-122.1665105	Sourcemap scale:	24000
Horiz Acc measure:	1	Horiz Acc measure units:	seconds
Horiz Collection method:	Interpolated from map		
Horiz coord refsys:	NAD83	Vert measure val:	200
Vert measure units:	feet	Vertacc measure val:	2
Vert accmeasure units:	feet		
Vertcollection method:	Interpolated from topographic map		
Vert coord refsys:	NGVD29	Countrycode:	US
Aquifername:	Not Reported		
Formation type:	Not Reported		
Aquifer type:	Not Reported		
Construction date:	19010101	Welldepth:	100
Welldepth units:	ft	Wellholedepth:	Not Reported
Wellholedepth units:	Not Reported		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1952-01-01	2	

A2
SW **FED USGS** **USGS40001261691**
1/4 - 1/2 Mile
Higher

Org. Identifier:	USGS-WA		
Formal name:	USGS Washington Water Science Center		
Monloc Identifier:	USGS-473228122334401		
Monloc name:	24N/05E-16R02		
Monloc type:	Well		
Monloc desc:	Not Reported		
Huc code:	17110012	Drainagearea value:	Not Reported
Drainagearea Units:	Not Reported	Contrib drainagearea:	Not Reported
Contrib drainagearea units:	Not Reported	Latitude:	47.5409332
Longitude:	-122.1665105	Sourcemap scale:	24000
Horiz Acc measure:	1	Horiz Acc measure units:	seconds
Horiz Collection method:	Interpolated from map		
Horiz coord refsys:	NAD83	Vert measure val:	200
Vert measure units:	feet	Vertacc measure val:	2
Vert accmeasure units:	feet		
Vertcollection method:	Interpolated from topographic map		
Vert coord refsys:	NGVD29	Countrycode:	US
Aquifername:	Not Reported		
Formation type:	Not Reported		

Aquifer type:	Not Reported		
Construction date:	19470108	Welldepth:	100
Welldepth units:	ft	Wellholedepth:	Not Reported
Wellholedepth units:	Not Reported		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1947-01-08	2	

3
WSW
1/2 - 1 Mile
Higher

Site ID:	2498	**AQUIFLOW**	**61470**
Groundwater Flow:	W		
Shallowest Water Table Depth:	6		
Deepest Water Table Depth:	8		
Average Water Table Depth:	Not Reported		
Date:	07/17/1991		

4
WSW
1/2 - 1 Mile
Higher

FED USGS **USGS40001261712**

Org. Identifier:	USGS-WA		
Formal name:	USGS Washington Water Science Center		
Monloc Identifier:	USGS-473230122103101		
Monloc name:	24N/05E-08K02		
Monloc type:	Well		
Monloc desc:	Not Reported		
Huc code:	17110012	Drainagearea value:	Not Reported
Drainagearea Units:	Not Reported	Contrib drainagearea:	Not Reported
Contrib drainagearea units:	Not Reported	Latitude:	47.5414887
Longitude:	-122.1765106	Sourcemap scale:	24000
Horiz Acc measure:	1	Horiz Acc measure units:	seconds
Horiz Collection method:	Interpolated from map		
Horiz coord refsys:	NAD83	Vert measure val:	140
Vert measure units:	feet	Vertacc measure val:	2
Vert accmeasure units:	feet		
Vertcollection method:	Interpolated from topographic map		
Vert coord refsys:	NGVD29	Countrycode:	US
Aquifername:	Not Reported		
Formation type:	Not Reported		
Aquifer type:	Not Reported		
Construction date:	19510101	Welldepth:	45
Welldepth units:	ft	Wellholedepth:	Not Reported
Wellholedepth units:	Not Reported		

Ground-water levels, Number of Measurements: 0

5
NW
1/2 - 1 Mile
Higher

FED USGS **USGS40001262154**

Org. Identifier:	USGS-WA		
Formal name:	USGS Washington Water Science Center		
Monloc Identifier:	USGS-473310122101601		
Monloc name:	22N/05E-21B02		
Monloc type:	Well		
Monloc desc:	Not Reported		
Huc code:	17110013	Drainagearea value:	Not Reported
Drainagearea Units:	Not Reported	Contrib drainagearea:	Not Reported
Contrib drainagearea units:	Not Reported	Latitude:	47.5525998
Longitude:	-122.172344	Sourcemap scale:	24000
Horiz Acc measure:	1	Horiz Acc measure units:	seconds
Horiz Collection method:	Interpolated from map		
Horiz coord refsys:	NAD83	Vert measure val:	485
Vert measure units:	feet	Vertacc measure val:	3
Vert accmeasure units:	feet		
Vertcollection method:	Interpolated from topographic map		
Vert coord refsys:	NGVD29	Countrycode:	US
Aquifername:	Not Reported		
Formation type:	Not Reported		
Aquifer type:	Not Reported		
Construction date:	19611003	Welldepth:	30
Welldepth units:	ft	Wellholedepth:	Not Reported
Wellholedepth units:	Not Reported		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1961-10-03	11	

6
West
1/2 - 1 Mile
Lower

FED USGS **USGS40001261771**

Org. Identifier:	USGS-WA		
Formal name:	USGS Washington Water Science Center		
Monloc Identifier:	USGS-473236122105001		
Monloc name:	24N/05E-28D01		
Monloc type:	Well		
Monloc desc:	Not Reported		
Huc code:	17110012	Drainagearea value:	Not Reported
Drainagearea Units:	Not Reported	Contrib drainagearea:	Not Reported
Contrib drainagearea units:	Not Reported	Latitude:	47.5431553
Longitude:	-122.1817885	Sourcemap scale:	24000
Horiz Acc measure:	5	Horiz Acc measure units:	seconds
Horiz Collection method:	Interpolated from map		
Horiz coord refsys:	NAD83	Vert measure val:	312
Vert measure units:	feet	Vertacc measure val:	1
Vert accmeasure units:	feet		
Vertcollection method:	Interpolated from topographic map		
Vert coord refsys:	NGVD29	Countrycode:	US
Aquifername:	Not Reported		
Formation type:	Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Aquifer type:	Not Reported		
Construction date:	19750502	Welldepth:	139
Welldepth units:	ft	Wellholedepth:	139
Wellholedepth units:	ft		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1975-05-02	1	

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

Federal EPA Radon Zone for KING County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 98059

Number of sites tested: 2

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.100 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Water Wells
Source: Department of Health
Telephone: 360-236-3148
Group A and B well locations.

Water Well Listing
Source: Public Utility District
Telephone: 206-779-7656
A listing of water well locations in Kitsap County.

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Listing
Source: Department of Natural Resources
Telephone: 360-902-1450
Locations that represent oil and gas test well sites in Washington State from 1890 to present.

RADON

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

Attachment F
Sanborn Map Report

Former Mutual Materials Site
6620 COAL CREEK PKWY SE
Renton, WA 98059

Inquiry Number: 3444311.3
October 30, 2012

Certified Sanborn® Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

10/30/12

Site Name:
Former Mutual Materials Site
6620 COAL CREEK PKWY SE
Renton, WA 98059

Client Name:
Environmental Partners
295 Northeast Gilman
Issaquah, WA 98027

EDR Inquiry # 3444311.3

Contact: Greg Mccormick

EDR® Environmental Data Resources Inc

The complete Sanborn Library collection has been searched by EDR, and fire insurance maps covering the target property location provided by Environmental Partners were identified for the years listed below. The certified Sanborn Library search results in this report can be authenticated by visiting www.edrnet.com/sanborn and entering the certification number. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by Sanborn Library LLC, the copyright holder for the collection.

Certified Sanborn Results:

Site Name: Former Mutual Materials Site
Address: 6620 COAL CREEK PKWY SE
City, State, Zip: Renton, WA 98059
Cross Street:
P.O. # Pending
Project: Former Mutual Materials Site
Certification # F164-4C35-831D

Sanborn® Library search results
Certification # F164-4C35-831D

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

The Sanborn Library includes more than 1.2 million Sanborn fire insurance maps, which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ✓ Library of Congress
- ✓ University Publications of America
- ✓ EDR Private Collection

The Sanborn Library LLC Since 1866™

Limited Permission To Make Copies

Environmental Partners (the client) is permitted to make up to THREE photocopies of this Sanborn Map transmittal and each fire insurance map accompanying this report solely for the limited use of its customer. No one other than the client is authorized to make copies. Upon request made directly to an EDR Account Executive, the client may be permitted to make a limited number of additional photocopies. This permission is conditioned upon compliance by the client, its customer and their agents with EDR's copyright policy; a copy of which is available upon request.

Disclaimer - Copyright and Trademark notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT. Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2012 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

Attachment G
Topographic Map Report

Former Mutual Materials Site
6620 COAL CREEK PKWY SE
Renton, WA 98059

Inquiry Number: 3444311.4
October 31, 2012

EDR Historical Topographic Map Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

EDR Historical Topographic Map Report

Environmental Data Resources, Inc.s (EDR) Historical Topographic Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topographic Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the early 1900s.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report AS IS. Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2012 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

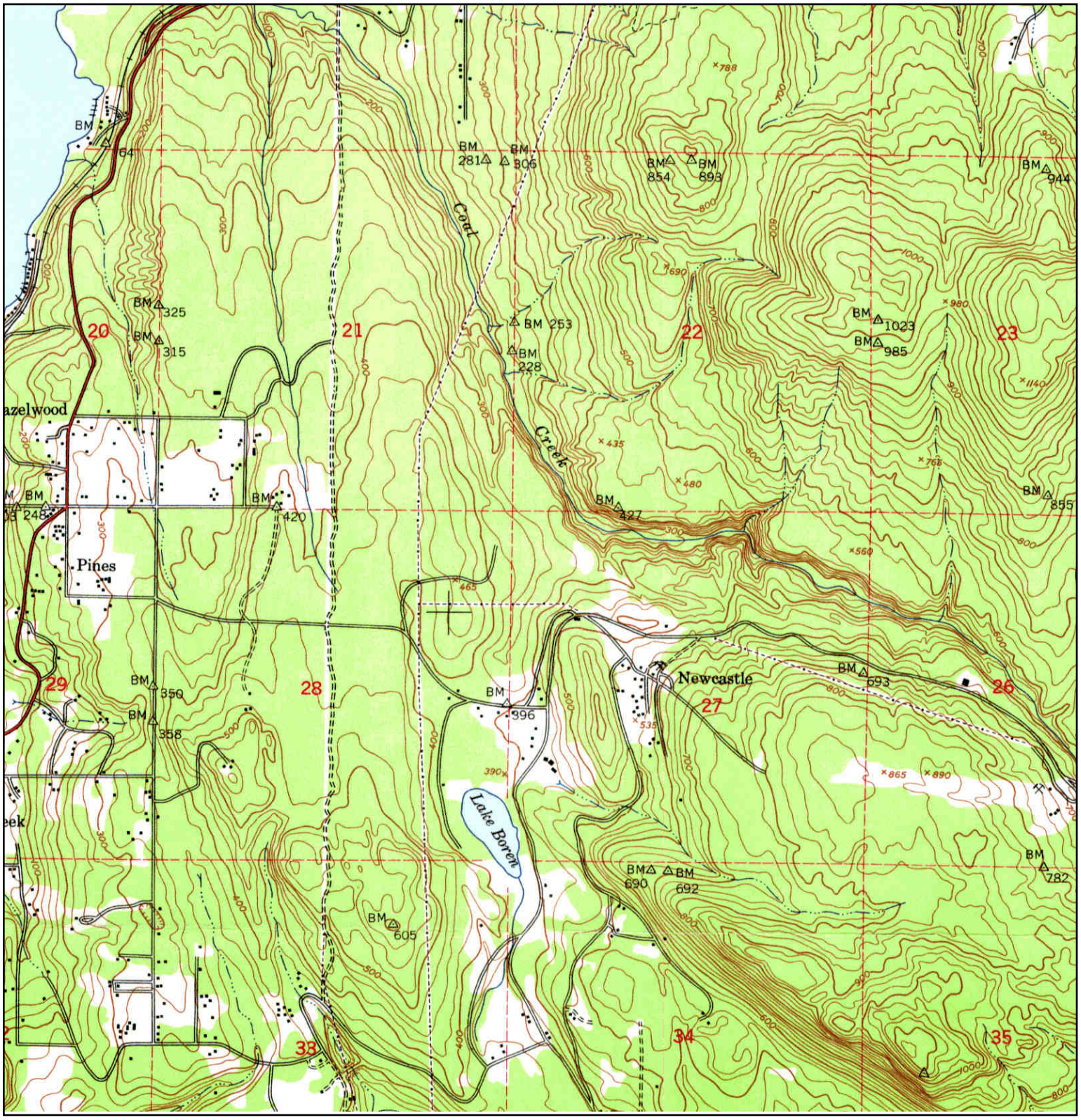
Historical Topographic Map

N	TARGET QUAD NAME: SNOHOMISH MAP YEAR: 1895 SERIES: 30 SCALE: 1:125000	SITE NAME: Former Mutual Materials Site ADDRESS: 6620 COAL CREEK PKWY SE Renton, WA 98059 LAT/LONG: 47.5438 / -122.1608	CLIENT: Environmental Partners CONTACT: Greg Mccormick INQUIRY#: 3444311.4 RESEARCH DATE: 10/31/2012

Historical Topographic Map

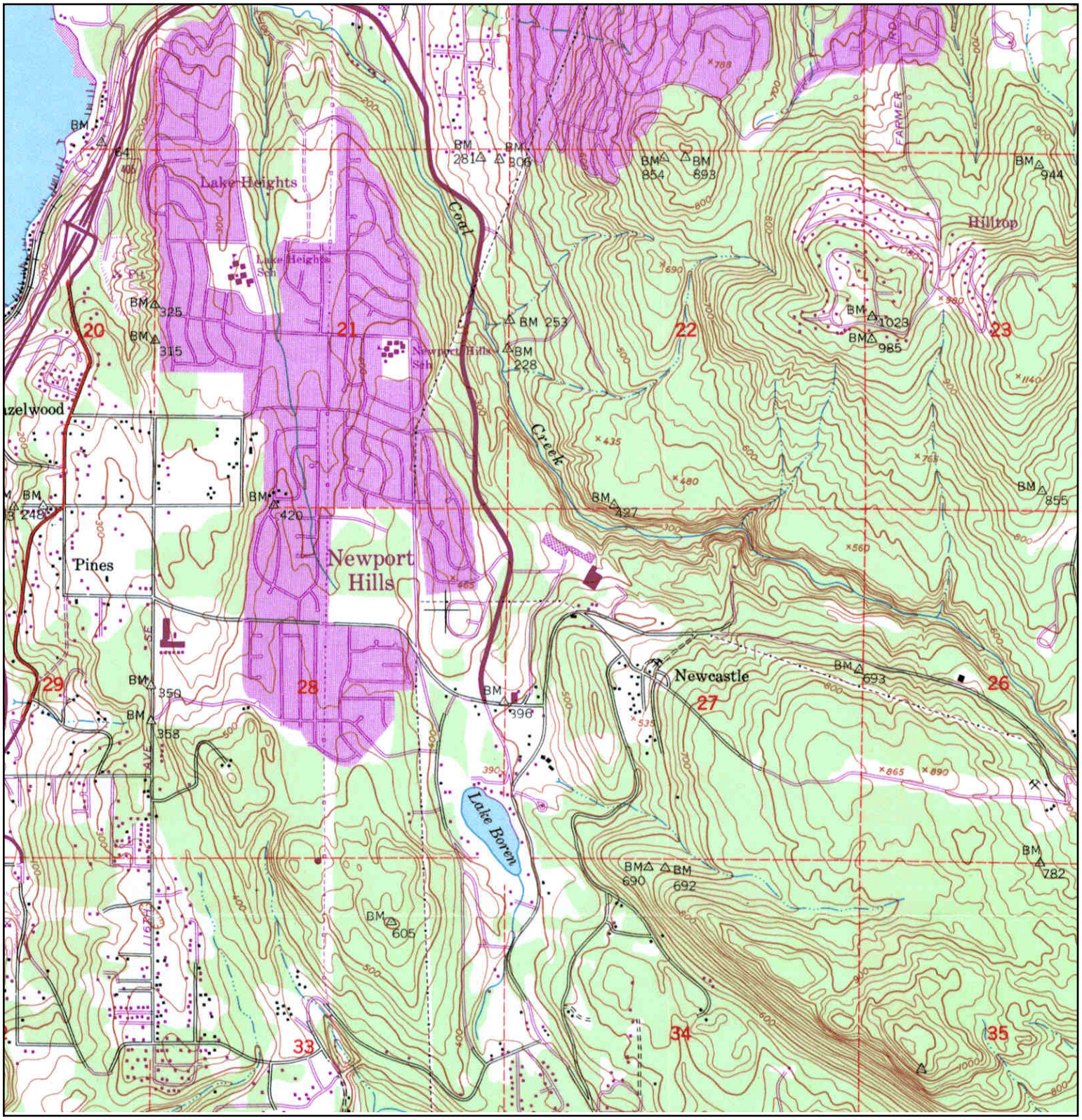
N	TARGET QUAD NAME: SEATTLE MAP YEAR: 1897 SERIES: 30 SCALE: 1:125000	SITE NAME: Former Mutual Materials Site ADDRESS: 6620 COAL CREEK PKWY SE Renton, WA 98059 LAT/LONG: 47.5438 / -122.1608	CLIENT: Environmental Partners CONTACT: Greg Mccormick INQUIRY#: 3444311.4 RESEARCH DATE: 10/31/2012

Historical Topographic Map



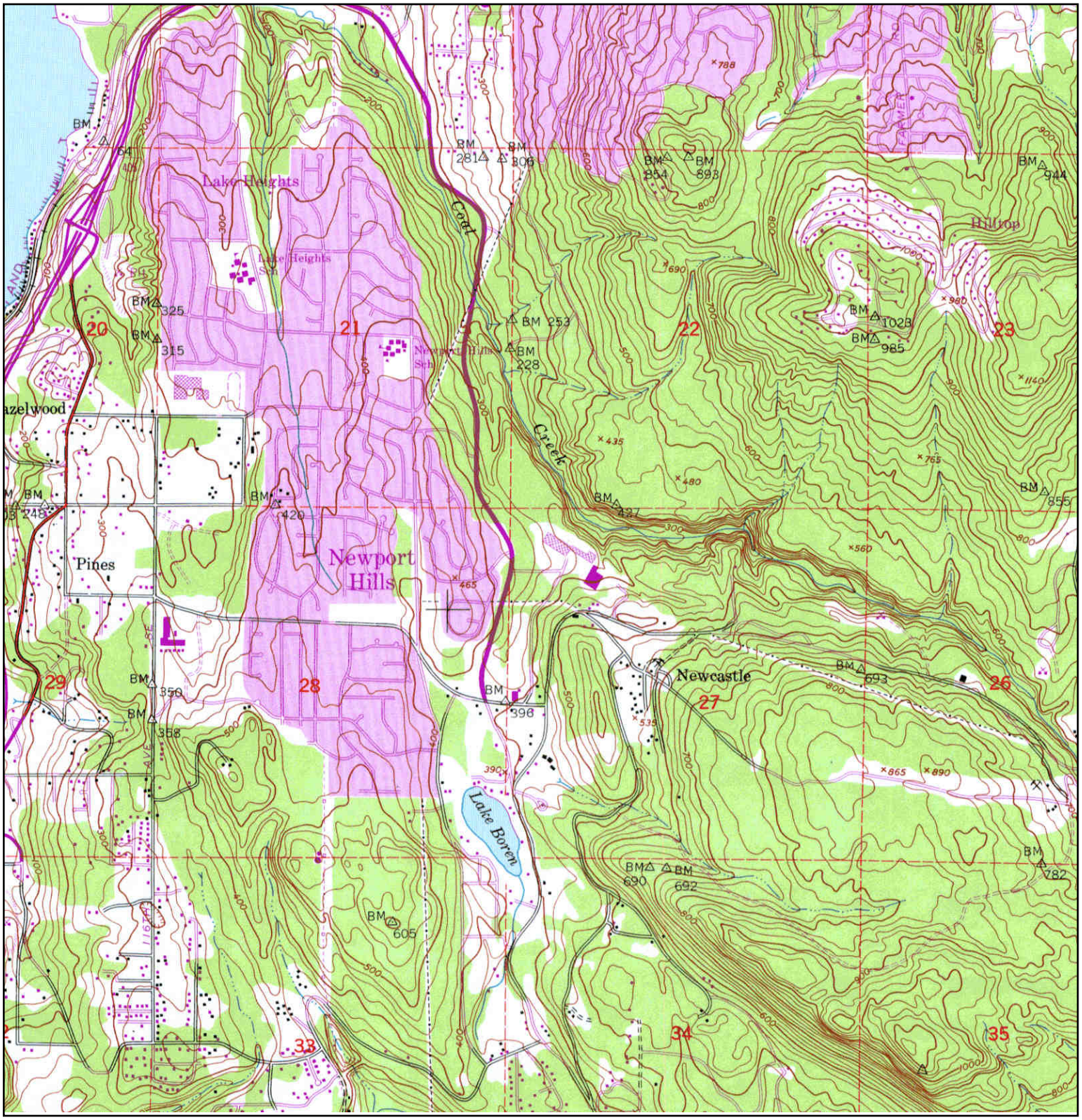
N	TARGET QUAD			
	NAME:	MERCER ISLAND	SITE NAME: Former Mutual Materials Site	CLIENT: Environmental Partners
	MAP YEAR:	1950	ADDRESS: 6620 COAL CREEK PKWY SE	CONTACT: Greg Mccormick
			Renton, WA 98059	INQUIRY#: 3444311.4
	SERIES:	7.5	LAT/LONG: 47.5438 / -122.1608	RESEARCH DATE: 10/31/2012
	SCALE:	1:24000		

Historical Topographic Map



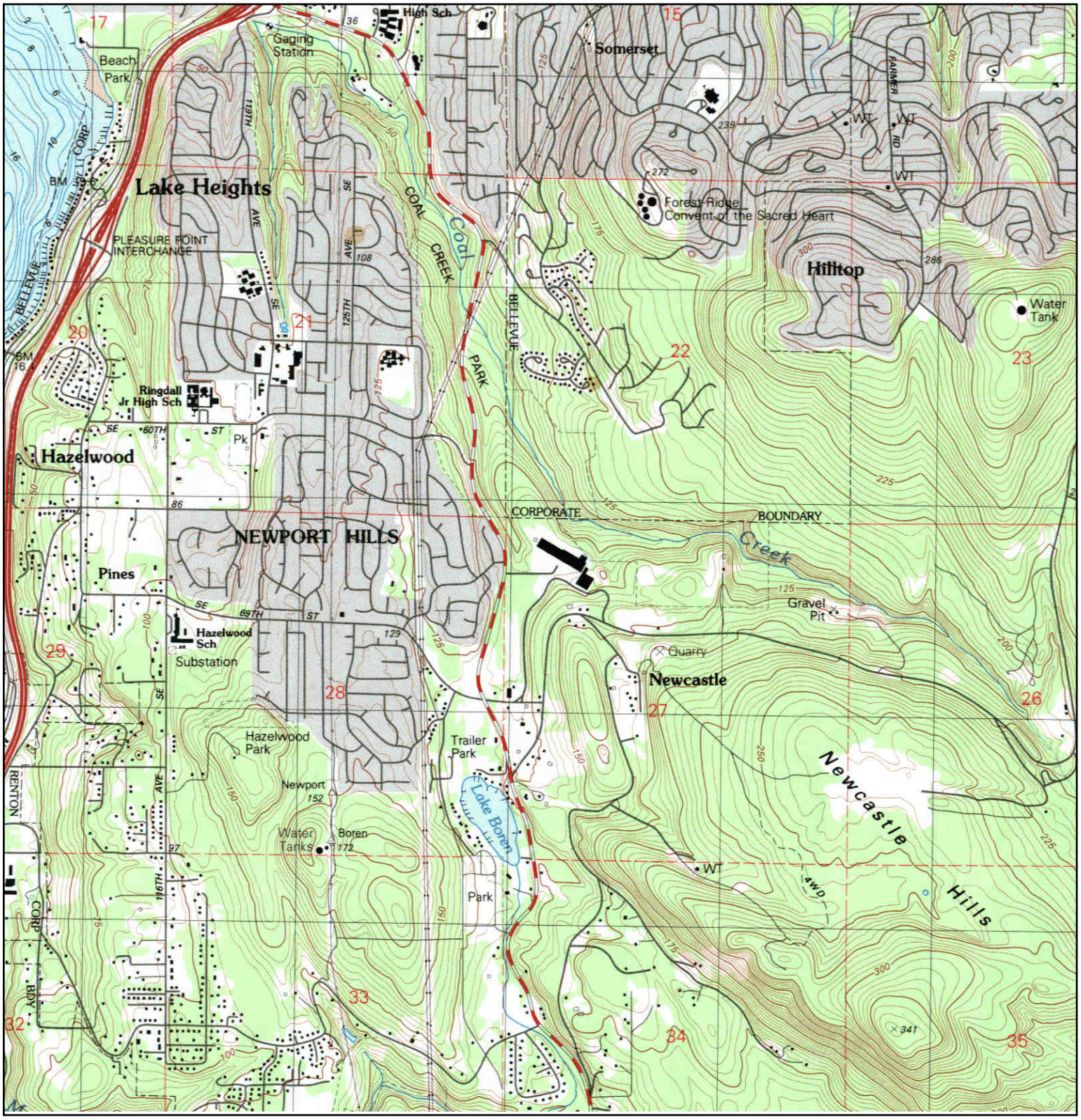
N	TARGET QUAD	SITE NAME: Former Mutual Materials Site	CLIENT: Environmental Partners
	NAME: MERCER ISLAND	ADDRESS: 6620 COAL CREEK PKWY SE	CONTACT: Greg Mccormick
	MAP YEAR: 1968	Renton, WA 98059	INQUIRY#: 3444311.4
	PHOTOREVISED FROM :1950	LAT/LONG: 47.5438 / -122.1608	RESEARCH DATE: 10/31/2012
	SERIES: 7.5		
	SCALE: 1:24000		

Historical Topographic Map



N	TARGET QUAD				
	NAME:	MERCER ISLAND	SITE NAME:	Former Mutual Materials Site	CLIENT: Environmental Partners
	MAP YEAR:	1973	ADDRESS:	6620 COAL CREEK PKWY SE	CONTACT: Greg Mccormick
	PHOTOREVISED FROM :	1950		Renton, WA 98059	INQUIRY#: 3444311.4
	SERIES:	7.5	LAT/LONG:	47.5438 / -122.1608	RESEARCH DATE: 10/31/2012
	SCALE:	1:24000			

Historical Topographic Map



N	TARGET QUAD NAME: BELLEVUE SOUTH MAP YEAR: 1983 SERIES: 7.5 SCALE: 1:25000	SITE NAME: Former Mutual Materials Site ADDRESS: 6620 COAL CREEK PKWY SE Renton, WA 98059 LAT/LONG: 47.5438 / -122.1608	CLIENT: Environmental Partners CONTACT: Greg Mccormick INQUIRY#: 3444311.4 RESEARCH DATE: 10/31/2012

Attachment H
Site Photographs

PHOTO 1: Brick storage shed on the south side of the Mutual Materials brick plant.

PHOTO 2: Pallets of rejected bricks on the south side of the Mutual Materials brick plant.

PHOTO 3: Former fenced enclosure for a 500-gallon diesel aboveground storage tank (AST).

PHOTO 4: Access road to The Approach apartments on 132nd Place SE.

PHOTO 5: Stream flow from a former coal mine along SE 132nd Place SE.

PHOTO 6: Clay storage shed on the east side of the former brick plant.

PHOTO 7: Scale house and scale southwest of the clay storage sheds.

PHOTO 8: Discarded bricks on the east side of the former brick plant.

PHOTO 9: Clay material and discarded brick in a brick storage shed.

PHOTO 10: Location of the former brick plant buildings looking east to west.

PHOTO 11: Oil release from machinery on the east side of the former brick plant.

PHOTO 12: East side of former brick plant and concrete slab foundation.

PHOTO 13: Electrical transformer enclosure at the northeast corner of former brick plant.

PHOTO 14: Central part of the former brick plant looking north to south.

PHOTO 15: East side of the former brick plant.

PHOTO 16: Saddle for a former 30,000-gallon propane tank and the current 1,000-gallon tank.

PHOTO 17: Storm drain insert during plant demolition.

PHOTO 18: Enclosure around natural gas line on the west side of the former brick plant.

PHOTO 19: Location of a former 8,000-gallon diesel fuel underground storage tank (UST).

PHOTO 20: Area of brick fill on the western portion of the former brick plant.

Attachment I
Storm Water Pollution Prevention Plan

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

Northwest Regional Office, 3190 - 160th Ave S.E. • Bellevue, Washington 98008-5452 • (206) 649-7000

April 2, 1992

Mr. Nel Bachelder
Mutual Materials Co.
Builders Brick Products
Po Box 2009
Bellevue, Wa. 98009

RE: Newcastle Plant

Dear Mr. Bachelder:

On 3-31, 1992, Lori LeVander and I inspected your Newcastle Facility. Our main emphasis was to evaluate the potential for adverse water quality effects on Coal Creek and its tributaries in the vicinity. Historically, we have not frequented your business, since there had not appeared to be a problem.

More recently, there have been reports of turbidity and sedimentation from downstream citizens. We are aware of the new construction and development in the vicinity and have dealt with the mud and water quality problems as they became apparent. We felt that it would be timely to also contact your company and express concern over the water quality. Mr. Ernie Sawyer gave us a tour of the manufacturing and the surrounding storage area. He was very helpful and congenial.

We understand that during the spring, most industries do house cleaning and regroup. There are recommendations that we made that should be considered during maintenance, regrading and cleanup.

The most significant potential problem is water control on the site.

1. The ponds will evidently mucked out to regain their original capacity. The sediments removed should be handled in a manner to preclude any effect on surface waters.

2. The culverts and the roads above drainage channels should be graded and/or restored to prevent mud and sediment from the haul road from entering the drainage, where possible.

3. Steep slopes that are unprotected by natural vegetation should be stabilized by seeding or by mulch.

4. A drainage plan for the site should be developed. The intent of the plan would be to minimize the amount of muddy water and to convey the maximum amount of clean water off site before it commingles with the dirty water. Detention

of the clean water and release at a restricted rate may be necessary under King County Surface Water criteria. The gutters are basically on the roof of the buildings, but the downspouts are gone. This allows clean waters from the roof to contribute to the water handling problem by increasing the volumes of muddy water. Your company engineer may have expertise that could develop a plan, if not you may need to seek outside help. The plan should include hydraulic calculations to assure that the total volume of runoff from each specific catchment area can be detained long enough to provide adequate sedimentation. I suspect the entire system needs to be enlarged to minimize the effect on surface waters.

5. On the perimeter of the site north and northeast of the shop, sheet flow and uncontrolled runoff overwhelmed the containment berm and has caused erosion of the slope in three or four places. This type of situation must be avoided. This may be a real problem area. Pumping of muddy water back uphill to a pond or settling area may be necessary. Controlling the water in this vicinity may be the most difficult component of the plan.

6. The oil storage area had a steel bin to contain oil spillage, but the slab does not provide containment. A supplemental curb would provide an additional margin of safety. The roof over the storage area would be recommended if you hadn't already provided it. There were several drums outside the storage area and about a quart of oil had spilled to the pad below. Spillage might be minimized by storing and handling used oil inside the containment area instead of outside.

7. Trucks and other heavy equipment should not drive through standing water that will end up leaving the site. Traffic through puddles will increase the amount of dirty water that must be controlled. Crowning the haul roads and attempting to keep hard material on top of the clay would help.

In summary, please examine the Newcastle site to assure that there will be no adverse effects on the nearby surface waters produced by the operations.

Another issue that is not directly related to water quality is the amount of brick that becomes "waste". The waste may be somewhat useful in road surfacing on site and for fill. I mentioned to Ernie that we have a resource section within Ecology that is primarily focused on waste reduction. They provide technical advice to industry and are non-regulatory. I spoke with Mr. Tom Spille (phone 649-7247). Undoubtedly your company has examined the amount of waste from an economic

perspective, but if you would like assistance from Ecology in examining potential waste reduction., please contact Tom. His operations and agenda are independent from our water quality concerns.

If you have questions or comments please contact me at 649-7028.

Sincerely,

Ronald C. Devitt

Ronald C. Devitt
Water Quality Inspector

cc: Lori LeVander
Kevin Fitzpatrick
Tom Spille, WRRlC

PP2

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

September 21, 1999

George A. Beamer
Mutual Materials Company
PO Box 2009
Bellevue, WA 98009-2009

Dear Mr. Beamer:

In response to your request, and based on the recommendation of our Eastern Regional Office, the Department of Ecology is granting Inactive Facility status to two Mutual Materials Company sites. This status relates to requirements for pollution prevention planning per Chapter 70.95C RCW for the sites noted below:

Site #:	CRK 000 008 670	Site #:	CRK 000 023 570
Site Address:	6620 Coal Creek Parkway SE Renton, WA 98055	Site Address:	10627 S Hwy 27 Mica, WA 99023

Inactive Facility status exempts you from having to submit further pollution prevention planning documents or annual progress reports at this time. This status will remain in effect unless these company sites exceed reporting thresholds in the future.

Inactive Facility status however, does **not** exempt you from submitting other reports such as the Annual Dangerous Waste Report, Tier Two Report, or the TRI Report if you are subject to those requirements. If you have questions regarding any of the above categories, please contact Holly Sullivan at (360) 407-6733.

Please contact me at (360) 407-6709 if you have any questions about the Inactive Facility status.

Sincerely,

Timothy E. Gaffney

Timothy E. Gaffney
Environmental Planner
Pollution Prevention/Community Right to Know Unit

cc: John Blunt, ERO
File

Department of Ecology
Water Quality Program

OCT 1 2 2001

Mutual Materials Company

Storm Water Pollution Prevention Plan

Newcastle Brick Plant POSTED

Permit # SO3000362

Contents

1. Introduction section 1
2. Notice of Intent and Baseline General Permit section 2
3. Pollution Prevention Plan Team Members section 3
4. Activities Checklist section 4
5. Site Assessment section 5
6. Material Inventory section 6
7. Exposed Significant Material section 7
8. Significant Spills and Leaks section 8
9. Non-Storm Water Discharge section 9
10. Pollution Source Identification section 10
11. BMP Identification section 11
12. BMP Implementation section 12
13. Employee Training section 13
14. Inspections and Maintenance section 14
15. Revisions section 15
16. Annual Site Compliance Evaluation section 16
17. Site Plan section 17

INTRODUCTION

section 1

Introduction

The Department of Ecology baseline general permit program is designed to reduce or eliminate the pollution of storm water from industrial point sources. Ecology's program requires eventual compliance with ground, surface and sediment management standards for those facilities that are required to obtain an NPDES [National Pollution Discharge Elimination System] permit. Any facility that discharges storm water to surface waters of Washington must file a Notice of Intent with Ecology to be accepted under the baseline general permit. This permit does not authorize the violation of ground water, surface water or sediment management standards.

To comply with the requirements of this general permit, the permittee must develop and implement a storm water pollution prevention plan.

The contents and requirements of the plan are:

1. Identify pollution prevention plan team members who will be responsible for development and implementation of the plan
2. Assess the facility for any pollutants that have the potential to pollute storm water discharges in significant amounts
3. List all materials stored on site that have the potential to contribute pollutants to storm water runoff
4. Describe the significant materials that were exposed to storm water during the past three years and/or are currently exposed
5. List of significant spills and leaks of toxic or hazardous pollutants that have occurred at the facility in the three years prior to the effective date of the permit
6. Assess the facility for any non-storm water discharges and complete the certificate of validation
7. List all identified storm water pollution sources and describe existing management practices that address those sources
8. Describe the Best Management Practices that you have selected to include in your plan
9. Develop a schedule for implementing each BMP

Introduction continued

10. Describe the employee training program needed to implement each BMP

11. As a minimum, conduct two inspections per year; one in the wet season and one in the dry season on all outfalls and control measures to insure compliance. Report all findings and record them in the plan

12. The plan must be revised when changes or modifications to the facility require new control measures or BMP

13. An annual site compliance evaluation must be performed each year. The results will be recorded in the plan

POLLUTION PREVENTION PLAN MEMBERS

section 3

Storm Water Pollution Prevention Plan

Emergency Contact Personnel Plan

Neal Bachelder	Plant Manager	255-1101
Dan Knight	Maint. Super	255-1101

Type of Manufacturing:	Brick
Operating Schedule:	24/7
Number of Employees	Varies
Average Waste water Discharge:	Unknown at this time.
NPDES Permit Number:	SO3000362

ACTIVITIES CHECKLIST

section 4

Activities Checklist

Check Activities that are occurring or will be occurring at this facility

- ✓ Storage of raw materials outside
- ---- Washing of vehicles or equipment
- ---- Tire washing
- ✓ Vehicle or equipment fueling
- ✓ Above ground storage of vehicle fuels
- ---- Underground storage of vehicle fuels
- ---- Loading or unloading of liquid toxic materials
- ✓ Loading or unloading of dry toxic chemicals [bagged material, the big three, Barium, Manganese and Chromite]
- ✓ Above ground storage of liquids
- ✓ Storage of used oil
- ✓ Vehicle maintenance and repair
- ---- Discharge of process waste water
- ---- Manufacturing or processes done outside

Planning And Organization

A. Forming the Pollution Prevention Team:

- ☐ Identify specific individuals
- ☐ Outline their responsibilities
- ☐ Evaluate applicable portions of plans prepared for other purposes

Assessment Phase

A. Site Map Which Shows the Following:

- ☐ Outline of site boundaries, buildings, and paved areas
- ☐ Physically constructed features used to drain, channel, or discharge stormwater
- ☐ Outline of the stormwater drainage areas for each stormwater discharge point (including discharges to ground water)
- ☐ Locations of industrial activities (such as fueling stations, loading and unloading areas, vehicle or equipment service and maintenance areas, waste disposal areas, storage areas)
- ☐ Locations of significant materials
- ☐ Location of any nearby stream, river, lake, or other water body receiving stormwater discharges from the site
- ☐ Areas of existing and potential soil erosion
- ☐ Lands adjacent to the site, if helpful, to identify discharge points or drainage routes
- ☐ Locate buildings and activities that may be sources of non-stormwater discharges (i.e., process water, non-contact cooling water, and wash water)

B. Materials Inventory:

- ☐ List of materials handled, treated, stored, or disposed of that can be exposed to precipitation
- ☐ List of *significant materials* that have been exposed to precipitation or runoff along with the method and location of on-site storage or disposal
- ☐ List of pollutants that may be present in your stormwater discharges
- ☐ Review any existing discharge sampling data

C. Identify Past Spills and Leaks:

- ☐ List of significant spills and leaks of toxic or hazardous pollutants since November 18, 1989, (listing non-hazardous spills is also recommended)

D. Identify All Areas Associated with Industrial Activities, Including the Following:

- ☐ Loading and unloading of dry bulk materials or liquids
- ☐ Outdoor storage of materials or products
- ☐ Outdoor manufacturing and processing
- ☐ Dust or particulate generating processes
- ☐ Roofs or other surfaces exposed to air emissions from a manufacturing building or a process area
- ☐ On-site waste treatment, storage, or disposal
- ☐ Vehicle and equipment maintenance and/or cleaning

E. Non-Stormwater Discharge Investigation:

- ☐ Certification by a responsible official that your facility has been investigated for the presence of non-stormwater discharges

BMP Selection and Plan Design Phase. The description shall include the following minimum requirements:

A. Operational BMPs:

1. ☐ Good housekeeping program
2. ☐ Routine preventive maintenance schedule
3. ☐ Spill prevention and emergency cleanup plan
4. ☐ Procedures for inspections and recordkeeping

a. Annual wet season inspection procedures shall include -

- ☐ Verify that the description of potential pollutant sources and the site map are accurate
- ☐ Make certain that the pollutant reduction controls are being implemented, maintained, and are functioning adequately
- ☐ Observations for the presence of floating materials, suspended solids, oil and grease, discolorations, turbidity, odor, etc., in the stormwater discharge(s)

b. The initial and annual dry season inspection procedures shall include -

- ☐ Determine if unpermitted non-stormwater discharges are present
- ☐ If such a discharge is found, comply with General Condition G3 of Ecology's permit

5. Records and Recordkeeping; Include in the SWPPP Reports Which Summarize -

- ☐ The scope of the inspection
- ☐ The personnel conducting the inspection
- ☐ The date(s) of the inspection
- ☐ Major observations relating to the implementation of the SWPPP
- ☐ Any actions taken as a result of the inspection to modify the SWPPP
- ☐ Keep a record of reports on incidents, such as discharge of spills and other noncompliance notification

6. ☐ Identify employee training schedule

B. Source Control BMPs:

Selected source control BMPs from the following list, for the following specific industrial activities -

- ☐ BMP S1.10 Fueling Stations
- ☐ BMP S1.20 Vehicle/Equipment Washing and Steam Cleaning
- ☐ BMP S1.30 Loading and Unloading Liquid Materials
- ☐ BMP S1.40 Liquid Storage in Above-Ground Tanks
- ☐ BMP S1.50 Container Storage of Liquids, Food Wastes or Dangerous Wastes
- ☐ BMP S1.60 Outside Storage of Raw Materials, By-Products or Finished Products
- ☐ BMP S1.70 Outside Manufacturing Activities
- ☐ BMP S1.90 Vegetation Management/Integrated Pest Management
- ☐ Description and explanation of a BMP for one of the above activities which will provide an equivalent level of source control
- ☐ Description and explanation of a BMP to control pollution from an industrial activity not listed above

C. Erosion and Sediment Control BMPs:

- ☐ Identify areas which have a high potential for significant soil erosion and measures to limit erosion

Additional BMPs

- ☐ Describe necessary treatment BMPs
- ☐ Describe innovative BMPs implemented

Implementation Schedule

- ☐ Develop an implementation schedule with target completion dates for BMPs and other activities described in the SWPPP

Solid and Liquid Waste

- ☐ Provide satisfactory and legal arrangement for the handling and disposal of all liquid and solid waste generated or accumulated on the property

SITE ASSESSMENT

section 5

Storm Water Pollution Prevention Plan

Emergency Contact Personnel Plan

Neal Bachelder	Plant Manager	255-1101
Dan Knight	Maint. Super	255-1101
Type of Manufacturing:	Brick	
Operating Schedule:	24/7	
Number of Employees	Varies	
Average Waste water Discharge:	Unknown at this time.	
NPDES Permit Number:	SO3000362	

Site Assessment

Persons Involved:

Neal Bachelder
Joe Kustok
Dan Knight

Ares of the facility that have the potential to pollute storm water runoff.

1. Outside fueling station for diesel powered loader located on the southwest side of the front brick storage area.

BMP- Built fueling station as per specification in BMP S1.10

2. Outside clay storage of white clay used in the manufacture of brick. Located in the southwest side of the clay storage area.

BMP- After each year's mining and winter storage is complete have clay piles hydro-seeded for the year. Direct any runoff into the holding pond.

3. Evaluate and test washing down of machine room production line after coated runs.

BMP- Currently we believe that we contain all water inside the building with our current procedures. We observe outfalls on the northeast side of the Machine Room building during a each down to see if there is a problem.

4. Water run off of the main covered clay storage area.

BMP- We have changed to gutter system to flow directly into the outfall on the northeast side of the covered clay storage area.

5. Drainage of the Dressler transfer track. This network of outlets are located in three areas. Thay are the Dressler kiln exit. The Dressler kiln entrance and Dressler Dryer entrance. They flow into the outfalls on the North side of the property.

BMP- Test outfalls for proper drainage. Further steps to be considered later if a problem develops.

MATERIAL INVENTORY

section 6

Material Inventory

Worksheet # 3
Completed By: Neal Bachelder
Title: Plant Manager
Date: 07/11/01

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollatants to storm water runoff. Also complete Worksheet 3A if the material has been exposed during the last three years.

Material	Purpose location	Quanity lbs. Year	Produced	Stored	Quanity Exposed in last three years	Likelihood of contact with strom water. If yes, describe reason.	Past significant Spill or leak	
pfizer 2093f iron oxide	brick coating main shed	0	no	yes	none	hone	no	
newman red clay	brick coating main shed	104700 lbs	no	yes	none	none	no	
iron oxide clay	brick coating main shed	23000 lbs	no	yes	none	none	no	
sodouim hex	brick coating mian shed	3950 lbs	no	yes	none	none	no	
ball clay	brick coating main shed	16200 lbs	no	yes	none	none	no	
glaze B	brick coating main shed	0	no	yes	none	none	no	

Material Inventory

Worksheet # 3

Completed By: Neal Bachelder
Title: Plant Manager
Date: 07/11/01

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollatants to storm water runoff. Also complete Worksheet 3A if the material has been exposed during the last three years.

Material	Purpose location	Quanity Used	Produced	Stored	Quanity Exposed in last three years	Likelihood of contact with strom water. If yes, describe reason.	Past significant Spill or leak
Outside White	Brick Mfg. West of main covered clay storage area.		no	yes	none	none	no
Barium	Main Building	412500 lbs	no	yes	none	none	no
Managneze	Main Building		no	yes	none	none	no
Oil used and New	Mach. Rm/Maint.		no	yes	none	none	no
Diesel Fuel	Above ground Southwast side of property.		no	yes	none	none	no
Brick Patch Mortar	rebuild kiln cars main shed		no	yes	none	none	no
EPK-Kaolin	cover kiln car decks main shed		no	yes	none	none	no
Hot top moldit	rebuild kiln cars main shed		no	yes	none	none	no
Bentonite Ball clay	brick coatings main shed	2000 lbs	no	yes	none	none	no
brikote englobe	brick coating main shed	no	yes	none	none	no	no
casting clay	brick coating main shed	no	yes	none	none	no	no
cedar heights	brick coating main shed	no	yes	none	none	no	no
chromite ore	brick body additive main shed	no	yes	none	none	no	no
celeouse	brick body additive main shed	no	yes	none	none	no	no
gerstely borate	brick coatind main shed	no	yes	none	none	no	no
manganese	brick coating main shed	no	yes	none	none	no	no

EXPOSED SIGNIFICANT MATERIAL

section 7

Description Of Exposed Significant Material

Worksheet 3A:
Completted By: Neal Bachelder
Title: Plant Manager
Date: 07/11/01

Instructions: Based on your material inventory, describedthe significant materials that were exposed to storm water during the past three years and/or are currently exposed. For the definition of "significant materials" see Appendix B of the manual.

Descripition of exposed Significant Material	Period of exposure	Quanity Exposed	Location see site map	Method of Storage or Disposal	Description of Material Management Practice
Outside White	all year		west side of covered clay storage area	outside piles	sedement pond below clay pile to catch run off

SIGNIFICANT SPILLS AND LEAKS

section 8

List of Significant Spills and Leaks 12/28/93

1. As of this date there has not been any spills that would be concidered significant with the guidelines given in Stormwater Pollution Prevention Plan developed by the State of Washington.

List of significant Spills and leaks

Worksheet # 4

Completed by: Neal Bachelder

Title: Plant Manager

Date: 07/11/01

Directions: Record below all significant spills and significant leaks of toxic or hazasdous pollutants that have occured at the facility in the three years prior to the effective date of the permit.

Definitions : Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities

1st Year prior				Description				Responce Proceedure			
Date	Spill	Leak	location (site map)	material	quanitity	source	reason	Amount of material recovered	Material no longer exposed to storm water true/false	Protective Measures taken	
NONE											
2nd Year prior				Description				Responce Proceedure			
Date	Spill	Leak	location (site map)	material	quanitity	source	reason	Amount of material recovered	Material no longer exposed to storm water true/false	Protective Measures taken	
NONE											
3rd Year prior				Description				Responce Proceedure			
Date	Spill	Leak	location (site map)	material	quanitity	source	reason	Amount of material recovered	Material no longer exposed to storm water true/false	Protective Measures taken	
NONE											

NON-STORM WATER DISCHARGE

section 9

Non-Storm Water Discharge Assessment and Certification

Date of test or Evaluation: 12-28-93

Outfall directly observed during the test: #2-11
(as indicated on site map)

Method used to test or evaluate discharge: VISUAL

Describe results from test for the presents of Non-storm water discharge: we have NO NON-STORM WATER DISCHARGE

Identify potential significant source:
N/A

Name of person who conducted the test or evaluation: NEAL BACHELDER
DAN KNIGHT

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification	Worksheet #6 Completed by: DAN KNIGHT Title: MAINT. SUPERVISOR Date: 5-22-95

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
5-22-95	#1	VISUAL	DITCH HAS BEEN BLOCKED OFF - NO DISCHARGE	TIRE WASH - DEAD SUMP NOW	DAN KNIGHT
"	#2	VISUAL	PIPE BROKEN 60 FEET FROM POND - NONE	EARTH TANK GROUNDS	" "
"	#3	VISUAL	NO-DISCHARGE	NO-SOURCE	" "
	#4	VISUAL	NO-DISCHARGE	NO-SOURCE	" "
	#5	VISUAL	NO-DISCHARGE	CAR REPAIR SAW	" "
	#6	VISUAL	NO-DISCHARGE	NO-SOURCE	" "
	#7	VISUAL	NO-DISCHARGE	NO-SOURCE	" "

CERTIFICATION CONT. ON NEXT PAGE

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title MAINT. Supv.	B. Phone: 255-1101
C. Signature	D. Date Signed 5-22-95

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT SUP.
Date: 5-22-95

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
5-22-95	#8	VISUAL	NO-DISCHARGE	NO-SOURCE	DAN KNIGHT
"	#9	VISUAL	NO-DISCHARGE	PONDS-NO SOURCE	" "
"	#10	VISUAL	NO-DISCHARGE	NO-SOURCE	

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title DAN KNIGHT MAINT. SUP.	B. Phone: 255 1101
C. Signature Dan Knight	D. Date Signed 5-22-95

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification

1 OF 2

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT. SUPERVISOR
Date: 8-29-96

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
8-29-96	#1	VISUAL	NO DISCHARGE DITCH BLOCKED	TIRE WASH - BLOCKED - NOT USED	DAN KNIGHT
"	#2	"	PIPE BROKEN 60' FROM POND - NO-DISCHARGE	LEACH THRU GROUND	"
"	#3	"	NO-DISCHARGE	NO-SOURCE	"
"	#4	"	NO-DISCHARGE	NO-SOURCE	"
"	#5	"	NO-DISCHARGE	NO-SOURCE	"
"	#6	"	NO-DISCHARGE	NO-SOURCE	"
"	#7	"	NO-DISCHARGE	NO-SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

2 of 7

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT SUPERVISOR
Date: 5-29-96

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
8-29-96	#8	VISUAL	NO-DISCHARGE	NO-SOURSE	DAN KNIGHT
"	#9	"	NO-DISCHARGE POND REBUILT	NO-SOURCE	" "
"	#10	"	NO-DISCHARGE	NO-SOURCE	" "
"	#11 ADDED LUNCHROOM GUTTER OUTFALL	"	NO-DISCHARGE	NO-SOURCE	" "

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification 1 OF 2	Worksheet #6 Completed by: DAN KNIGHT Title: MAINT. SUPERVISOR Date: 9-3-97

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-3-97	#1	VISUAL	NO DISCHARGE DITCH BLOCKED	NO-SOURCE	DAN KNIGHT
"	#2	VISUAL	PIPE STILL BROKEN 60' OUT - NO-DISCHARGE	LEACH THRU GROUND NO-SOURCE	"
"	#3	VISUAL	NO-DISCHARGE-OUT-FALL PIPE EXTENDED 20'	NO-SOURCE	"
"	#4	VISUAL	NO-DISCHARGE	NO SOURCE	"
"	#5	VISUAL	NO-DISCHARGE	NO SOURCE	"
"	#6	VISUAL	NO-DISCHARGE	NO SOURCE	"
"	#7	VISUAL	NO-DISCHARGE	NO SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

2 OF 2

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT. SUP.
Date: 9-3-97

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-3-97	#8	VISUAL	NO DISCHARGE	NO SOURCE	DAN KNIGHT
"	#9	"	NO DISCHARGE	NO SOURCE	"
"	#10	"	NO DISCHARGE	NO SOURCE	"
"	#11	"	NO DISCHARGE	NO SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

1 OF 2

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT. SUPERVISOR
Date: 7-16-98

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
7-16-98	#1	VISUAL	NO DISCHARGE INACTIVE	NO SOURCE	DAN KNIGHT
"	#2	"	REPAIRED PIPE NO DISCHARGE	DREDGED SEDIMENT FROM POND NO SOURCE	"
"	#3	"	NO DISCHARGE	NO SOURCE	"
"	#4	"	NO DISCHARGE	NO SOURCE	"
"	#5	"	NO DISCHARGE	NO SOURCE	"
"	#6	"	NO DISCHARGE	NO SOURCE	"
"	#7	"	NO DISCHARGE	NO SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

2 OF 2

Worksheet #6
Completed by: DAN KNIGHT
Title: MAINT. SUP.
Date: 9-16-98

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-16-98	#8	VISUAL	NO DISCHARGE	NO SOURCE	DAN KNIGHT
"	#9	"	NO DISCHARGE	NO SOURCE	"
"	#10	"	NO DISCHARGE	NO SOURCE	"
"	#11	"	NO DISCHARGE	NO SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification 1 OF 2	Worksheet #6 Completed by: DAN KNIGHT Title: MAINT. SUPERVISOR Date: 8-25-99

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
8-25-99	#1	VISUAL	NO DISCHARGE DITCH INACTIVE	NO SOURCE	DAN KNIGHT
"	#2	"	NO DISCHARGE	NO SOURCE	"
"	#3	"	NO DISCHARGE	NO SOURCE	"
"	#4	"	NO DISCHARGE	NO SOURCE	"
"	#5	"	NO DISCHARGE	NO SOURCE	"
"	#6	"	NO DISCHARGE	NO SOURCE	"
"	#7	"	NO DISCHARGE	NO SOURCE	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification 2 OF 2	Worksheet #6 Completed by: DAN KNIGHT Title: MAINT. SUPERVISOR Date: 8-25-99

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
8-25-99	#8	VISUAL	NO DISCHARGE	NO SOURCE	DAN KNIGHT
"	#9	"	NO DISCHARGE	NO SOURCE	"
"	#10	"	NO DISCHARGE	NO SOURCE	"
"	#11	"	NO DISCHARGE	NO SOURCE	"
	(REPAIRS TO SYSTEM)				
11-17-99	#6	VISUAL - WATER LEAK IN GROUND	LEACHING THROUGH OUTFALL - & STANDING	WATER PIPE BROKEN SURFACE WATER	"
11-5-99	#2	VISUAL - DUG UP EXISTING OUTFALL 110' FROM C.B. & EXTENDED 80' TO CHECK DAM - OUTFALL VISIBLE NOW - BACK FLUSH SYSTEM	NO DISCHARGE	NO SOURCE	

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge
Dry Weather (May to September 30)
Assessment & Certification

Worksheet #6
Completed by: Paul Bachik
Title: Plant Mgr
Date: 9-2000

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-2000	#1	Visual	NO DISCHARGE	NO SOURCE	Paul Bachik
	#2	"	"	"	"
	#3	"	"	"	"
	#4	"	"	"	"
	#5	"	"	"	"
	#6	"	"	"	"
	#7	"	"	NO SOURCE	Paul Bachik

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title	B. Phone:
C. Signature	D. Date Signed

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification	Worksheet #6 Completed by: _____ Title: _____ Date: _____

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
T-2000	# 8	VISUAL	NO DISCHARGE	NO SOURCES	Neal Ballew
	# 9	"	"	"	"
	# 10	"	"	"	"
	# 11	VISUAL	"	NO SOURCES	Neal Ballew

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title Neal Ballew PLANT Mgr	B. Phone: 255-1101
C. Signature	D. Date Signed 9-4-2000

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification	Worksheet #6 Completed by: DAN KNIGHT Title: MAINTENANCE SUP. Date: 9-28-01

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-28-01	#1	VISUAL	NO	NO SOURCE	DAN KNIGHT
"	# 2	"	"	"	"
"	# 3	"	"	"	"
"	# 4	"	"	"	"
"	# 5	"	"	"	"
"	# 6	"	"	"	"
"	# 7	"	"	"	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title DAN KNIGHT MAINT. SUP.	B. Phone: 425 255 1101
C. Signature Dan Knight	D. Date Signed 9-28-01

Non-Stormwater Discharge Dry Weather (May to September 30) Assessment & Certification

Worksheet #6
Completed by: DK
Title: MAINT. Sup.
Date: 9-28-01

The dry season inspection shall determine the presence of unpermitted non-stormwater discharges such as domestic wastewater, non-contact cooling water, or process wastewater (including *leachate*) to the *stormwater drainage system*.

Tests may include: visual observations of flows, odors, and other abnormal conditions; dye tests, television line surveys; and/or analysis and validation of accurate piping schematics.

Date	Discharge Location (as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for Presence of Non-Stormwater Discharge	Identify Potential Significant Sources	Person Who Conducted the Test
9-28-01	#8	VISUAL	NO DISCHARGE	NO SOURCE	DAN KNIGHT
"	#9	"	"	"	"
"	#10	"	"	"	"
"	#11	"	"	"	"

CERTIFICATION

Based on my inquiry of the person or persons who manage the systems or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Title DAN KNIGHT MAINT. SUP.	B. Phone: 425 255 1101
C. Signature Dan Knight	D. Date Signed 9-28-01

POLLUTION SOURCE IDENTIFICATION

section 10

Pollutant Source Identification

Worksheet # 7

Completed BY: Neal Bachelder

Title: Plant Manager

Date: 07/11/01

Instructions: List all identified storm water pollutant sources and describe existing management practices that address thoes sources. In the third column, list BMP options that can be incorported into the plan to address remaining sources of pollutants.

Storm Water Pollutant Sources	Existing Management Practices	Description Of New BPM Options
Outside white Clay storage	Run off drains to settling pond	Cover with plastic sheeting develope better run off system to collect more into settling pond.
deisel fuel station	minimize fuel spills clean up with floor sweep	build fueling ststion as outline in BMP S1.10

BMP IDENTIFICATION

section 11

BMP Identification

Worksheet # 7.A
Completed By:
Title:
Date:

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the baseline BMP's describe actions that will be incorporated into facility operations. Also describe any additional BMP's (active specific (Chapter 3) and site specific BMP's (chapter 4) that you have selected. Attach additional sheets if necessary.

BMP's	Brief Description of Activities
Good Housekeeping	See section on house Keeping.
Preventive Maintenance	See section on preventive maintenance
Inspections	See section on inspections.
Spill Prevention Responce	See section on prevention responce.
Sediment and Erosion Control	See sediment and erosion control.
Management of runoff	See section on management of runoff.
Additional BMP's active-specific and Site specific	See section on Additional BMP's.

Worksheet #8

Implementation

1. Good housekeeping -- 3/1/94 --- Dan Knight and Joe Kusto

   Develop training for diesel refueling.

2. Preventive Maintenance-- 3/1/94 --- Dan Knight

   Develop a Maintenance schedule for the inspection of storm water management control devices.

3. Inspections -- 3/1/94 --- Dan Knight, Joe Kustok

   Develop an inspection and record schedule.

4. Spill Prevention and Response

   Same as house keeping.

5. Sediment and Erosion control -- 3/1/94 --- Joe Kustok, Dan Knight

   Hydro-seed outside clay piles.
   Maintain storm water runoff control devices.

Worksheet #7e

Management of Runoff

1.Keep all catch basins drainage pipe and outfalls clear of debris and sediment.

Worksheet #7c
Spill Prevention Responce

1. Build oil storage house and fueling station to accomidate regulations stated in BMP.
DONE

2. Follow thru with clean-up and spill procedures.

Worksheet #7
Preventive Maintenance

1. Inspect all storm water management control devices.

2. Inspect all gutters and down spouts

3. Clean and repair all storm water management control devices as needed.

Worksheet #7
Inspections

1. Inspect all storm water management devices biannually.

2. Review all written procedures to insure BMP's are up to date with current regulations annually.

3. Repair all storm water management devices as needed according to findings of biannual inspections.

Worksheet #7
Good Housekeeping

1. Sweep yard weekly by professionals with sweeper trucks.

2. Do not keep any oil exposed to outside weather conditions.

3. Follow diesel refueling procedures to include spill containment and clean up.

BMP IMPLEMENTATION

section 12

Worksheet #8

Implementation

1. Good housekeeping -- 3/1/94 --- Dan Knight and Joe Kustok

   Develop training for diesel refueling.

2. Preventive Maintenance-- 3/1/94 --- Dan Knight

   Develop a Maintenance schedule for the inspection of storm water management control devices.

3. Inspections -- 3/1/94 --- Dan Knight, Joe Kustok

   Develop an inspection and record schedule.

4. Spill Prevention and Response

   Same as house keeping.

5. Sediment and Erosion control -- 3/1/94 --- Joe Kustok, Dan Knight

   Hydro-seed outside clay piles.
   Maintain storm water runoff control devices.

BMP Implemention

1.Good Housekeeping.			
Sweep yard	contact vendor	done	Plant Mgt.
Keep oil out of rain	Train employees	3/1/94	Plant Mgt.
Diesel refueling	Train employees	3/1/94	Plant Mgt.
2. Preventive Manitenance			
Inspect swro system	inspect system	3/1/94	Plant Mgt.
Train plant employees	train	3/1/94	Plant Mgt.
3. Spill Prevention and			
Emergency Clean-up.	train employees	3/1/94	Plant Mgt.
4. Inspection			
Inspect storm water management	inspect system	3/1/93	Plant Mgt.
5. Source Contol BMP's			
cover outside clay	plastic sheeting	11/18/94	Plant Mgt
Fueling station	build to BMP spec	11/18/95	Plant Mgt.
6. Erosion and Sediment	clean system	3/1/94	Plant Mgt.
	Hydor-seed outside clay	11/18/94	Plant Mgt.
7. Treatment	not needed		
8. Innovative BMP's	still thinking		

EMPLOYEE TRAINING

section 13

Worksheet #9a
Employee Training

1. Diesel Refueling	4/1/94	maintenance loader operator's
2. Good Housekeeping	4/1/94	maintenance loader operator's mix maker's burners All plant employees
3. Material Management Practices	4/1/94	mix maker's loader operator's maintenance Clay hauling contractor

4. Other Topics

Worksheet #10
Employee Training

1. Training topics

Spill prevention and responce	lecture emply Involv.	9/15/94
Good Housekeeping	lecture emply Involv.	4/1/94
Material management	lecture emply Involv.	9/15/94
Other topics	lecture employ involv.	(?)
Communacation Channels	lecture employ involv.	4/1/94

INSPECTIONS AND MAINTENANCE

section 14

Inspections and Maintenance

Date: 9-20-00

Persons Involved: DAN KNIGHT - AQUA CLEAN & SET

Things Inspested: BASINS & DISCHARGE PIPES

What maintained: CLEANED ALL BASINS AND BACK JETTED SEDIMENT FROM OUTFALL PIPING

Inspections and Maintenance

Date: 11-17-99

Persons Involved: DAN KNIGHT - JOE KOSTOK

Things Inspested: #6 ON SITE MAP - OUTFALL AND SURFACE WATER VISIBLE

What maintained: BROKEN WATER LINE AT CORNER OF BUILDING, DUG UP AND REPAIRED EXISTING WATER LINE

Inspections and Maintenance

Date: 10-5-99

Persons Involved: DAN KNIGHT

Things Inspested: #2 ON SITE MAP - DISCHARGE FROM DETENTION POND

What maintained: PIPE DUG UP 160' FROM C.B. (AT POND)

REPAIRED 20' DAMAGED SECTION, BACK FLUSHED OUTFALL PIPE - NO END EXISTING - ADDED 80' TO END OF OUTFALL, BUILT LARGE CHECK DAM AROUND OUTFALL TOO SLOW FLOW, NOW SYSTEM OPERATING WELL WITH LEACH SYSTEM THROUGH SWALE.

Inspections and Maintenance

Date: 8-12-98

Persons Involved: DAN KNIGHT - AQUA CLEAN & JET.

Things Inspested: CATCHBASINS & #2 DISCHARGE

What maintained: CATCH BASINS, SETTED OUTFALL PIPE FROM DETENTION POND, PIPE COLLAPSED 60' FROM C.B. (AT POND) REPAIRED 40' OF PIPE, PIPE BACKFLUSHED TO 160' FROM POND, LEACHING FINE, END OF OUTFALL NEEDS RELOCATED TO FINISH RUN

Inspections and Maintenance

Date: 9-3-97

Persons Involved: DAN KNIGHT

Things Inspested: #3 ON SITE MAP - DISCHARGE COVERED DURING ROAD RELOCATION

What maintained: ADDED 20' TO EXISTING OUTFALL, CREATED A LARGE CHECK DAM AT EXIT

Inspections and Maintenance

Date: 8-29-96

Persons Involved: DAN KNIGHT / NEAL BACHELDER

Things Inspested: ADDED ADDITIONAL C.B. AND OUTFALL TO LUNCHROOM, LABELED # 11 ON SITE MAP

What maintained: DOG DITCH, PLACED TYPE B C.B., CONNECTED GUTTERS TO PIPE, CREATED BREAK AT DISCHARGE END.

REVISIONS

section 15

Revisions

Date:

Persons Involved:

For what reason:

What took place:

ANNUAL SITE COMPLIANCE EVALUATION

section 16

Annual Site Compliance Evaulation

Date: 8-94

Persons involved: Neal, Joe, Joe Taft

Areas assessed: CATCH BASINS + OUTFALLS

Results: need catch basins cleaned.

Needed Changes or modification:

Annual Site Compliance Evaulation

Date: 8-95

Persons involved: Neal, DAN

Areas assessed: ENTIRE SYSTEM

Results: Need work on ostrich for pond

Needed Changes or modification:

Annual Site Compliance Evaulation

Date: 8-96

Persons involved: Neal, Jon

Areas assessed: All CATCH BASIN + OUTFALLS

Results: Gutter REPAIR need behind Lunch room.

Needed Changes or modification:

Annual Site Compliance Evaulation

Date: 8-97

Persons involved: Neal, DAN, Joe

Areas assessed: ALL CATCH BASINS + OUTFALLS

Results: ALL LOOKED ACCEPTABLE - HAVE CATCH BASINS cleaned,

Needed Changes or modification:

Inspections and Maintenance

Date: 8-98

Persons Involved: NEAL, DAN

Things Inspested: NEED TO REPAIR COLLAPSED PIPE IN #2 POND OUTFALL PIPE – WATER OVER ROAD – NO LEACHING INTO GROUND

What maintained: REPAIRED PIPE & BACKFLUSH SYSTEM – DREDGED POND OF SEDIMENT

Inspections and Maintenance

Date: 10-5-99

Persons Involved: JOE, DAN, ROGER, ROE

Things Inspested: WATER LEAK AT N.E. SIDE OF BUILDING #6 ON SITE MAP - SURFACE WATER & LEAKAGE THROUGH OUTFALL AT #6

What maintained: DUG UP & REPAIRED WATER LINE

Inspections and Maintenance

Date: 12-99

Persons Involved: DAN, NEAL

Things Inspested: NEED TO REPAIR OUTFALL ~~AT~~ FROM POND AND EXTEND PIPE TO AN OUTFALL SYSTEM

What maintained: DUG UP EXISTING PIPE 160' FROM SOURCE CONNECTED 80 ADDITIONAL FEET TO SYSTEM, CREATED A LARGE CHECK DAM AROUND OUTFALL FOR TRAPPING SEDIMENTS THROUGH THE LEACHING PROCESS - SURFACE WATER THAN LEACHES THROUGH EXISTING SWALE AND VEGETATION TO RICHMOND MINE CREEK JUST SOUTH OF ENTRANCE DRIVEWAY

Inspections and Maintenance

Date: 10-12-2000

Persons Involved: DAN, Neil

Things Inspested: OUTFALLS

What maintained:

ALL LOOKS good

Annual Site Compliance Evaulation

Date: 9-28-2001

Persons involved: DAN KNIGHT, ROGER PARS

Areas assessed: ALL OUTFALLS

Results: LOOKS GOOD, NO VISIBLE CONTAMINATION OR FLOW

Needed Changes or modification: NONE

SITE PLAN

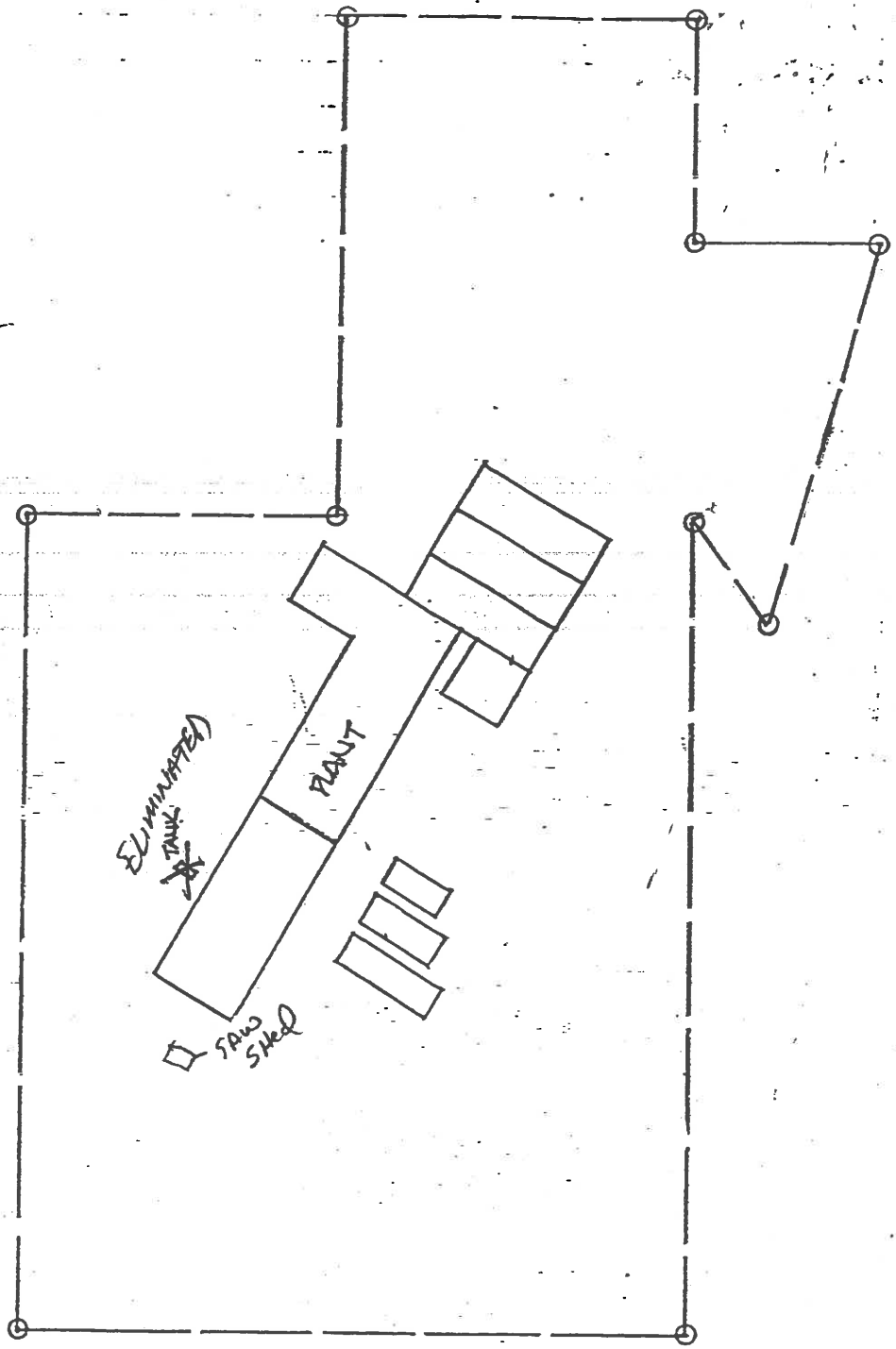
section 17

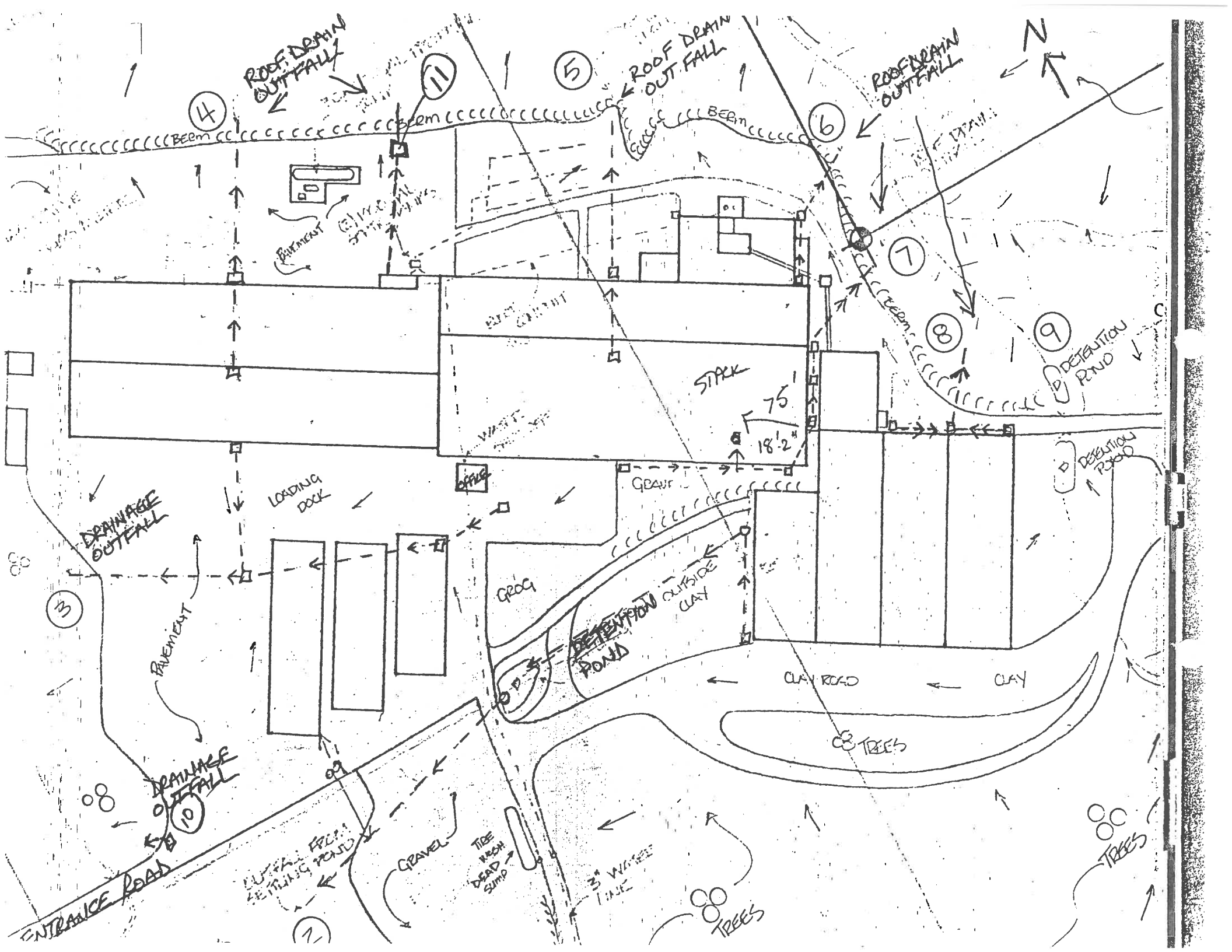
DEVELOPING A SITE MAP (Section 2.2.1)	Worksheet #2 Completed by: _____ Title: _____ Date: _____

Instructions: Draw a map of your site including a footprint of all buildings, structures, paved areas, and parking lots. The information below describes additional elements required by EPA's General Permit (see example maps in Figures 2.3 and 2.4).

EPA's General Permit requires that you indicate the following features on your site map:

- All outfalls and storm water discharges
- Drainage areas of each storm water outfall
- Structural storm water pollution control measures, such as:
  - Flow diversion structures
  - Retention/detention ponds
  - Vegetative swales
  - Sediment traps
- Name of receiving waters (or if through a Municipal Separate Storm Sewer System)
- Locations of exposed significant materials (see Section 2.2.2)
- Locations of past spills and leaks (see Section 2.2.3)
- Locations of high-risk, waste-generating areas and activities common on industrial sites such as:
  - Fueling stations
  - Vehicle/equipment washing and maintenance areas
  - Area for unloading/loading materials
  - Above-ground tanks for liquid storage
  - Industrial waste management areas (landfills, waste piles, treatment plants, disposal areas)
  - Outside storage areas for raw materials, by-products, and finished products
  - Outside manufacturing areas
  - Other areas of concern (specify:_____)


ELIMINATED
TANK
PLANT
SAW SHED


ROOF DRAIN OUTFALL
ROOF DRAIN OUT FALL
ROOF DRAIN OUTFALL
BEAM
BEAM
BEAM
PAVEMENT
STACK
75'
18'-2"
OFFICE
LOADING DOCK
GRAVEL
DRAINAGE OUTFALL
PAVEMENT
GROG
DETENTION POND
OUTSIDE CLAY
CLAY ROAD
CLAY
TREES
DRAINAGE OUTFALL
ENTRANCE ROAD
GRAVEL
TREE
DEAD
3" WATER LINE
TREES
TREES
DETENTION POND
DETENTION POND
N

Attachment J
Archived Tax Assessor Information

FOLIO 22736 A

ADDITION Tax Lots

Section 27 Twp. 24 Range 5 Ewm. Block FOR REFERENCE ONLY

Tax Lot 6 Tract

PERMIT NO. 156743

DATE 8-5-58

Address 6805 - 133rd S.E. "BLDG #1" BLDG 1

Fee Owner Builders Rock Co. Architect Contractor

Condition of Exterior Good Interior Good Foundation Good Floor Plan: Good Accept Good

USE Factory

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

TYPE OF CONSTRUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. & Plus
	Tile Brick
	Con. Rein.

Good X Med. Cheap.

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete 50% Pile 50% cont. ftg.

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters,
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
50%	Cavity 6" % Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" 50%
Y	Cor-Aluma Kind
	Stone Cast S.
	Terra Cotta
	Stru. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

Mill Construction

Rein. Con.

ROOF CONSTRUCTION

	Frame Lam.
	Mill Construction
	Rein. Concrete
X	No. Trusses STEEL BEAMS 20'0.C.
	Wood Steel

ROOFING MATERIAL

	Tar and Gravel
Or.	Cor. Aluma

FLOOR FINISHES

	Fir Maple
	Oak 2"x6" T&G
	Lino. 3"x6" T&G
	Cement
	Terrazzo
	Raccolith
	Tile
Or.	B-Top

Tile Lino.

	Baths Fl. Walls
Tile Total	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
Lino. Total	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
	Kit's Fl. Walls

PLUMBING

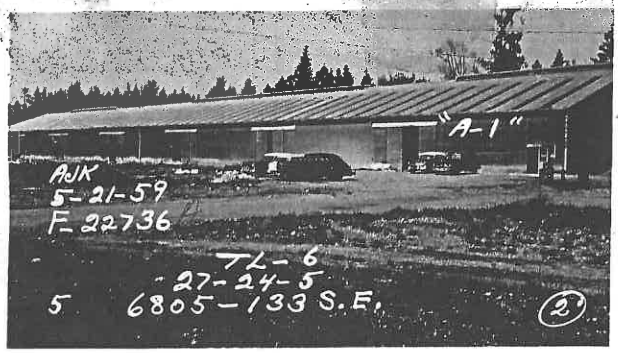
	No. Fixtures
	Toilets ?
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond. Fan
	Suspended Gas. Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Built 1958-59 Finished X Unfinished Remodeled Years

Year	Assessed Value
1960	12,510
1961	33700
1971	67,400



	Pass.	Freight		Treated Piles, Timb		Knob & Tube	
	Auto.	Elec.		Untreated		Flex. Cable	
	Man.	Hyd.		Treated Piles only	X	Conduit	
		Man.		Average Length	X	Power Wiring	
				Paved		Range Wiring	
						No. Outlets	

Hoists: Elec. Hyd.

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

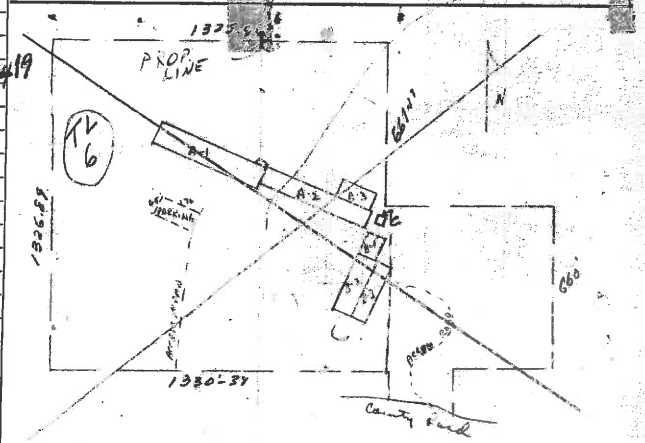
	Fir
	Mah. Oak
	Metal
	Metal Doors
	Steel Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H.

B	
1	16
2	16 7x19
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 2660 M

TOTAL FLOOR AREA



~~PLOT PLAN~~

See supl. sheets for bldg. drawings & PLOT PLAN

	Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
	Garage					x			$		$	$
						x			$		$	$
						x			$		$	$
						x			$		$	$

5M 2-56

FOLIO 22736A

ADDITION Tax Lots

Section 27 Twp 24 Range 5 Ewm Block Tax Lot 6 Tract

FOR REFERENCE ONLY

PERMIT NO. 156743

DATE 8-5-58

Address 6805-133rd S.E. Bldg. 1

Fee Owner Burgess

Condition of Exterior Good

Contractor

Accept Good

USE Factory

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm.
	4 rm. 5 rm.

TYPE OF CONSTRUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel Rein. Con. Alum
	Tile Brick Fiber
	Con. Rein. Co

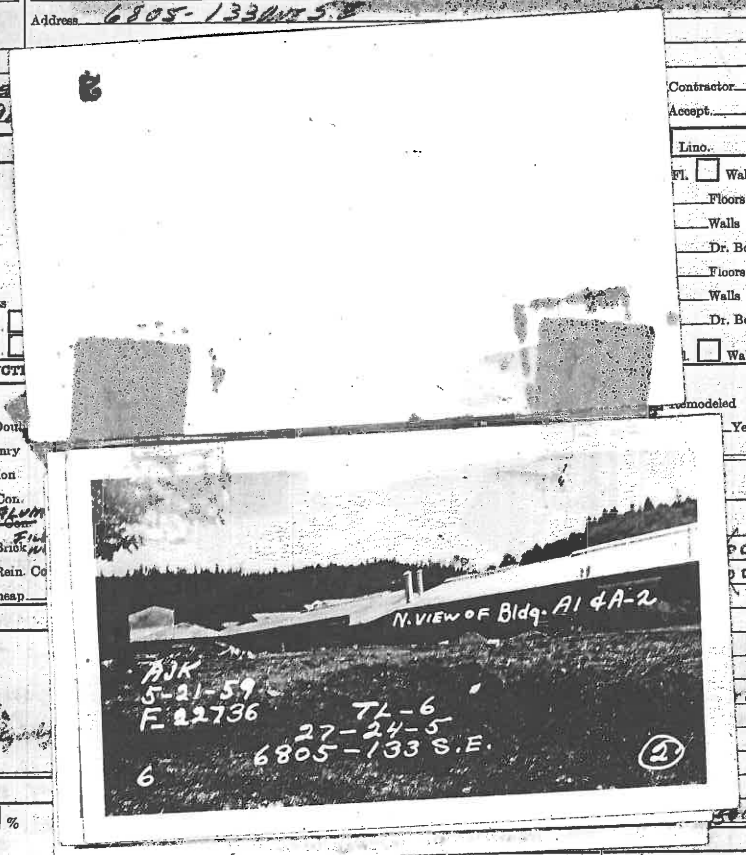
Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete 30"
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms



Pass. Freight

Auto. Elec.

Man. Hyd.

Man.

Hoists: Elec. Hyd.

Treated Piles, Timb

Untreated

Treated Piles only

Average Length

Paved

Knob & Tube

Flex. Cable

X Conduit

X Power Wiring

Range Wiring

No. Outlets

PLUMBING

	No. Fixtures
	Toilets ?
	Tub, Leg or Pem.
	Basins, Fed.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove ?
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas. Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	12,810
1961	33700 ADD-60
1971	67,400 AP '70

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
50%	Brick 6" Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" 50%
Y	Cor. Alum Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

Mill Construction

Rein. Con.

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

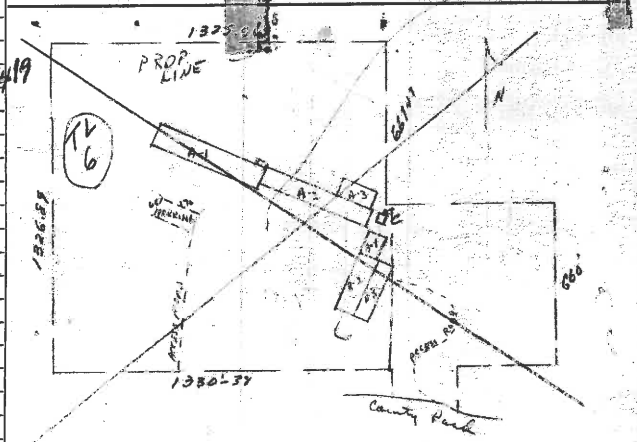
	Fir
	Mah. Oak
	Metal
	METAL Doors
	STEEL Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H.

B	
1	16
2	14 24 19
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA

TOTAL FLOOR AREA



~~PLOT PLAN~~

See supl. sheets for bldg. drawings & PLOT PLAN

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

FOLIO 22736A

ADDITION Tax Lots

Section 27 Twp. 24 Range 5 Ewm. Block FOR REFERENCE ONLY

Tax Lot 6 Tract

PERMIT NO. 156743

DATE 8-5-58

Address 6805-133RD S.E.

Fee Owner Bunn

Condition of Exterior F

USE Factory

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm.
	4 rm. 5 rm.

TYPE OF CONSTRUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel & Conc. & Brick
	Tile Brick
	Con. Rein. Co

Good X Med Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete 50%
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
50%	Brick 6" Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" 50%
X	Con. Block Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

Mill Construction

Rein. Con.

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Metal Doors
	Wood Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H.

	Pass.
	Auto.
	Man.
	Freight
	Elec.
	Hyd.
	Man.

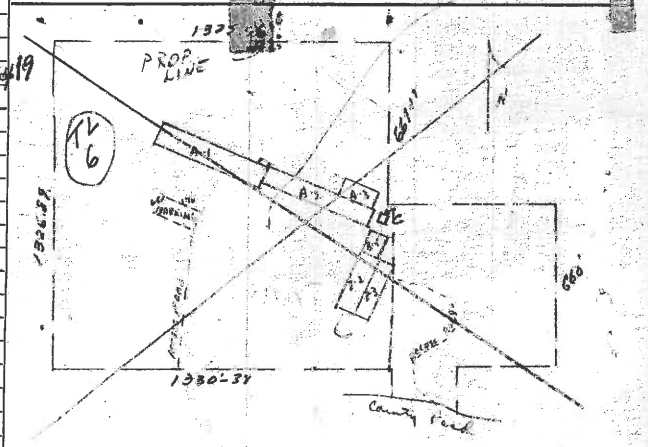
Hoists: Elec. Hyd.

	Treated Piles, Timb
	Untreated
	Treated Piles only
	Average Length
	Paved

	Knob & Tube
	Flex. Cable
X	Conduit
X	Power Wiring
	Range Wiring
	No. Outlets

GROUND FLOOR AREA 32,000 ±

TOTAL FLOOR AREA



PLOT PLAN

See supl. sheets for bldg. drawings & PLOT PLAN

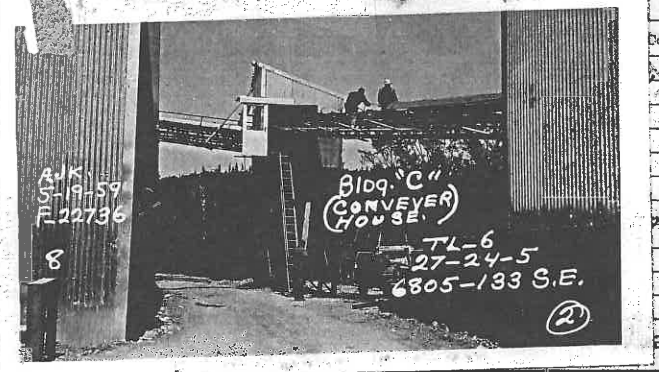
PLUMBING

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas. Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	12,860 A1-9
1961	33700 adj to
1971	67,400 AP '70



Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

FOLIO 22736A

ADDITION Tax Lots

Section 27 Twp. 24 Range 5 Ewm. Block Tax Lot 6 Tract

PERMIT NO. 156743

DATE 8-5-58

Address 6805-133RD ST

Bldg 1

Fee Owner Bunda

Condition of Exterior G

USE Factory

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm.
	4 rm. 5 rm.

TYPE OF CONSTRUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel Bldg.
	Tile Brick
	Con. Rein. Con.

Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
50%	Brick 6" & Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" 50%
Y	Corr. Alum. Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

Mill Construction

Rein. Con.

REPRODUCTION COST Factor Make-Up

Factor	Plus or Minus	Dimensions	S. F. Area	Factor	Cost
460		80 x 400	32000	3.94	126,080
50	2" Wood Stud	15 x 20	300	4.00	1200
10	6" Insulation 50%	x			
55	Light	x			
-10	Fdtn.	x			
11	Comp.	Ech. x			
-36	Roof	Pol. x			
504					
76	1,158	10 Ton Crane			
580		1 Hoist			
3.94					

35% to Mfg '60

Total

Less Depreciation

Total

Other Buildings

Total Value (Full)

Assessed Valuation 50%

TANKS, ETC., LIST

Hoists: Elec. Hyd.

ELEVATORS

Pass.	Freight
Auto.	Elec.
Man.	Hyd.
	Man.

DOCKS AND PIERS

	Treated Piles, Timb.
	Untreated
	Treated Piles only
	Average Length
	Paved

WIRING

	Knob & Tube
	Flex. Cable
X	Conduit
X	Power Wiring
	Range Wiring
	No. Outlets

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Metal Doors
	Steel Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H.

B	
1	10'
2	14' 7" 19
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA

TOTAL FLOOR AREA

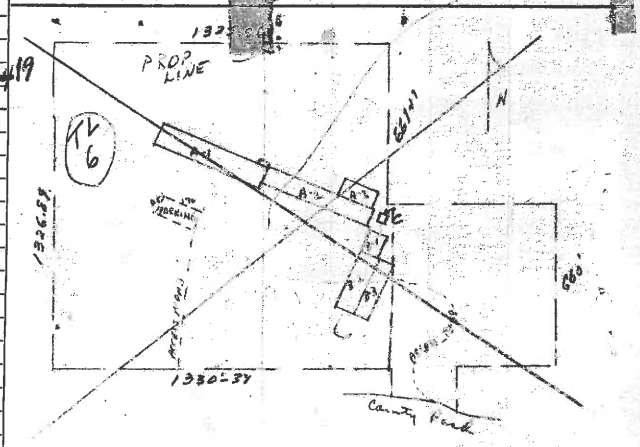
PLUMBING

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas. Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	12,800
1961	33700
1971	67,400



~~PLOT PLAN~~

See supl. sheets for bldg drawings & PLOT PLAN

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage											

5M 2-56

This mfg as of 5-31-59 practically complete except for wiring
but appears as 759, mfg dept - 30-59 a/ft - no delivery yet

W Steel I Beam plate flanges at Tops and Steel I Beam from top of roof to
rigid of roof 20' O.C. - 6" alum Z channels walls & roof 3' O.C.
Cor alum over Roof & 50% of perimeter walls balance of perimeter walls
12"x12"x6" Brick Filler wall. a/ft - 5-21-59
with Buck Pilasters

All mfgs except Bldg 2 1960 Unit - Put up by Soule Steel Co

FOR REFERENCE ONLY

FOLIO 22736A | ADDITION THX LOT | Section 27 Twp. 24 Range 5 Ewm. Block | Tax Lot 6 | Lot or Tract

PERMIT NO. 156743

DATE 8-5-58

Address 6805 - 133rd Ave S.E. "Block 2" Blog 2

Fee Owner Burlington Bean Co. Architect Contractor

Condition of Exterior Good Interior good Foundation good Floor Plan: Good Accept Good

USE Factory

1	No. Stories
	No. Stores
1	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

TYPE OF CONSTRUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Plum
	Tile Brick
	Con. Rein. Con.

Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete 50% Spot Ftgs.
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
X	Tile Walls Steel Frame
	Rein. Con. Skel.
X	BRICK 50% Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" 50%
X	Cor. Plum Kind
	Stone Cast S.
	Terra Cotta
	Struct. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

	Mill Construction
/	Rein. Con.

ROOF CONSTRUCTION

	Frame Lam
	Mill Construction
	Rein. Concrete
X	No. Trusses Steel Bar Joists 2'0" O.C.
	Wood Steel

ROOFING MATERIAL

	Tar and Gravel
	Comp. Roll

FLOOR FINISHES

	Fir Maple
	Oak 2"x6" T&G
	Lino. 3"x6" T&G
X	Cement 11,760 SF Remks
	Terrazzo
	Raecolith
	Tile
Dr. X	Bar. Rep.

Tile Lino.

	Baths Fl. Walls
Tile Total	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
Lino. Total	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
	Kit's Fl. Walls

PLUMBING

	No. Fixtures
	Toilets
	Tube, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	11,500 HIS
61	25,500 A&P Co
1971	51,000 AP 70

1958-59 Finished 22K open 20-54 Unfinished Remodel

Basement Area Years Future Life Years

TANKS, ETC., LIST

Steam Ft Lights Gas
(2) Q-Tanks

Hoists: Elec Hyd.

ELEVATORS

Pass.		Freight	
Auto.		Elec.	
Man.		Hyd.	
		Man.	

DOCKS AND PIERS

	Treated Piles, Timb
	Untreated
	Treated Piles only
	Average Length
	Paved

WIRING

	Knobe & Tube
	Flex. Cable
X	Conduit
X	Power Wiring
X	Range Wiring
	No. Outlets

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Doors
	Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H. O. FLOOR AREA Sewer 24000

TOTAL FLOOR AREA

B	
1	16'
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

	Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
	Garage					x			$		$	$
						x			$		$	$
						x			$		$	$
						x			$		$	$

N.P.B.N. CO.

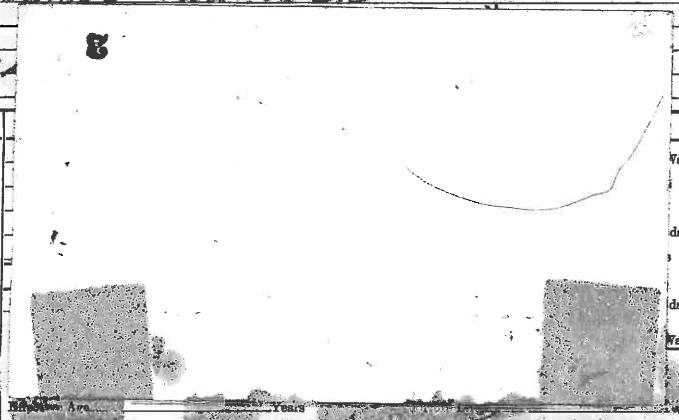
FOR REFERENCE ONLY

FOLIO 22736A | ADDITION Tax Lot | Section 27 Twp 24 Range 5 Ewm. Block | Tax Lot 61 | Lot or Tract

PERMIT NO 156743

DATE 8-5-58 | Address 16805 - 123rd Ave SE | 2 Car

Fee Owner Bernacchi | Condition of Exterior Good | Good



USE Factory

1	No. Stories
	No. Stores
1	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. ☐ 2 rm. ☐ 3 rm.
	4 rm. ☐ 5 rm. ☐ 6 rm.

TYPE OF CONSTRUCTION

	Frame
	Single ☐ Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Plum
	Tile X Brick
	Con. ☐ Rein. Con.

Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete 50% spot fgs. 50%
	Pile

BASEMENT

	Full ☐ %
	Sub-Basement
	Size
	Garage ☐ No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single ☐ Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
X	Tile Walls Steel Frame
	Rein. Con. Skel.
X	Brick 50% Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding ☐ Shingles
	Shakes ☐ Stucco
X	Brick Veneer 6" 50%
V	Con. Plum Kind
	Stone ☐ Cast S.
	Terra Cotta
	Struct. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bldg. ☐

	Mill Construction
/	Rein. Con.

Valls | ds. | ds. | Walls

Year Built Age Years | Depr. for Condition | Depr. for Ob. | Depr. for Ec. | Total

REPRODUCTION COST Factor Make Up

Factor	Plus or Minus	Dimensions	S. F. Area	Factor	Cost
$ 460		60 x 440	26400	$ 3.50	$ 92,400
50	1/2 Insulation	x			$
10.	50% O.H. walls	x			$
55	Ugt 6/12 27'	x			$
- 20	Floors	Pch. x			$
- 11	Found	Pch. x			$
- 36	Heat				$
5 88		25% Ab 1/60			
5 76	15% 1/2 Insulation				
5 84					
350	Adj to 60's				

Total $ 92,400

Less Depreciation $

Total $

Other Buildings $

Total Value (Full) $

Assessed Valuation 50% $ 46,200

PLUMBING

	No. Fixtures
	Toilets
	Tube, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains ☐
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	11,500 HTS
61	25,500 Add 60
1971	51,000 Ap 70

TANKS, ETC., LIST

10 Gal Fuel Oil Storage
Ltg. Trans

ELEVATORS

Pass. ☐ Freight ☐
Auto. ☐ Elec. ☐
Man. ☐ Hyd. ☐
Man. ☐

Hoists: Elec. Hyd.

DOCKS AND PIERS

	Treated Piles, Timb
	Untreated
	Treated Piles only
	Average Length
	Paved

WIRING

	Knobe & Tube
	Flex. Cable
X	Conduit
X	Power Wiring
X	Range Wiring
	No. Outlets

INTERIOR WALLS

	Stud and Plaster
	Lam. ☐ Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain ☐ Varnish
	Kalsomine
	Whitewashed
X	Unfinished

INTERIOR TRIM

	Fir
	Mah. ☐ Oak
	Metal
	Doors
	Windows
	Stained
	Varnished
	Painted
X	Unfinished

C. H. [illegible] AREA 26000 24000

TOTAL FLOOR AREA

B	
1	16'
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

N.P.B.N. CO.

same construction Bldg #1 - no wall between bldg - #1 & #2 or between #2 & #3 or between 2 & 5 JRS 3/73 as of 5/59

Items approx - 1000 lin ft of light gage ex. tech all in one slabs 6' wide constitutes floor area as of 5-2059. check additional finished floor sites

FOLIO 22736A

PERMIT NO. 156743

DATE 8-3-58

ADDITION Tax Lots

Section 27 Twp 24 Range 5E Ewm. Block ____ Lot ____

Tax Lot 6 Tract ____

FOR REFERENCE ONLY

Address 6805 - 133rd Ave SE

Bldg #3

Bldg 3

Fee Owner: Burrows Bakery Co

Architect ____ Contractor ____

Condition of Exterior: good Interior: good Foundation: good - Floor Plan: Good Accept ____ Good ____

USE Factory

1 No. Stories
No. Stores
No. Rooms
Basement
No. Offices
No. Apartments
1 rm. 2 rm. 3 rm.
4 rm. 5 rm. 6 rm. Or

TYPE OF CONSTRUCTION

Frame
Single Double
X Ordinary Masonry
Mill Construction
Class A Rein. Con.
Strn. Steel and Con.
Tile X Brick
Con. Rein. Con.
Good X Med. Cheap

FOUNDATION

Mud Sills
Post and Pier
Brick
X Concrete Fdn's under columns
Pile

BASEMENT

Full %
Sub-Basement
Size
Garage No. Cars
Floors
Plastered
Living Rooms
Service Rooms

ROOF CONSTRUCTION

Frame Lam.
Mill Construction
Rein. Concrete
X No. Trusses Steel Beams 20' o.c.
Wood X Steel

ROOFING MATERIAL

Tar and Gravel
Or Metal

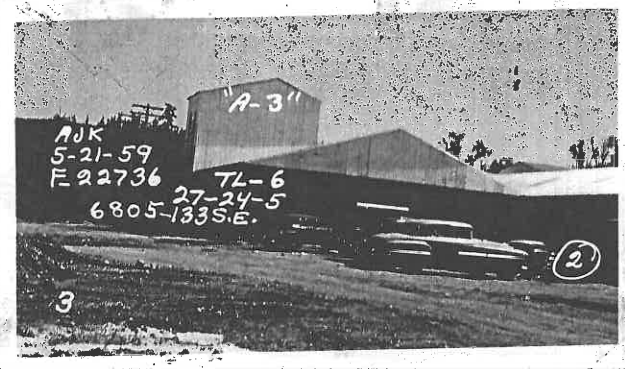
FLOOR FINISHES

Fir Maple
Oak 2"x6" T&G
Lino. 3"x6" T&G
X Cement wearing T. only
Terrazzo
Raccolith
Tile
Or X B-Top

Tile Lino.
Baths Fl. Walls
Sq. Ft. Floors
Sq. Ft. Walls
Lin. Ft. Dr. Bds.
Sq. Ft. Floors
Sq. Ft. Walls
Lin. Ft. Dr. Bds.
Kit's Fl. Walls

Date Built 1955-59 Finished
Effective Age Years
Dep. for Cond. Dep. for Ob. Dep. for Ec. Total

25 yrs 30-55
X Unfinished Remodeled
Future Life Years



PLUMBING

No. Fixtures
Toilets
Tub, Leg or Pem.
Basins, Ped.
Sinks
Urinals
Showers (Tub) (Stall)
Laundry Trays
H. W. Tank Fl. Drains
Sprink. Sys. No. Hds.

HEATING

Stove
Pipeless Furnace
Gravity H. A.
Air Cond., Fan
Suspended Gas, Hot Water
Steam Heat
Hot Water
Oil Burner

Year	Assessed Value
1960	3500 M/S
61	6100 appl-60
1971	12,200 AP 70

Pass. Freight
Auto. Elec.
Man. Hyd.
Man.

Treated Piles, Timb
Untreated
Treated Piles only
Average Length
Paved

Knob & Tube
Flex. Cable
X Conduit
X Power Wiring
Range Wiring
No. Outlets

Hoists: Elec. Hyd.

EXTERIOR WALL CONST.

Single Double
2" x 4" Stud Walls
2" x 6" Stud Walls
Brick Walls
X Brick with Pilasters 6"
Concrete Walls
Con. with Pilasters
Tile Walls
Rein. Con. Skel.
Filler Walls
Laminated Walls

EXTERIOR FACING

Siding Shingles
Shakes Stucco
X ~~Brick Veneer~~ Scr. Tile 6"
Kind
Stone Cast S.
Terra Cotta
Struc. Glass
Trim

FLOOR CONSTRUCTION

Joist Con. Size x
O.C. In Bridg.
Mill Construction
Rein. Con.

INTERIOR WALLS

Stud and Plaster
Lam. Plastered
Plywood
Ceiled
Plaster Board
Painted
Stain Varnish
Kalsomine
Whitewashed
Unfinished
X Exp-Brick

INTERIOR TRIM

Fir
Mah. Oak
Metal
Doors
Windows
Stained
Varnished
Painted
1 Unfinished

	C. H.
B	
1	16'-32'
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 8460 sq ft

TOTAL FLOOR AREA 5550 sq ft

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

FOLIO 22726A

PERMIT NO. 156743

DATE 8-5-58

ADDITION Tax Lots

Section 27 Twp 24 Range 2 Ewm. Block Tax Lot 6 Lot of Tract

FOR REFERENCE ONLY

Address 6535 133 Ave SE

Fee Owner Burrell

Condition of Exterior Good

USE Factory

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

TYPE OF CONSTAUCTION

	Frame
	Single Double
X	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
	Struc. Steel and Con.
	Tile X Brick
	Con. Rein. Con.

Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete FTG's
	Pile WALLS & Columns

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls
X	Brick with Pilasters 6"
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
	Filler Walls
	Laminated Walls

EXTERIOR FACING

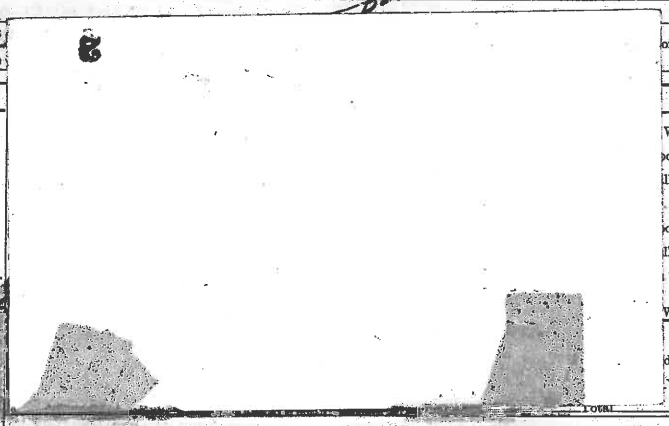
	Siding Shingles
	Shakes Stucco
X	Brick Veneer 6" SCR TILE
	Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

	Mill Construction
	Rein. Con.



REPRODUCTION COST Factor Make-Up

Factor	Plus or Minus	Dimensions	S. F. Area	Factor	Cost
460		70 x 120	8400	3.15	26,460
50	Wall Hts. 18 & 20	35 x 35	1225	1.25	1531
55	Roof Type GABLE (Low)	x			
16	Sprinkler Sys.	x			
- 35	Openings WOOD	Pch. x			
- 10	25 lbs per sq ft	Pch. x			
- 36	Heat				
- 42	Factors				
457					
+ 69	15%				
526					
316	4 Tanks				

Total 27,991

Less Depreciation

Total

Other Buildings

Total Value (Full)

Assessed Valuation 50% 14,000

PLUMBING

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	3500 - 157
67	6100 add-60
1971	12,200 AV 70

TANKS, ETC., LIST

Hoists: Elec. Hyd.

ELEVATORS

	Pass.		Freight
	Auto.		Elec.
	Man.		Hyd.
			Man.

DOCKS AND PIERS

	Treated Piles, Timb
	Untreated
	Treated Piles only
	Average Length
	Paved

WIRING

	Knob & Tube
	Flex. Cable
X	Conduit
X	Power Wiring
X	Range Wiring
	No. Outlets

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted
	Stain Varnish
	Kalsomine
	Whitewashed
	Unfinished
X	EXP-BRICK

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Doors
	Windows
	Stained
	Varnished
	Painted
1	Unfinished

	C. H.
B	
1	16'-32'
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 8400 sq ft

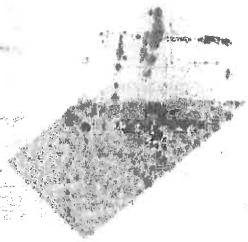
TOTAL FLOOR AREA

	Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
	Garage					x			$		$	$
						x			$		$	$
						x			$		$	$
						x			$		$	$

5M 2-56

This bldg (3) walls only of 12"x12"x6" structural bricks filled with lt. Pilaster Roof const same as bldg-A-2 - actually part of Bldg A-2. (35'x35' area is raised approx 16 above roof lines to house vats for part of operation. This portion all steel & cor-drum) Floors part Conc & part B-top

The portion that is raised above the roof line is designated on the overall plot sketch as "A-4". It is 14% of total Bldg 3 area.



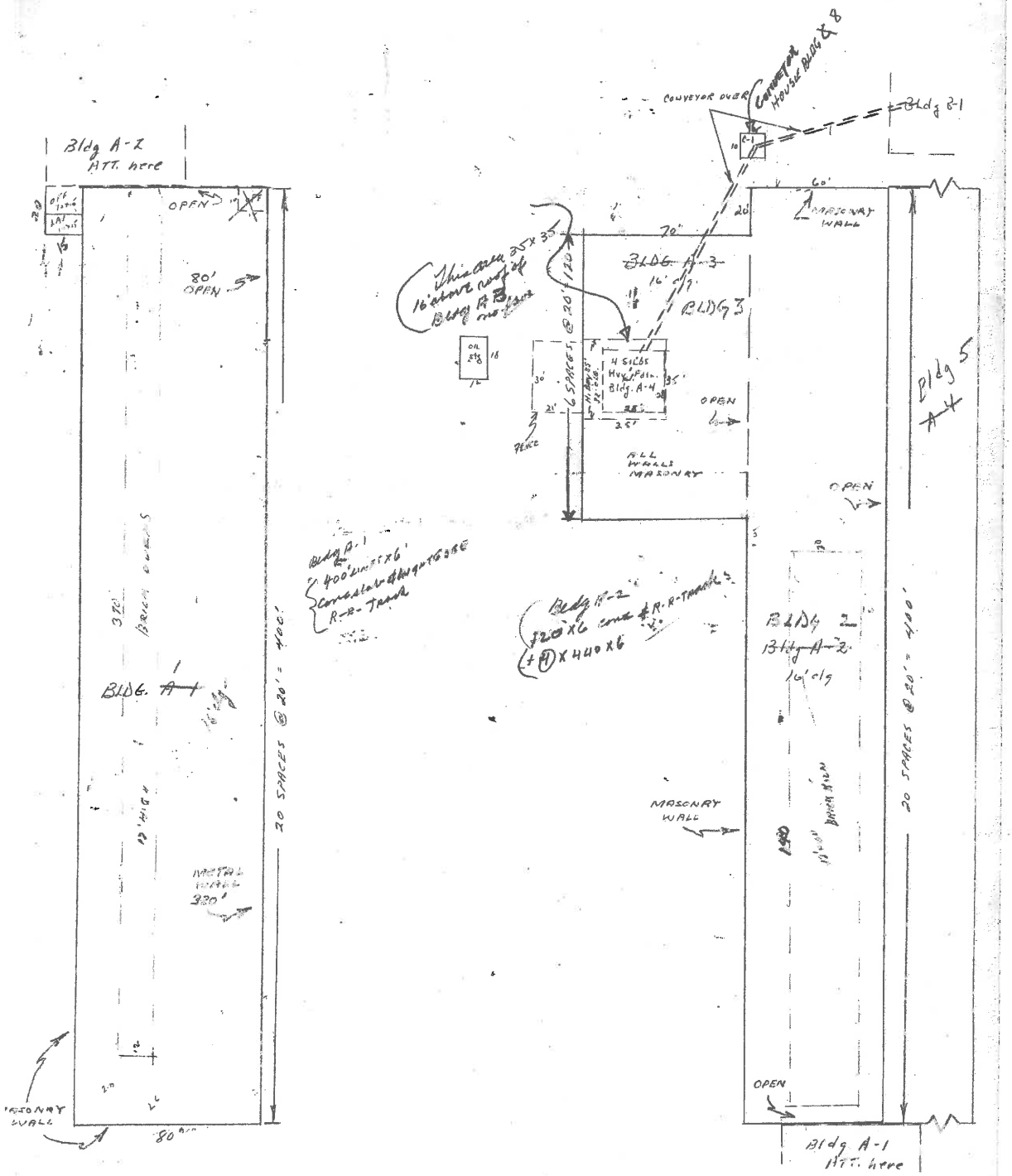
DATE

Section 21 Twp. 24 Range 3 Ewm. Block 6 Lot or Tract

FOR REFERENCE ONLY

ADDRESS 6805 - 13301 S.E.

Fee Owner Builders Brick Co.



COM'D

FOLIO 22736A

ADDITION Twp-Lot-S

Section 27 Twp 24 Range 5 Ewm. Block — Tax Lot 6

LOT — Tract — FOR REFERENCE ONLY

PERMIT NO. C-1078-60 1658

DATE 11-23-59

Address 6805 - 133 PLACE (Bldg D) BLDG 4

Fee Owner Burlsons-Rain-Go- Architect — Contractor

Condition of Exterior good Interior good Foundation good Floor Plan: Good — Accept — Good

USE Farm Store 580

- 1 No. Stories
- No. Stores
- No. Rooms
- Basement
- No. Offices
- No. Apartments
- 1 rm. 2 rm. 3 rm.
- 4 rm. 5 rm. 6 rm.

TYPE OF CONSTRUCTION

- Frame
- Single ☐ Double
- Ordinary Masonry
- Mill Construction
- Class A Rein. Con.
- X Stru. Steel and Con. Frame
- Tile ☐ Brick
- Con. ☐ Rein.

Good X Med. Cheap

FOUNDATION

- Mud Sills
- Post and Pier
- Brick
- X Concrete
- Pile

BASEMENT

- Full ☐ %
- Sub-Basement
- Size
- Garage ☐ No.
- Plastered
- Living Rooms
- Service Rooms

ROOF CONSTRUCTION

- Frame Lam. ☐
- Mill Construction
- Rein. Concrete
- No. Trusses
- Wood ☑ Steel

ROOFING MATERIAL

- Tar and Gravel
- Or X Comp-Asbestos

FLOOR FINISHES

- Fir ☐ Maple
- Oak ☐ 2"x6" T&G
- Lino. ☐ 2"x6" T&G
- Cement
- Terrazzo
- Racolith
- Tile
- Or X B-Top

Tile ☐ Lino.

Tile: Baths ☐ Fl. ☐ Walls; Total Sq. Ft. Floors; Total Sq. Ft. Walls; Lin. Ft. Dr. Bds.

Lino.: Total Sq Ft Floors; Total Sq. Ft. Walls; Lin. Ft. Dr. Bds.

Kit's ☐ Fl. ☐ Walls

PLUMBING

- No. Fixtures
- Toilets
- Tub, Leg or Pem.
- Basins, Ped.
- Sinks
- Urinals
- Showers (Tub) (Stall)
- Laundry Trays
- H. W. Tank Fl. Drains ☐
- Sprink. Sys. No. Hds

HEATING

- Stove
- Pipeless Furnace
- Gravity H. A.
- Air Cond., Fan
- Suspended Gas, Hot Water
- Steam Heat
- Hot Water
- Oil Burner

Date Built 1959 ☒ Finished ☐ Unfinished ☐ Remodeled

Effective Age Years Future Life Years

Dep. for Cond Dep. for Fo Dep. for Pa Total

Date Built

Effective A

Dep. for Co

FACTOR

Year	Assessed Value
61	14700 10% 60
71	48,600 AP 70

TOTAL 97,200

LESS DEPRECIATION

DEPR. FULL VALUE

ASSESSED VAL. 48,600

EXTERIOR WALL CONST.

- Single ☐ Double
- 2" x 4" Stud Walls
- 2" x 6" Stud Walls
- Brick Walls Stuc-o-lite
- Brick with Pilasters
- Concrete Walls
- Con. with Pilasters
- Tile Walls
- Rein. Con. Skel.
- Filler Walls
- Laminated Walls

EXTERIOR FACING

- Siding ☐ Shingles
- Shakes ☐ Stucco
- Brick Veneer
- X Corrulum (1) END Kind
- Stone ☐ Cast S.
- Terra Cotta
- Struc. Glass
- Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg. ☐

- Mill Construction
- Rein. Con.

INTERIOR WALLS

- Stud and Plaster
- Lam. ☐ Plastered
- Plywood
- Ceiled
- Plaster Board
- Painted Spun
- Stain ☐ Varnish
- Kalsomine
- Whitewashed
- Unfinished

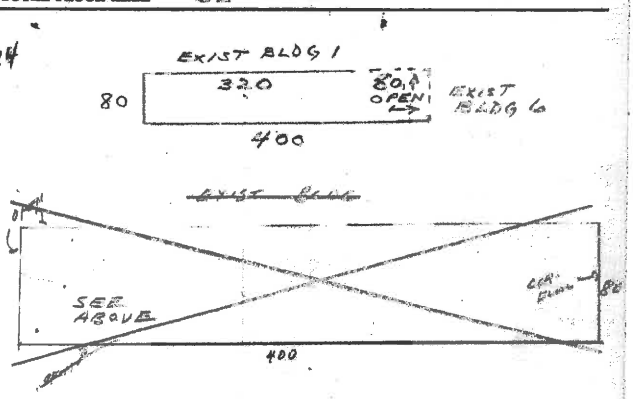
INTERIOR TRIM

- Fir
- Mah. ☐ Oak
- Metal
- Doors
- Windows
- Stained
- Varnished
- Painted
- Unfinished

C. H.	
B	
1	14-24
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 32000

TOTAL FLOOR AREA 32000



Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

SM 1-59

COM'D

FOLIO 22736A

ADDITION Tax Lots

Section 27 Twp. 24 Range 5 Ewm. Block Tax Lot 6

LOT Tract FOR REFERENCE ONLY

PERMIT NO. C-10784 & 1652

DATE 11-22-59

Address 6805 - 133 Place S.E. BLDG 4

Fee Owner Burgess - Brier

Condition of Exterior Good Interior Good

USE Gas Station Store

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

ROOF

Or X

TYPE OF CONSTRUCTION

	Frame
	Single Double
	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Frame
	Tile Brick
	Con. Rein.

Good X Med. Cheap

Date Built

Effective Age

Dep. for Cond.

FACTOR

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No.
	Plastered
	Living Rooms
	Service Rooms

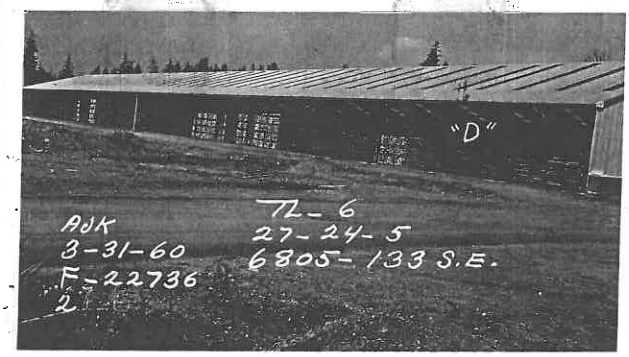
PLUMBING

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1961	14700 / 22560
971	48,600 / AP 70



TOTAL	41,280
LESS DEPRECIATION	
DEPR. FULL VALUE	48,600
ASSESSED VAL.	

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls Steel Skeleton
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
	Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
	Brick Veneer
X	Corrugated Iron END Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size

O.C. In Bridg.

	Mill Construction
	Rein. Con.

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted open
	Stain Varnish
	Kalsomine
	Whitewashed
	Unfinished

INTERIOR TRIM

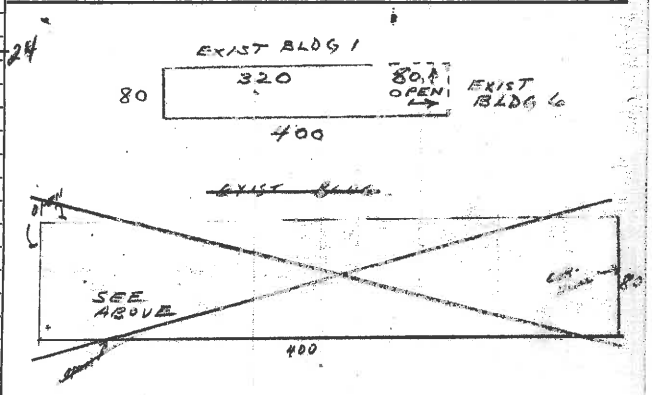
	Fir
	Mah. Oak
	Metal
	Doors
	Windows
	Stained
	Varnished
	Painted
	Unfinished

C. H.

B 1 14-24 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

GROUND FLOOR AREA 32000

TOTAL FLOOR AREA 32000



Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Depr.	Deprec.	Net Value
Garage								$		$	$
								$		$	$
								$		$	$
								$		$	$

5M 1-59

COM'D

FOLIO 22736A

ADDITION TAX LOT-S

Section 27 Twp 24 Range 5 Ewm Block — Tax Lot 6

FOR REFERENCE ONLY

Tract

PERMIT NO. C-1076-59-1658

DATE 11-23-59

Address 6805 - 123 RIVER RD

BLDG 4

Fee Owner BUILDERS-BASIC

Condition of Exterior GOOD Inte — Good

USE Dairy Storage Shed

ROOF

PLUMBING

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. ☐ 2 rm. ☐ 3 rm.
	4 rm. ☐ 5 rm. ☐ 6 rm. Or X

ROOF

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains ☐
	Sprink. Sys. No. Hds.

TYPE OF CONSTRUCTION

	Frame
	Single ☐ Double
	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Frame
	Tile ☐ Brick
	Con. ☐ Rein.

Date Built 1960 Date Add. Built — ☑ Finished ☐ Unfinished ☐ Remodeled ENCLOSED 1970

Effective Age — Years Future Life — Years

Dep. for Cond. — Dep for Ob. — Dep. for Es. 2 Total

Good X Med. Cheap

REPRODUCTION COST For or Make-Up

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1961	14700 / 9800
1971	48,600 - 40 70

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete
	Pile

BASEMENT

	Full ☐ %
	Sub-Basement
	Size
	Garage ☐ No.
	F
	Plastered
	Living Rooms
	Service Rooms

FACTOR	ITEM	DIMENSIONS	SQ. FT. AREA	FACTOR	COST
		80 X 400	32000	1.40	44800
		X			
		X			
	See Sketch	X			
1	Floor	B. TOP	38,000	10	3800
					48,600
		FOR 50%	AV		42
		TOTAL			97,200
		LESS DEPRECIATION			
		DEPR. FULL VALUE			48,600
		ASSESSED VAL.			

EXTERIOR WALL CONST.

	Single ☐ Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls Shelf Addition
	Brick with Pilasters
	Concrete Walls
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
	Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding ☐ Shingles
	Shakes ☐ Stucco
	Brick Veneer
X	Corrugated Iron END Kind
	Stone ☐ Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg. ☐

	Mill Construction
	Rein. Con.

INTERIOR WALLS

	Stud and Plaster
	Lam. ☐ Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted Open
	Stain ☐ Varnish
	Kalsomine
	Whitewashed
	Unfinished

INTERIOR TRIM

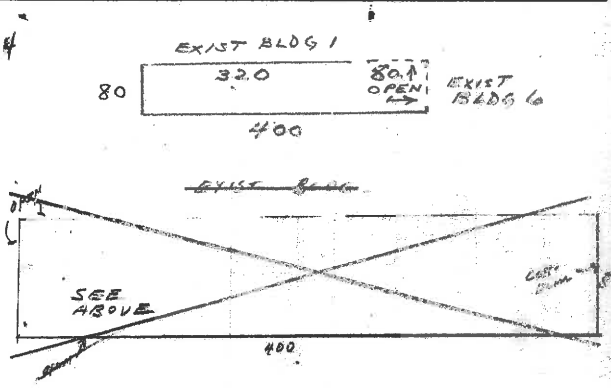
	Fir
	Mah. ☐ Oak
	Metal
	Doors
	Windows
	Stained
	Varnished
	Painted
	Unfinished

C. H.

B	
1	14-24
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 32000

TOTAL FLOOR AREA 32000



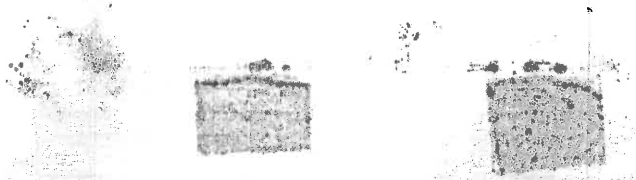
	Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Depree.	Net Value
	Garage					x			$		$	$
						x			$		$	$
						x			$		$	$
						x			$		$	$

5M 1-59

Brick storage - 3 sides open steel frame - corten roof
- no heat - no wiring - no plbg. etc
off 4-7-60

Typ of clay storage bldg just has 6 - top 2 roof -

The shed completely dismantled. Used steel beam
on comparable bldg in area 3/70 AP



FOLIO 22736-A
PERMIT NO. 10006
DATE 9-26-69

ADDITION TAX LOT — COM'L
Section NW 27 Twp 24 Range 5 EWM. Block ____ Lot or ____
Tax Lot 6 Tract ____
Address 6805 - 133rd SE — BLDG 5
~~BLDG A~~ — BLDG 5

Fee Owner Mutual Materials — Architect ____ — Contractor Commercial Ind.
Zoning MP — Condition of Exterior G — Interior G — Foundation G — Floor Plan: Good ____ Accept. ✓ Poor ____

USE FACTORY

	No. Stories
1	No. Stores
	No. Rooms
	Basement Unit Sq. Ft.
	No. Offices
	No. Apartmts.
	1 rm. ☐ 2 rm. ☐ 3 rm.
	4 rm. ☐ 5 rm. ☐ 6 rm.

TYPE OF CONSTRUCTION

	Frame
✓	Metal-Prefab
	Ordinary Masonry
	Mill Construction
	Class A Rein. Conc.
	Stru. Steel and Conc.
	Struct. Steel, Frame

QUALITY-TYPE: ood ✓ Med. Cheap

FOUNDATION

	Mud Sill ☐ Post Pier
✓	Conc. ☐ Brick
	Load Hgt. ☐ Piling

BASEMENT

	Full ____ % Part.
	Sub-Basement
	Size ____
	Garage ☐ No. Cars ____ Floors
	Plastered ☐ Pl. Bd.
	No. Apartments
	Service Rooms

EXTERIOR WALL CONST.

	Single ☐ Double
	Stud Walls
	Brick ____ Pil. ☐
	Conc. ____ Pil. ☐
	Rein. Conc. Skeleton
✓	Str. Stl.-Frame
	Pre-Fab Metal
	Tilt-Up
	____ Filler Wall
	____ Curtain Wall

EXTERIOR FACING

EYAL	Siding
	Stucco ____ Shakes
	Marblecrete
	Brick ☐ Veneer
	Conc. ☐ Conc. Blk.

FLOOR CONSTRUCTION

	____ x ____ x ____ O.C.
	Mill ____ Car Deck
✓	R-Conc. ____ Elev.
	Steel ____ GLB.

ROOF COVERING

	Blt.-Up ____ Tar.&Gr.
	Comp. ____ Metal

ROOF CONSTRUCTION

	Frame-Joist ____
	Mill-Deck ____
	Rein. Conc. ____ GLB
✓	Steel Fr. ____ Metal Deck
	Trusses ____ Span
	Wood ____ Steel

SOULE - TYPE

FLOOR FINISHES

	Fir	☐	Maple
	Oak	☐	2x6TG
	Lino	☐	3x6TG
	Cement	☐	Lgtwgt. Conc.
	Terrazzo		
	Asphalt Tile	☐	Vinyl Tile

or

☐ Tile ☐ Lino ☐ Form.

	Bath Floor
	Bath Walls
	Tub Recess
	Drain Bds.
	Vanities

PLUMBING

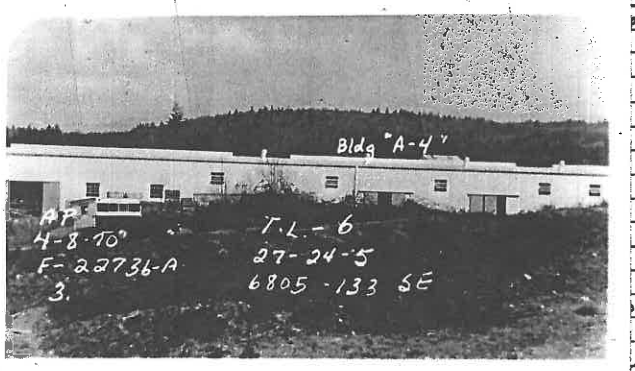
	No. Fixtures
	Toilets ____ Urinals
	Tubs Leg. or Pem.
	Basins ____ Dr. Ftns.
	Sinks
	Washers ____ Dryers
	Showers (tub) (stall)
	H.W. Tanks ____ Ldy. Trays
	D-Washers ____ Disposals
	Sprinkler Sys.

Date Built 1970 — Date Add. Built ____ — 10/69 ☒ Finished — ~~☐~~ Unfinished — ☐ Remodeled
Effective Age ____ Years — Future Life ____ Years
Dep. for Cond. ____ Dep for Ob. ____ Dep. for Es. ____ Total ____

HEATING

	Elec. ____ Oil ____ Gas
	H.W. ____ St. ____ H.A.
	B.Bd. ____ Suspended
	FHA ____ Pipeless
	A. Cond. ____ Wall Unit
	Comb. Unit ____ Custom
	Refrig. ____ Convector
	Heat Pump ____ Fireplace

YEAR	ASSESSED VALUE
1971	66500 AP 70
	\ PARTIAL /
1972	23,440 RDS-20



MISC. TANKS, Etc.
HOISTS: Elec. Hydr.

ELEVATORS

	Pass.	Frght.	
	Auto.	Elec.	
	Man.	Hydr.	
Doors-Auto		Man.	
	Escalators		
	Stops	Speed	
Cap'y.			

DOCKS AND PIERS

	Hvy.	Med.	Lgt.
	Untrtd. Pile Tmbr.		
	Conc. Piles & Bms.		
	Trtd. Pile Tmbr.		
	Paved		
	Dolphins		
Deck			

WIRING CODE

	Knob & Tube
	Flex. Cable
	Conduit
	Pwr. Wiring
	Range Wiring
	Outlets

INTERIOR WALLS & CEILING

Stud	Wood	Metal
Plaster	DryWall	
Acc. Tile	Celotex	
Ceiled	Plywood	
Solid	Block	
Sound Proofed		Lamin.
Finished		Unfinished
Painted		Varnished

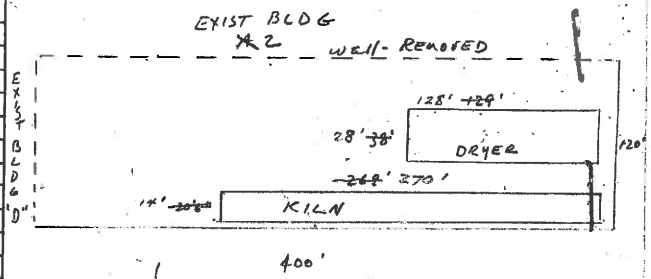
INSULATION

	Exter.		Partitions
	Roof		Floor

INTERIOR TRIM

	Fir		Birch
	Mah.		Oak
	Metal		
	Wood	Metal	Doors
	Wood	Metal	Sash
	Stained		Varnish
	Painted		Unfin.

	C.Hgt.	
SB		GROUND FLOOR AREA 48,000 +/-
B		TOTAL FLOOR AREA
1	~~48'~~	
2	26-26	
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		



OM 11/63

Saule type bldg. Used two existing walls
all of floor not finished. Kitchen + dryer
about 1/2 Conc. Pack up extra on floor -
dryer - toilet + inside spare walls at
later date. 3/70 RDS

Permit 9975 dryer + toilet foundation 19.00

1990 Completed Portal Added For Spur [redacted] S.F. L.F. & Floor 1/3 BT 2/3 Conc.
~~Kitchen & Dining Area Partial Roof Off~~ 10/70 RDS

FOLIO 22736A

ADDITION Tax Lot

Section 27 Twp. 24 Range 5 Ewm. Block Tax Lot 6 Lot or Tract FOR REFERENCE ONLY

PERMIT NO. 156743

DATE 8-5-58

Address 6805 - 133rd Ave S.E. "Bldg B-1" Bldg 6

Fee Owner BUILDERS BRICK CO. Architect Contractor

Condition of Exterior Good Interior Good Foundation Good Floor Plan: Good Accept Good

USE FACTORY

- 1 No. Stories
- No. Stores
- No. Rooms
- Basement
- No. Offices
- No. Apartments
- 1 rm. 2 rm. 3 rm.
- 4 rm. 5 rm. 6 rm.

TYPE OF CONSTAUCTION

- Frame
- Single Double
- Ordinary Masonry
- Mill Construction
- Class A Rein. Con.
- X Stru. Steel and Con. Equiv.
- Tile Brick
- Con. Rein. Con.

Good X Med Cheap

FOUNDATION

- Mud Sills
- Post and Pier
- Brick
- X Concrete FTGS
- Pile CAISSON COL.
- X BRICK WALL

BASEMENT

- Full %
- Sub-Basement
- Size
- Garage No. Cars
- Floors
- Plastered
- Living Rooms
- Service Rooms

ROOF CONSTRUCTION

- Frame Lam.
- Mill Construction
- Rein. Concrete
- X Nor. Trusses STEEL BEAMS 20' O.C.
- Wood Steel

ROOFING MATERIAL

- Tar and Gravel
- Or COR-RUGM
- Or X DIAF

FLOOR FINISHES

- Fir Maple
- Oak 2"x6" T&G
- Lino. 3"x6" T&G
- Cement
- Terrazzo
- Racolith
- Tile

Tile Lino. Total

- Baths Fl. Walls
- Sq. Ft. Floors
- Sq. Ft. Walls
- Lin. Ft. Dr. Bds.

Lino. Total

- Sq. Ft. Floors
- Sq. Ft. Walls
- Lin. Ft. Dr. Bds.
- Kit's Fl. Walls

PLUMBING

- No. Fixtures
- Toilets
- Tub, Leg or Pem.
- Basins, Ped.
- Sinks
- Urinals
- Showers (Tub) (Stall)
- Laundry Trays
- H. W. Tank Fl. Drains
- Sprink. Sys. No. Hds.

HEATING

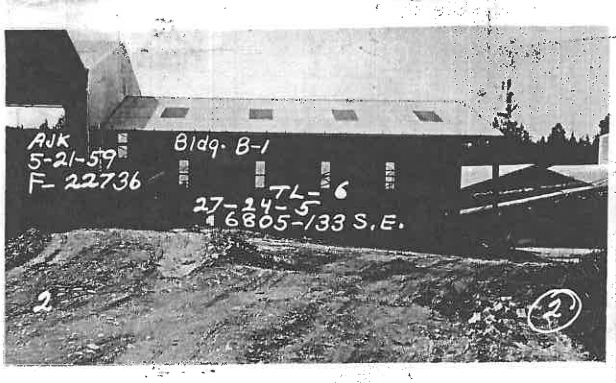
- Stove
- Pipeless Furnace
- Gravity H. A.
- Air Cond., Fan
- Suspended Gas, Hot Water
- Steam Heat
- Hot Water
- Oil Burner

Year	Assessed Value
1960	1250 KTS9
61	21150 9/1-60
1971	4300 AP 70

Date Built 1958-59 X Finished Unfinished Remodeled

Effective Age Years Future Life Years

Dep. for Cond. Dep. for Ob. Dep. for Fu. Total



Auto. Elec. Untreated Flex. Cable

Man. Hyd. Treated Piles only X Conduit

Man. Average Length X Power Wiring

Paved X Range Wiring

Hoists: Elec. Hyd. No. Outlets

EXTERIOR WALL CONST.

- Single Double
- 2" x 4" Stud Walls
- 2" x 6" Stud Walls
- Brick Walls STEEL FRAME
- Brick with Pilasters
- Concrete Walls
- Con. with Pilasters
- Tile Walls
- Rein. Con. Skel.
- Filler Walls
- Laminated Walls

EXTERIOR FACING

- Siding Shingles
- Shakes Stucco
- Brick Veneer
- X CORRUGUM 50% Kind
- Stone Cast S.
- Terra Cotta
- Struc. Glass
- X 50% OPEN Trim

FLOOR CONSTRUCTION

Joist Con. Size x

O.C. In Bridg.

- Mill Construction
- Rein. Con.

INTERIOR WALLS

- Stud and Plaster
- Lam. Plastered
- Plywood
- Ceiled
- Plaster Board
- Painted
- Stain Varnish
- Kalsomine
- Whitewashed
- X Unfinished
- X 50% open

INTERIOR TRIM

- Fir
- Mah. Oak
- Metal
- Doors
- Windows
- Stained
- Varnished
- Painted
- X Unfinished

C. H.

B 1 25' 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

GROUND FLOOR AREA 4500 ±

TOTAL FLOOR AREA

SEE SUPPL COVERING BLDGS 6&7

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

FOLIO 22736A

ADDITION Tax Lot

Section 27 Twp. 24 Range 5 Ewm. Block Tax Lot 6 Lot or Tract FOR REFERENCE ONLY

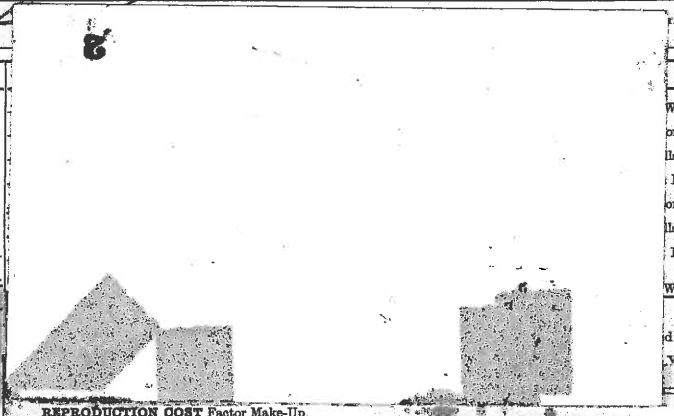
PERMIT NO. 156743

DATE 8-5-58

Address 6805 - 13346 S.E. [illegible] Bldg 6

Fee Owner BUILDERS

Condition of Exterior Good Good



USE FACTORY

1 No. Stories
No. Stores
No. Rooms
Basement
No. Offices
No. Apartments
1 rm. 2 rm. 3 rm.
4 rm. 5 rm. 6 rm.

TYPE OF CONSTAUCTION

Frame
Single Double
Ordinary Masonry
Mill Construction
Class A Rein. Con.
X Stru. Steel and Con. Ferum
Tile Brick
Con. Rein. Con.
Good X Med. Cheap

FOUNDATION

Mud Sills
Post and Pier
Brick
X Concrete FTG'S
Pile DAISER COL.
X BRICK WALL

BASEMENT

Full %
Sub-Basement
Size
Garage No. Cars
Floors
Plastered
Living Rooms
Service Rooms

EXTERIOR WALL CONST.

Single Double
2" x 4" Stud Walls
2" x 6" Stud Walls
Brick Walls STEEL FRAME
Brick with Pilasters
Concrete Walls
Con. with Pilasters
Tile Walls
Rein. Con. Skel.
Filler Walls
Laminated Walls

EXTERIOR FACING

Siding Shingles
Shakes Stucco
Brick Veneer
X Corrugum 26 Gage Rind
Stone Cast S.
Terra Cotta
Struc. Glass
X 50% OPEN Trim

FLOOR CONSTRUCTION

Joist Con. Size x
O.C. In Bridg.
Mill Construction
Rein. Con.

REPRODUCTION COST Factor Make-Up

Factor	Plus or Minus	Dimensions	S. F. Area	Factor	Cost
$ 72	Basic Unit	60 x 80	4800	215	$ 10008
18	Roofing	x			$
48	Ceiling	x			$
30	Extra Height 15' & 8'	x			$
10	Extra Elec.	Pch. x			$
50	Mill Type Construction	Pch. x			$
40	Extra Wall Cover 50% Open				
298					
45 = 15%					
343					
137					
206 = 60%					

Total $
Less Depreciation $
Total $
Other Buildings $
Total Value (Full) $ 10008
Assessed Valuation 50% $ 5004

PLUMBING

No. Fixtures
Toilets
Tub, Leg or Pem.
Basins, Ped.
Sinks
Urinals
Showers (Tub) (Stall)
Laundry Trays
H. W. Tank Fl. Drains
Sprink. Sys. No. Hds.

HEATING

Stove
Pipeless Furnace
Gravity H. A.
Air Cond., Fan
Suspended Gas. Hot Water
Steam Heat
Hot Water
Oil Burner

Year	Assessed Value
1960	1250 HTG
61	21450 9X-60
1971	4300 AP 70

TANKS, ETC., LIST

Hoists: Elec. Hyd.

ELEVATORS

Pass. Freight
Auto. Elec.
Man. Hyd.
Man.

DOCKS AND PIERS

Treated Piles, Timb
Untreated
Treated Piles only
Average Length
Paved

WIRING

Knob & Tube
Flex. Cable
X Conduit
Power Wiring
Range Wiring
No. Outlets

INTERIOR WALLS

Stud and Plaster
Lam. Plastered
Plywood
Ceiled
Plaster Board
Painted
Stain Varnish
Kalsomine
Whitewashed
Unfinished
X 50% open

INTERIOR TRIM

Fir
Mah. Oak
Metal
Doors
Windows
Stained
Varnished
Painted
X Unfinished

C. H.	
B	
1	25'
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 4800

TOTAL FLOOR AREA

SEE SUPPL COVERING BLDG 6B"

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

Roof & upper 50% of upper walls (6" Z channels alum) - 3'o.c & Corrulum over.
Heavy steel Columns 20'o.c. with Heavy steel I Beams from top of Col. to top of ridge.
dirt floors

POLIO 22736 A

PERMIT NO. 156743

DATE 5-5-58

ADDITION Tax Lot

Section 27 Twp 24 Range 5 Ewm. Block Tax Lot (2) Lot or Tract

FOR REFERENCE ONLY

COM'L

Address 6805 - 133 Ave S.E. (1 Bldg 83 Units) Bldg 7

Fee Owner Burgess Brick Co. Architect Contractor

Condition of Exterior good Interior good Foundation good. Floor Plan: Good Accept Good

USE Clay Storage

1	No. Stories
	No. Stores
	No. Rooms
	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

TYPE OF CONSTAUCTION

	Frame
	Single Double
	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Plum
	Tile Brick
	Con. Rein. Con.

Good X Med. Cheap

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
X	Concrete FTG's
	Pile

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls OPEN
	Brick with Pilasters
	Concrete Walls STEEL
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
	Filler Walls
	Laminated Walls

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
	Brick Veneer
X	OPEN Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

FLOOR CONSTRUCTION

Joist Con. Size x O.C. In Bridg.

	Mill Construction
	Rein. Con.

ROOF CONSTRUCTION

	Frame Lam.
	Mill Construction
	Rein. Concrete
X	No. Trusses STEEL (CLEAR) 20'0.C
	Wood Steel

ROOFING MATERIAL

	Tar and Gravel
	Or. COMP-ALUM

FLOOR FINISHES

	Fir Maple
	Oak 2"x6" T&G
	Lino. 3"x6" T&G
	Cement
	Terrazzo
	Raccolith
	Tile
Or. X	DIRT

Tile Lino.

	Baths Fl. Walls
	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
	Sq. Ft. Floors
	Sq. Ft. Walls
	Lin. Ft. Dr. Bds.
	Kit's Fl. Walls

PLUMBING

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Fl. Drains
	Sprink. Sys. No. Hds.

Date Built 1958-59 X Finished Unfinished Remodeled

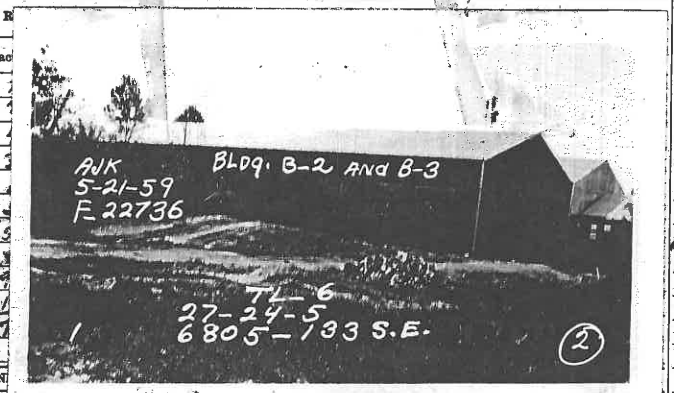
Effective Age Years Future Life Years

Dep. for Cond. Dep. for Ob Dep. for Es. Total

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

Year	Assessed Value
1960	27,700 AP 59
1961	12,300 AP-60
1971	24,600 AP 70



Pass. Auto. Man. Freight Elec. Hyd. Man.

Treated Piles, Timb. Untreated Treated Piles only Average Length Paved

Knob & Tube Flex. Cable Conduit Power Wiring Range Wiring No. Outlets

Hoists: Elec. Hyd.

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted OPEN
	Stain Varnish
	Kalsomine
	Whitewashed
	Unfinished

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Doors
	Windows
	Stained
	Varnished OPEN
	Painted
	Unfinished

	C. H.
B	
1	25
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA ~~20600~~ 46200

TOTAL FLOOR AREA

STR 3 STORAGE

Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Deprec.	Net Value
Garage					x			$		$	$
					x			$		$	$
					x			$		$	$
					x			$		$	$

5M 2-56

FOLIO 22736A

ADDITION Tax Lot

Section 27 Twp 24 Range 5 Ewm. Block Tax Lot (6) Lot or Tract

COM'L

FOR REFERENCE ONLY

PERMIT NO. 156744

DATE 5-5-58

Address 6805-132 AVE S.E. H 8806 B2 & B3

BLDG 1

Fee Owner Burgess E

Condition of Exterior Good Int Good

USE Gen. Store

ROOF

PLUMBING

1	No. Stories
	No. Stores
	No. Rooms
X	Basement
	No. Offices
	No. Apartments
	1 rm. 2 rm. 3 rm.
	4 rm. 5 rm. 6 rm.

	No. Fixtures
	Toilets
	Tub, Leg or Pem.
	Basins, Ped.
	Sinks
	Urinals
	Showers (Tub) (Stall)
	Laundry Trays
	H. W. Tank Ft. Drains
	Sprink. Sys. No. Hds.

TYPE OF CONSTAUCTION

	Frame
	Single Double
	Ordinary Masonry
	Mill Construction
	Class A Rein. Con.
X	Stru. Steel and Con. Stucco
	Tile Brick
	Con. Rein. Con.

Good X Med. Cheap

HEATING

	Stove
	Pipeless Furnace
	Gravity H. A.
	Air Cond., Fan
	Suspended Gas, Hot Water
	Steam Heat
	Hot Water
	Oil Burner

FOUNDATION

	Mud Sills
	Post and Pier
	Brick
V	Concrete FTG.'S
	Pile

REPRODUCTION COST Factor Make-Up

Factor	Plus or Minus	Dimensions	S. F. Area	Factor	Cost
$ 7	Base Cost	140 x 220	30800	1.50	65,940
48	Roofing	x			$
48	Mill Frame	x			$
30	Ext. Wall @ 2'	x			$
10	Ext. Wall	Peh. x			$
50	Partitions	Peh. x			$
258					
+ 39	+15%				
297					
-118	-40%				
179	Scale				

Total	$
Less Depreciation	$
Total	$
Other Buildings	$
Total Value (Full)	$ 55,940
Assessed Valuation 50%	$ 27,700

Year	Assessed Value
1960	27,700 AV 59
1961	12,300 AV-60
1971	24,600 AV 70

BASEMENT

	Full %
	Sub-Basement
	Size
	Garage No. Cars
	Floors
	Plastered
	Living Rooms
	Service Rooms

TANKS, ETC., LIST

Hoists: Elec. Hyd.

ELEVATORS

Pass.	Freight
Auto.	Elec.
Man.	Hyd.
	Man.

DOCKS AND PIERS

	Treated Piles, Timb
	Untreated
	Treated Piles only
	Average Length
	Paved

WIRING

	Knob & Tube
	Flex. Cable
	Conduit
	Power Wiring
	Range Wiring
	No. Outlets

EXTERIOR WALL CONST.

	Single Double
	2" x 4" Stud Walls
	2" x 6" Stud Walls
	Brick Walls OPEN
	Brick with Pilasters
	Concrete Walls STEEL
	Con. with Pilasters
	Tile Walls
	Rein. Con. Skel.
	Filler Walls
	Laminated Walls

INTERIOR WALLS

	Stud and Plaster
	Lam. Plastered
	Plywood
	Ceiled
	Plaster Board
	Painted OPEN
	Stain Varnish
	Kalsomine
	Whitewashed
	Unfinished

C. H.

B	
1	25
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

GROUND FLOOR AREA 30800 46,200

TOTAL FLOOR AREA

EXTERIOR FACING

	Siding Shingles
	Shakes Stucco
	Brick Veneer
X	OPEN Kind
	Stone Cast S.
	Terra Cotta
	Struc. Glass
	Trim

INTERIOR TRIM

	Fir
	Mah. Oak
	Metal
	Doors
	Windows
	Stained
	Varnished OPEN
	Painted
	Unfinished

FLOOR CONSTRUCTION

	Joist Con. Size x
	O.C. In Bridg.
	Mill Construction
	Rein. Con.

	Other Buildings	Construction	Floor	Roof	Stories	Dimensions	S. F. Area	Factor	Value	% Dep.	Depres.	Net Value
	Garage					x			$		$	$
						x			$		$	$
						x			$		$	$
						x			$		$	$

5M 2-56

Clay storage shelter not only same const as balance of Bldgs—
no wiring. This area will possibly be included at later date.
Check dates—

DATE

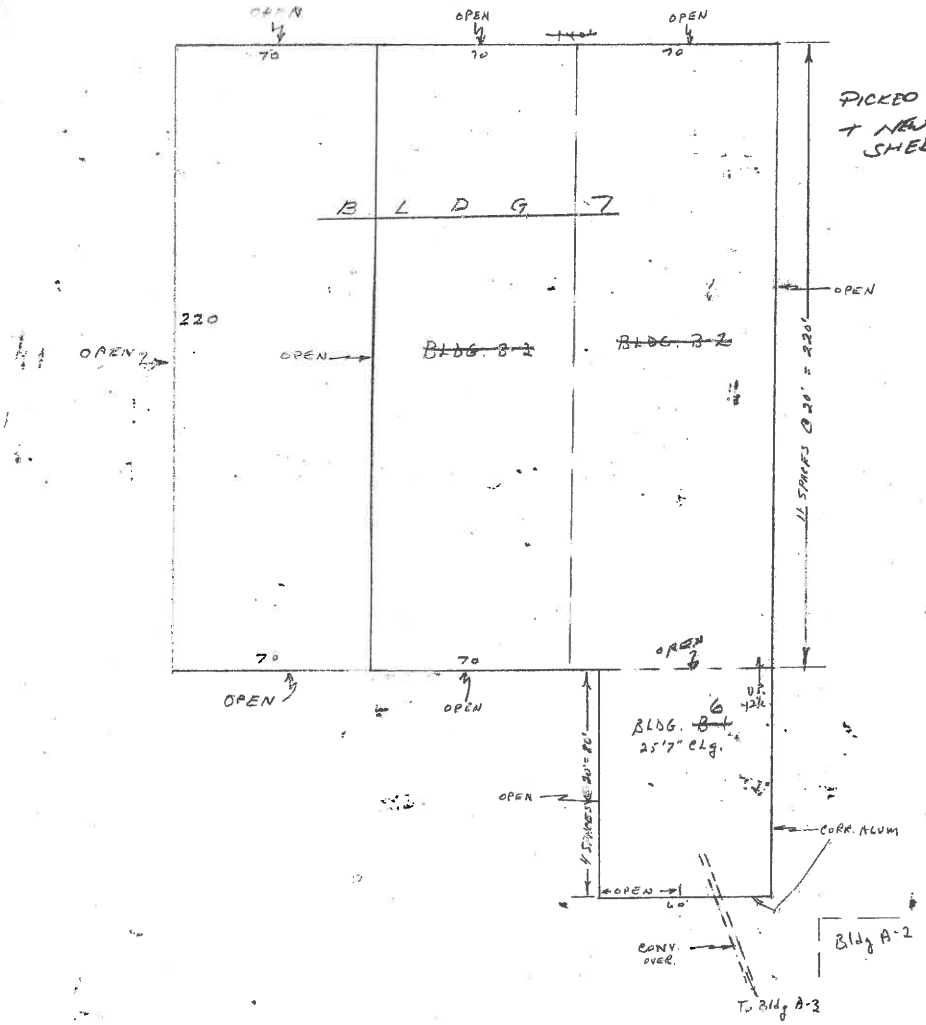
Section 27 Twp. 24 Range 5 Ewm. Block | Lot or Tract

Tax Lot 6

ADDRESS 6805 - 133 Ave SE

Fee Owner

FOR REFERENCE ONLY

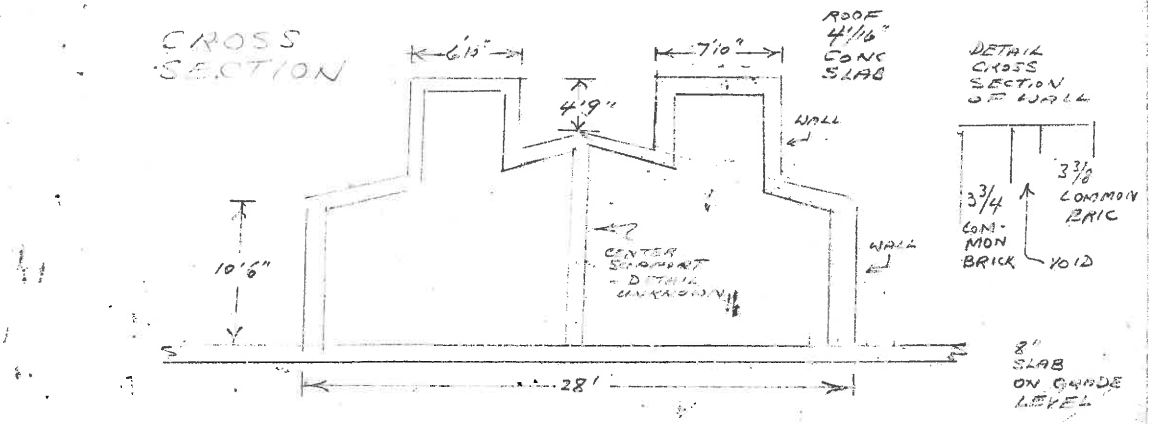


FOLIO 22736-A
PERMIT NO.
DATE
BLDG.#

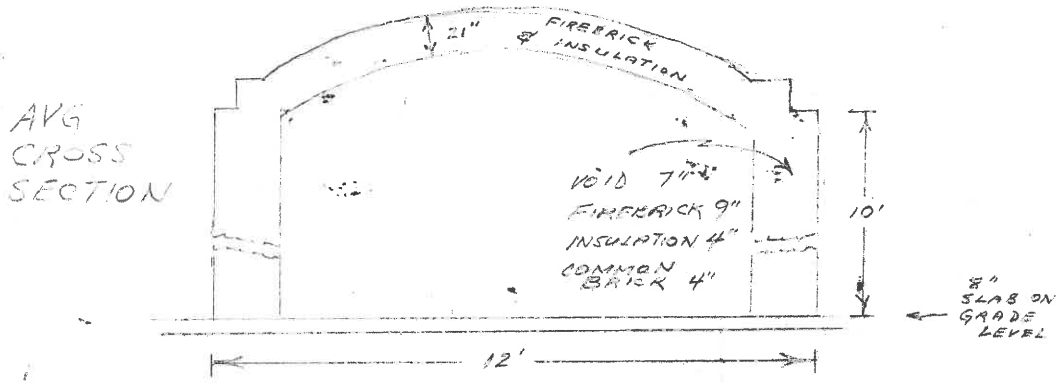
ADDITION
Section Twp Range EWM. Block Lot or
FOR REFERENCE ONLY Tract
Address
Scale: NONE to 1 Ft.

DETAIL OF KILNS & DRYERS

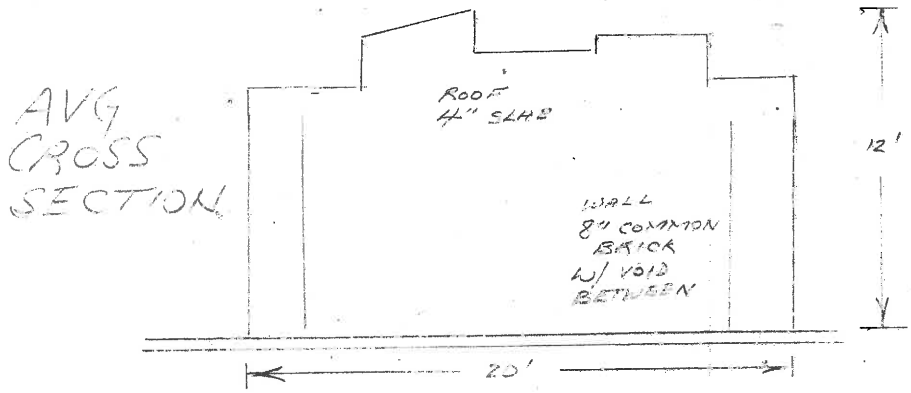
KELLER DRYER



SWINDLER - DRESSLER KILN



SWINDLER - DRESSLER DRYER



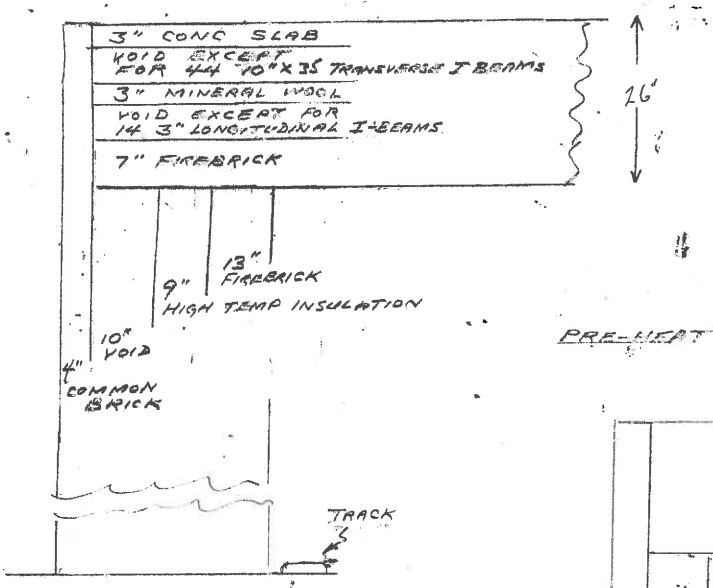
FOLIO 22736-A
PERMIT NO.
DATE
BLDG.#

ADDITION
Section 27 Twp 24 Range 5 EWM. Block FOR REFERENCE ONLY
Tax Lot 6 Tract
Address MURIAL MATERIALS CO
NEWCASTLE BRICK PLANT
Scale: NONE to 1 Ft.

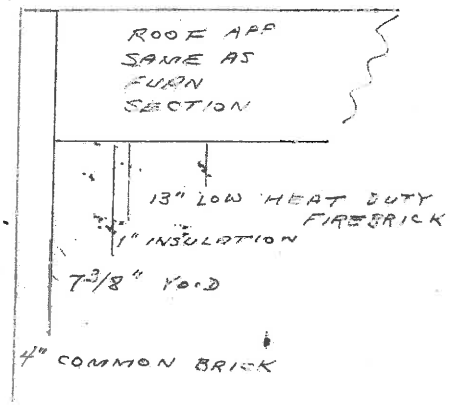
DETAIL OF KILNS & DRYERS

KELLER KILN

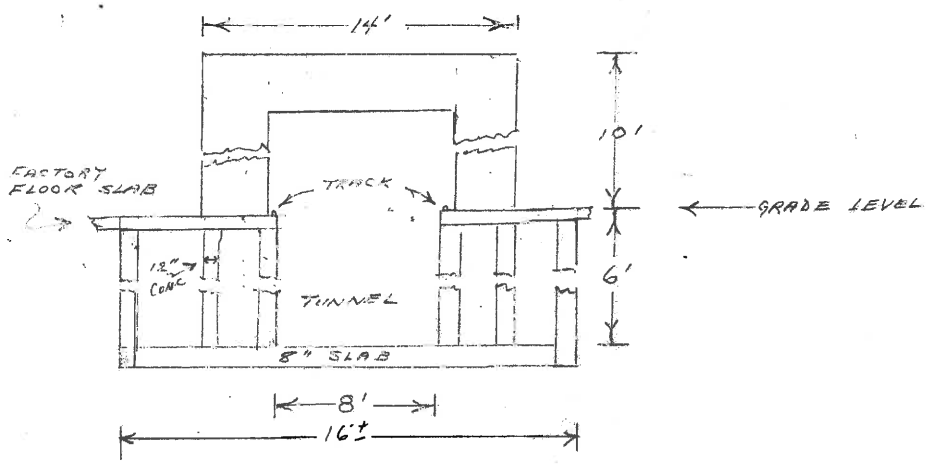
FURNACE SECTION



PRE-HEAT & COOLING SECTIONS



TYPICAL CROSS-SECTION SHOWING FOUNDATION

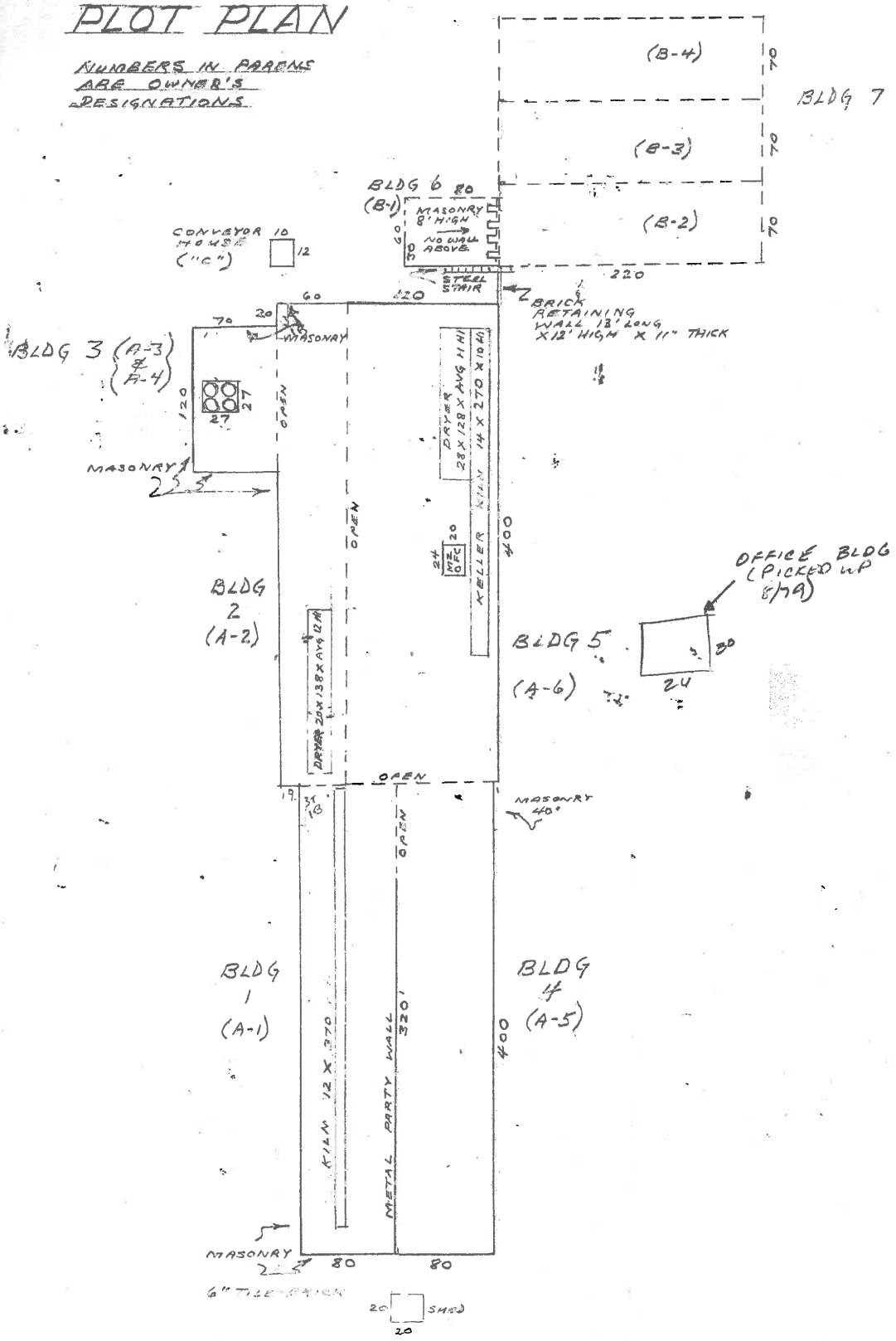


10M 11-65

FOLIO 22736-A	ADDITION
PERMIT NO.	Section 27 Twp 24 Range 5 EWM. Block ____ Lot or Tax Lot FOR REFERENCE ONLY
DATE	Address MUTUAL MATERIALS CO NEWCASTLE BRICK PLANT
BLDG.#	Scale: 1"= 100' to 1 Ft.

PLOT PLAN

NUMBERS IN PARENS ARE OWNER'S DESIGNATIONS



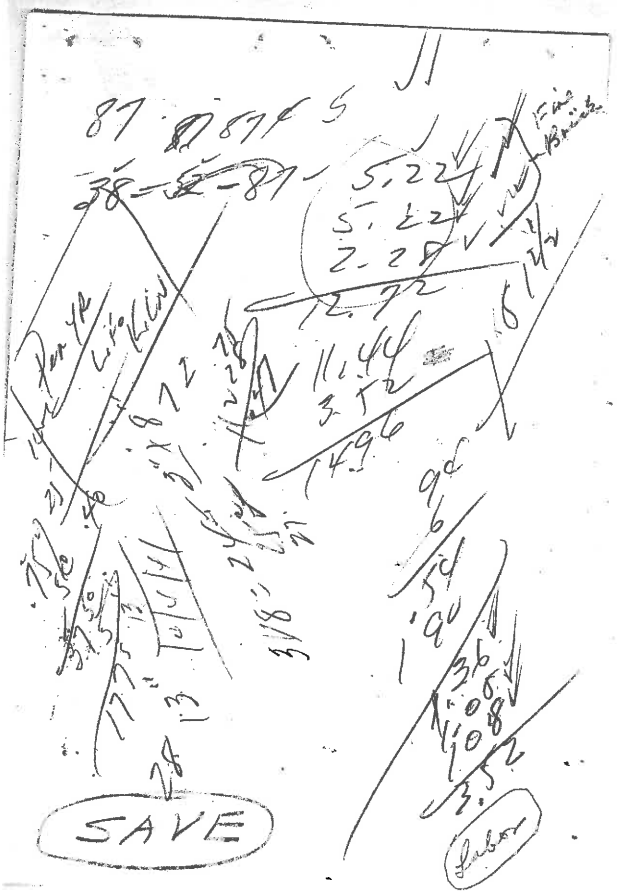
11-65

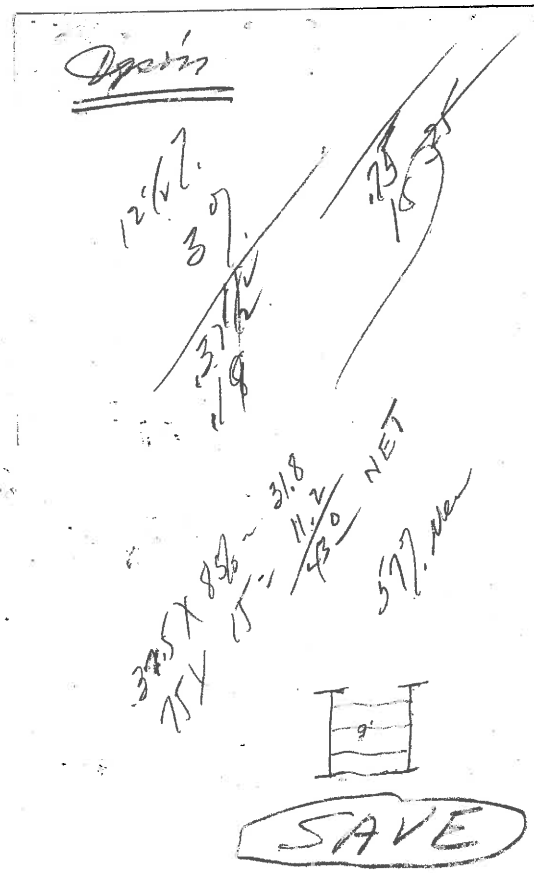
ITEM	PART	SEC	ELEMT L&/OR M	COMPONENT	LIN PER
Keller Kiln	Roof	All.	M	F-Brk	.87x
"	"	"	L	"	1.36
"	"	"	M	Insul	.37
"	"	"	L	"	.15
"	"	"	L&M	Conc	1.60
"	"	"	L&M	TRANS 10" I-BM	1.60
"	"	"	L&M	LONG. 3" I BM	.20
"	Total Roof				
"	Wall	Form	M	F-Brk	.87x
"	"	"	M	"	.38x
"	"	"	L	"	1.36
"	"	"	L	"	1.08
"	"	"	L&M	COM BRK	1.80
"	"	"	M	INSUL	.37
"	"	"	L	"	.15
"	"	"	"	"	.10
"	"	PREH & COOL	M	F BRK	.38x6
"	"	"	L	"	1.36
"	"	"	L&M	COM BRK	1.80
"	"	"	M	INSUL	.37
"	"	"	L	"	.15
"	Total Wall				
"	Found	All	L&M	CONC SLAB	1.20
"	"	"	L&M	CONC FOOT	1.20
"	"	"	L&M	COUND EXCAV	.08
"	"	"	L&M	FORMS	.45
"	"	"	L&M	BACKF	.06
	Total Found Item				
	Total Keller Kiln (Excluding Firing, Vents, etc.)				
					+13% ±

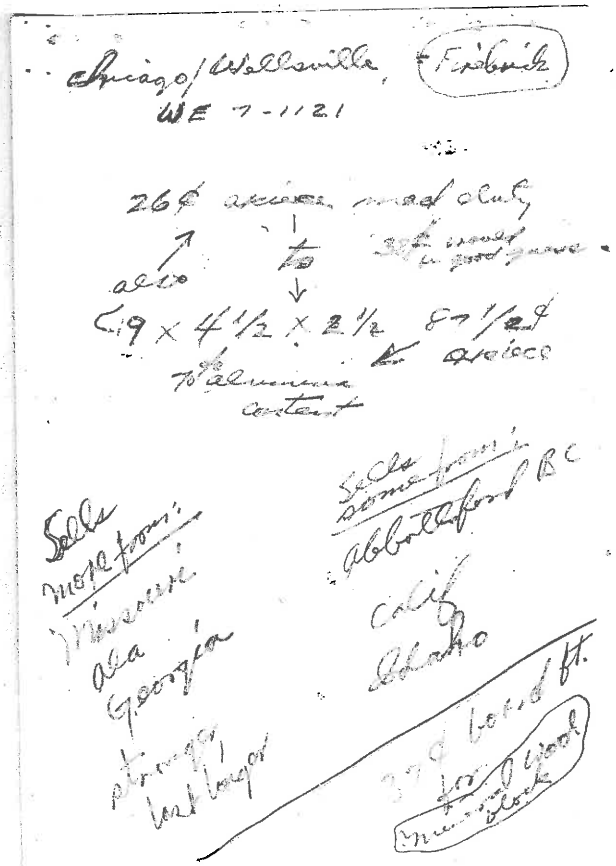
COM'L	Structural	Area
A-1	A-1	1
A-2	A-2	2
A-3	{A-3 / A-4}	3
D	A-5	4
B-4	A-6	5
B-1	B-1	6
B-2 & B-3	B-2	7
C	B-3 (Cont)	
	B-4 (Cont)	

ITEM	PART	SEC	ELEMT L&M	COMPONENT	UNIT PER ft	COST FOR	DIMENSIONS	THICKNESS FAC.	COST
Keller Kiln	Roof	ACC	M	F-Brk	.87x6	4½"	14' x 270'	1.5	$29597
"	"	"	L	"	1.36	7"	14' x 270'	1.0	5140
"	"	"	M	Insul	.37	1"	14' x 270'	3.0	4193
"	"	"	L	"	.15	1"	14' x 270'	3.0	1701
"	"	"	L&M	Conc.	1.60	4"	14' x 270'	.75	4536
"	"	"	L&M	TRANS 10" I-Bm	1.60	ENTIRE ROOF	14' x 270'	1.0	6048
"	"	"	L&M	LONG. 3"I-Bm	.20	"	14' x 270'	1.0	756
"	Total Roof								$51973.
"	Wall	Furn	M	F-Brk	.87x6	4½"	8' x 90' x 2	1.0	$ 7516
"	"	"	M	"	.38x6	4½	8' x 90' x 2	2.0	6566
"	"	"	L	"	1.36	4½"	8' x 90' x 2	1.0	1958
"	"	"	L	"	1.08	4½"	8' x 90' x 2	2.0	3110
"	"	"	L&M	CONC BRK	1.80	4½"	8' x 90' x 2	1.0	2592
"	"	"	M	INSUL	.37	1"	8' x 90' x 2	9.0	4794
"	"	"	L	"	.15	1"	8' x 90 x 2	3.0 TOT 90	648
"	"	"	"	"	.10	1"	8' x 90 x 2	6.0	864
"	"	PRE-H & COOL	M	F-Brk	.38x6	4½"	8' x 180 x 2	1.0	6566
"	"	"	L	"	1.36	4½"	8' x 180 x 2	1.0	3916
"	"	"	L&M	CONC BRK	1.80	4½"	8' x 180 x 2	2.0	10368
"	"	"	M	INSUL	.37	1"	8' x 180 x 2	4.0	4262
"	"	"	L	"	.15	1"	8' x 180 x 2	4.0	1728
"	Total Wall								$54888
"	Found	ACC	L&M	CONC SLAB	1.20	1'	14' x 270'	.66	$ 2973
"	"	"	L&M	CONC FOUND WALLS	1.20	1'	6' x 270' x 4	1.0	7776
"	"	"	L&M	FOUND EXCAV	.08	1'	6' x 270'	14.0	1814
"	"	"	L&M	FORMS	.45	SURFACE AREA OF FORMS	6' x 270'	8.0	5832
"	"	"	L&M	CAULK	.06	1'	6' x 270'	2.0	1944
	Total Foundations								$20359
	Total Keller Kiln (Exclusive of Piping, Vents etc.)								$127220
								+13% ±	143,640

ITEM	PART	SEC	L&/OR M	COMPONENT	PER IN	FOR	DIMENSIONS	FAC.	COST
KELLER DRYER	ROOF	ALL	L&M	CONC	1.60	4"	28 X 128	1.0	5734
"	WALL	"	L&M	COMMON BRK	1.80	4½"	128 X 10 X 2 WALLS	1.7	7833
"	"	"	L&M	"	1.80	4½"	128 X 5 X 4 WALLS	1.7	7833
	TOTAL KELLER DRYER								21400
SWINDLER DRESSLER KILN	ROOF	ALL(INS)	M	F-BRK	.87x6	4½"	9 X 370	1.5	26073
"	"	"	L	"	1.36	4½"	9 X 370	1.5	6793
"	"	"	M	INSUL	.37	1"	9 X 370	7.5	9240
"	"	"	L	"	.15	1"	9 X 370	7.5	3746
	WALL	"	L&M	COMM BRK	1.80	4½"	10 X 370 X 2 WALLS	.8	10656
	"	"	M	F-BRK	.87x6	4½"	10 X 370 X 2 "	2.0	77256
	"	"	L	"	1.36	4½"	10 X 370 X 2 "	2.0	20128
	"	"	M	INSUL	.37	1"	10 X 370 X 2 "	4.0	10952
	"	"	L	"	.15	1"	10 X 370 X 2 "	4.0	4445
	Total Swindler - Dressler Kiln								169284
SWINDLER DRESSLER DRYER	ROOF	ALL	L&M	CONC	1.60	4"	20 X 138	1.0	4416
	WALL	"	L&M	COMM BRK	1.80	4½"	12 X 138 X 2	1.7	10134
	Total Swindler - Dressler Dryer								14550


SAVE
Labor


Open
SAVE


Chicago/Wellsville
Fabrick
WE 7-1121
Sells more from: Minnesota Georgia
Sells some from: Abbotsford BC
Calif
Idaho

Keller Kiln

2½ x 9 x 7½
52.6 Bricks
per ft² of 4½" wall

Fire Brick

No. of Bricks / ft² = a 1-Brick thick wall:
.208 x .75 = .156 ft²/Brick
1.0 ÷ .156 = 6.4 Bricks / ft²

Furnace Wall Fire Brick Cost:
Inner wall $.87 x 6 = $5.22 / ft²
Middle Insulation .38 x 6 x 2 = $4.56 / ft²
Total Materials = $9.78 / ft²
Labor 3.52 / ft² = $13.30 / ft²

Preheat & Cooling wall Fire Brick Cost:
Inner wall $.38 x 6 = $2.28 / ft²
Labor 1.08 ft² = $3.36 / ft²

Roof Fire Brick Cost - All Sections
(Roof have 7" of Fire Brick):
$.83 x 6 x 1.5 Bricks thick = 7.83
Labor 1.08 = $8.91 / ft²

Common Brick

$1.80 / ft² / 4" of thickness

Furnace Wall Common Brick Cost: $1.20 / ft²

Preheat & Cooling Wall Common Brick Cost:
$1.80 x 1.2 thickness = $3.60 / ft²

Insulation

$.37 / Bd Ft = $37 / ft² / 1" of thickness

Furnace Wall Insulation Cost:
$.37 x 9" = $3.33
Labor: 2 x .50 1.00 = $4.33 / ft²

Preheat & Cooling Wall Insul. Cost: —

Roof Insulation Cost - All Sections:
$.37 x 3" = $1.11
Labor .50 = $1.61 / ft²

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 272405 MINOR 9006 SPLIT BLDG.NO. 1

2 – PROPERTY PR CODE [ ] [ ] MO [ ] [ ] YR [ ] [ ]

FDID 22736 SUBLETTER A SUBNUMBER

TOTAL BLDGS. 7 LAST SALE DATE AMOUNT

ADDRESS 6205+133 Ave SE

ADDITION Tax Lots

QUARTER NE SECTION 27 TOWNSHIP 24 RANGE 05

BLOCK LOT TAX LOT 006 TRACT

DESCRIPTION

FEE OWNER MUTUAL MATERIALS

3 – LAND 3240

ZONE ACTUAL MP CONFORMITY Y HIGHEST & BEST USE Y

LOT WIDTH FF VALUE LOT ACRE

LOT DEPTH ACRE VALUE

STANDARD WIDTH LOT SF

STANDARD DEPTH SF VALUE SITE VALUE 225900

4 – BUILDING CLASSIFICATION

	PREDOMINANT SHELL TYPE		PREDOMINANT USE TYPE
1	LIGHT WOOD	1	APARTMENT
2	HEAVY TIMBER	2	HOTEL OR MOTEL
3	LOAD BEARING MASONRY	3	OFFICE
X	STEEL (NOT FIREPROOFED)	4	COMMERCIAL
5	FIRE RESISTANT	X	INDUSTRIAL
6	PRE-ENG (GALVANIZED STEEL)		SERVICE STATION OR SPECIALTY TYPE
7	PRE-ENG (ENAMELED STEEL OR ALUMINUM)		
8	PRE-ENG (INSULATED SANDWICH PANELS)		
9	SERVICE STATION OR SPECIALTY BLDG.		

FACTORY

YEAR BUILT 1959 OVERAL QUALITY

EFFECTIVE YEAR 19 59 | A HIGH | B ABOVE AVERAGE | C AVERAGE | D BELOW AVERAGE | X LOW

OBSOLESCENCE 50 %

TOTAL NET CONDITION %

PERCENT COMPLETE %

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) (9 A-E)	PERIMETER (1-8, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	E	960	32000		1	19
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "–" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	±	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
4	E	+		9120

7 – PEDESTRIAN DOORS

1 REVOLVING 2 AUTOMATIC SWINGING 3 AUTOMATIC SLIDING 4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL 2–STEEL SECTIONAL 3–STEEL ROLLUP 4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS

1–WOOD 2–CONCRETE 3–STEEL CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS

11 – FIRE PLACES

QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS

1 – CONCRETE ON GRADE SHELLS 2 – WOOD (SHELLS 1, 2, & 11) 3 – CONCRETE & STEEL (SHELLS 3 & 4) 4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	±	MEASUREMENTS (LENGTH, WIDTH)	AREA

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPR'FED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	±	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 2 – WOOD GLULAM BEAM 3 – STEEL TRUSS 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	80		32000

17 – CANOPIES

QUALITY A-E	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

AVERAGE SF/APT

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4–SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

1 – DRIVE-IN WINDOW 3 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT FHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L FHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND FHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER

ONLY FOR HEAT. TYPES 1, 4, OR 7

25 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED 3–LARGE

TYPE	NUMBER

26 – PLUMBING

1 – APTS 2 – COM'L. 3 – IND.

TYPE	QUALITY (ACE)	NUMBER
3	E	4

27 – ELECTRICAL

1 – APT 2 – COML. 3 – IND. DO NOT USE FOR SHELL TYPE 9

ILLUMINATION: 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (3E: 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
3	D	3		32000

28 – SPRINKLERS

1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 2–CHILLER 3–FREEZER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

ASSESSOR'S FORM 210-A

MAJOR _____ MINOR _____ SPLIT ____ FOLIO _____ SUBLETTER ____ SUBNUMBER ____

33 – PLAT OF BUILDING

SEE ORIGINAL

34 – CALCULATIONS

OWNER OPERATOR

AREA

80 X 400 = 32000

33-55 – ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	BIN OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
37	PAVEMENT	2	C					93000									1959	1959	%
55	UTIL BLDG														FV	500		19	%
53	RAIL ROAD TRACK				3200												1959	1959	%
54	TANK	6		1					1000	BBL							1959	1959	%
55	KILN														FV	55000		19	%
																		19	%
																		19	%
																		19	%
																		19	%

56 – REMARKS

This is a Stake Type Bldg with 2 Sides brick walls & remaining walls missing

57 – INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT ____ X UNIT VALUE ____ = ____)	
LAND RATE (INTEREST ____ % + TAXES ____ % = ____ %)	
LESS LAND INCOME (VALUE ____ X RATE ____ %)	
NET INCOME TO BUILDING	$
÷ BUILDING RATE (INTEREST ____ % + TAXES ____ % + RECAPTURE ____ %)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

58 – PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
156743	8/5/58	?	1958	1959

59 – SALES RECORD

MONTH	YEAR	AMOUNT

60 – STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/76	55	55		

61 – APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 272405 MINOR 9006 SPLIT BLDG.NO. 2

2-4 PROPERTY Pr.Code | Mo. | Yr. |

FOLIO 23736 SUBLETTER A SUBNUMBER

TOTAL BLDGS 7 LAST SALE DATE AMOUNT

ADDRESS

ADDITION

QUARTER SECTION TOWNSHIP RANGE

BLOCK LOT TAX LOT TRACT

DESCRIPTION

FEE OWNER

3 – LAND

ZONE ACTUAL CONFORMITY HIGHEST & BEST USE

LOT WIDTH FF VALUE LOT ACRE

LOT DEPTH ACRE VALUE

STANDARD WIDTH LOT SF

STANDARD DEPTH SF VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE		PREDOMINANT USE TYPE	
1	LIGHT WOOD	1	APARTMENT
2	HEAVY TIMBER	2	HOTEL OR MOTEL
3	LOAD BEARING MASONRY	3	OFFICE
X	STEEL (NOT FIREPROOFED)	4	COMMERCIAL
5	FIRE RESISTANT	X	INDUSTRIAL
6	PRE-ENG (GALVANIZED STEEL)		SERVICE STATION OR SPECIALTY TYPE
7	PRE-ENG (ENAMELED STEEL OR ALUMINUM)		
8	PRE-ENG (INSULATED SANDWICH PANELS)		
9	SERVICE STATION OR SPECIALTY BLDG.		

FACTORY

YEAR BUILT 1959 OVERAL QUALITY

EFFECTIVE YEAR 19 59 A HIGH

OBSOLESCENCE 60 % B ABOVE AVERAGE

TOTAL NET CONDITION % X AVERAGE

PERCENT COMPLETE % D BELOW AVERAGE

X LOW

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–ROCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) (9 A-E)	PERIMETER (1-8, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	E	920	24000		1	16'
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "-" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	*	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
1	E	+		2720
4	E	+		2720

7 – PEDESTRIAN DOORS

1 REVOLVING 2 AUTOMATIC SWINGING 3 AUTOMATIC SLIDING 4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL 2–STEEL SECTIONAL 3–STEEL ROLLUP 4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS

1–WOOD 2–STEEL CONCRETE 3–CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS

11 – FIRE PLACES

QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS

1 – CONCRETE ON GRADE SHELLS 3 – CONCRETE & STEEL (SHELLS 3 & 4)
2 – WOOD (SHELLS 1, 2, & 11) 4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPROOFED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 3 – STEEL TRUSS
2 – WOOD GLULAM BEAM 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	60		24000

17 – CANOPIES

QUALITY A-E	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS.		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4– SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE SF/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

2 – DRIVE-IN WINDOW 3 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT PHA
3–APT UNIT HEATERS
4–COM'L. HW OR STEAM
5–COM'L PHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND PHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER **25 – PLUMBING**

ONLY FOR HEAT. TYPES 1, 4, OR 7 1 APTS 2 – COM'L 3 – IND

26 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED 3–LARGE

TYPE	QUALITY (ACE)	NUMBER
3	E	4

TYPE	NUMBER

27 – ELECTRICAL

1 – APT 2 – COML. 3 – IND. DO NOT USE FOR SHELL TYPE 9

ILLUMINATION 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (SE 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
3	D	2		24000

28 – SPRINKLERS

1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 3–FREEZER
2–CHILLER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMPWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

ASSESSOR'S FORM 210-A

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

32 -- PLAT OF BUILDING

SEE ORIGINAL

34 -- CALCULATIONS

AREA

60X400 = 24000

35-55 -- ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	BIN OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
55	Brick Dwgs														FV	8700		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
		340																19	%
																		19	%
																		19	%

56 -- REMARKS

This is a single type dwlg with 340 of brick & cinderblk, remainder of perimeter has no walls.

57 -- INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT ____ X UNIT VALUE ____ = ____)	
LAND RATE (INTEREST ____ % + TAXES ____ % = ____ %)	
LESS LAND INCOME (VALUE ____ X RATE ____ %)	
NET INCOME TO BUILDING	$
BUILDING RATE (INTEREST ____ % + TAXES ____ % + RECAPTURE ____ %)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

58 -- PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
165745	8/5/58	?	1958	1959

59 -- SALES RECORD

MONTH	YEAR	AMOUNT

60 -- STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/26	55	55		

61 -- APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 272405 MINOR 9006 SPLIT BLDG.NO. 3
2 – PROPERTY PI.Code 1 Mo. 1 Yr. 1
FOLIO 22736 SUBLETTER A SUBNUMBER
TOTAL BLDGS. 3 LAST SALE DATE AMOUNT
ADDRESS
ADDITION
QUARTER SECTION TOWNSHIP RANGE
BLOCK LOT TAX LOT TRACT
DESCRIPTION
FEE OWNER

3 – LAND

ZONE ACTUAL CONFORMITY HIGHEST & BEST USE
LOT WIDTH FF VALUE LOT ACRE
LOT DEPTH ACRE VALUE
STANDARD WIDTH LOT SF
STANDARD DEPTH SF VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE		PREDOMINANT USE TYPE	
1	LIGHT WOOD	1	APARTMENT
2	HEAVY TIMBER	2	HOTEL OR MOTEL
X	LOAD BEARING MASONRY	3	OFFICE
4	STEEL (NOT FIREPROOFED)	4	COMMERCIAL
5	FIRE RESISTANT	X	INDUSTRIAL
6	PRE-ENG (GALVANIZED STEEL)		SERVICE STATION OR SPECIALTY TYPE
7	PRE-ENG (ENAMELED STEEL OR ALUMINUM)		
8	PRE-ENG (INSULATED SANDWICH PANELS)		
9	SERVICE STATION OR SPECIALTY BLDG.		

FACTORY

YEAR BUILT 1959 OVERAL QUALITY
EFFECTIVE YEAR 19 59 A HIGH
OBSOLESCENCE 50 % B ABOVE AVERAGE
TOTAL NET CONDITION % C AVERAGE
PERCENT COMPLETE % D BELOW AVERAGE
X LOW

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) 19 A-E	PERIMETER (1-9, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	3	E	380	7400		1	16'
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "–" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	±	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
4	E	+		4160
1	E	+		1728

7 – PEDESTRIAN DOORS

1 REVOLVING 3 AUTOMATIC SLIDING
2 AUTOMATIC SWINGING 4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL 3–STEEL ROLLUP
2–STEEL SECTIONAL 4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS

1–WOOD 3–STEEL CONCRETE
2–CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS

11 – FIRE PLACES

QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS

1 – CONCRETE ON GRADE SHELLS 3 – CONCRETE & STEEL SHELLS 3 & 4)
2 – WOOD (SHELLS 1, 2, & 11) 4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPROOFED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 3 – STEEL TRUSS
2 – WOOD GLULAM BEAM 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	60		7400

17 – CANOPIES

QUALITY A-E	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS.		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4– SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE SF/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

1 – DRIVE-IN WINDOW 2 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT FHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L FHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND FHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER (ONLY FOR HEAT. TYPES 1, 4, OR 7)

25 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED. 3–LARGE

TYPE	NUMBER

26 – PLUMBING

1 – APTS 2 – COM'L 3 – IND

TYPE	QUALITY (ACE)	NUMBER

27 – ELECTRICAL

1 – APT 2 – COM'L 3 – IND. DO NOT USE FOR SHELL TYPE 9
ILLUMINATION: 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (26, 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
3	E	2		7400

28 – SPRINKLERS

1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 3–FREEZER
2–CHILLER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

ASSESSOR'S FORM 210-A

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

35 – PLAT OF BUILDING

See Original

36 – CALCULATIONS

AREA

20X120 = 2400

33-35 – ACCESSORY IMPROVEMENTS

SECTION NO	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL THICK	BIN OUTSIDE DIAMETER	PB	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
55	Silos														FU	4000		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%

38 – REMARKS

MW 16X120

37 – INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT ____ X UNIT VALUE ____ = ____)	
LAND RATE (INTEREST ____ % + TAXES ____ % + ____ %)	
LESS LAND INCOME (VALUE ____ X RATE ____ %)	
NET INCOME TO BUILDING	$
+ BUILDING RATE (INTEREST ____ % + TAXES ____ % + RECAPTURE ____ %)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

58 – PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
15743	8/68	3	1968	1969

59 – SALES RECORD

MONTH	YEAR	AMOUNT

60 – STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/16	SS	SS		

61 – APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 252405 MINOR 9006 SPLIT BLDG.NO. 4

3 – PROPERTY Pr.Code | Mo. | Yr.

FOLIO 22736 SUBLETTER A SUBNUMBER

TOTAL BLDGS 7 LAST SALE DATE AMOUNT

ADDRESS

ADDITION

QUARTER SECTION TOWNSHIP RANGE

BLOCK LOT TAX LOT TRACT

DESCRIPTION

FEE OWNER

3 – LAND

ZONE ACTUAL CONFORMITY HIGHEST & BEST USE

LOT WIDTH FF VALUE LOT ACRE

LOT DEPTH ACRE VALUE

STANDARD WIDTH LOT $/F

STANDARD DEPTH $/F VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE

1	LIGHT WOOD
2	HEAVY TIMBER
3	LOAD BEARING MASONRY
X	STEEL (NOT FIREPROOFED)
5	FIRE RESISTANT
6	PRE-ENG (GALVANIZED STEEL)
7	PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8	PRE-ENG (INSULATED SANDWICH PANELS)
9	SERVICE STATION OR SPECIALTY BLDG.

PREDOMINANT USE TYPE

1	APARTMENT
2	HOTEL OR MOTEL
3	OFFICE
X	COMMERCIAL
5	INDUSTRIAL
	SERVICE STATION OR SPECIALTY TYPE

STORAGE

YEAR BUILT 1960 OVERAL QUALITY

EFFECTIVE YEAR 19 60 | A HIGH | B ABOVE AVERAGE

OBSOLESCENCE 60 % | X AVERAGE

TOTAL NET CONDITION % | D BELOW AVERAGE

PERCENT COMPLETE % | LOW

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) (9 A-E)	PERIMETER (1-8, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	E	960	32000		1	19'
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "–" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	+	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
1	E	+		2560
4	E	+		760

7 – PEDESTRIAN DOORS

1 REVOLVING
2 AUTOMATIC SWINGING
3 AUTOMATIC SLIDING
4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL
2–STEEL SECTIONAL
3–STEEL ROLLUP
4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

8 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS

1–WOOD 2–CONCRETE 3–STEEL CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS	QUALITY (ACE)	NUMBER

11 – FIRE PLACES

12 – FLOOR ADJUSTMENTS

1 – CONCRETE OR GRADE SHELLS 3 – CONCRETE & STEEL (SHELLS 3 & 4)
2 – WOOD (SHELLS 1, 2, & 11) 4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPROOFED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 3 – STEEL TRUSS
2 – WOOD SCULLAM BEAM 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	80		32000

17 – CANOPIES

QUALITY A-E	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS.		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4–SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE S/F/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

2 – DRIVE-IN WINDOW 3 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT FHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L FHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND FHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER

ONLY FOR HEAT. TYPES 1, 4, OR 7

25 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED 3–LARGE

TYPE	NUMBER

25 – PLUMBING

1 – APTS. 2 – COM'L. 3 – IND.

TYPE	QUALITY (ACE)	NUMBER

27 – ELECTRICAL

1 – APT 2 – COML. 3 – IND. DO NOT USE FOR SHELL TYPE 9
ILLUMINATION: 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (2E: 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

28 – SPRINKLERS

1–APTS 2–COM'L. 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 3–FREEZER
2–CHILLER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

ASSESSOR'S FORM 210-A

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

30 – PLAT OF BUILDING

SEE ORIGINAL

34 – CALCULATIONS

AREA

80X400 – 32000

35-56 – ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	SIN. OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%

58 – REMARKS

NW 480'

57 – INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT_____ X UNIT VALUE_____ = _____)	
LAND RATE (INTEREST_____% + TAXES_____% + _____%)	
LESS LAND INCOME (VALUE_____ X RATE _____%)	
NET INCOME TO BUILDING	$
+ BUILDING RATE (INTEREST_____% + TAXES_____% + RECAPTURE_____%)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

59 – PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
C1075	11/25/69	?	1969	1969

59 – SALES RECORD

MONTH	YEAR	AMOUNT

60 – STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/76	SS	SS		

61 – APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION
MAJOR 272405 MINOR 9006 SPLIT BLDG.NO. 5
2 – PROPERTY Pr.Code | Mo. | Yr.
FOLIO 22736 SUBLETTER A SUBNUMBER
TOTAL BLDGS. 7 LAST SALE DATE AMOUNT
ADDRESS
ADDITION
QUARTER SECTION TOWNSHIP RANGE
BLOCK LOT TAX LOT TRACT
DESCRIPTION
FEE OWNER

3 – LAND
ZONE ACTUAL CONFORMITY HIGHEST & BEST USE
LOT WIDTH FF VALUE LOT ACRE
LOT DEPTH ACRE VALUE
STANDARD WIDTH LOT SF
STANDARD DEPTH SF VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE
1 LIGHT WOOD
2 HEAVY TIMBER
3 LOAD BEARING MASONRY
X STEEL (NOT FIREPROOFED)
5 FIRE RESISTANT
6 PRE-ENG (GALVANIZED STEEL)
7 PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8 PRE-ENG (INSULATED SANDWICH PANELS)
9 SERVICE STATION OR SPECIALTY BLDG.

PREDOMINANT USE TYPE
1 APARTMENT
2 HOTEL OR MOTEL
3 OFFICE
4 COMMERCIAL
X INDUSTRIAL
SERVICE STATION OR SPECIALTY TYPE

FACTORY

YEAR BUILT 1970
EFFECTIVE YEAR 19 70
OBSOLESCENCE 50 %
TOTAL NET CONDITION %
PERCENT COMPLETE %

OVERAL QUALITY
A HIGH
B ABOVE AVERAGE
C AVERAGE
D BELOW AVERAGE
X LOW

5 – STRUCTURAL SHELL SECTIONS
1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SEC ION	TYPE	QUALITY (ACE) (9 ACE)	PERIMETER (1-8, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	E	1040	48000		1	22'
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL
DO NOT USE "–" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILT UP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STONE FRONTS

TYPE	QUALITY (ACE)	±	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
1	E	+		11462

7 – PEDESTRIAN DOORS
1 REVOLVING
2 AUTOMATIC SWINGING
3 AUTOMATIC SLIDING
4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS
DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL
2–STEEL SECTIONAL
3–STEEL ROLLUP
4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS
1–WOOD 2–CONCRETE 3–STEEL CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS

11 – FIRE PLACES

QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS
1 – CONCRETE ON GRADE SHELLS
2 – WOOD (SHELLS 1, 2, & 11)
3 – CONCRETE & STEEL (SHELLS 3 & 4)
4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	±	MEASUREMENTS (LENGTH, WIDTH)	AREA

13 – BALCONIES
1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA
1	E	Finished	480

14 – FLOOR GRATING
1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS
1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPROFED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	±	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS
1 – WOOD TRUSS
2 – WOOD GLULAM BEAM
3 – STEEL TRUSS
4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	120		48000

17 – CANOPIES

QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS.		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS
DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4–SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE SF/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
E	E			480

20 – BANK VAULTS
1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS
1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES
2 – DRIVE-IN WINDOW 3 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING
1–APT HW OR STEAM
2–APT FHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L FHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND FHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER
ONLY FOR HEAT TYPES 1, 4, OR 7

25 – PLUMBING
1 – APTS 2 – COM'L. 3 – IND

26 – MINIMUM INDUSTRIAL UNIT HEATERS
1–SMALL 2–MED 3–LARGE

TYPE	NUMBER

TYPE	QUALITY (ACE)	NUMBER

27 – ELECTRICAL
1 – APT 2 – COM'L 3 – IND DO NOT USE FOR SHELL TYPE 9
ILLUMINATION 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (3E 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
3	E	2		48450

28 – SPRINKLERS
1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE
1–COOLER 3–FREEZER
2–CHILLER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS
1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-9)	NUMBER

32 + OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

32 – PLAT OF BUILDING

SEE ORIGINAL

34 – CALCULATIONS

AREA

120K 400 48000

Jim Bolenbaugh

20X24 – 480

48480

32-33 – ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	BIN OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
55	KILN														FV	106000		19	%
56	BRICK DRYER														FV	17000		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%

36 – REMARKS

57 – INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT ____ x UNIT VALUE ____ = ____)	
LAND RATE (INTEREST ____ % + TAXES ____ % + ____ %)	
LESS LAND INCOME (VALUE ____ x RATE ____ %)	
NET INCOME TO BUILDING	$
BUILDING RATE (INTEREST ____ % + TAXES ____ % + RECAPTURE ____ %)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

58 – PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
1006	9/Bldg	123000	1969	1970

59 – SALES RECORD

MONTH	YEAR	AMOUNT

60 – STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/76	GS	SS		

61 – APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 272405 MINOR 9006 SPLIT BLDG.NO. 6

2 – PROPERTY Pr.Code | Mo. | Yr.

FOLIO 22736 SUBLETTER A SUBNUMBER

TOTAL BLDGS. 7 LAST SALE DATE AMOUNT

ADDRESS

ADDITION

QUARTER SECTION TOWNSHIP RANGE

BLOCK LOT TAX LOT TRACT

DESCRIPTION

FEE OWNER

3 – LAND

ZONE ACTUAL CONFORMITY HIGHEST & BEST USE

LOT WIDTH FF VALUE LOT ACRE

LOT DEPTH ACRE VALUE

STANDARD WIDTH LOT SF

STANDARD DEPTH SF VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE		PREDOMINANT USE TYPE	
1	LIGHT WOOD	1	APARTMENT
2	HEAVY TIMBER	2	HOTEL OR MOTEL
3	LOAD BEARING MASONRY	3	OFFICE
X	STEEL (NOT FIREPROOFED)	4	COMMERCIAL
5	FIRE RESISTANT	X	INDUSTRIAL
6	PRE-ENG (GALVANIZED STEEL)		SERVICE STATION OR SPECIALTY TYPE
7	PRE-ENG (ENAMELED STEEL OR ALUMINUM)		
8	PRE-ENG (INSULATED SANDWICH PANELS)		
9	SERVICE STATION OR SPECIALTY BLDG.		

FACTORY

YEAR BUILT 1959

EFFECTIVE YEAR 19 59

OBSOLESCENCE %

TOTAL NET CONDITION %

PERCENT COMPLETE %

OVERAL QUALITY

A	HIGH
B	ABOVE AVERAGE
X	AVERAGE
D	BELOW AVERAGE
X	LOW

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) (3 A-E)	PERIMETER (1-9, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	E	280	4800		1	25
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "-" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	*	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA
1	E	+		2750
4	E	+	8X10	490

7 – PEDESTRIAN DOORS

1 REVOLVING 2 AUTOMATIC SWINGING 3 AUTOMATIC SLIDING 4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL 2–STEEL SECTIONAL 3–STEEL ROLLUP 4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS **11 – FIRE PLACES**

1–WOOD 2–CONCRETE 3–STEEL CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS	QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS DIRT

1 – CONCRETE ON GRADE SHELLS 2 – WOOD SHELLS 1, 2, & 11) 3 – CONCRETE & STEEL SHELLS 3 & 4) 4 – REINFORCED CONCRETE SHELLS 5 & 10)

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA
1	C	–		4800

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPR'FED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 2 – WOOD GLULAM BEAM 3 – STEEL TRUSS 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA
3	E	60		4800

17 – CANOPIES

QUALITY A-E	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4–SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE SF/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

1 – DRIVE-IN WINDOW 2 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT PHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L PHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND PHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER **25 – PLUMBING**

ONLY FOR HEAT. TYPES 1, 4, OR 7

1 – APTS 2 – COM'L 3 – IND

26 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED 3–LARGE

TYPE	NUMBER

TYPE	QUALITY (ACE)	NUMBER

27 – ELECTRICAL

1 – APT 2 – COML 3 – IND DO NOT USE FOR SHELL TYPE 9

ILLUMINATION: 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (SE: 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
3	D	2		4800

28 – SPRINKLERS

1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 2–CHILLER 3–FREEZER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

ASSESSOR'S FORM 210-A

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

32 – PLAT OF BUILDING

SEE ORIGINAL

34 – CALCULATIONS

AREA

60 x 80 = 4800

33-35 – ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	BIN OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%

36 – REMARKS

MW 110'

37 – INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT_____ x UNIT VALUE_____ = _____)	
LAND RATE (INTEREST_____% + TAXES_____% + _____%)	
LESS LAND INCOME (VALUE_____ x RATE _____%)	
NET INCOME TO BUILDING	$
+ BUILDING RATE (INTEREST _____% + TAXES_____% + RECAPTURE _____%)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

38 – PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
15743	7/6/58	?	1958	1959

39 – SALES RECORD

MONTH	YEAR	AMOUNT

80 – STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/76	55	155		

81 – APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

KING COUNTY ASSESSOR'S COMMERCIAL - INDUSTRIAL PROPERTY RECORD
PRINCIPAL BUILDINGS

1 – IDENTIFICATION

MAJOR 282405 MINOR 9006 SPLIT BLDG.NO. 7

8 – PROPERTY Pr.Code | Mo. | Yr.

FOLIO 23736 SUBLETTER A SUBNUMBER

TOTAL BLDGS. 7 LAST SALE DATE AMOUNT

ADDRESS

ADDITION

QUARTER SECTION TOWNSHIP RANGE

BLOCK LOT TAX LOT TRACT

DESCRIPTION

FEE OWNER

3 – LAND

ZONE ACTUAL CONFORMITY HIGHEST & BEST USE

LOT WIDTH FF VALUE LOT ACRE

LOT DEPTH *ACRE VALUE

STANDARD WIDTH LOT SF

STANDARD DEPTH SF VALUE SITE VALUE

4 – BUILDING CLASSIFICATION

PREDOMINANT SHELL TYPE

1 LIGHT WOOD
2 HEAVY TIMBER
3 LOAD BEARING MASONRY
X STEEL (NOT FIREPROOFED)
5 FIRE RESISTANT
6 PRE-ENG (GALVANIZED STEEL)
7 PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8 PRE-ENG (INSULATED SANDWICH PANELS)
9 SERVICE STATION OR SPECIALTY BLDG.

PREDOMINANT USE TYPE

1 APARTMENT
2 HOTEL OR MOTEL
3 OFFICE
X COMMERCIAL
5 INDUSTRIAL
SERVICE,STATION OR SPECIALTY TYPE

STORAGE

YEAR BUILT 1959
EFFECTIVE YEAR 19 59
OBSOLESCENCE 25 %
TOTAL NET CONDITION %
PERCENT COMPLETE %

OVERAL QUALITY

A HIGH
B ABOVE AVERAGE
X AVERAGE
X BELOW AVERAGE
LOW

5 – STRUCTURAL SHELL SECTIONS

1–LIGHT WOOD
2–HEAVY TIMBER
3–LOAD BEARING MASONRY
4–STEEL (NOT FIREPROOFED)
5–FIRE RESISTANT
6–PRE-ENG (GALVANIZED STEEL)
7–PRE-ENG (ENAMELED STEEL OR ALUMINUM)
8–PRE-ENG (INSULATED SANDWICH PANELS)
9–SERVICE STATION OR SPECIALTY BLDG.
10–BASEMENT & CONCRETE 1ST FLOOR
11–BASEMENT & WOOD 1ST FLOOR
12–DOCK HIGH FOUNDATION

SECTION	TYPE	QUALITY (ACE) (9 A-E)	PERIMETER (1-8, 10-12)	GROUND AREA	WALL RATIO	STORIES (1-11)	HEIGHT
A	4	C	160	46200		1	25
B							
C							
D							
E							
F							
G							
H							

6 – EXTERIOR WALL

DO NOT USE "–" ENTRY FOR SHELL TYPES 1-5
FOR SHELL TYPES 6-9, USE ONLY FOR SUBSTITUTIONS OR MISSING WALLS
1–GROOVED PLYWOOD, STEEL SIDING, ETC.
2–WOOD OR ASBESTOS SIDING, CEMENT BLOCK, CLAY TILE, ETC.
3–TILTUP CONCRETE, MARBLECRETE, ETC.
4–COMMON BRICK, METAL SANDWICH PANELS, ETC.
5–FACE BRICK, REINFORCED CONCRETE, ETC.
6–COMMON BRICK PLUS CONCRETE
7–FACE BRICK PLUS CONCRETE
8–PRECAST CONCRETE PANELS, GLASS PANELS, ETC.
9–METAL & GLASS CURTAIN WALL
10–STONE MASONRY
11–LIMESTONE, SLATE, ETC.
12–MARBLE, ETC.
13–POLISHED GRANITE, ETC.
14–STORE FRONTS

TYPE	QUALITY (ACE)	*	MEASUREMENTS (HEIGHT, LENGTH)	WALL AREA

7 – PEDESTRIAN DOORS

1 REVOLVING
2 AUTOMATIC SWINGING
3 AUTOMATIC SLIDING
4 AIR CURTAIN

TYPE	QUALITY (ACE)	NUMBER (1-3)	LIN. FT. (4)

8 – VEHICLE DOORS

DO NOT USE FOR SHELL TYPE 9
1–WOOD SECTIONAL
2–STEEL SECTIONAL
3–STEEL ROLLUP
4–HANGER TYPE STEEL

TYPE	QUALITY (ACE)	NUMBER	MEASUREMENTS (WIDTH, HEIGHT)	AREA

9 – VEHICLE DOOR OPERATOR

QUALITY (ACE)	NUMBER

10 – EXTERIOR STAIRS

1–WOOD 3–STEEL CONCRETE
2–CONCRETE 4–STEEL

TYPE	QUALITY (ACE)	FLIGHTS

11 – FIRE PLACES

QUALITY (ACE)	NUMBER

12 – FLOOR ADJUSTMENTS DIRT

1 – CONCRETE ON GRADE SHELLS 3 – CONCRETE & STEEL (SHELLS 3 & 4)
2 – WOOD (SHELLS 1, 2, & 11) 4 – REINFORCED CONCRETE (SHELLS 5 & 10)

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA
1	C	–		46200

13 – BALCONIES

1 – WOOD 2 – CONCRETE 3 – STEEL & CONCRETE

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

14 – FLOOR GRATING

1 – STEEL 2 – ALUMINUM 3 – PLASTIC

TYPE	QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

15 – ROOF ADJUSTMENTS

1–LIGHT WOOD (SHELL 1)
2–HEAVY TIMBER (SHELL 2)
3–STEEL NOT FIREPROOFED (SHELLS 3 & 4)
4–CONCRETE (SHELL 5)
5–GALVANIZED STEEL (SHELL 6)
6–ENAM. STEEL OR ALUM (SHELL 7)
7–INSUL. SANDWICH PANELS (SHELL 8)
8–PRECAST CONCRETE

TYPE	QUALITY (ACE)	*	MEASUREMENTS (LENGTH, WIDTH)	AREA

16 – WIDE SPAN ROOFS

1 – WOOD TRUSS 3 – STEEL TRUSS
2 – WOOD GLULAM BEAM 4 – PRESTRESSED CONCRETE

TYPE	QUALITY (ACE)	SPAN WIDTH	MEASUREMENTS (LENGTH, WIDTH)	AREA

17 – CANOPIES

QUALITY (ACE)	MEASUREMENTS (LENGTH, WIDTH)	AREA

18 – APARTMENT BUILDING DATA

NUMBER	ITEM	NUMBER	ITEM
	STUDIO APTS.		EXHAUST FAN
	1 BEDROOM APTS.		EXHAUST HOOD & FAN
	2 BEDROOM APTS.		RANGE TOP & OVEN
	3 BEDROOM APTS.		DROPIN RANGE
			ELECTRIC FIREPLACE
	GARBAGE DISPOSAL		INTERCOM SYSTEM
	DISHWASHER		

19 – INTERIOR DEVELOPED AREAS

DO NOT USE FOR SHELL TYPE 9
1–APARTMENTS
2–APT UTILITY AREA
3–HOTELS & MOTELS
4–SMALL OFFICES
5–OPEN OFFICES
6–PROFESSIONAL OFFICES
7–CLINICS
8–RETAIL DISCOUNT TYPE
9–OTHER RETAIL STORES
10–BANKS & THEATERS
11–WAREHOUSES
12–LIGHT MANUFACTURING
13–HEAVY MANUFACTURING

AVERAGE SF/APT

TYPE	QUALITY (A-E)	NO. APTS. (1)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA
			UNF	

20 – BANK VAULTS

1 – CASH 2 – RECORDS

TYPE	MEASUREMENTS (LENGTH, WIDTH)	AREA

21 – BANK VAULT DOORS

1 – CASH 2 – RECORDS

TYPE	THICKNESS (INCHES)	MEASUREMENTS (HEIGHT, WIDTH)	AREA

22 – BANK ACCESSORIES

2 – DRIVE-IN WINDOW 3 – NIGHT DEPOSITORY

TYPE	QUALITY (ACE)	NUMBER

23 – HEATING & COOLING

1–APT HW OR STEAM
2–APT FHA
3–APT UNIT HEATERS
4–COM'L HW OR STEAM
5–COM'L FHA
6–COM'L UNIT HEATERS
7–IND HW OR STEAM
8–IND FHA
9–IND UNIT HEATERS
10–APT CENTRAL COOLING
11–APT PACKAGE COOLING
12–COM'L CENTRAL COOLING
13–COM'L PACKAGE COOLING
14–IND CENTRAL COOLING
15–IND PACKAGE COOLING
16–APT CENTRAL COMB
17–APT PACKAGE COMB
18–COM'L CENTRAL COMB
19–COM'L PACKAGE COMB
20–IND CENTRAL COMB
21–IND PACKAGE COMB

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

24 – NO BOILER

25 – PLUMBING

ONLY FOR HEAT. TYPES 1, 4, OR 7 1 APTS 2 – COM'L 3 – IND

26 – MINIMUM INDUSTRIAL UNIT HEATERS

1–SMALL 2–MED 3–LARGE

TYPE	NUMBER

TYPE	QUALITY (ACE)	NUMBER

27 – ELECTRICAL

1 – APT 2 – COML 3 – IND. DO NOT USE FOR SHELL TYPE 9

ILLUMINATION: 1–BRIGHT 2–ADEQUATE 3–MINIMUM 4–INADEQUATE

TYPE	QUALITY (ACE)	ILLUM (1-3) (SE: 4)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

28 – SPRINKLERS

1–APTS 2–COM'L 3–IND

TYPE	QUALITY (ACE)	MEASUREMENTS (FLOORS, LENGTH, WIDTH)	AREA

29 – COLD STORAGE

1–COOLER 3–FREEZER
2–CHILLER 4–QUICK FREEZE

TYPE	MEASUREMENTS (LENGTH, WIDTH,	AREA

30 – ESCALATORS

QUALITY (ACE)	WIDTH (INCHES)	HEIGHT	FLIGHTS

31 – ELEVATORS

1 – PASS AUTO ELEC LOC
2 – PASS AUTO ELEC EXP
3 – PASS MAN ELEC LOC
4 – PASS MAN ELEC EXP
5 – PASS HYD
6 – FREIGHT ELEC
7 – FREIGHT HYD
8 – PERSONNEL LIFT
9 – SIDEWALK MAN
10 – SIDEWALK HYD
11 – SIDEWALK ELEC
12 – DUMBWAITER ELEC
13 – DUMBWAITER MAN

TYPE	QUALITY (ACE) (1-7)	CAPACITY (LBS) (1-7)	STOPS (1-8)	NUMBER

32 – OTHER PRINCIPAL BUILDING COMPONENTS

SECTION	TYPE	QUALITY	OTHER DESCRIPTION	REPLACEMENT COST

MAJOR _____ MINOR _____ SPLIT _____ FOLIO _____ SUBLETTER _____ SUBNUMBER _____

32 -- PLAT OF BUILDING

SEE ORIGINAL

34 -- CALCULATIONS

AREA

210 X 220 = 46200

33-35 -- ACCESSORY IMPROVEMENTS

SECTION NO.	SECTION TITLE	TYPE	QUALITY	NUMBER	LENGTH	WIDTH	HEIGHT	AREA	CAPACITY	GAL/BBL	OUTSIDE DIAMETER	WALL LENGTH	BIN OUTSIDE DIAMETER	PSI	TOWER HEIGHT	DEPRECIATED VALUE	YEAR BUILT	EFFECTIVE YEAR	NET CONDITION
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%
																		19	%

36 -- REMARKS

Storage Bldg w walls

37 -- INCOME DATA

ANNUAL ECONOMIC OR ACTUAL GROSS INCOME	$
LESS VACANCY	
ANNUAL EFFECTIVE GROSS INCOME	$
LESS EXPENSES	
ANNUAL NET INCOME	$
LAND VALUE (UNIT ____ X UNIT VALUE ____ = ____)	
LAND RATE (INTEREST ____ % + TAXES ____ % = ____ %)	
LESS LAND INCOME (VALUE ____ X RATE ____ %)	
NET INCOME TO BUILDING	$
+ BUILDING RATE (INTEREST ____ % + TAXES ____ % + RECAPTURE ____ %)	
BUILDING VALUE	$
PERSONAL PROPERTY VALUE	
LAND VALUE	
INDICATED TOTAL PROPERTY VALUE	$

38 -- PERMIT DATA

NUMBER	DATE	VALUE	DATE STARTED	DATE COMPLETED
15743	8/5/68	?	1968	1969

39 -- SALES RECORD

MONTH	YEAR	AMOUNT

60 -- STAFF

DATE	ENUMERATOR	CLASSIFIER	CALCULATOR	REVIEWER
4/76	055	055		

61 -- APPRAISAL DATA

YEAR	PRINCIPAL BUILDING	OTHER BUILDINGS	ACCESSORY IMPROVEMENTS	TOTAL IMPROVEMENTS	LAND	TOTAL APPRAISED VALUE	REASON FOR APPRAISAL

Attachment K
ASTM Questionnaire

ENVIRONMENTAL PARTNERS INC 295 NE Gilman Blvd., Suite 201 Issaquah, Washington 98027 ph 425.395.0010 fax 425.395.0011

1527-05 QUESTIONNAIRE

Date: _____ **EPI Project No:** _____

EPI Interviewer: _____ **Email:** _____

User Name MUTUAL MATERILS

Subject Property Address 6620 COAL CREEK PARKWAY

Organization Manufacturing

Phone Number 425-452-2362

In order to qualify for one of the *Landowner Liability Protections (LLPs)* offered by the Small Business Liability Relief and Brownfields Revitalization Act of 2001 (the "*Brownsfields Amendments*"), the *user* must provide the following information (if available) to the *environmental professional.* Failure to provide this information could result in a determination that "*all appropriate inquiry*" is not complete.

(1.) Environmental cleanup liens that are filed or recorded against the site (40 CFR 312.25).
Are you aware of any environmental cleanup liens against the *property* that are filed or recorded under federal, tribal, state or local law? **None**

(2.) Activity and land use limitations that are in place on the site or that have been filed or recorded in a registry (40 CFR 312.26). Are you aware of any AULs, such as *engineering controls*, land use restrictions or *institutional controls* that are in place at the site and/or have been filed or recorded in a registry under federal, tribal, state or local law? **None**

(3.) Specialized knowledge or experience of the person seeking to qualify for the LLP (40 CFR 312.28).
As the *user* of this *ESA* do you have any specialized knowledge or experience related to the *property* or nearby properties? For example, are you involved in the same line of business as the current or former *occupants* of the *property* or an adjoining *property* so that you would have specialized knowledge of the chemicals and processes used by this type of business? **Question is not applicable to seller**

(4.) Relationship of the purchase price to the fair market value of the *property* if it were not contaminated (40 CFR 312.29). Does the purchase price being paid for this *property* reasonably reflect the fair market value of the *property*? If you conclude that there is a difference, have you considered whether the lower purchase price is because contamination is known or believed to be present at the *property*? **Purchase price does not reflect any discount for contamination.**

(5.) Commonly known or *reasonably ascertainable* information about the *property* (40 CFR 312.30).
Are you aware of commonly known or *reasonably ascertainable* information about the *property* that would help the *environmental professional* to identify conditions indicative of releases or threatened releases? For example, as *user*,

(a.) Do you know the past users or the *property*? **Yes**
(b.) Do you know of specific chemicals that are present or once were present at the *property*? **Have knowledge of some – see Tier Two report**
(c.) Do you know of spills or other chemical releases that have taken place at the *property*? **Yes**
(d.) Do you know of any environmental cleanups that have taken place at the *property*? **Yes – 8,000 gal diesel tank**

(6.) The degree of obviousness of he presence of likely presence of contamination at the *property*, and the ability to detect the contamination by appropriate investigation (40 CFR 312.31). As the *user* of this *ESA*, based on your knowledge and experience related to the *property* are there any *obvious* indications that point to the presence or likely presence of contamination at the *property*? **Not aware of any contamination except small amount of diesel during underground tank removal – see UST removal submitted**

(7.) Prior Environmental Documentation
Are you aware of any of the following environmental documents? If you are in possession of such documentation, will it be provided for review as part of the Phase I ESA process?
Helpful documents include:

- Environmental site assessment *reports*. **Phase 1provide**
- Environmental compliance audit *reports*. **None**
- Environmental permits (for example, solid waste, disposal permits, *hazardous waste* disposal permits, *wastewater permits*, NPDES permits, *underground injection* permits), **NPDES – stormwater pollution prevention plan on record - permit no SO3-000362, source point emission permit on record PSCAA**
- Registrations for underground and above-ground storage tanks, **UST submitted**
- Registrations for *underground injection* systems, **None**
- *Material safety data sheets*, **Can provide**
- Community right-to-know plan, **Tier Two report provided**
- Safety plans; preparedness and prevention plans; spill prevention, countermeasure and control plans; etc. **None**
- *Reports* regarding hydrogeologic conditions on the *property* or surrounding area, **Critical areas report submitted**
- Notices or other correspondence from any government agency relating to past or current violations of environmental laws with respect to the *property* or relating to *environmental liens* encumbering the *property*, **None**
- *Hazardous waste* generator notices or *reports*, **None**
- Geotechnical studies, **Critical areas report submitted**
- Risk assessments, and **None**
- Recorded AULs. – **Activity Use Limitations - None**

Completed by:

Jeff Linstad
Signature

NOV 1 2012
Date

JEFF LINSTAD MFG ENGR
Name/Title (please print)

MUTUAL MATERIALS
Company (please print)

Newcastle Environmental History
October 31, 2012

1. Underground diesel fuel storage tank:
    a. 8,000 gallon diesel tank install in 1957
    b. Removed in October 1994 by O'Sullivan Omega
    c. UST closure and site assessment report submitted to DOE
    d. Some PCS was noticed under the building footing and was not removed to protect the building support
2. Installed a 500 gal above ground diesel tank for loader fueling in 1994
3. Phase One Environmental Site Assessment – 2009
4. Critical Areas Report 2012
5. Asbestos removal:
    a. 2012 - Dressler kiln dryer baffles (transite panels), Dressler kiln dryer expansion joints, Dressler kiln control room window frame caulking and plant office window frame caulking was removed by FS and GS on June 22, 2012. Asbestos removal completion statement submitted to Puget Sound Clean Air Agency.
6. Main plant power transformers:
    a. Soil was tested around the three transformers by Kane Environmental.
    b. No leakage or contamination was noted, sampling report was submitted to Mutual Materials
    c. The oil in the three transformers was tested by Spectra Laboratories confirming Non-PCB transformer classification.
    d. Transformer Technologies removed the three transformers from the site and submitted a certification of destruction to Mutual Materials
7. An Industrial Stormwater General Permit was issued by the Department of Ecology annual
8. Annual Tier Two reports were submitted to the Department of Ecology reporting any hazardous substances on site over 10,000lb – Propane, Barium Carbonate, Manganese Oxide, and Chromite, Chrome Ore. The last three substances were used in or on the brick before firing and becomes an integral part of the brick that does not leach out over time. All amounts were used in the brick before shut down.
9. An annual source point emission permit through Puget Sound Clean Air Agency for the Keller kiln

Specific Information by Chemical
Revised September 2005

Community Right-to-Know
(REQUIRED INFORMATION)

(12-digit number beginning with CRK or WA)

Facility Identification UBI/DOR#: 178001617
Name MUTUAL MATERIALS CO NEWCASTLE BRICK PLANT
Address 6620 COALCREEK PKWY SE
City NEWCASTLE County King State Zip 98059
NAICS Code 327121 Latitude 0 -0 -0 Longitude 0 -0 -0
SIC Code 3251 Dun & Bradstreet No. 00-924-4377 LEPC KING

Owner/ Operator Name MUTUAL MATERIALS
Street 605 119TH NE
City BELLEVUE State WA Zip 98009- Phone (425) 455-2869

Main Contact Name JEFF LINSTAD Email jlinstad@mutualmaterials.com
Title MANUFACTURING ENGINEER Phone (425) 452-2362 Fax (425) 454-7732

Mailing Address *Must be included if different from Facility Address*
Address PO BOX 2009
City BELLEVUE State WA Zip 98009

Emergency Contact
Name Neal Bachelder Title Plant
Phone (425) 255-1101 24-hr. Phone (425) 788-8683
Name JEFF LINSTAD Title MANUFACTURING ENGINEER
Phone (425) 452-2362 24-hr. Phone

Important: Read all instructions before completing form.

Reporting Period: From January 1 to December 31, 2011

☐ Subject to section 112r of Clean Air Act

Chemical Description	Physical and Health Hazards (check all that apply)	INVENTORY	Storage Codes: Container Type / Pressure / Temperature	Storage Locations (Non-Confidential)
CAS 000513-77-9 Trade Secret ☐ Chem. Name BARIUM CARBONATE EHS Name Check all that apply: ☒ Pure ☐ Mix ☒ Solid ☐ Liquid ☐ Gas ☐ EHS	☐ Fire ☐ Sudden Release of Pressure ☒ Reactivity ☒ Immediate (acute) ☒ Delayed (chronic)	10,000 Max. Amount (lbs.) 5,000 Avg. Amount (lbs.) 4 Max. Daily Amount (code) 3 Avg. Daily Amount (code) 180 No. of Days On-site	J / 1 / 4	SEE SITE PLAN
CAS 000074-98-6 Trade Secret ☐ Chem. Name PROPANE EHS Name Check all that apply: ☒ Pure ☐ Mix ☐ Solid ☐ Liquid ☒ Gas ☐ EHS	☒ Fire ☒ Sudden Release of Pressure ☐ Reactivity ☒ Immediate (acute) ☒ Delayed (chronic)	3,000 Max. Amount (lbs.) 1,500 Avg. Amount (lbs.) 3 Max. Daily Amount (code) 3 Avg. Daily Amount (code) 365 No. of Days On-site	A / 2 / 6	SEE SITE PLAN

Certification (Read and sign after completing all sections)
I certify under penalty of law that I have personally examined and am familiar with the information submitted in pages one thru 2 and that based on my inquiry of these individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

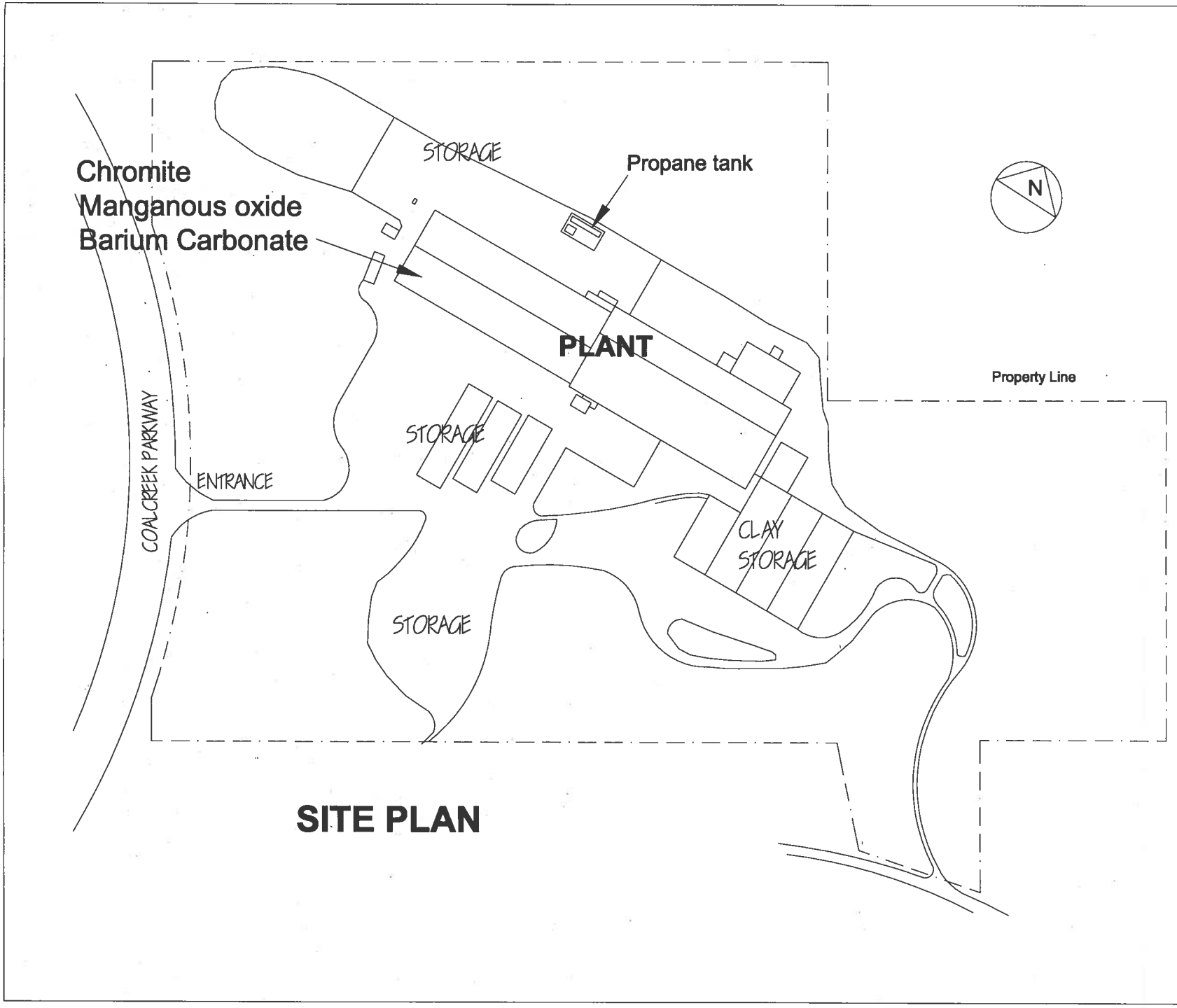
JEFF LINSTAD - MANUFACTURING ENGINEER
Name and offical title of owner/operator's authorized representative

Jeff Linstad
Signature

FEB 20 2012
Date Signed

OPTIONAL ATTACHMENTS
☐ I have attached a site plan
☐ I have attached a list of site coordinate abbreviations
☐ I have attached a description of dikes and other safeguard measures

Chemical Description	Physical and Health Hazards *(check all that apply)*	INVENTORY	Storage Codes: Container Type / Pressure / Temperature	Storage Locations (Non-Confidential)
CAS 001344-43-0 Trade Secret ☐ Chem. Name: **Manganous Oxide** EHS Name: Check all that apply: ☒ Pure ☐ Mix ☒ Solid ☐ Liquid ☐ Gas ☐ EHS	☐ Fire ☐ Sudden Release of Pressure ☐ Reactivity ☒ Immediate (acute) ☒ Delayed (chronic)	**10,000** Max. Amount (lbs.) **5,000** Avg. Amount (lbs.) **4** Max. Daily Amount (code) **3** Avg. Daily Amount (code) **180** No. of Days On-site	J / 1 / 4	SEE SITE PLAN
CAS 001308-31-2 Trade Secret ☐ Chem. Name: **CHROMITE CHROME ORE** EHS Name: Check all that apply: ☒ Pure ☐ Mix ☒ Solid ☐ Liquid ☐ Gas ☐ EHS	☐ Fire ☐ Sudden Release of Pressure ☐ Reactivity ☒ Immediate (acute) ☒ Delayed (chronic)	**10,000** Max. Amount (lbs.) **5,000** Avg. Amount (lbs.) **4** Max. Daily Amount (code) **3** Avg. Daily Amount (code) **180** No. of Days On-site	J / 1 / 4	SEE SITE PLAN



Date: February 17, 2003
Drawn by: Linstad

Newcastle Brick Plant
Site Plan

mutual materials co.

N -1

Attachment L
Qualifications of Environmental Professional

Thomas C. Morin, L.G.
President and Principal Geologist

Professional Profile

CREDENTIALS

- M.S., Geology, University of Missouri, Columbia
- B.S., Geology, Purdue University
- Washington Licensed Geologist No. 1146
- Qualified Expert Witness

PROFESSIONAL AFFILIATIONS

- National Ground Water Association
- Geological Society of America

FIELDS OF COMPETENCE

- Environmental Site Investigation and Remediation
- Regulatory negotiations and interaction
- Evaluation of natural attenuation/intrinsic re-mediation process
- Expert Witness and Litigation Support
- Contaminant Fate and Mobility
- Implementation and maintenance of ground water monitoring systems
- Evaluation and implementation of active remedial alternatives including in situ and ex situ soil and ground water treatment, AS/SVE, NoVOCs and DDC, bioventing, catalytic/thermal oxidation, and enhanced biological attenuation.
- Exploratory drilling programs and techniques (i.e., DPT, HSA, Air Rotary, Mud Rotary, Dual Tube/Reverse Circulation, Becker Hammer)
- Multimedia sampling programs dealing with ground water, surface water, stream sediments and subsurface and surface soils
- Phase I Environmental Assessments and Trans-action Screen Environmental Assessments

EXPERIENCE SUMMARY

Twenty-three years experience as project manager and/or technical lead for numerous environmental investigations and remediations in the United States. Experience in characterizing and remediating contaminants in soil and ground water, treatment system evaluation and conceptual design, technical writing, regulatory records reviews, site visits, personnel interviews, and evaluation of aerial photographs and historical maps.

Field experience in hydrogeologic studies, treatability studies, monitoring well installation and decommissioning, ground water sampling, and sediment and soil sampling pertaining to environmental investigations.

Mr. Morin also has significant experience with expert witness testimony and forensic evaluation of site data.

Sole or lead author of professional and technical articles relating to natural attenuation/intrinsic remediation processes in ground water.

Mr. Morin also serves as office manager for EPI's Bellevue office. In this capacity Mr. Morin has responsibility for training staff in the techniques and practice of all phases of environmental site assessments, QA/QC of deliverable documents, and evaluation of staff performance.

KEY PROJECTS

- Principal-in-Charge and technical lead for investigation and remediation of hazardous waste landfill containing 40,000 buried drums of mixed waste under Agreed Orders. Ground water contamination extends for >1.5 miles from source zone.
- Principal-in-Charge and technical lead for investigation and remediation of historical industrial property along the Thea Foss Waterway in Tacoma, Washington. Project involves evaluation of unique contaminant pathways and development of media specific cleanup levels for protection of surface water resources.
- Principal-in-Charge of remediation of 100,000 cubic yards of petroleum-contaminated soil and Brownfields Redevelopment in Bellevue, Washington.

Thomas C. Morin, L.G.
President and Principal Geologist

KEY PROJECTS (cont'd)

- Principal-in-Charge of remediation of 20,000 cubic yards of formaldehyde-contaminated soil in Renton, Washington through ex situ bioremediation.

- Principal-in-Charge and technical lead for investigation and remediation of a site in Renton, Washington. Remediation included excavation and off-site treatment of about 7,000 cubic yards of soil contaminated with gasoline, diesel, heating oil, and heavy oil from multiple discrete sources. Site is in VCP.

- Principal-in-Charge and technical lead for investigation and remediation of site in Tacoma Washington. Remediation included excavation and on-site *ex situ* bioremediation of diesel fuel contamination. Site is under TPCHD oversight.

- Principal-in-Charge of investigation and remediation of leaking product storage/delivery systems at gasoline stations for a confidential client.

- Principal-in-Charge and technical lead for investigation of PCE in multiple aquifers in Seattle, Washington.

- Technical Expert for PLP in Hylebos Waterway CERCLA and NRDA settlements.

- Technical consultant for PRP in Thea Foss Arbitration as part of CB/NT Superfund Site.

- Manager for subsurface investigation and evaluation of soil washing and solidification of metals-contaminated soils on South Tacoma Field Superfund Site.

- Project Manager for Washington State-lead site for remediation of metals and PCBs in the intertidal zone on Hylebos Waterway (Commencement Bay Superfund Site). Provided technical assistance for negotiation of a consent decree.

- Project Manager for over 40 ground water remediations involving dissolved-phase petroleum hydrocarbons in ground water. Remedial approaches involved intrinsic remediation with oxygen supplementation, ground water pump and treat, and bioventing.

- Project Manager for Washington State-lead site of a sole source aquifer contaminated with perchloroethylene.

- Project Geologist/Hydrogeologist for investigation of metals-contaminated sites in the Commencement Bay Superfund - Tide Flats Operable Unit.

- Project Hydrogeologist for ground water investigation at Triumph Mine Tailings Piles Superfund Site in Triumph, Idaho.

- Project Geologist/Task Manager for hydrogeologic characterization of large airplane manufacturing facility in Seattle, Washington. Contaminants of concern were chlorinated hydrocarbons.

PUBLICATIONS

- Morin, Thomas C.: Enhanced Intrinsic Bioremediation Speeds Site Cleanup; Pollution Engineering February 1997.

- Morin, Thomas C.: Field Results of the Use of Solid-Phase Oxygen Supplementation Compounds to Accelerate Intrinsic Biodegradation of BTEX in a High K Aquifer; Proceedings of National Ground Water Association, Fall 1997.

- Morin, Thomas C. and Susan M. Henry, Ph.D; Using Intrinsic Processes to Manage Site Remediation. Environmental Technology, January 1998.

- Houck, C.E., Morin, T.C., Jones, A.J., Palagyi, A.J.; Dual-Phase Extraction and Bio-Venting of Petroleum-Contaminated Soils and Ground Water at Gasoline Station 63-232-0049 in Seattle, Washington; Proceedings of the Fifth International Symposium of In Situ and On-site Bioremediation, April 1999.

Attachment B
Laboratory Analytical Reports

November 5, 2012

Mr. Greg McCormick
Environmental Partners, Inc.
295 NE Gilman Blvd., Suite 201
Issaquah, WA 98027

Dear Mr. McCormick,

On October 26th, 6 samples were received by our laboratory and assigned our laboratory project number EV12100171. The project was identified as your 38814.0. The sample identification and requested analyses are outlined on the attached chain of custody record.

No abnormalities or nonconformances were observed during the analyses of the project samples.

Please do not hesitate to call me if you have any questions or if I can be of further assistance.

Sincerely,

ALS Laboratory Group

Rick Bagan
Laboratory Director

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS JOB#:	EV12100171
		ALS SAMPLE#:	-01
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/25/2012 8:28:00 AM
CLIENT SAMPLE ID	TP-32	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Mercury	EPA-7471	U	0.020	1	MG/KG	10/31/2012	RAL
Mercury (TCLP)	EPA-7470/1311	U	0.00025	1	MG/L	10/31/2012	RAL
Antimony	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Arsenic	EPA-6020	**7.6**	1.0	5	MG/KG	10/29/2012	RAL
Beryllium	EPA-6020	**0.62**	0.50	5	MG/KG	10/29/2012	RAL
Cadmium	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Chromium	EPA-6020	**98**	0.50	5	MG/KG	10/29/2012	RAL
Copper	EPA-6020	**16**	0.50	5	MG/KG	10/29/2012	RAL
Lead	EPA-6020	**17**	0.50	5	MG/KG	10/29/2012	RAL
Nickel	EPA-6020	**29**	0.50	5	MG/KG	10/29/2012	RAL
Selenium	EPA-6020	U	5.0	5	MG/KG	10/29/2012	RAL
Silver	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Thallium	EPA-6020	U	4.6	5	MG/KG	10/29/2012	RAL
Zinc	EPA-6020	**28**	2.6	5	MG/KG	10/29/2012	RAL
Antimony (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Arsenic (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Beryllium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Cadmium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Chromium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Copper (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Lead (TCLP)	EPA-6020/1311	**0.052**	0.025	5	MG/L	11/02/2012	RAL
Nickel (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Selenium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Silver (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Thallium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Zinc (TCLP)	EPA-6020/1311	**0.065**	0.025	5	MG/L	11/02/2012	RAL

U - Analyte analyzed for but not detected at level above reporting limit.
Note: Mercury TCLP reporting limit raised due to TCLP blank contamination.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS JOB#:	EV12100171
		ALS SAMPLE#:	-02
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/25/2012 8:10:00 AM
CLIENT SAMPLE ID	Tran:0	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
PCB-1016	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1268	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1221	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1232	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1242	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1248	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1254	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1260	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP

SURROGATE	METHOD	%REC	ANALYSIS DATE	ANALYSIS BY
TCMX	EPA-8082	**75.0**	10/27/2012	LAP
DCB	EPA-8082	**55.0**	10/27/2012	LAP

U - Analyte analyzed for but not detected at level above reporting limit.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS JOB#:	EV12100171
		ALS SAMPLE#:	-03
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/25/2012 8:16:00 AM
CLIENT SAMPLE ID	Tran:4	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
PCB-1016	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1268	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1221	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1232	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1242	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1248	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1254	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1260	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP

SURROGATE	METHOD	%REC	ANALYSIS DATE	ANALYSIS BY
TCMX	EPA-8082	**80.0**	10/27/2012	LAP
DCB	EPA-8082	**59.0**	10/27/2012	LAP

U - Analyte analyzed for but not detected at level above reporting limit.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE: ALS JOB#: ALS SAMPLE#:	11/5/2012 EV12100171 -04
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/25/2012 10:30:00 AM
CLIENT SAMPLE ID	DxW:1	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
TPH-Diesel Range	NWTPH-DX	**7300**	250	10	MG/KG	10/29/2012	EBS
TPH-Oil Range	NWTPH-DX	**270**	100	2	MG/KG	10/31/2012	EBS

SURROGATE	METHOD	%REC	ANALYSIS DATE	ANALYSIS BY
C25 2X Dilution	NWTPH-DX	**94.6**	10/31/2012	EBS
C25 10X Dilution	NWTPH-DX	**94.3 DS2**	10/29/2012	EBS

DS2 - Due to high dilution factor surrogate results should be considered uncontrolled.
Chromatogram indicates that it is likely that sample contains weathered diesel and lube oil.
Oil range product results biased high due to diesel range product overlap.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS JOB#:	EV12100171
		ALS SAMPLE#:	-05
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/25/2012 10:35:00 AM
CLIENT SAMPLE ID	DX:4	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
TPH-Diesel Range	NWTPH-DX	**35**	25	1	MG/KG	10/29/2012	EBS
TPH-Oil Range	NWTPH-DX	U	50	1	MG/KG	10/29/2012	EBS

SURROGATE	METHOD	%REC	ANALYSIS DATE	ANALYSIS BY
C25	NWTPH-DX	**80.2**	10/29/2012	EBS

U - Analyte analyzed for but not detected at level above reporting limit.
Chromatogram indicates that it is likely that sample contains weathered diesel.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS JOB#:	EV12100171
		ALS SAMPLE#:	-06
CLIENT CONTACT:	Greg McCormick	DATE RECEIVED:	10/26/2012
CLIENT PROJECT:	38814.0	COLLECTION DATE:	10/26/2012 9:03:00 AM
CLIENT SAMPLE ID	TP-9	WDOE ACCREDITATION:	C601

DATA RESULTS

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Mercury	EPA-7471	U	0.020	1	MG/KG	10/31/2012	RAL
Mercury (TCLP)	EPA-7470/1311	U	0.00025	1	MG/L	10/31/2012	RAL
Antimony	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Arsenic	EPA-6020	**5.9**	1.0	5	MG/KG	10/29/2012	RAL
Beryllium	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Cadmium	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Chromium	EPA-6020	**11**	0.50	5	MG/KG	10/29/2012	RAL
Copper	EPA-6020	**7.2**	0.50	5	MG/KG	10/29/2012	RAL
Lead	EPA-6020	**5.0**	0.50	5	MG/KG	10/29/2012	RAL
Nickel	EPA-6020	**6.8**	0.50	5	MG/KG	10/29/2012	RAL
Selenium	EPA-6020	U	5.0	5	MG/KG	10/29/2012	RAL
Silver	EPA-6020	U	0.50	5	MG/KG	10/29/2012	RAL
Thallium	EPA-6020	U	4.7	5	MG/KG	10/29/2012	RAL
Zinc	EPA-6020	**22**	2.7	5	MG/KG	10/29/2012	RAL
Antimony (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Arsenic (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Beryllium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Cadmium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Chromium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Copper (TCLP)	EPA-6020/1311	**0.052**	0.025	5	MG/L	11/02/2012	RAL
Lead (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Nickel (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Selenium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Silver (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Thallium (TCLP)	EPA-6020/1311	U	0.025	5	MG/L	11/02/2012	RAL
Zinc (TCLP)	EPA-6020/1311	**0.056**	0.025	5	MG/L	11/02/2012	RAL

U - Analyte analyzed for but not detected at level above reporting limit.
Note: Mercury TCLP reporting limit raised due to TCLP blank contamination.

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT: Environmental Partners, Inc.
295 NE Gilman Blvd., Suite 201
Issaquah, WA 98027

CLIENT CONTACT: Greg McCormick
CLIENT PROJECT: 38814.0

DATE: 11/5/2012
ALS SDG#: EV12100171
WDOE ACCREDITATION: C601

LABORATORY BLANK RESULTS

MB-102612S - Batch 3207 - Soil by NWTPH-DX

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
TPH-Diesel Range	NWTPH-DX	U	25	1	MG/KG	10/26/2012	EBS
TPH-Oil Range	NWTPH-DX	U	50	1	MG/KG	10/26/2012	EBS

MBLK-10272012 - Batch R79111 - Soil by EPA-8082

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
PCB-1016	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1268	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1221	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1232	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1242	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1248	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1254	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP
PCB-1260	EPA-8082	U	0.10	1	MG/KG	10/27/2012	LAP

MBLK-10312012 - Batch R79107 - Soil by EPA-7471

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Mercury	EPA-7471	U	0.020	1	MG/KG	10/31/2012	RAL

MBLK-10302012 - Batch R79110 - Soil by EPA-7470

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Mercury (TCLP)	EPA-7470/1311	U	0.00025	1	MG/L	10/30/2012	RAL

MB-102912S - Batch 3202 - Soil by EPA-6020

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Antimony	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Arsenic	EPA-6020	U	0.20	1	MG/KG	10/29/2012	RAL
Beryllium	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Cadmium	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Chromium	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Copper	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Lead	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Nickel	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL
Selenium	EPA-6020	U	1.0	1	MG/KG	10/29/2012	RAL
Silver	EPA-6020	U	0.10	1	MG/KG	10/29/2012	RAL

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS SDG#:	EV12100171
		WDOE ACCREDITATION:	C601
CLIENT CONTACT:	Greg McCormick		
CLIENT PROJECT:	38814.0		

LABORATORY BLANK RESULTS

MB-102912S - Batch 3202 - Soil by EPA-6020

Thallium	EPA-6020	U	0.87	1	MG/KG	10/29/2012	RAL
Zinc	EPA-6020	U	0.50	1	MG/KG	10/29/2012	RAL

MBLK-1122012 - Batch R79113 - Soil by EPA-6020

ANALYTE	METHOD	RESULTS	REPORTING LIMITS	DILUTION FACTOR	UNITS	ANALYSIS DATE	ANALYSIS BY
Antimony (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Arsenic (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Beryllium (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Cadmium (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Chromium (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Copper (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Lead (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Nickel (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Selenium (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Silver (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Thallium (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL
Zinc (TCLP)	EPA-6020/1311	U	0.0050	1	MG/L	11/02/2012	RAL

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS SDG#:	EV12100171
		WDOE ACCREDITATION:	C601
CLIENT CONTACT:	Greg McCormick		
CLIENT PROJECT:	38814.0		

LABORATORY CONTROL SAMPLE RESULTS

ALS Test Batch ID: 3207 - Soil by NWTPH-DX

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
TPH-Diesel Range - BS	NWTPH-DX	**92.7**			10/26/2012	EBS
TPH-Diesel Range - BSD	NWTPH-DX	**97.8**	**5**		10/26/2012	EBS

ALS Test Batch ID: R79111 - Soil by EPA-8082

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
PCB-1016 - BS	EPA-8082	**92.0**			10/27/2012	LAP
PCB-1016 - BSD	EPA-8082	**103**	**11**		10/27/2012	LAP
PCB-1260 - BS	EPA-8082	**94.0**			10/27/2012	LAP
PCB-1260 - BSD	EPA-8082	**103**	**9**		10/27/2012	LAP

ALS Test Batch ID: R79107 - Soil by EPA-7471

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Mercury - BS	EPA-7471	**95.0**			10/31/2012	RAL
Mercury - BSD	EPA-7471	**96.0**	**1**		10/31/2012	RAL

ALS Test Batch ID: R79110 - Soil by EPA-7470

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Mercury - BS	EPA-7470	**97.0**			10/31/2012	RAL
Mercury - BSD	EPA-7470	**94.0**	**3**		10/31/2012	RAL

ALS Test Batch ID: 3202 - Soil by EPA-6020

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Antimony - BS	EPA-6020	**90.3**			10/29/2012	RAL
Antimony - BSD	EPA-6020	**96.0**	**6**		10/29/2012	RAL
Arsenic - BS	EPA-6020	**97.1**			10/29/2012	RAL
Arsenic - BSD	EPA-6020	**100**	**3**		10/29/2012	RAL
Beryllium - BS	EPA-6020	**89.9**			10/29/2012	RAL
Beryllium - BSD	EPA-6020	**98.2**	**9**		10/29/2012	RAL
Cadmium - BS	EPA-6020	**94.6**			10/29/2012	RAL
Cadmium - BSD	EPA-6020	**104**	**9**		10/29/2012	RAL
Chromium - BS	EPA-6020	**101**			10/29/2012	RAL
Chromium - BSD	EPA-6020	**105**	**4**		10/29/2012	RAL
Copper - BS	EPA-6020	**103**			10/29/2012	RAL
Copper - BSD	EPA-6020	**106**	**3**		10/29/2012	RAL

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS SDG#:	EV12100171
		WDOE ACCREDITATION:	C601
CLIENT CONTACT:	Greg McCormick		
CLIENT PROJECT:	38814.0		

LABORATORY CONTROL SAMPLE RESULTS

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Lead - BS	EPA-6020	**96.8**			10/29/2012	RAL
Lead - BSD	EPA-6020	**105**	**8**		10/29/2012	RAL
Nickel - BS	EPA-6020	**104**			10/29/2012	RAL
Nickel - BSD	EPA-6020	**107**	**2**		10/29/2012	RAL
Selenium - BS	EPA-6020	**96.8**			10/29/2012	RAL
Selenium - BSD	EPA-6020	**100**	**4**		10/29/2012	RAL
Silver - BS	EPA-6020	**104**			10/29/2012	RAL
Silver - BSD	EPA-6020	**108**	**3**		10/29/2012	RAL
Thallium - BS	EPA-6020	**92.7**			10/29/2012	RAL
Thallium - BSD	EPA-6020	**104**	**12**		10/29/2012	RAL
Zinc - BS	EPA-6020	**97.8**			10/29/2012	RAL
Zinc - BSD	EPA-6020	**100**	**3**		10/29/2012	RAL

ALS Test Batch ID: R79113 - Soil by EPA-6020

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Antimony - BS	EPA-6020	**96.9**			11/02/2012	RAL
Antimony - BSD	EPA-6020	**95.7**	**1**		11/02/2012	RAL
Arsenic - BS	EPA-6020	**97.4**			11/02/2012	RAL
Arsenic - BSD	EPA-6020	**95.3**	**2**		11/02/2012	RAL
Beryllium - BS	EPA-6020	**95.3**			11/02/2012	RAL
Beryllium - BSD	EPA-6020	**95.4**	**0**		11/02/2012	RAL
Cadmium - BS	EPA-6020	**98.2**			11/02/2012	RAL
Cadmium - BSD	EPA-6020	**96.8**	**1**		11/02/2012	RAL
Chromium - BS	EPA-6020	**95.8**			11/02/2012	RAL
Chromium - BSD	EPA-6020	**93.9**	**2**		11/02/2012	RAL
Copper - BS	EPA-6020	**97.2**			11/02/2012	RAL
Copper - BSD	EPA-6020	**95.7**	**2**		11/02/2012	RAL
Lead - BS	EPA-6020	**97.7**			11/02/2012	RAL
Lead - BSD	EPA-6020	**97.1**	**1**		11/02/2012	RAL
Nickel - BS	EPA-6020	**96.3**			11/02/2012	RAL
Nickel - BSD	EPA-6020	**95.0**	**1**		11/02/2012	RAL
Selenium - BS	EPA-6020	**97.7**			11/02/2012	RAL
Selenium - BSD	EPA-6020	**97.6**	**0**		11/02/2012	RAL
Silver - BS	EPA-6020	**97.5**			11/02/2012	RAL
Silver - BSD	EPA-6020	**95.8**	**2**		11/02/2012	RAL
Thallium - BS	EPA-6020	**92.9**			11/02/2012	RAL
Thallium - BSD	EPA-6020	**93.2**	**0**		11/02/2012	RAL
Zinc - BS	EPA-6020	**97.3**			11/02/2012	RAL

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

CERTIFICATE OF ANALYSIS

CLIENT:	Environmental Partners, Inc. 295 NE Gilman Blvd., Suite 201 Issaquah, WA 98027	DATE:	11/5/2012
		ALS SDG#:	EV12100171
		WDOE ACCREDITATION:	C601
CLIENT CONTACT:	Greg McCormick		
CLIENT PROJECT:	38814.0		

LABORATORY CONTROL SAMPLE RESULTS

SPIKED COMPOUND	METHOD	%REC	RPD	QUAL	ANALYSIS DATE	ANALYSIS BY
Zinc - BSD	EPA-6020	**96.4**	**1**		11/02/2012	RAL

APPROVED BY

Laboratory Director

ADDRESS 8620 Holly Drive, Suite 100, Everett, WA 98208 | PHONE 425-356-2600 | FAX 425-356-2626
ALS Laboratory Group A Campbell Brothers Limited Company

Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

ALS Environmental
8620 Holly Drive, Suite 100
Everett, WA 98208
Phone (425) 356-2600
(425) 356-2626 Fax
http://www.alsglobal.com

Chain Of Custody/ Laboratory Analysis Request

ALS Job# (Laboratory Use Only): EV12100171

Date 10/26/12 Page 1 Of 1

PROJECT ID: 38814.0
REPORT TO COMPANY: Environmental Partners
PROJECT MANAGER: G. McCormick
ADDRESS: 295 NE Gilman Blvd Ste 201 Issaquah WA
PHONE: 425-358-0001 FAX:
P.O. NUMBER: 38814.0 E-MAIL: gregm@epi-wa.com kristina@epi-wa.com
INVOICE TO COMPANY: EPI
ATTENTION: T. Elsemore
ADDRESS:

ANALYSIS REQUESTED

SAMPLE I.D.	DATE	TIME	TYPE	LAB#	NWTPH-HCID	NWTPH-DX	NWTPH-GX	BTEX by EPA-8021	MTBE by EPA-8021 ☐ EPA-8260 ☐	Halogenated Volatiles by EPA 8260	Volatile Organic Compounds by EPA 8260	EDB / EDC by EPA 8260 SIM (water)	EDB / EDC by EPA 8260 (soil)	Semivolatile Organic Compounds by EPA 8270	Polycyclic Aromatic Hydrocarbons (PAH) by EPA-8270 SIM ☐	PCB ☒ Pesticides ☐ by EPA 8081/8082	Metals-MTCA-5 ☐ RCRA-8 ☐ Pri Pol ☒ TAL ☐	Metals Other (Specify)	TCLP-Metals ☐ VOA ☐ Semi-Vol ☐ Pest ☐ Herbs ☐ 7PM ☒	OTHER (Specify)	NUMBER OF CONTAINERS	RECEIVED IN GOOD CONDITION?
1. TP-32	10/25/12	0828	crushed Brick	1													X		X		2	
2. Tran:0	↓	0810	Soil	2												X					1	
3. Tran:4	↓	0816	Soil	3												X					1	
4. DxW:1	10/25/12	1030	Soil	4		X															1	
5. DX:4	↓	1035	Soil	5		X															1	
6. TP-9	10/26/12	0903	crushed Brick	6													X		X		1	
7.																						
8.																						
9.																						
10.																						

LABORATORY COPY

SPECIAL INSTRUCTIONS: Please pulverize brick samples

SIGNATURES (Name, Company, Date, Time):
1. Relinquished By: Kristina L. Addis 10/26/12 1245
Received By: ALS 10/26/12 12:45
2. Relinquished By:
Received By:

TURNAROUND REQUESTED in Business Days*
Organic, Metals & Inorganic Analysis: [X] Standard [5] [3] [2] [1] [SAME DAY]
Fuels & Hydrocarbon Analysis: [X] Standerd [3] [1] [SAME DAY]
OTHER:
Specify:

* Turnaround request less than standard may incur Rush Charges

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

April 10, 2015

Eric Koltes, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: Newcastle 38814.0, F&BI 504114

Dear Mr. Koltes:

Included are the results from the testing of material submitted on April 7, 2015 from the Newcastle 38814.0, F&BI 504114 project. There are 12 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0410R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on April 7, 2015 by Friedman & Bruya, Inc. from the Environmental Partners Newcastle Newcastle 38814.0, F&BI 504114 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
504114 -01	A1-B1:6
504114 -02	A1-B2:5
504114 -03	A1-SW1:3
504114 -04	A1-SW2:4
504114 -05	A1-SW3:3
504114 -06	A1-SW4:3
504114 -07	A2-B1:6
504114 -08	A2-SW1:3
504114 -09	A2-SW2:4
504114 -10	A2-SW3:3
504114 -11	A2-SW4:4
504114 -12	A1-SW5:3

All quality control requirements were acceptable.

Date of Report: 04/10/15
Date Received: 04/07/15
Project: Newcastle 38814.0, F&BI 504114
Date Extracted: 04/07/15
Date Analyzed: 04/07/15

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 56-165)
A1-B1:6 504114-01	<50	<250	115
A1-B2:5 504114-02	<50	<250	111
A1-SW1:3 504114-03	<50	<250	113
A1-SW2:4 504114-04	270 x	2,800	111
A1-SW3:3 504114-05	<50	<250	101
A1-SW4:3 504114-06	<50	<250	110
A1-SW5:3 504114-12	<50	<250	112
Method Blank 05-707 MB2	<50	<250	99
Method Blank 05-710 MB	<50	<250	107

Analysis For Total Metals By EPA Method 200.8

Client ID:	A2-B1:6	Client:	Environmental Partners
Date Received:	04/07/15	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	504114-07
Date Analyzed:	04/07/15	Data File:	504114-07.012
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	86	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	7.46

Analysis For Total Metals By EPA Method 200.8

Client ID:	A2-SW1:3	Client:	Environmental Partners
Date Received:	04/07/15	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	504114-08
Date Analyzed:	04/07/15	Data File:	504114-08.013
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	84	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	4.95

Analysis For Total Metals By EPA Method 200.8

Client ID:	A2-SW2:4	Client:	Environmental Partners
Date Received:	04/07/15	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	504114-09
Date Analyzed:	04/07/15	Data File:	504114-09.014
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	104	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	10.1

Analysis For Total Metals By EPA Method 200.8

Client ID:	A2-SW3:3	Client:	Environmental Partners
Date Received:	04/07/15	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	504114-10
Date Analyzed:	04/07/15	Data File:	504114-10 rr.050
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	94	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	9.40

Analysis For Total Metals By EPA Method 200.8

Client ID:	A2-SW4:4	Client:	Environmental Partners
Date Received:	04/07/15	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	504114-11
Date Analyzed:	04/07/15	Data File:	504114-11.016
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	85	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	7.96

Analysis For Total Metals By EPA Method 200.8

Client ID:	Method Blank	Client:	Environmental Partners
Date Received:	NA	Project:	Newcastle 38814.0, F&BI 504114
Date Extracted:	04/07/15	Lab ID:	I5-203 mb2
Date Analyzed:	04/07/15	Data File:	I5-203 mb2.011
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	ML

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Germanium	85	60	125

Analyte:	Concentration mg/kg (ppm)
Chromium	<1

Date of Report: 04/10/15
Date Received: 04/07/15
Project: Newcastle 38814.0, F&BI 504114

QUALITY ASSURANCE RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 504087-07 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	mg/kg (ppm)	5,000	<50	92	97	73-135	5

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	mg/kg (ppm)	5,000	90	74-139

Date of Report: 04/10/15
Date Received: 04/07/15
Project: Newcastle 38814.0, F&BI 504114

QUALITY ASSURANCE RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 504092-03 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	mg/kg (ppm)	5,000	<50	98	106	64-133	8

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	mg/kg (ppm)	5,000	105	58-147

Date of Report: 04/10/15
Date Received: 04/07/15
Project: Newcastle 38814.0, F&BI 504114

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR TOTAL METALS USING EPA METHOD 200.8

Laboratory Code: 503483-04 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Chromium	mg/kg (ppm)	50	5.91	73	90	57-128	21 vo

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Chromium	mg/kg (ppm)	50	96	78-121

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

504114

SAMPLE ~~CHAIN~~ OF CUSTODY

ME 04/07/15 CI3

Page # 1 of 1

Send Report To

Company: Environmental Partners, Inc.

Address: 1180 NW Maple ST, STE 310

City, State, ZIP: Issaquah, WA 98027

Phone #: 425-395-0010 Fax #:

SAMPLERS (signature):

PROJECT NAME/NO.: Newcastle 38814.0

PO #:

REMARKS: email results to E. Kuitsi erick@epi-wa.com

TURNAROUND TIME
- ☐ Standard (2 Weeks)
- ☒ RUSH 24 hr
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☒ Dispose after 30 days
- ☐ Return samples
- ☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	ANALYSES REQUESTED: TPH-Diesel -DX	TPH-Gasoline	BTEX by 8021B	VOCs by 8260	SVOCs by 8270	HFS	Total Chromium						Notes
A1-B1:6	01	4/6/15	08:55	Soil	1	X												(*2) -prEC 4/7/15 ms.
A1-B2:5	02		08:56		1	X												
A1-SW1:3	03		08:59		1	X												
A1-SW2:4	04		09:01		1	X												
A1-SW3:3	05		09:03		1	X												
A1-SW4:3	06		09:05		1	X												
A2-B1:6	07		10:40		1							X						
A2-SW1:3	08		10:42		1							X						
A2-SW2:4	09		11:33		1							X						
A2-SW3:3	10		11:36		1							X						
A2-SW4:4	-11		11:39		1							X						
A1-SW5-3	-12	4/6/15	09:07		1	(*)												Added at lab (NP) 4/7

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Eric Caddey	EPI	4/7/15	07:49
Received by:	Michael E-chli	FEBI	↓	↓
Relinquished by:				
Received by:		Samples received at 4 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

Attachment C
Terrestrial Ecological Evaluation

ENVIRONMENTAL PARTNERS INC
1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Revised Site-Specific Terrestrial Ecological Evaluation Report

Former Mutual Materials Property
6620 Coal Creek Parkway Southeast
Newcastle, Washington 98059

Prepared For:

Newcastle Joint Venture LLC
600 108th Avenue NE, Suite 840
Bellevue, Washington 98004

June 7, 2017

Prepared By:

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

Douglas Kunkel FOR

Eric Koltes, L.G.
Senior Geologist

State of Washington
1148
Licensed Geologist

Thomas C. Morin

Thomas Morin, L.G.
President/Principal Geologist

EPI Project Number: 38814.1

QR TR

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Description and History of Property 1

1.2 Description of Sites Requiring Site-Specific TEE 2

2.0 PROBLEM FORMULATION STEP 2

2.1 Potential Chemicals of Ecological Concern 3

2.2 Exposure Pathways 4

2.3 Terrestrial Ecological Receptors of Concern 4

2.4 Literature Survey 4

2.4.1 Antimony EISCs 5

2.4.2 Beryllium EISCs 5

2.4.3 Silver EISCs 5

2.5 Complete Set of EISCs for Potential COECs 6

2.6 Final Chemicals of Ecological Concern 6

3.0 SITE-SPECIFIC TOXICOLOGICAL STUDY 8

3.1 Sampling and Analysis 8

3.2 Soil Bioassay 9

3.3 Bioaccumulation Study 9

3.3.1 Antimony 10

3.3.2 Arsenic 10

3.3.3 Lead 10

4.0 FINAL TEE CLEANUP LEVELS 10

TABLES

Table 1 Summary of Analytical Data (in mg/kg)
Table 2 Table 749-3 EISCs for the Initial COPECs (in mg/kg) – embedded
Table 3 Final EISCs (in mg/kg) – embedded
Table 4 Summary of Chemicals of Potential Ecological Concern
Table 5 Summary of TEE Confirmation Sample Analytical Results (in mg/kg)
Table 6 TEE Bioassay and Bioaccumulation Test Results Summary
Table 7 Final TEE Cleanup Levels (in mg/kg) – embedded

FIGURES

Figure 1 General Vicinity Map
Figure 2 Map Depicting Property and Developable Road, and Open Space Portions

ATTACHMENTS

Attachment A Literature Survey Documents
Attachment B Wildlife Calculations
Attachment C Laboratory Analytical Data Sheets
Attachment D Box-and-Whisker Plot Charts
Attachment E AECOM Toxicology, Soil Toxicity Evaluation Reports

ABBREVIATIONS AND ACRONYMS

Abbreviation/ Acronym	Definition
BAF	Bioaccumulation factor
COEC	Chemical of ecological concern
Ecology	Washington State Department of Ecology
EISC	Ecological indicator soil concentrations
EPA	U.S. Environmental Protection Agency
LOEC	Lowest observed effects concentration
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
TEE	Terrestrial Ecological Evaluation
WAC	Washington Administrative Code
WEM	Wildlife Exposure Model for Site-Specific Evaluations

1.0 INTRODUCTION

This Report presents the rationale, methodology, and results of a site-specific terrestrial ecological evaluation (TEE) conducted for an approximately 54-acre parcel of real property formerly owned by Mutual Materials located at 66209 Coal Creek Parkway SE in Newcastle, Washington (Property). The Property is identified in the property records of King County as Tax Parcel Numbers 2724059006, 2724059040, and 2824059099. Newcastle Joint Venture LLC (Owner) acquired the Property in January 2015.

The Owner is in the process of subdividing the Property into three portions: (1) an approximately 27-acre portion that will be developed into apartments, townhomes, retail spaces, parks, and plazas (Developable Portion); (2) an approximately 5-acre portion that will be dedicated to the City of Newcastle for public roads (Road Portion); and (3) an approximately 22-acre portion that will remain as open space and critical area tracts (Open Space Portion). The Developable Portion is being subdivided into 11 Lots, known as Lots 1a and 1b and Lots 2 through 10. Recently, The Quadrant Corporation purchased Lots 8 and 10 from the Owner. The Property is depicted on Figure 1. The Developable Portion, Road Portion, and Open Space Portion are depicted on Figure 2. The sizes and orientations of the lots constituting the Developable Portion are depicted on Figure 2.

The Owner has completed environmental investigations of the Property, which have identified multiple, distinct areas of soil within the Property containing elevated concentrations of hazardous substances. Each of these areas constitutes a separate “site” under the Model Toxics Control Act (Chapter 70.105D RCW) and its implementing regulations (Chapter 173-340 of the Washington Administrative Code [WAC]), which together are referred to as MTCA. Based on WAC 173-340-7491(1)(b), most of the sites qualify for exclusion from a TEE because they are in areas of the Property that will, after development, be covered with buildings, paved roads, pavement, or other physical barriers that will prevent plants and wildlife from being exposed to the soil contamination. Other sites qualify for exclusion from a TEE because the hazardous substances will, after development, be located at depths below the standard point of compliance of 15 feet below ground surface (WAC 173-340-7491(1)(a)).

The sites that do not qualify for an exclusion from a TEE are those that that are located in areas of the Property that will not be developed or those that contain hazardous substances at depths above the standard point of compliance (Non-Excluded Sites). The Non-Excluded Sites share common characteristics, including the chemicals of ecological concern, exposure pathways, soil types, climate, and terrestrial ecological receptors of concern. Accordingly, a single, site-specific TEE was developed for the Non-Excluded Sites, and the cleanup levels established in this Report for the protection of terrestrial plants and animals apply to all of the Non-Excluded Sites.

1.1 Description and History of Property

The Property is located at 6620 Coal Creek Parkway SE in Newcastle, King County, Washington. According to the City of Newcastle Zoning Map and Comprehensive Plan, the Property is zoned as a combination of Mixed Use (MU) Residential and MU Commercial. Owner’s planned redevelopment is consistent with this zoning and has been approved and permitted by the City of Newcastle.

Historical records indicate the Property is within what was once known as the Newcastle Mining District, which extended several miles to the east of the Property. The Property reportedly contained several coal seams that were mined until the early 1910s. An estimated 75,000 cubic yards of mine tailings are present on the southeastern portion of the Property, almost entirely within the Open Space Portion. The mine tailings vary in thickness and extend off the Property to the east. It cannot be determined whether the mine tailings originate from mining activities conducted on the Property or on other properties.

The Property appears to have been unoccupied between approximately 1920 and the mid-1950s. The central portion of the Property was developed in approximately 1957 as a brick manufacturing plant. The plant included two kiln buildings, maintenance and storage buildings, a scale house, and raw material storage sheds. Operations at the plant ceased in 2011. All plant structures and improvements have since been removed from the Property.

1.2 Description of Sites Requiring Site-Specific TEE

The Property contains multiple sites, only a few of which constitute Non-Excluded Sites because they are located in areas of the Property that will not be developed or where hazardous substances will remain in soil above the standard point of compliance. The Non-Excluded Sites, although separate and distinct, all contain inorganic metals in relatively shallow soil.

The TEE documented herein is relevant for all the Sites at the Property due to the similar soil types, mode of release, climate types, and contaminants evaluated.

2.0 PROBLEM FORMULATION STEP

Pursuant to WAC 173-340-7493(2), the first step in performing a site-specific TEE, referred to as the "Problem Formulation Step," is to identify the following:

- Chemicals of ecological concern (COECs);
- Exposure pathways; and
- Terrestrial ecological receptors of concern.

The next step is to identify significant adverse effects that may result to the terrestrial ecological receptors of concern from exposure to the COECs, based on information from toxicological literature.

The purpose of the Problem Formulation Step is to determine whether site-specific cleanup levels must be developed to protect terrestrial plants and animals that are exposed to COECs at a site. Such cleanup levels are referred to in this Report as "TEE cleanup levels."

The following sections discuss the Problem Formulation Step in more detail.

2.1 Potential Chemicals of Ecological Concern

The potential COECs for the Non-Excluded Sites consist of: (1) inorganic metals detected at concentrations exceeding the Ecological Indicator Soil Concentrations (EISC) for protection of terrestrial plants and animals set forth in Table 749-3 of WAC 173-340-900 and; (2) inorganic metals detected in soil at concentrations exceeding a practical quantitation limit (PQL) but for which Table 749-3 does not include an EISC. EISCs are organized in Table 749-3 by receptors of concern as plants, soil biota, and wildlife.

Based on these criteria, the potential COECs for the Non-Excluded Sites are as follows:

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Zinc

The EISCs set forth in Table 749-3 for the potential COECs are summarized in the following Table 2.

Table 2
Table 749-3 EISCs for the Potential COECs (in mg/kg)

COPEC	Plants	Soil Biota	Wildlife
Antimony	5	--	--
Arsenic	10	60	7
Beryllium	10	--	--
Cadmium	4	20	14
Chromium	42	42	67
Copper	100	50	217
Lead	50	500	118
Mercury	0.3	0.1	5.5
Nickel	30	200	980
Silver	2	--	--
Zinc	86	200	360

Notes:
mg/kg Milligrams per kilogram.
-- No value established.

2.2 Exposure Pathways

The primary exposure pathway for potential terrestrial ecological receptors of concern at the Non-Excluded Sites is direct contact with contaminated soil. Secondary exposure pathways can occur when potential receptors of concern feed on other affected organisms, resulting in bioaccumulation of contaminants through the food chain. Plants exposed to contaminants may directly uptake the contamination from the soil in their roots. Animals may be exposed from direct contact with contaminated soil or by consuming affected plants and/or soil biota.

2.3 Terrestrial Ecological Receptors of Concern

Due to the open potential habitat at and surrounding the Non-Excluded Sites, the terrestrial ecological receptors of concern include vascular vegetation, soil biota, ground-feeding birds, ground-feeding small mammal predators, and herbivorous small mammals. These are categorized into the following three basic categories:

- Plants
- Soil Biota
- Wildlife

2.4 Literature Survey

Table 749-3 does not provide an EISC for each receptor of concern for each hazardous substance detected in soil at the Property. For example, beryllium has an EISC of 10 mg/kg for protection of plants, but there is no EISC for the protection of soil biota and wildlife receptors of concern.

The following hazardous substances were included as potential COECs because Table 749-3 does not include an EISC for the soil biota and wildlife receptors of concern:

- Antimony
- Beryllium
- Silver

According to Table 749-3, for hazardous substances where an EISC value is not provided, EISCs will be based on a literature survey conducted in accordance with WAC 173-340-7493(4). Therefore, a literature study was performed to determine appropriate EISCs for the soil biota and wildlife receptors of concern for these hazardous substances. All documents obtained through the literature survey are provided in Attachment A.

The results of the literature survey are included in the following sections.

2.4.1 Antimony EISCs

EISCs for antimony were obtained from the document entitled, *Ecological Soil Screening Levels for Antimony,* U. S. Environmental Protection Agency (EPA), February 2005. The EISCs are as follows:

- Protection of soil biota – 78 mg/kg
- Protection of wildlife – 0.27 mg/kg

2.4.2 Beryllium EISCs

EISCs for beryllium were obtained from the document entitled, *Ecological Soil Screening Levels for Beryllium,* EPA, February 2005. The EISCs are as follows:

- Protection of soil biota – 40 mg/kg
- Protection of wildlife – 21 mg/kg

2.4.3 Silver EISCs

An EISC for silver for protection of wildlife of 4.2 mg/kg was obtained from the document entitled, *Ecological Soil Screening Levels for Silver,* EPA, September 2006. At the time this document was published, no data were available regarding the toxicity of silver to soil invertebrates. The development of an EISC for silver for protection of soil biota is described in the following paragraphs.

To determine an EISC for exposures of soil biota to silver, EPI conducted a literature survey in accordance with the document entitled, *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision*, Oak Ridge National Laboratory, 1997 (Oakridge Document), as directed by footnote (d) of Table 749-3. The literature survey produced only one article: *Effects of Silver Nanoparticles and Silver Nitrate in the Earthworm Reproductive Test,* Schlich et al., Environmental Toxicology and Chemistry, 32, 2013 (Schlich Article).

EPI evaluated the data in the Schlich Article using the criteria required by MTCA and the EPA document entitled, *Guidance for Developing Soil Screening levels (Eco-SSLs), US EPA, 2003.* The data in the Schlich Article meets the review criteria provided in MTCA and the EPA guidance and was deemed appropriate for development of an EISC for soil biota for exposure to silver.

The Schlich Article reports lowest observed effects concentration (LOEC) values less than or equal to 15 mg/kg, and no observed effects concentration (NOEC) values of less than 15 mg/kg for earthworm exposures to silver nitrate. The authors also report an LOEC value of 30 mg/kg and an NOEC value of 15 mg/kg for silver nanoparticles, and report that the silver nitrate was found to be approximately twice as toxic to earthworms as silver nanoparticles. Therefore, the initial screening level used for silver is 15 mg/kg, as this is the LOEC documented in the Schlich Article.

In accordance with the Oakridge Document, it is appropriate to apply a "safety factor" depending upon the number of studies that are used to generate a screening level, or in the case of this TEE, an EISC. A typical safety factor reported in the Oakridge Document is 5 times for screening levels that are developed from a single study. Since the initial EISC for silver is generated from a single study source, the safety factor of 5 is appropriate. Thus, the reported LOEC value of 15 mg/kg divided by 5 results in a conservative EISC for silver that is protective of soil biota of 3 mg/kg.

Therefore, the EISCs selected for silver are as follows:

- Protection of soil biota – 3 mg/kg
- Protection of wildlife – 4.2 mg/kg

2.5 Complete Set of EISCs for Potential COECs

After performance of the literature survey documented in Section 2.4, the complete set of EISCs for the potential COECs are summarized in Table 3, below.

Table 3
EISCs for Potential COECs (in mg/kg)

COPEC	Plants	Soil Biota	Wildlife
Antimony	5	78	0.27
Arsenic	10	60	7
Beryllium	10	40	21
Cadmium	4	20	14
Chromium	42	42	67
Copper	100	50	217
Lead	50	500	118
Mercury	0.3	0.1	5.5
Nickel	30	200	980
Silver	2	3	4.2
Zinc	86	200	360

Notes:
Unless indicated by shading, values are from Table 749-3 of WAC 173-340-900.
Cells shaded gray contain values from the literature survey documented in Section 2.4.

2.6 Final Chemicals of Ecological Concern

In accordance with WAC 173-340-7493(2)(a)(i), hazardous substances may be eliminated from further evaluation when the maximum, or the upper 95 percent confidence limit, soil concentrations found at the site do not exceed EISCs. In addition, at other similar sites, the Washington State Department of Ecology (Ecology) has required that the two following criteria be met before a hazardous substance can be eliminated from further evaluation:

- No single sample concentration shall be greater than two times the EISC; and
- Less than 10 percent of the sample concentrations exceed the EISC.

In order to perform this analysis, EISCs were developed for the default wildlife receptors (i.e., ground-feeding birds, ground-feeding small mammal predators, and herbivorous small mammals) following Ecology's Wildlife Exposure Model for Site-Specific Evaluations (WEM; Table 749-4 of WAC 173-340-900). The WEM identifies the following surrogate species for the wildlife receptors:

- Ground-feeding birds – American Robin (*Turdus migratorius*)
- Ground-feeding small mammal predator – Shrew (*Sorex*)
- Herbivorous small mammals – Vole (*Microtus*)

The EISC calculations for the wildlife receptors are included in Attachment B.

Table 4 summarizes the potential COECs for the Non-Excluded Sites, the maximum measured concentration of each potential COEC in soil, the upper 95 percent confidence limit soil concentrations calculated for each COEC, and the EISCs for all terrestrial ecological receptors that apply to each potential COEC, including the wildlife receptors.

As indicated on Table 4, if the concentration of a potential COEC did not exceed the EISC for any terrestrial ecological receptor using the above criteria, then the potential COEC was eliminated from further evaluation. If the concentration of a potential COEC exceeded the EISC for any terrestrial ecological receptor using the above criteria, then it was considered a final COEC.

For example, the maximum concentration of antimony in soil at the Property did not exceed the EISC for the soil biota receptor, but it did exceed the EISC for the plant and wildlife receptors. Therefore, antimony is considered a final COEC for the Non-Excluded Sites.

As another example, the maximum concentration of nickel in soil at the Property did not exceed the EISCs for the soil biota or wildlife receptors, eliminating those receptors from concern. With respect to the plant receptor, the upper 95 percent confidence level soil concentration for nickel was less than the EISC for the plant receptor, no sample contained nickel at twice the EISC for the plant receptor, and less than 10 percent of the samples contained nickel at concentrations exceeding the EISC for the plant receptor. Therefore, nickel was eliminated from further evaluation and is not considered a final COEC.

Following the above criteria, the following hazardous substances were eliminated from further evaluation:

- Beryllium
- Cadmium
- Nickel
- Silver

The final COECs and their potential receptors at the Non-Excluded Sites are as follows (the surrogate species for wildlife receptors, if applicable, are indicated in parentheses):

- Antimony – Vascular Plants and Wildlife (Shrew)
- Arsenic – Vascular Plants, Soil biota, and Wildlife (Shrew)
- Chromium – Vascular Plants and Soil Biota
- Copper – Vascular Plants and Soil Biota
- Lead – Vascular Plants and Wildlife (Robin)
- Mercury – Vascular Plants and Soil Biota
- Zinc – Vascular Plants

3.0 SITE-SPECIFIC TOXICOLOGICAL STUDY

Based on the Problem Formulation Step discussed in Section 2.0, TEE cleanup levels must be developed to protect terrestrial plants and animals that are exposed to COECs at the Non-Excluded Sites. The TEE cleanup levels may consist of the EISCs available as book values (Table 749-3) or from literature surveys (WAC 173-340-7493(3)(a)) or site-specific values developed following one or more of the methods listed in WAC 173-340-7493(3)(a) through (g).

EISCs available as book values or from literature surveys are “predictive” and may be overly conservative. Accordingly, site-specific TEE cleanup levels were developed for a subset of the final COECs for which the EISCs are either excessively low (stringent) and/or the volume of soil associated with remediation of those soils would be excessive. The COECs and receptors of concern that were addressed through the site-specific toxicological study are as follows:

- Antimony – Wildlife
- Arsenic – Vascular Plants and Wildlife
- Lead – Wildlife

TEE cleanup levels for the remaining COECs consist of the EISCs presented above in Table 3.

3.1 Sampling and Analysis

Laboratory analytical results from previously collected soil samples were used to select the locations from which soil samples were collected for use in the toxicological study. Soil samples were collected from prior sampling locations TP-47 and HSA-1, where the highest concentrations of COECs were detected in soil. In order to confirm the starting concentrations of the COECs in the collected soil, each sample was divided into five subsamples and submitted to the Friedman & Bruya, Inc. laboratory located in Seattle, Washington, for analysis of COECs. The analytical results are summarized in Table 5. Copies of the original laboratory analytical reports for the samples are included in Attachment C.

Upon receiving the analytical data for the samples, a starting concentration for each COEC was derived by calculating a mathematical mean. The concentrations in the samples are presented as box-and-whisker plots in addition to tabular or point/linear estimated mean values. These plots are depicted on charts included in Attachment D. The mean concentrations are summarized on Table 5.

3.2 Soil Bioassay

Arsenic was the only COEC studied for protectiveness of vascular plants. In order to address whether arsenic impacts to soil are protective of vascular plants, arsenic-impacted soil was subjected to bioassay screening, as specified in WAC 173-340-7493(3)(b)(i). In order to confirm the starting concentration of arsenic before the bioassay analysis, sampling and analysis was conducted using the procedures documented in Section 3.1.

Soil samples for bioassay analyses were submitted to AECOM Toxicology of Fort Collins, Colorado (AECOM). The soil bioassay was conducted in accordance with Ecology Publication No. 96-324, *Early Seedling Growth Protocol for Soil Toxicity Screening*. The results of the soil bioassay are included in Attachment E.

For soil biota bioassays, a 0.5 soil dilution was performed prior to performance of each bioassay, which included a total of three dilutions: 100 percent, 50 percent, and 25 percent. The bioassay results indicated that when compared to the control sample, the 100 percent dilution had a statistically significant impact on the germination and biomass of the plants, while the 50 percent and 25 percent dilutions did not show statistically significant impact. Therefore, the 50 percent dilution concentration is considered protective of plants.

As shown in Table 6, the starting concentration for arsenic is 35.2 mg/kg. Therefore, the 50 percent concentration is 17.6 mg/kg. Thus, the site-specific TEE cleanup level for arsenic for protection of plants is 17.6 mg/kg.

3.3 Bioaccumulation Study

Site-specific bioaccumulation factors (BAFs) for wildlife receptors potentially exposed to antimony, arsenic, and lead were developed using the results of a 28-day bioaccumulation study, as allowed by WAC 173-340-7493(3)(c)(i).

The surrogate species for wildlife receptors are the American Robin, Shrew, and Vole; all of which are ground-feeding carnivorous species. As indicated in the WEM (Table 749-4 of WAC 173-340-900), the potential exposure pathway for these wildlife receptors is through consumption of worms living in contaminated soil. Accordingly, red wiggler worms (*Eisenia fetida*) were added to the soil collected for the TEE (Section 3.1) by the laboratory as a part of the bioaccumulation study. The earthworms were grown in contaminated media in accordance with the *Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm* Eisenia Fetida *and the Enchytraeid Potworm* Enchytraeus albidus (ASTM E1676-04 2007). Following the 28-day bioaccumulation incubation period, the earthworms were removed from the soil, placed in chemistry containers, and submitted to Test America of Seattle, Washington, for tissue analysis for the selected COECs.

The results of the 28-day earthworm bioaccumulation study are summarized in the sections below.

3.3.1 Antimony

As shown in Table 6, the starting soil concentration for antimony was 30 mg/kg. The antimony concentration detected in the earthworm sample after the 28-day study was 1 mg/kg. Therefore, the site-specific calculated BAF for antimony is 0.033. Using the BAF of 0.033, the calculated antimony concentrations that are considered protective of mammalian predators is 5 mg/kg. It should be noted that there is no available antimony Toxicity Reference Value for avian predators. Therefore, it is not possible to calculate an antimony TEE cleanup level that is protective of avian predators.

3.3.2 Arsenic

As shown in Table 6, the starting soil concentration for arsenic was 89 mg/kg. The arsenic concentration detected in the earthworm sample after the 28-day study was 13 mg/kg. Therefore, the calculated BAF for arsenic is 0.15. Using the BAF of 0.15, the calculated arsenic concentrations that are considered protective of avian predators and mammalian predators are 60 mg/kg and 49 mg/kg, respectively.

3.3.3 Lead

As shown in Table 6, the starting soil concentration for lead was 64.3 mg/kg. The lead concentration detected in the earthworm sample after the 28-day study was 0.43 mg/kg. Therefore, the calculated BAF for lead is 0.007. Using the BAF of 0.007, the calculated lead concentrations that are considered protective of avian predators and mammalian predators are 508 mg/kg and 3,292 mg/kg, respectively.

4.0 FINAL TEE CLEANUP LEVELS

The final TEE cleanup levels for the Non-Excluded Sites consist of a mix of EISC book values established in Table 749-3, EISC values developed through the literature survey documented in Section 2.4, and the values developed through the site-specific toxicological study documented in Section 3.0.

For each COEC, a TEE cleanup level was generated for each terrestrial ecological receptor of concern. The final TEE cleanup level for the COEC is the most conservative (i.e., lowest) value from the TEE cleanup levels generated for each terrestrial ecological receptor of concern. For example, the TEE cleanup levels for antimony are as follows (source of TEE cleanup level in parenthesis):

- Vascular Plants – 5 mg/kg (Table 749-3)
- Soil Biota – 78 mg/kg (Literature Survey)
- Wildlife – 5 mg/kg (Site-Specific 28-day Bioaccumulation Study)

The most conservative value of these three TEE cleanup levels is 5 mg/kg, which is based on protection of plants and wildlife. Therefore, 5 mg/kg is the TEE cleanup level for antimony.

The following Table 7 summarizes the final TEE cleanup levels for each COEC.

Table 7
Final TEE Cleanup Levels (in mg/kg)

COEC	Plants	Soil Biota	Wildlife	Final TEE Cleanup Level
Antimony	5	78	5[a]	**5**
Arsenic	17.6	60	49[a]	**17.6**
Chromium	42	42	67	**42**
Copper	100	50	217	**50**
Lead	50	500	508[b]	**50**
Mercury	0.3	0.1	5.5	**0.1**
Zinc	86	200	360	**86**

Notes:
Unless indicated by shading, values are from Table 749-3.
Cells shaded gray contain values from the literature survey documented in Section 2.4.
Cells shaded blue contain site-specific values documented in Section 3.0.
a Based on protection of mammalian predators.
b Based on protection of avian predators.

Tables

Table 1
Summary of Analytical Data (in mg/kg)
Revised Site-Specific Terrestrial Ecological Evaluation
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway, Newcastle, Washington

	Sample Name	Approximate Sample Depth	Sample Matrix	Metals[a]										
				Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury[b]	Nickel	Silver	Zinc
Test Pits	TP-9	NA	Brick (composite)	<0.50	5.9	<0.50	<0.50	11	7.2	5.0	<0.020	6.8	<0.50	22
	TP-12	NA	Brick (composite)	<0.50	4.5	<0.50	<0.50	7.5	11	8.3	<0.020	8.1	<0.50	31
	TP-14	5	Brick	<0.50	4.3	<0.50	<0.50	4.0	2.1	<0.50	<0.020	1.4	<0.50	4.8
		11.5	Fill Soil	<0.50	16	0.59	<0.50	7.4	40	10	0.034	16	<0.50	68
		15	Fill Soil	<0.50	2.8	<0.50	<0.50	11	48	3.4	0.023	12	<0.50	36
	TP-19	3.5	Soil	<0.50	3.4	<0.50	<0.50	32	14	4.0	0.027	28	<0.50	32
		6	Native Soil	<0.50	5.9	<0.50	<0.50	39	19	5.9	0.080	32	<0.50	40
	TP-32	NA	Brick composite	<0.50	7.6	0.62	<0.50	98	16	17	<0.020	29	<0.50	28
	TP-35	3	Soil	<0.50	3.1	<0.50	<0.50	24	8.8	6.5	0.032	21	<0.50	29
	TP-37	0.5	Black Fill Soil	0.71	17	0.90	<0.50	17	44	330	3.1	16	<0.50	120
	TP-38	2	Fill (Clay)	<0.50	2.4	1.0	<0.50	18	29	14	0.046	18	<0.50	83
		11	Native Soil	<0.50	2.3	<0.50	<0.50	16	12	4.6	0.026	14	<0.50	97
	TP-43	0.5	Soil	0.78	17	<0.50	0.78	17	23	47	0.070	22	<0.50	83
		2	Soil	<0.50	3.4	<0.50	<0.50	19	12	2.6	<0.020	23	<0.50	35
	TP-44	1.5	Soil	<0.50	6.0	<0.50	<0.50	22	17	86	0.16	28	<0.50	77
		7.5	Soil	<0.50	2.0	<0.50	<0.50	17	9.0	3.2	0.027	21	<0.50	44
	TP-46	2	Tailings, soil, brick	0.60	10	<0.50	<0.50	18	18	23	0.055	22	<0.50	69
		13.5	Native Soil	<0.50	3.7	<0.50	<0.50	20	13	5.5	0.036	24	<0.50	37
	TP-47Tail	NA	Tailings	1.2	34	2.2	<0.50	13	41	31	0.16	13	<0.50	66
	TP100	0-12	Brick (composite)	1.34	4.81	<1	<1	7.10	19.6	12.8	<0.1	12.4	<1	45.3
		12-15	Native Soil	<1	3.59	<1	<1	11.2	7.07	3.98	<0.1	6.54	<1	14.1
	TP101	0-8	Soil	<1	76.0	<1	<1	11.7	10.5	6.92	<0.1	7.58	<1	26.7
		8-15	Soil	<1	2.78	<1	<1	5.39	10.3	2.24	<0.1	7.07	<1	7.98
	TP101-N20	0-8	Soil	1.75	20.8 J	<1	1.20 J	44.8	15.7	11.2	<0.1	26.8	<1 J	57.5
	TP101-N40	0-11	Soil	1.51	13.6	<1	<1	12.8	12.5	11.3	<0.1	10.6	<1	41.4
	TP101-E20	0-4	Soil	<1	12.2	<1	<1	8.42	10.4	9.54	<0.1	14.5	<1	36.3
	TP101-S20	0-4	Soil	2.17	20.1	<1	<1	30.7	19.5	30.6	<0.1	14.2	<1	55.9
		4-8	Soil	2.10	9.43	<1	<1	12.7	12.6	5.45	<0.1	12.6	<1	18.3
	TP101-S40	0-2	Soil	2.85	11.6	<1	<1	13.5	14.6	9.55	<0.1	11.2	<1	34.2
	TP101-W20	0-9	Soil	1.05	11.8	<1	<1	14.8	19.4	12.8	<0.1	13.7	<1	69.8
	TP401	0.5	Tailings	<1 ca	5.80	<1	<1	9.10	21.7	73.4	3.0	8.16	<1 jl	41.4
		3.5	Tailings	<1 ca	1.71	<1	<1	8.68	6.74	2.10	<0.1	10.3	<1 jl	11.8
	TP402	0.25	Tailings	1.22 ca	14.2	<1	<1	10.7	19.0	122	0.28	10.6	3.50 jl	75.3
		0.75	Tailings	<1 ca	3.38	<1	<1	8.48	8.62	2.43	<0.1	13.6	<1 jl	14.4
	TP403	2	Tailings	<1 ca	11.9	<1	<1	5.79	10.1	6.02	0.24	10.2	<1 jl	33.1
		4.5	Tailings	<1 ca	2.78	<1	<1	9.36	10.4	3.96	<0.1	11.3	<1 jl	22.0
	TP404	0.75	Tailings	<1 ca	9.47	<1	<1	10.1	17.5	83.2	0.13	9.86	<1 jl	33.5
		2	Tailings	<1 ca	13.0	<1	<1	8.51	8.16	4.96	<0.1	7.15	<1 jl	30.7
	TP405	1	Tailings	<1 ca	14.4	<1	<1	10.3	11.8	10.2	<0.1	8.85	<1 jl	39.1
		3	Tailings	<1 ca	19.6	<1	<1	9.45	7.65	6.96	<0.1	5.83	<1 jl	22.3
	TP406	1.5	Tailings	<1 ca	8.37	<1	<1	14.1	40.8	487	0.15	10.8	<1 jl	308
		2.5	Tailings	<1 ca	7.72	<1	<1	9.31	5.14	3.60	<0.1	4.04	<1 jl	30.8
	TP407	1	Tailings	<1 ca	12.6	<1	<1	10.0	45.8	207	0.48	6.97	<1 jl	59.9
		2.5	Tailings	<1 ca	4.64	<1	<1	9.33	5.43	3.41	<0.1	7.64	3.07 jl	15.4
	TP408	1	Tailings	<1 ca	8.67	<1	<1	11.1	5.32	8.22	<0.1	6.19	<1 jl	31.8
	TP409	1	Tailings	<1 ca	10.4	2.13 jl	<1	11.9	76.3	81.9	0.21	8.80	1.66 jl	110
		2.5	Tailings	<1 ca	13.4	<1	<1	12.4	5.67	4.80	<0.1	7.59	<1 jl	26.9
	TP413	0.5	Tailings	<1 ca	7.97	<1	<1	9.62	14.8	53.8	0.76	7.00	<1 jl	30.3
		1.5	Tailings	<1 ca	1.47	<1	<1	5.15	<5	1.32	<0.1	6.24	<1 jl	7.59
	TP414	2.5	Tailings	<1 ca	4.81	<1	<1	<5	5.42	2.84	<0.1	4.15	<1 jl	19.0
		5.5	Tailings	<1 ca jl	2.91	<1	<1	9.40	5.16	2.53	<0.1	7.51	<1 jl	17.0
	TP415	0.5	Tailings	1.35 ca j	15.2	<1	<1	9.27	37.1	122	0.37	7.03	<1 jl	81.3
		1.5	Tailings	<1 ca jl	2.09	<1	<1	9.81	8.23	3.65	<0.1	11.4	<1 jl	18.4
	Block-4-Footing-Trench 1	NA	Soil	--	4.10	--	<1	11.3	--	2.99	<1	--	<1	--
	ET-EX-B1	20	Soil	<1	1.19	<1	<1	7.53	9.04	1.74	<0.1	8.68	<1	17.3
	EP-8-EPI	10	Soil	<1	19.1	<1	<1	2.70	6.34	3.81	<0.1	8.59	<1	28.1
	EP-9-EPI	8	Soil	<1	11.1	1.53	<1	2.89	17.9	2.88	0.51	7.95	<1	13.2
Hollow-stem Auger	HSA1	2.5	Tailings	41	230	<0.50	0.67	7.9	300	160	0.080	15	0.56	320
		5	Tailings	<0.50	1.5	0.99	<5.0	7.7	120	5.5	0.066	7.5	<0.50	52
		10	Native Soil	<0.50	18	<0.50	<0.50	21	12	5.1	0.062	13	<0.50	55
		15	Native Soil	<0.50	19	<0.50	<0.50	16	10	5.6	<0.020	15	<0.50	55
		20	Native Soil	<0.50	17	<0.50	<0.50	19	8.7	5.6	<0.020	13	<0.50	61
	HSA-2	5	Tailings	<1.0	<3.1	<1.5	<0.96	20	27	25	0.022	24	<0.98	31
		10	Tailings	<1.2	14	<1.8	<1.2	6.9	20	5.7	0.072	6.8	<1.2	17
		15	Native Soil	<0.50	4.9	<0.50	<0.50	27	9.8	3.8	<0.020	28	<0.50	38
		20	Native Soil	<0.50	13	<0.50	<0.50	8.4	5.2	4.4	<0.020	5.5	<0.50	24
		25	Native Soil	<0.50	20	0.7	<0.50	12	26	10	<0.020	29	<0.50	120
	Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals[d]		Plants	5	10	10	4	42	100	50	0.3	30	2	86
			Soil Biota	--	60	--	20	42	50	500	0.1	200	--	200
			Wildlife	--	7	--	14	67	217	118	5.5	980	--	360

Notes:
All samples analyzed by ALS Environmental in Everett, Washington
All results presented in milligrams/kilogram (mg/kg).
Bold Bold results indicate that the compound was detected.
Shaded results indicate the maximum concentration.
a Analyzed by EPA Method 6020.
b Analyzed by EPA Method 7471 or EPA Method 1631E.
c Upper Ninety-Five Percent Confidence Limit generated using MTCAStat tools
d Ecological Indicator Concentrations for Protection of Plants and Animals - MTCA Table 749-3.
-- Indicates no value available

Qualifiers:
ca The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.
jl The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

Table 4
Summary of Chemicals of Potential Ecological Concern
Revised Terrestrial Ecological Evaluation
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway, Newcastle, Washington

Chemicals of Potential Ecological Concern	Maximum Concentration (mg/kg)	Current UCL[a]	Vasular Plants		Soil Biota		Wildlife Receptors			FINAL COEC
			EIC[b]	Receptor Eliminated[c]	EIC[b]	Receptor Eliminated[c]	EIC[d]	Surrogate Receptor[e]	Receptor Eliminated[c]	
Antimony	41	2	5	No	78[f]	Yes - M	0.27[f]	MP (shrew)	No	**YES**
Arsenic	230	19	10	No	60	No	7	MP (shrew)	No	**YES**
Beryllium	2.2	0.6	10	Yes - M	40[f]	Yes - M	21[f]	MP (shrew)	Yes - M	**NO**
Camium	1.2	0.5	4	Yes - M	20	Yes - M	14	Not Specified	Yes - M	**NO**
Chromium	98	16	42	No	42	No	67	Not Specified	Yes - U	**YES**
Copper	300	25	100	No	50	No	217	Not Specified	Yes - M	**YES**
Lead	330	43	50	No	500	Yes - M	118	AP (robin)	No	**YES**
Mercury	3.1	0.3	0.3	No	0.1	No	5.5	AP (robin)	Yes - M	**YES**
Nickel	32	15	30	Yes - U	200	Yes - M	980	AP (robin)	Yes - M	**NO**
Silver	0.56	0.54	2	Yes - M	3[f]	Yes - M	4.2[f]	MP (shrew)	Yes - M	**NO**
Zinc	320	60	86	No	200	Yes - U	360	MP (shrew)	Yes - U	**YES**

Notes:

a 95 percent upper confidence level (UCL) calculated using MTCA-Stat 97.

b Unless otherwise indicated, Ecological Indicator Soil Concentrations (EIC) for Protection of Terrestrial Pland and Animals (Table 749-3) - mg/kg.

c Receptors eliminated from further TEE according to the following basis:
M - The maximum concentration observed at the facility is less than the EIC for that particular receptor.
U - The upper 95% confidence level soil concentration is less than the EIC for that particular receptor, no sample exceeds twice the EIC, less than 10% of the samples exceed the EIC.
R - Remediation will occur to a depth below the conditional point of compliance (i.e., 6 feet below grade).
HS - 'Hot spot' planned for remediation. After 'hot spot' remediation, remaining site-wide data will comply with the statisical criteria listed in footnote c-U.
HH - Remediation will occur to a remediation level protective of human health, which is below that particular EIC.

PG - The data required for TEE for the applicable potential receptor has been gathered during different phases of TEE sampling and analysis. Data will be summarized in the future TEE Data Report.

d EIC calculated using the Wildlife Exposure Model (WEM) for Site-Specific Evaluations (Table 749-4).

e Surrogate Receptor for the WEM
AP - Avian Predator (American Robin)
MP - Mamallian Predator (Shrew)
MH - Mamallian herbivore (Vole)

f EIC obtained by a literature survey, as documented in Section 2.2.4.

Site-specific toxicological data will be collected in order to determine a site-specific concentration that will be protective of a particular receptor of concern.

Table 5
Summary of TEE Confirmation Sample Analytical Results (in mg/kg)
Revised Terrestrial Ecological Evaluation
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway, Newcastle, Washington

Sample ID	Run Code	Antimony[a]		Arsenic[a]		Lead[a]	
		Concentration	Mean	Concentration	Mean	Concentration	Mean
TP-47-1	A	--	N/A	43.1	35.2	--	N/A
	B	--		31.7		--	
	C	--		30.8		--	
	D	--		37.7		--	
	E	--		32.8		--	
HSA-1	A	39.2	30.0	143	89.0	80.5	64
	B	34.4		116		106	
	C	27.1		44.5		25	
	D	25.3		50.2		26.2	
	E	24		91.3		83.7	

Notes:
All results presented in milligrams/kilogram (mg/kg).
a Analyzed using EPA Method 200.8.
N/A Not applicable.

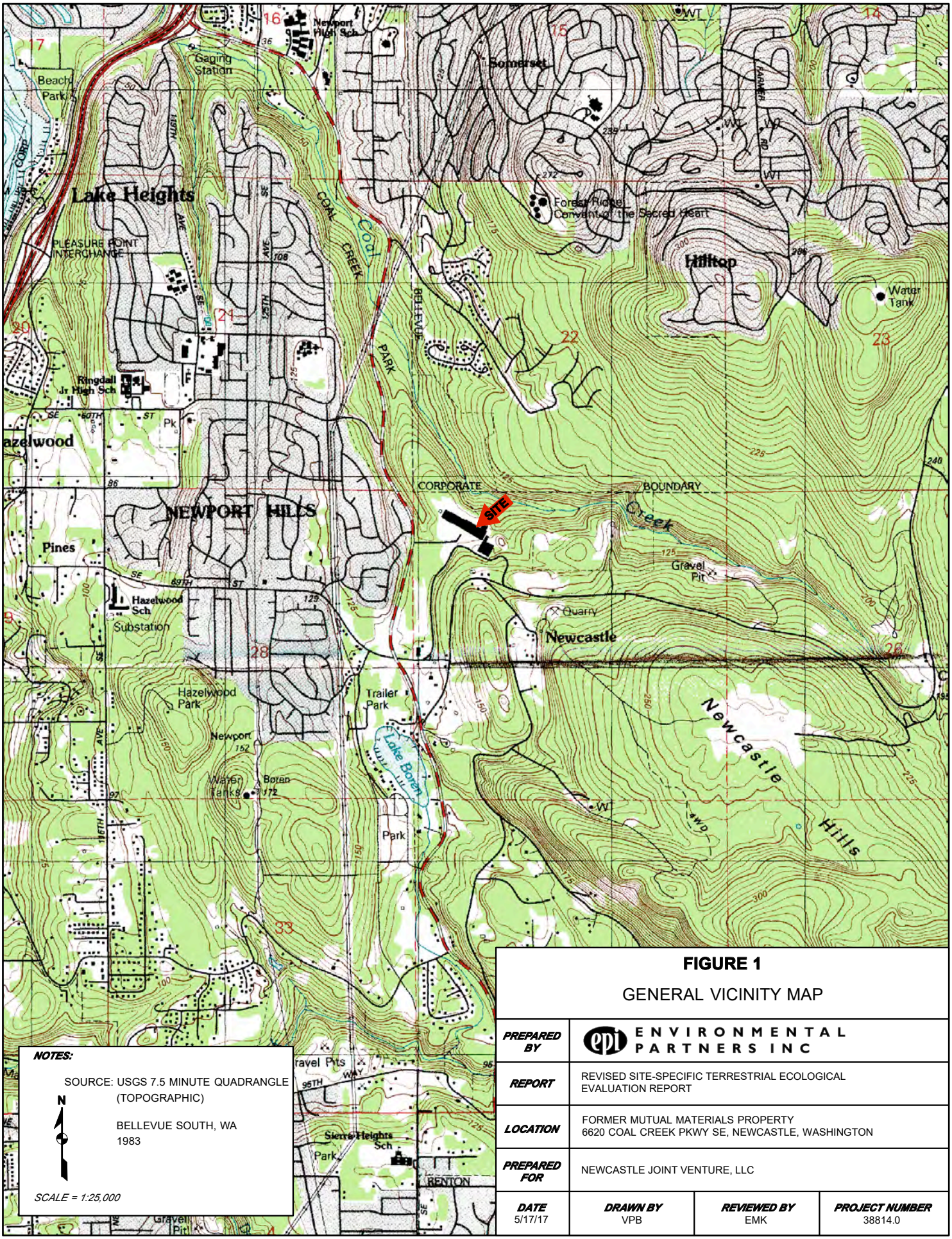
Table 6
TEE Bioassay and Bioaccumulation Test Results Summary
Revised Terrestrial Ecological Evaluation
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway, Newcastle, Washington

Sample	COEC	Soil Dilution	Soil Concentration (mg/kg)	Site-Specific Toxicological Study		
				BAF-28 day		Lettuce-14 day
				Worm Concentration (mg/kg)	BAF	
TP-47-1	Arsenic	100%	35.2	--	--	FAIL
		50%	17.6	--	--	PASS
		25%	8.8	--	--	PASS
HSA-1	Antimony	100%	30	1	0.033	--
	Arsenic	100%	89	13	0.15	--
	Lead	100%	64	0.43	0.007	--

Notes:
All results presented in milligrams/kilogram (mg/kg), unless otherwise indicated.

--	Not applicable.
COEC	Chemical of ccological concern.
BAF	Bioaccumulation factor (determined by dividing worm COEC concentration by soil COEC concentration).

Figures



NOTES:

SOURCE: USGS 7.5 MINUTE QUADRANGLE (TOPOGRAPHIC)

BELLEVUE SOUTH, WA
1983

N

SCALE = 1:25,000

FIGURE 1

GENERAL VICINITY MAP

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	REVISED SITE-SPECIFIC TERRESTRIAL ECOLOGICAL EVALUATION REPORT		
LOCATION	FORMER MUTUAL MATERIALS PROPERTY 6620 COAL CREEK PKWY SE, NEWCASTLE, WASHINGTON		
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC		
DATE 5/17/17	***DRAWN BY*** VPB	***REVIEWED BY*** EMK	***PROJECT NUMBER*** 38814.0

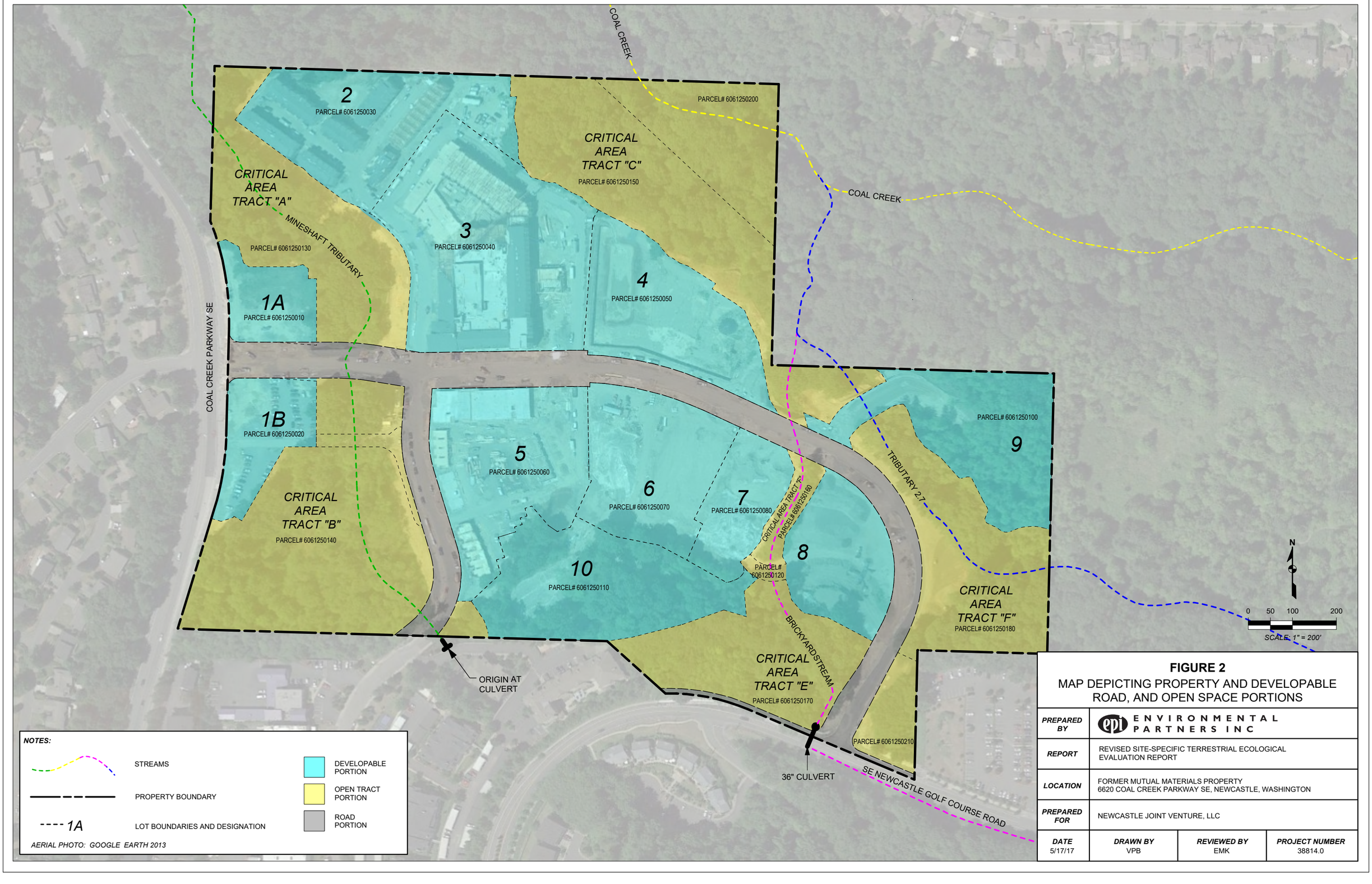


FIGURE 2

MAP DEPICTING PROPERTY AND DEVELOPABLE ROAD, AND OPEN SPACE PORTIONS

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	REVISED SITE-SPECIFIC TERRESTRIAL ECOLOGICAL EVALUATION REPORT		
LOCATION	FORMER MUTUAL MATERIALS PROPERTY 6620 COAL CREEK PARKWAY SE, NEWCASTLE, WASHINGTON		
PREPARED FOR	NEWCASTLE JOINT VENTURE, LLC		
DATE 5/17/17	**DRAWN BY** VPB	**REVIEWED BY** EMK	**PROJECT NUMBER** 38814.0

Attachment A
Literature Survey Documents

Ecological Soil Screening Levels for Antimony

Interim Final

OSWER Directive 9285.7-61

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

February 2005

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR ANTIMONY 1

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 3

4.0 ECO-SSL FOR SOIL INVERTEBRATES 3

5.0 ECO-SSL FOR AVIAN WILDLIFE 3

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 5
- 6.1 Mammalian TRV 5
- 6.2 Estimation of Dose and Calculation of the Eco-SSL 5

7.0 REFERENCES 9
- 7.1 General Antimony References 9
- 7.2 References for Plants and Soil Invertebrates 9
- 7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs . . 9
- 7.4 References Used for Deriving Wildlife TRV 10
- 7.5 References Rejected for Use in Derivation of Wildlife TRV 11

LIST OF TABLES

Table 2.1 Antimony Eco-SSLs (mg/kg dry weight in soil) 2

Table 4.1 Soil Invertebrate Toxicity Data - Antimony 4

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Antimony 6

Table 6.2 Calculation of the Mammalian Eco-SSL for Antimony 8

LIST OF FIGURES

Figure 2.1 Typical Background Concentrations of Antimony in U.S. Soils 2

Figure 6.1 Mammalian TRV Derivation for Antimony 7

LIST OF APPENDICES

Appendix 6-1 Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Antimony

1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (U.S. EPA, 2003). The derivation procedures represent the collaborative effort of a multi-stakeholder team consisting of federal, state, consulting, industry, and academic participants led by the U.S. EPA Office of Solid Waste and Emergency Response.

This document provides the Eco-SSL values for antimony and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying antimony concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR ANTIMONY

Antimony (Sb, stibium) is a semi-metallic element that belongs to group (VA) of the periodic table and shares some chemical properties with lead, arsenic, and bismuth (U.S. EPA, 1992). In nature, antimony is associated with sulfur as stibnite. Antimony also occurs in ores with arsenic, and the two metals share similar chemical and physical properties. Antimony is a common component of lead and copper alloys and is used in the manufacturing of ceramics, textiles,

paints, explosives, batteries, and semiconductors. Major sources of environmental contamination are smelters, coal combustion, and incineration of waste and sewage sludge. In the past, antimony compounds have been used therapeutically as an anti-helminthic and anti-protozoic treatment. This practice has been largely discontinued as a result of antimony toxicity.

Antimony exists in valences of 0, -3, +3, +5. The tri- and pentavalent forms are the most stable forms of antimony (U.S. EPA, 1992) and are of the most interest in biological systems. The toxicokinetics and toxicity of the tri- and pentavalent forms vary, with the trivalent form considered to be more toxic.

Ingested antimony is absorbed slowly, and many antimony compounds are reported to be gastrointestinal irritants. Trivalent antimony is absorbed more slowly than the pentavalent form. Approximately 15-39% of trivalent antimony is reported to be absorbed in the gastrointestinal tract of animals (Rossi et al., 1987). The toxic effects of antimony in mammals involve cardiovascular changes. Observed changes include degeneration of the myocardium, arterial hypotension, heart dysfunction, arrhythmia, and altered electrocardiogram patterns (Rossi et al. 1987). The mode of action for antimony-induced cardiotoxicity is unknown.

The Eco-SSL values derived to date for antimony are summarized in Table 2.1.

Table 2.1 Antimony Eco-SSLs (mg/kg dry weight in soil)

Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
NA	78	NA	0.27

NA = Not Available. Data were insufficient to derive an Eco-SSL.

Eco-SSL values for antimony were derived for soil invertebrates and mammalian wildlife. Eco-SSL values for antimony could not be derived for plants or avian wildlife. For these receptor groups, data were insufficient to derive soil screening values.

The Eco-SSL value for mammals at 0.27 mg/kg dry weight (dw) is less than the range of reported typical background concentrations in U.S. soils (Figure 2.1).

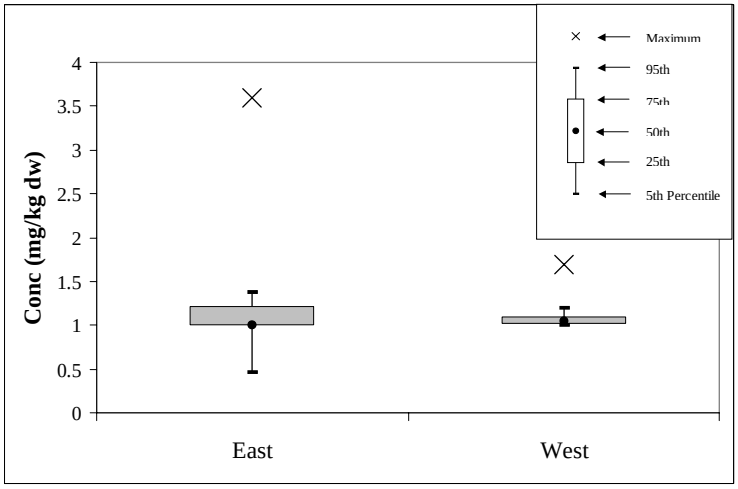


Figure 2.1 Typical Background Concentrations of Antimony in U.S. Soils

The soil invertebrate Eco-SSL at 78 mg/kg dw is well above the reported range of background concentrations for both eastern and western U.S. soils. The reported background concentrations of many metals in the U.S. soils are described in Attachment 1-4 of the Eco-SSL guidance (U.S. EPA, 2003).

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 12 were selected for acquisition for further review. Of those papers acquired, one paper met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). Studies in this paper were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). There were no studies with an Evaluation Score greater than ten. Thus, an Eco-SSL for plants for antimony could not be derived.

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, seven were selected for acquisition for further review. Of those papers acquired, three papers met all 11 Study Acceptance Criteria. These papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2). Three studies received an Evaluation Score greater than ten. The data for these studies are listed in Table 4.1.

The studies in Table 4.1 are sorted by bioavailability score and all study results with a bioavailability score of one or two were used to derive the soil invertebrate Eco-SSL for antimony. Three studies are used to derive the soil invertebrate Eco-SSL according to the Eco-SSL guidance (U.S. EPA, 2003). The Eco-SSL is the geometric mean of the EC_{20} values reported for each of three test species under similar test conditions (pH and % organic matter (OM)) and is equal to 78 mg/kg dw.

5.0 ECO-SSL FOR AVIAN WILDLIFE

The derivation of the Eco-SSL for avian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

The literature search completed according to guidance for Eco-SSLs (U.S. EPA, 2003; Attachment 4-2) identified some studies concerning antimony and avian species but all were rejected for use in deriving a wildlife TRV as described in Section 7.5. An avian TRV for antimony could not be derived therefore an Eco-SSL for avian wildlife for antimony was not calculated.

Table 4.1 Soil Invertebrate Toxicity Data - Antimony

Reference	Test Organism		Soil pH	OM %	Bio-availability Score	ERE	Tox Parameter	Tox Value Soil Conc. (mg/kg dw)	Total Eval. Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Kuperman et al., 2002	Enchytraeid	*Enchytraeus crypticus*	4.08 - 5.29	1.2	2	REP	EC_{20}	194	16	Y	Y
Phillips et al., 2002	Springtail	*Folsomia candida*	4.57 - 5.29	1.2	2	REP	EC_{20}	81	17	Y	Y
Simini et al., 2002	Earthworm	*Eisenia fetida*	4.39 - 5.29	1.2	2	REP	EC_{20}	30	15	Y	Y
							Geometric Mean	78			

EC_{20} = Effective concentration to 20% of the test population
ERE = Ecologically relevant endpoint
OM = Organic matter content
REP = Reproduction
Y= Yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First, the TRV was derived according to the guidance for Eco-SSLs (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the exposure model and the TRV.

6.1 Mammalian TRV

The literature search completed according to the guidance for Eco-SSLs (U.S. EPA, 2003; Attachment 4-1) identified 69 papers with possible toxicity data for antimony for either avian or mammalian species. Of these papers, 58 were rejected for use as described in Section 7.5. The remaining 11 papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 6.1. The complete results are provided in Appendix 6-1.

Within the 11 papers, there are 31 results for biochemical (BIO), behavioral (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints with a Data Evaluation Score >65 that can be used to derive the TRV (U.S. EPA, 2003; Attachment 4-4). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The no-observed adverse effect level (NOAEL) results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for growth and reproduction was calculated at 13.3 mg antimony/kg bw/day. However, this value is higher than the lowest bounded LOAEL for effects on reproduction, growth, or survival. Therefore, the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL and is equal to 0.059 mg antimony/kg bw/day.

6.2 Estimation of Dose and Calculation of the Eco-SSL

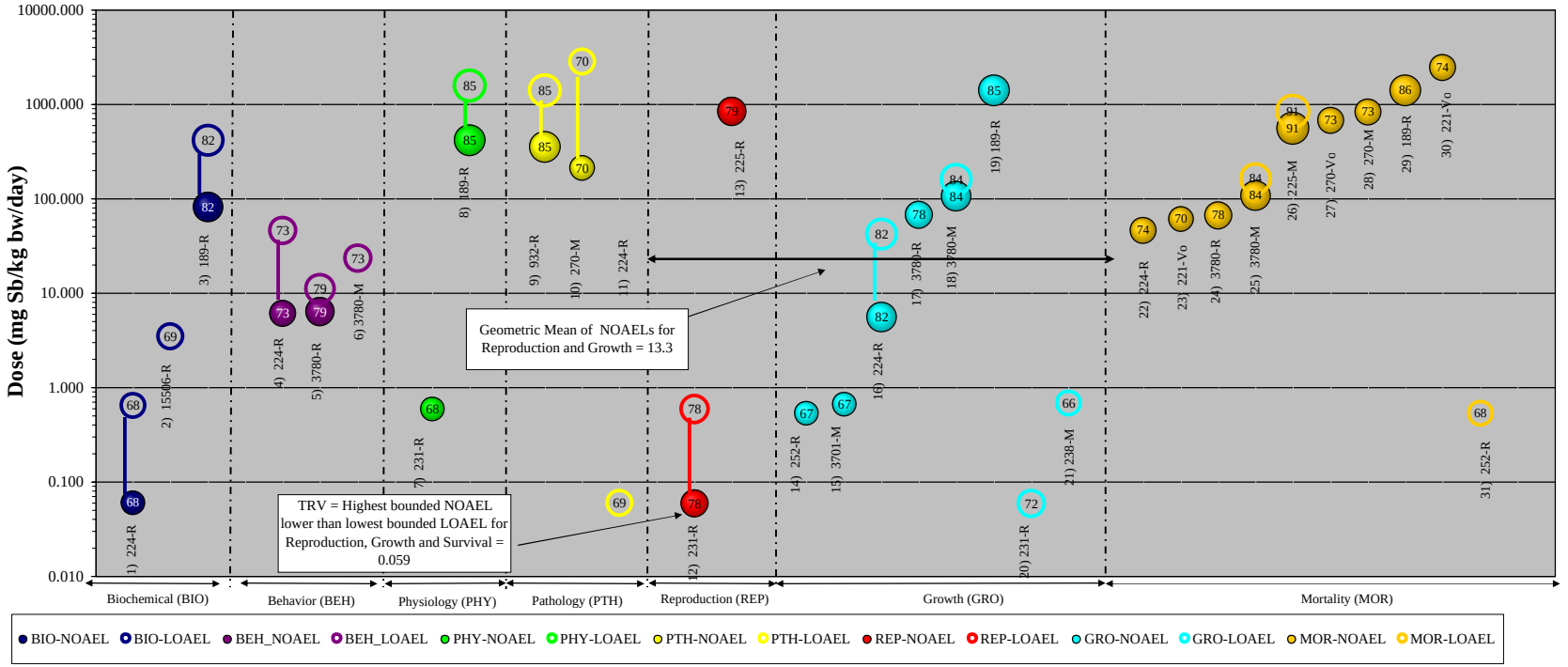
Three separate Eco-SSL values were calculated for mammalian wildlife, one each for three surrogate species representing different trophic groups. The mammalian Eco-SSLs derived for antimony are calculated according to the Eco-SSL guidance (U.S. EPA 2003) and are summarized in Table 6.2.

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Antimony

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	General Effect Group	Effect Measure	Response Site	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Evaluation Score
Biochemical																		
1	Poon et al., 1998	224	Rat (*Rattus norvegicus*)	5	UX	DR	13	w	NR	NR	JV	F	BIO	GLUC	WO	0.060	0.640	68
2	Shroeder, 1968	15506	Rat *(Rattus norvegicus)*	2	U	DR	767	d	21	d	JV	B	BIO	CHOL	SR		3.50	69
3	Hext et al., 1999	189	Rat (*Rattus norvegicus*)	4	UX	FD	90	d	NR	NR	AD	F	BIO	ALPH	BL	81.0	413	82
Behavior																		
4	Poon et al., 1998	224	Rat (*Rattus norvegicus*)	5	UX	DR	13	w	NR	NR	JV	F	BEH	WCON	WO	6.10	46.0	73
5	Dieter, 1992	3780	Rat (*Rattus norvegicus*)	6	U	DR	14	d	8	w	NR	F	BEH	WCON	WO	6.35	11.1	79
6	Dieter, 1992	3780	Mouse (*Mus musculus*)	6	U	DR	14	d	8	w	NR	B	BEH	WCON	WO		23.4	73
Physiology																		
7	Rossi et al., 1987	231	Rat (*Rattus norvegicus*)	3	U	DR	38	d	NR	NR	GE	F	PHY	BLPR	WO	0.592		68
8	Hext et al., 1999	189	Rat (*Rattus norvegicus*)	4	UX	FD	90	d	NR	NR	AD	F	PHY	EXCR	WO	413	1570	85
Pathology																		
9	Hext et al., 1999	189	Rat (*Rattus norvegicus*)	4	UX	FD	90	d	NR	NR	AD	M	PTH	ORWT	LI	352	1410	85
10	Ainsworth et al., 1991	270	Mouse *(Mus musculus)*	3	U	FD	18	d	NR	NR	NR	NR	PTH	ORWT	KI	211	2820	70
11	Poon et al., 1998	224	Rat (*Rattus norvegicus*)	5	UX	DR	13	w	NR	NR	JV	F	PTH	GHIS	WO		0.0600	69
Reproduction																		
12	Rossi et al., 1987	231	Rat (*Rattus norvegicus*)	3	U	DR	31	d	NR	NR	GE	F	REP	PRWT	WO	0.0590	0.590	78
13	Gurnani et al., 1993	225	Mouse (*Mus musculus*)	4	U	GV	14	d	8	w	JV	M	REP	SPCV	WO	835		79
Growth																		
14	Shroeder etal., 1970	252	Rat *(Rattus norvegicus)*	2	U	DR	725	d	21	d	JV	M	GRO	BDWT	WO	0.533		67
15	Kanisawa and Shroeder, 1969	3701	Mouse (*Mus musculus*)	2	U	DR	519	d	21	d	JV	B	GRO	BDWT	WO	0.664		67
16	Poon et al., 1998	224	Rat (*Rattus norvegicus*)	5	UX	DR	13	w	7	w	JV	M	GRO	BDWT	WO	5.60	42.0	82
17	Dieter, 1992	3780	Rat (*Rattus norvegicus*)	6	U	DR	14	d	8	w	JV	B	GRO	BDWT	WO	67.0		78
18	Dieter, 1992	3780	Mouse (*Mus musculus*)	6	U	DR	14	d	8	w	JV	F	GRO	BDWT	WO	106	161	84
19	Hext et al., 1999	189	Rat (*Rattus norvegicus*)	4	UX	FD	90	d	NR	NR	AD	M	GRO	BDWT	WO	1410		85
20	Rossi et al., 1987	231	Rat (*Rattus norvegicus*)	3	U	DR	20	d	NR	NR	GE	F	GRO	BDWT	WO		0.0590	72
21	Shroeder et al., 1968	238	Mouse *(Mus musculus)*	2	U	DR	339	d	21	d	JV	F	GRO	BDWT	WO		0.678	66
Survival																		
22	Poon et al., 1998	224	Rat (*Rattus norvegicus*)	5	UX	DR	13	w	NR	NR	IM	F	MOR	MORT	WO	46.0		74
23	Ainsworth et al., 1991	221	Short-tailed vole (*Microtus agrestis*	2	U	FD	60	d	35	d	NR	M	MOR	MORT	WO	60.9		70
24	Dieter, 1992	3780	Rat (*Rattus norvegicus*)	6	U	DR	14	d	8	w	JV	B	MOR	SURV	WO	66.6		78
25	Dieter, 1992	3780	Mouse (*Mus musculus*)	6	U	DR	14	d	8	w	JV	M	MOR	MORT	WO	108	161	84
26	Gurnani et al., 1993	225	Mouse (*Mus musculus*)	4	U	GV	21	d	8	w	JV	M	MOR	MORT	WO	557	835	91
27	Ainsworth et al., 1991	270	Short-tailed vole (*Microtus agrestis*	3	U	FD	21	d	NR	NR	NR	NR	MOR	MORT	WO	673		73
28	Ainsworth et al., 1991	270	Mouse *(Mus musculus)*	3	U	FD	18	d	NR	NR	NR	NR	MOR	MORT	WO	826		73
29	Hext et al., 1999	189	Rat (*Rattus norvegicus*)	4	UX	FD	90	d	NR	NR	AD	M	MOR	MORT	WO	1408		86
30	Ainsworth et al., 1991	221	Short-tailed vole (*Microtus agrestis*	3	U	FD	12	d	35	d	NR	M	MOR	MORT	WO	2440		74
31	Shroeder etal., 1970	252	Rat (*Rattus norvegicus*)	2	U	DR	784	d	21	d	JV	F	MOR	TDTH	WO		0.533	68

ALPH = alkaline phosphatase; AD = adult; B = both; BDWT = body weight changes; BEH = behavior; BIO = biochemical; BL = blood; BLPR = blood pressure; CHOL = cholesterol; d = days; DR = drinking water; EXCR = excretion; F=female; FD = food; FDB = feeding behavior; GE = gestational; GHIS = general histology; GLUC = glucose; GRO = Growth; GV=gavage; HYPL = hyperplasia; IM = immature; JV=juvenile; KI = kidney; kg = kilogram; lf = lifetime; LI = liver; l = liter; LOAEL = lowest-observed adverse effect level; M = measured; M=male; mg = milligram; MOR = mortality; MORT = mortality; N = no; NOAEL = no-observed adverse effect level; NR = not reported; ORWT = organ weight; PHY = physiology; PRWT = progeny weight; PTH = pathology; REP = reproduction; Score = Total Data Evaluation Score as described in US EPA (2003; Attachment 4-3); SPCV= sperm cell count; SR = serum; SURV = survival; TDTH = time to death; Y = yes; U = unmeasured; UX = reported as measured but data not provided; w = weeks; WCON = water consumption; WO = whole organism.

Figure 6.1 Mammalian TRV Derivation for Antimony

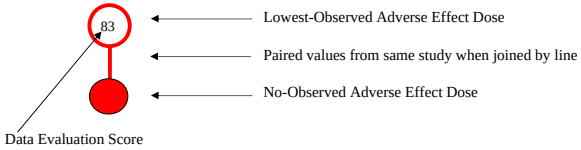


Result number → 1) 10 - C ← Test Species

Reference Number

Test Species Key

Vo = Short-tailed field vole
M = Mouse
R = Rat



Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are at least three NOAEL results available for calculation of a geometric mean.
3) The geometric mean of the NOAEL values for growth and reproductive effects equals 13.3 mg antimony/kg BW/day but is higher than the lowest bounded LOAEL for reproduction, growth, or mortality effects.
4) The mammalian wildlife TRV for antimony is equal to 0.059 mg antimony/kg BW/day which is the highest bounded NOAEL below the lowest bounded LOAEL for effects on reproduction, growth or survival.

Table 6.2 Calculation of the Mammalian Eco-SSL for Antimony						
Surrogate Receptor Group	**TRV for Antimony (mg dw/kg bw/d) [1]**	**Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)[2]**	**Concentration of Antimony in Biota Type (i)[2,3] (B_i) (mg/kg dw)**	**Antimony in Diet of Prey [4] (C_{diet})**	**Eco-SSL (mg/kg dw)[5]**
Mammalian herbivore (vole)	0.059	0.0875	0.032	$\ln(B_i) = 0.938 * \ln(Soil_j) - 3.233$ where i = plants	NA	10
Mammalian ground insectivore (shrew)	0.059	0.209	0.030	$B_i = Soil_j * 1.0$ where i = earthworms	NA	0.27
Mammalian carnivore (weasel)	0.059	0.130	0.043	$B_i = C_{diet} * 0.05$ where i = mammals	$C_{diet} = 1 * Soil_j$	4.9

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] C_{diet} = Concentration in the diet of small mammals consumed by predatory species (weasel).
[5] $HQ = FIR * (Soil_j * P_s + B_i) / TRV$ solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

7.0 REFERENCES

7.1 General Antimony References

Rossi, F., R. Acampora, C. Vacca, S. Maione, M. G. Matera, R. Servodio, and E. Marmo. 1987. Prenatal and postnatal antimony exposure in rats: effect on vasomotor reactivity development of pups. *Teratog. Carcinog. Mutagen.* 7(5): 491-496.

United States Environmental Protection Agency (U.S. EPA). 2003. *Guidance for Developing Ecological Soil Screening Levels*. November. Office of Solid Waste and Emergency and Remedial Response. OSWER Directive 9285.7-55.

United States Environmental Protection Agency (U.S. EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-28.P.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment*. Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

United States Environmental Protection Agency (U.S. EPA). 1992. *Drinking Water Criteria Document for Antimony.* Final. Office of Science and Technology, Office of Water, Washingtone, D.C., EPA /920/5-00372

7.2 References Used for Derivation of Plant and Soil Invertebrate Eco-SSLs

Kuperman, R.G., Checkai, R.T., Phillips, C.T., Simini, M., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Enchytraeid Reproduction Benchmark Values*. Technical Report No. ECBC-TR-324. U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

Phillips, C.T., Checkai, R.T., Kuperman, R.G., Simini, M., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Folsomia Reproduction Benchmark Values.* Technical Report No. ECBC-TR-326. U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

Simini, M., Checkai, R.T., Kuperman, R.G., Phillips, C.T., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Earthworm (Eisenia fetida) Benchmark Values.* Technical Report No. ECBC-TR-325. U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

7.3 References Rejected for Use in Derivation of Plant and Soil Invertebrate Eco-SSLs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

No Dur Ainsworth, N., Cooke, J. A., and Johnson, M. S. 1991. Biological significance of antimony in contaminated grassland. *Water Air Soil Pollut.* 57-58[0], 193-200

No Dose / ERE Cataldo, D. A. and Wildung, R. E. 1978. Soil and Plant Factors Influencing the Accumulation of Heavy Metals by Plants. *Environ.Health Perspect.* 27: 149-159.

Species Crecelius, E. A., Johnson, C. J., and Hofer, G. C. 1974. Contamination of soils Near a Copper Smelter by Arsenic, Antimony, and Lead. *Water Air Soil Pollut.* 3: 337-342.

FL Fuzailov, I. U. M. and Khamidov, A. Kh. 1983. <Translated> wild growing drug plants of the fergana valley, concentrators of antimony. *Uzbekskii Biologicheskii Zhurnal*. [6], 28-30.

FL Fuzailov, Yu and Khamidov, A. Kh. 1983. Antimony absorption by plants under extreme conditions. *Uzb.Biol.Zh.* [5], 25-26

No Dur Ghuman, G. S., Motes, B. G., Fernandez, S. J., Weesner, F. J., and McManus, G. J. Deposition And Resuspension Of Antimony-125 And Cesium-137 In The Soil-Plant System In The Environment Of A Nuclear Fuel Reprocessing Plant. Govt-Reports-Announcements-&-Index-(GRA&I),-Issue-02,-1993

Media Hara, T., Sonoda, Y., and Iwai, I. 1977. Growth Response of Cabbage Plants to Arsenic and Antimony Under Water Culture Conditions. *Soil Sci.Plant Nutr*. 23[2]: 253-256.

Score He, M. and Yang, J. 1999. Effects of Different Forms of Antimony on Rice During the Period of Germination and Growth and Antimony Concentration in Rice Tissue. *Sci.Total Environ.* 243/244: 149-155.

Not Avail Mulder, D. E., Cardinaals, J. M., Mak, J. K., and Van Knippenberg, J. A. J. 1986. Review of Literature Data on Antimony and Some Anorganic Antimony Compounds 38916. NOTOX Toxicol.Res.& Consultancy's Hertogenbosch, and DHV Consulting Eng.B.V., Amersfoort

FL Piret, T. 1980. Antimony in the Environment. *Ann.Gembloux*. 86[1]: 53-60.

FL Rafel, Yu and Popov, Yu. 1988. Validation of Maximum Allowable Concentrations of Antimony in Soil. *Gigiena i Sanitariya* 1: 63-64.

Rev Slooff, W., Pont, P. F. H., Hesse, J. H., and Loos, B. 1992. Exploratory Report Antimony and Antimony Compounds. RIVM Rep.No.710401 020, The Netherlands , 40

FL Zyrin, N. G., Kovnatskii, E. F., Roslyakov, N. P., Ryakhovskii, A. V., and Samonov, A. M. 1985. Determination of Arsenic and Antimony in Plants. *Yad.-Fiz.Metody Anal.Kontrole Okruzh.Sredy, Tr.Vses.Soveshch*. 228-231.

7.4 References Used for Derivation of Wildlife TRVs

Ainsworth, N., Cooke, J. A., and Johnson, M. S. 1991. Behavior and toxicity of antimony in the short-tailed field vole (*Microtus agrestis*). *Ecotoxicol. Environ. Saf.* 21(2):165-170. Ref #221

Ainsworth, N., Cooke, J. A., and Johnson, M. S. 1991. Biological significance of antimony in contaminated grassland. *Water Air Soil Pollut.* 57-58:193-197. Ref #270

Dieter, M. P., Jameson, C. W., Elwell, M. R., Lodge, J. W., Hejtmancik, M., Grumbein, S. L., Ryan, M., and Peters, A. C. 1991. Comparative toxicity and tissue distribution of antimony potassium tartrate in rats and mice dosed by drinking water or intraperitoneal injection. *J Toxicol Environ Health* 34(1):51-82. Ref # 226

Gurnani, N., Sharma, A., and Talukder, G. 1993. Comparison of clastogenic effects of antimony and bismuth as trioxides on mice in vivo. *Biol Trace Elem Res*. 37(2-3):281-292. Ref #225

Dieter, M. P. 1992. NTP report on the toxicity studies of antimony potassium tartrate in F344/N rats and B6C3F1 mice (drinking water and intraperitoneal injection studies). NIH Publication No. 92-3130. Ref #3780

Hext, P. M., Pinto, P. J., and B.A. Rimmel. 1999. Subchronic feeding study of antimony trioxide in rats. *J.Appl.Toxicol*. 19(3):205-209. Ref #189

Kanisawa, M. and Schroeder, H. A. 1969. Life term studies on the effect of trace elements on spontaneous tumors in mice and rats. *Cancer Res*. 29(4):892-895. Ref #3701

Poon, R., Chu, I., Lecavalier, P., Valli, V. E., Foster, W., Gupta, S., and Thomas, B. 1998. Effects of antimony on rats following 90-day exposure via drinking water. *Food Chem Toxicol* 36(1):21-35. Ref #224

Rossi, F., Acampora, R., Vacca, C., Maione, S., Matera, M. G., Servodio, R., and Marmo, E. 1987. Prenatal and postnatal antimony exposure in rats: effect on vasomotor reactivity development of pups. *Teratog Carcinog Mutagen.* 7(5):491-496. Ref #231

Schroeder, H. A., Mitchener, M., and Nason, A. P. 1970. Zirconium, niobium, antimony, vanadium and lead in rats: life term studies. *J Nutr*. 100(1): 59-68. Ref #252

Schroeder, H. A. 1969. Serum cholesterol levels in rats fed thirteen trace elements. *J. Nutr.* 94(4): 475-80. Ref #15506

Schroeder, H. A., Mitchener, M., Balassa, J. J., Kanisawa, M., and Nason, A. P. 1968. Zirconium, niobium, antimony and fluorine in mice: effects on growth, survival and tissue levels. *J Nutr*. 95(1): 95-101. Ref #238

7.5 References Rejected for Use in Derivation of Wildlife TRVs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Drug Abdel-Wahab, M. F., Abdulla, W. A., Nasr, A., El-Garhi, M. Z., and Kamel, S. 1974. On the synthesis and fate of a new labelled antibilharzial drug (Bilharcid- 124Sb). *Egypt J Bilharz*. 1(1): 91-100.

Diss Ainsworth, N. 1988. Distribution and biological effects of antimony in contaminated grasslands.:325. Council for National Academic Awards (United Kingdom).

Bio Acc Ainsworth, N., Cooke, J. A., and Johnson, M. S. 1990. Distribution of antimony in contaminated grassland. 2. Small mammals and invertebrates. *Environ. Pollut.* 65(1): 79-87.

No Oral al Khawajah, A., Larbi, E. B., Jain, S., al-Gindan, Y., and Abahussain, A. 1992. Subacute toxicity of pentavalent antimony compounds in rats. *Hum Exp Toxicol.* 11(4): 283-288.

Unrel Alpert, N. R. and Mulieri, L. A. 1986. Determinants of energy utilization in the activated myocardium. *Fed Proc*. 45 (11): 2597-600.

No Oral Anonymous. 1994. Antimon-v-oxid Toxikologische Bewertung. Berufsgenossenschaft der chemischen Industrie 236:11.

Rev ATSDR. 1992. *Toxicological Profile for Antimony*. Syracuse Research Corp.

Oral Baetjer, A. M. 1969. Effects of dehydration and environmental temperature on antimony toxicity. *Arch. Environ. Health*. 19(6): 784-792.

Unrel Bai, K. M. and Majumdar, S. K. 1984. Enhancement of mammalian safety by incorporation of antimony potassium tartrate in zinc phosphide baits *Pesticides (Bombay)*. 18(9): 34-37.

Organic metal Bomhard, E., Loser, E., Dornemann, A., and Schilde, B. 1982. Subchronic oral toxicity and analytical studies on nickel rutile yellow and chrome rutile yellow with rats. *Toxicol Lett.* 14(3-4): 189-94.

No Oral Bradley, W. R. and Fredrick, W. G. 1941. Toxicity of antimony-animal studies. *Ind. Med*. 2:15.

Unrel Cohen, R. J., Sachs, J. R., Wicker, D. J., and Conrad, M. E. 1968. Methemoglobinemia provoked by malarial chemoprophylaxis in Vietnam. *N Engl J Med.* 279(21): 1127-31.

Lead Shot Damron, B. L. and Wilson, H. R. 1975. Lead toxicity of bobwhite quail. *Bull Environ Contam Toxicol*. 14(4): 489-9.

No Oral Dieter, M. P. 1993. Ntp report on the toxicity studies of antimony potassium tartrate (cas no. 28300-74-5) in f344/n rats and b6c3f1 mice (drinking water and intraperitoneal injection studies). Govt Reports Announcements & Index (GRA&I)(9)

Dup Dieter, M. P. 1992. NTP report on the toxicity studies of antimony potassium tartrate in F344/N rats and B6C3F1 mice (drinking water and intraperitoneal injection studies). National Toxicology Program. NIH Publication No. 92-3130.

FL Erusalimskii, E. I. 1973. Effect of antimony trioxide and urethane on the weight and peripheral blood of mice *Vopr. Klin. Eksp. Onkol.* 9: 214-19.

FL Filippelli, A., Marrazzo, R., Angrisani, M., Filippelli, W., and Rossi, F. 1992. Vasomotor reactivity in rats exposed pre- and postnatally to toxic agents and drugs. Sibirskii Biologicheskii Zhurna. 32-44.

Unrel Gavett, A. P. and Wakeley, J. S. 1986. Diets of house sparrows in urban and rural habitats. *Wilson Bull.*

Rev Gebel, T. 1997. Arsenic and antimony: comparative approach on mechanistic toxicology. *Chem.Biol.Interact.* 107(3):131-144.

Mix Gerber, G. B., Maes, J., and Eykens, B. 1982. Transfer of antimony and arsenic to the developing organism. *Arch Toxicol*. 49(2):159-68.

No Oral Ghaleb, H. A., Shoeb, H. A., el-Gawhary, N., el-Borolossy, A. W., el-Halawany, S. A., and Madkour, M. k. 1979. Acute toxicity studies of some new organic trivalent antimonials. *J Egypt Med Assoc.* 62(1-2): 45-62.

Mix Goncharenko, L. E. and Kozyreva, O. I. 1970. Results of a histological study of the brain of rabbits poisoned with antimonous hydride and treated with unithiol. *Farmakol. Toksikol. (Kiev)* 5: 173-8.

No Oral Goodwin, L. G. 1944. The toxicity and trypanocidal activity of some organic antimonials. *J. Pharmacol*. 81:224.

FL Grin', N. V., Bessmertnyi, A. N., Govorunova, N. N., Besedina, E. I., and Galeta, S. G. 1989. [Substantiation of maximum permissible levels of antimony trioxide and pentasulide in the atmospheric air of inhabitated places]: <Original> Obosnovanie predel'no dopustimoi kontsentratsii trekhokisi i piatisernistoi sur'my v atmosfernom vozdukhe naselennykh mest. *Gig Sanit*. (4): 68-9.

FL Grin, N. V., Govorunova, N. N., Bessemrnyi, A. N., and Pavlovich, L. V. 1987. A study of the embryotoxic action of antimony oxide in an experiment *Gig Sanit*; 10: 85-86.

FL Grin, N. V., Govorunova, N. N., Bessmertny, A. N., and Pavlovich, L. V. 1987. Experimental study of embryotoxic effect of antimony oxide *Gig Sanit.* 10: 85-86.

No oral Groth, D. H., Stettler, L. E., and Burg, J. R. 1986. Carcinogenic effects of antimony trioxide and antimony ore concentrate in rats *J Toxicol Environ Health*. 18: 607-626.

Gene Gurnani, N., Sharma, A., and Talukder, G. 1994. Comparison of the clastogenic effects of antimony trioxide on mice in vivo following acute and chronic exposure. *Biometals*. 5(1): 47-50.

Drug Hashash, M., Serafy, A., and State, F. 1981. Histopathological Cochlear Changes Induced by Antimonial Antibilharzial Drugs. *J Laryngol Otol.*

Bio Acc Henny, C. J., Blus, L. J., Thompson, S. P., and Wilson, U. W. 1989. Environmental contaminants, human disturbance and nesting of double-crested cormorants in northwestern Washington (USA). *Colon Waterbirds*. 12(2): 198-206.

FL Hiraoka, Norio. 1986. The toxicity and organ distribution of antimony after chronic administration to rats. *Kyoto-furitsu Ika Daigaku Zasshi*. 95(8): 997-1017.

No Oral Hoshishima, K. 1983. 'Play' behavior and trace dose of metal(s) in mice *Dev. Toxicol. Environ. Sci.* 11:525-528.

CP Hoshishima, K., Tsujii, H., Aota, S., and Kirchgessner, M. 1978. The combined effects of two kinds of metals administered to mice upon their bitter tasting and their spontaneous activity. *Trace Elem. Metab. Man Anim., Proc. Int. Symp*., 3rd, 199-202.

CP Hoshishima, K., Tujii, H., and Kano, K. 1978. Effects of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their offspring. *Proc Int Congr Toxicol* 1ST 1977 569-570.

CP Hoshishima, Keiichiro, Shimai, Satoshi, <EDITOR> Mills, C. F. Ed, Bremner, I. Ed, Chesters, J. K Ed, Edel, J., Marafante, E., Sabbioni, E., and Manzo, L. 1985. Trace amounts of metal(s) prenatally administered and the circadian drinking rhythm in mice: Metabolic behavior of inorganic forms of antimony in the rat. Trace Elem. Man Anim. -- TEMA 5, Proc. Int. Symp., 5th, P292-4Heavy Met. Environ., Int. Conf., 4th, V1,, P574-7.

Unrel Houpt, K., Zgoda, J. C., and Stahlbaum, C. C. 1984. Use of taste repellants and emetics to prevent accidental poisoning of dogs. *Am J Vet Res.* 45(8): 1501-3.

No Control James, L. F., Lazar, V. A., and Binns, W. 1966. Effects of sublethal doses of certain minerals on pregnant ewes and fetal development *Am J Vet Res.* 27(116): 132-135.

Unrel Komiya, Y. 1966. Clonorchis and clonorchiasis. *Adv Parasitol*. 4: 53-106.

Rev Liepins, R. and Pearce, E. M. 1976. Chemistry and toxicity of flame retardants for plastics. *Environ Health Perspect.* 17: 55-63.

Rev Lynch, B. S., Capen, C. C., Nestmann, E. R., Veenstra, G., and Deyo, J. A. 1999. Review of subchronic/chronic toxicity of antimony potassium tartrate *Regul.Toxicol.Pharmacol*. 30(1): 9-17.

No Dose Malzahn, E. 1983. Post natal changes in trace elements and in oxidation reduction activity in laboratory bank voles *Clethrionomys-glareolus Acta Theriol.* 28(1-8): 33-54.

Bio Acc Malzahn, E. 1981. Trace elements and their significance in the post natal development of seasonal generations of the bank vole clethrionomys-glareolus Acta Theriol 26(8-15):231-256.

No Dose Marmo, E., Matera, M. G., Acampora, R., Vacca, C., De Santis D, Maione, S., Susanna, V., Chieppa, S., Guarino, V. and others. 1987. Prenatal and postnatal metal exposure: effect on vasomotor reactivity development of pups. Experimental research with antimony trichloride, thallium sulfate, and sodium metavanadate *Curr Ther Res Clin Exp*. 42(5): 823-838.

Bio Acc Molokhia, M. M. and Smith, H. 1969. The behaviour of antimony in blood. *J Trop Med Hyg* 72(9): 222-5.

Rev NAS, Subcommittee on Mineral Toxicity Committee on Animal Nutrition. 1980. Mineral Tolerance of Domestic Animals. National Research Council (NRC): United States. 588.

Rev Oskarsson, A. and Fowler, B. A. 1987. Alterations in renal heme biosynthesis during metal nephrotoxicity *Ann.N.Y.Acad.Sci.* 514: 268-277.

Lead Shot Pain, D. J., Amiard-Triquet, C., and Sylvestre, C. 1992. Tissue lead concentrations and shot ingestion in nine species of waterbirds from the Camargue (France). *Ecotoxicol Environ Saf* 24(2): 217-33.

No Oral Paul, M., Mason, R., and Edwards, R. 1989. Effect of potential antidotes on the acute toxicity, tissue disposition and elimination of selenium in rats. *Res Commun Chem Pathol Pharmacol* 66(3): 441-50.

Acu Pribyl, E. 1927. Nitrogen metabolism in experimental subacute arsenic and antimony poisoning. *J. Biol. Chem.* 74:775.

No Oral Ridgway, L. P. and Karnofsky, D. A. 1952. The effects of metals on the chick embryo: toxicity and production of abnormalities in development *Ann N Y Acad Sci.* 55: 203-215.

Rev Schardein, J. L., Keller, K. A., and Schwetz, B. A. 1989. Potential human developmental toxicants and the role of animal testing in their identification and characterization. *Crit Rev Toxicol*. 19(3): 251-339.

DUP Schroeder, H. A. 1970. Metallic Micronutrients and Intermediary Metabolism: *Progress rept. no. 3 (Final).* 22 p.

Rev Smyth Jr., H. F. and Carpenter, C. P. 1948. Further experience with the range finding test in the industrial toxicology laboratory. *J. Ind. Hyg. Toxicol*. 30(1): 63-68.

BioAcc Stanier, P. and Blackmore, D. J. 1983. Antimony concentrations in equine serum. *Veterinary Record*. 113(7): 157.

No Oral Tsujii, H. and Hoshishima, K. 1979. Effect of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their offspring *Shinshu Daigaku Nogakubu Kiyo(j Fac Agric Shinshu Univ)* 16: 13-28.

Rev U.S.EPA. 1992. Drinking Water Criteria Document for Antimony. Health and Ecological Criteria Division, Office of Science and Technology, Office of Water.

Not Avail U.S.EPA. 1983. The single dose and subacute toxicity of antimony oxide (Sb_2O_3) with cover letter EPA/OTS; Doc #878210812

Rev Venugopal, D. and T. D. Luckey, Eds. 1978. Antimony (Sb). In: Venugopal, D. and T. D. Luckey, Eds. *Metal Toxicity in Mammals* - Vol 2. Chemical Toxicity of Metals and Metalloids. Plenum: New York, NY. 213-216.

This Page Intentionally Left Blank

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

This Page Intentionally Left Blank

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Antimony

---

February 2005

This page intentionally left blank

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Antimony

Ref		Exposure																	Effects					Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref No.	Chemical Form	MW%		Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Method of Chem Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported	Body Weight (kg)	Ingestion Rate Reported?	Ingestion Rate (kg or L/day)	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																							
1	224	potassium antimony tartrate	100	Rat *(Rattus norvegicus)*	1	5	0/0.06/0.64/6.13/45.69	mg/kg bw/d	UX	DR	13	w	NR	NR	JV	F	CHM	GLUC	WO	0.06	0.64	Y	0.136	N	0.01644	0.0600	0.640	10	5	10	5	7	1	6	10	10	4	68
2	15506	antimony potassium tartrate	100	Rat *(Rattus norvegicus)*	1	2	0/3.5	mg/kg bw/d	U	DR	767	d	21	d	JV	B	CHM	CHOL	SR		3.5	N	0.235	N	0.00269		3.50	10	5	5	5	10	1	4	10	10	4	69
3	189	antimony trioxide	83.53	Rat (*Rattus norvegicus*)	2	4	0/97/494/1879	mg/kg bw/d	UX	FD	90	d	NR	NR	AD	F	ENZ	ALPH	BL	97	494	Y	0.491	N	0.02400	81.0	413	10	10	10	10	7	1	8	10	6	10	82
Behavior																																							
4	224	potassium antimony tartrate	100	Rat (*Rattus norvegicus*)	1	5	0/0.06/0.64/6.13/45.69	mg/kg bw/d	UX	DR	13	w	NR	NR	JV	F	FDB	WCON	WO	6.1	46	Y	0.136	N	0.01644	6.10	46.0	10	5	10	5	7	4	8	10	10	4	73
5	3780	antimony potassium tartrate	39.67	Rat (*Rattus norvegicus*)	1	6	0/16/28/59/94/168	mg/kg bw/d	U	DR	14	d	8	w	NR	F	FDB	WCON	WO	16	28	Y	139	Y	0.01560	6.35	11.1	10	5	5	5	10	4	10	10	10	10	79
6	3780	antimony potassium tartrate	39.67	Mouse (*Mus musculus*)	2	6	0/59/98/174/273/407	mg/kg bw/d	U	DR	14	d	8	w	NR	B	FDB	WCON	WO		59	Y	0.024	Y	0.007600		23.4	10	5	5	5	10	4	4	10	10	10	73
Physiology																																							
7	231	antimony trichloride	53.38	Rat (*Rattus norvegicus*)	1	3	0/1/10	mg/L	U	DR	38	d	NR	NR	GE	F	PHY	BLPR	WO	10		Y	0.323	N	0.03580	0.592		10	5	5	10	6	4	4	10	10	4	68
8	189	antimony trioxide	83.53	Rat (*Rattus norvegicus*)	2	4	0/97/494/1879	mg/kg bw/d	UX	FD	90	d	NR	NR	AD	F	PHY	EXCR	WO	494	1879	Y	0.279	N	0.02400	413	1570	10	10	10	10	7	4	8	10	6	10	85
Pathology																																							
9	189	antimony trioxide	83.53	Rat (*Rattus norvegicus*)	1	4	0/84/421/1686	mg/kg bw/d	UX	FD	90	d	NR	NR	AD	M	ORW	ORWT	LI	421	1686	Y	0.491	N	0.0383	352	1410	10	10	10	10	7	4	8	10	6	10	85
10	270	antimony trioxide	100	Mouse *(Mus musculus)*	2	3	0/500/6700	mg/kg diet	U	FD	18	d	NR	NR	NR	NR	ORW	ORWT	KI	500	6700	N	0.0375	N	0.000016	211	2820	10	10	5	10	5	4	6	10	6	4	70
11	224	potassium antimony tartrate	100	Rat (*Rattus norvegicus*)	1	5	0/0.06/0.64/6.13/45.69	mg/kg bw/d	UX	DR	13	w	NR	NR	JV	F	HIS	GHIS	WO		0.06	Y	0.136	N	0.01644		0.060	10	5	10	5	7	4	4	10	10	4	69
Reproduction																																							
12	231	antimony trichloride	53.38	Rat (*Rattus norvegicus*)	1	3	0/1/10	mg/L	U	DR	31	d	NR	NR	GE	F	REP	PRWT	WO	1.0	10	Y	0.33	N	0.03650	0.0590	0.590	10	5	5	10	6	10	8	10	10	4	78
13	225	antimony trioxide	83.53	Mouse (*Mus musculus*)	1	4	0/400/666.67/1000	mg/kg bw/d	U	GV	14	d	8	w	JV	M	REP	SPCV	WO	1000		Y	0.03	N	0.003847	835		10	8	10	10	10	10	4	3	10	4	79
Growth																																							
14	252	antimony potassium tartrate	100	Rat *(Rattus norvegicus)*	1	2	0/5	mg/L	U	DR	725	d	21	d	JV	M	GRO	BDWT	WO	5		Y	0.475	N	0.0051	0.533		10	5	5	5	6	8	4	10	10	4	67
15	3701	antimony potassium tartrate	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	U	DR	519	d	21	d	JV	B	GRO	BDWT	WO	5		Y	0.0531	N	0.0071	0.664		10	5	5	5	6	8	4	10	10	4	67
16	224	potassium antimony tartrate	100	Rat (*Rattus norvegicus*)	2	5	0/0.06/0.56/5.58/42.17	mg/kg bw/d	UX	DR	13	w	7	w	JV	M	GRO	BDWT	WO	5.58	42.16	Y	0.375	N	0.04100	5.60	42.00	10	5	10	5	7	8	8	10	10	4	82
17	3780	antimony potassium tartrate	39.67	Rat (*Rattus norvegicus*)	1	6	0/16/28/59/94/168	mg/kg bw/d	U	DR	14	d	8	w	JV	B	GRO	BDWT	WO	168		Y	0.184	Y	0.01190	67.0		10	5	5	5	10	8	4	10	10	10	78
18	3780	antimony potassium tartrate	39.67	Mouse (*Mus musculus*)	2	6	0/59/98/174/273/407	mg/kg bw/d	U	DR	14	d	8	w	JV	F	GRO	BDWT	WO	273	407	Y	0.024	Y	0.002100	106	161	10	5	5	5	10	8	10	10	10	10	84
19	189	antimony trioxide	83.53	Rat (*Rattus norvegicus*)	1	4	0/84/421/1686	mg/kg bw/d	UX	FD	90	d	NR	NR	AD	M	GRO	BDWT	WO	1686		Y	0.491	N	0.03828	1410		10	10	10	10	7	8	4	10	6	10	85
20	231	antimony trichloride	53.38	Rat (*Rattus norvegicus*)	1	3	0/1/10	mg/L	U	DR	20	d	NR	NR	GE	F	GRO	BDWT	WO		1	Y	0.33	N	0.03650		0.0590	10	5	5	10	6	8	4	10	10	4	72
21	238	antimony potassium tartrate	100	Mouse *(Mus musculus)*	1	2	0/5	mg/L	U	DR	339	d	21	d	JV	F	GRO	BDWT	WO		5	Y	0.043	N	0.00058		0.678	10	5	5	5	6	8	4	10	10	4	66
Survival																																							
22	224	potassium antimony tartrate	100	Rat (*Rattus norvegicus*)	1	5	0/0.06/0.64/6.13/45.69	mg/kg bw/d	UX	DR	13	w	NR	NR	IM	F	MOR	MORT	WO	46		Y	0.136	N	0.016436	46.0		10	5	10	5	7	9	4	10	10	4	74
23	221	antimony trioxide	100	Short-tailed vole (*Microtus agrestis*)	1	2	0/500	mg/kg diet	U	FD	60	d	35	d	NR	M	MOR	MORT	WO	500		N	0.04	N	0.004874	60.9		10	10	5	10	5	9	4	10	3	4	70
24	3780	antimony potassium tartrate	39.67	Rat (*Rattus norvegicus*)	1	6	0/16/28/59/94/168	mg/kg bw/d	U	DR	14	d	8	w	JV	B	MOR	SURV	WO	168		N	0.184	Y	0.01190	66.6		10	5	5	5	10	9	4	10	10	10	78
25	3780	antimony potassium tartrate	39.67	Mouse (*Mus musculus*)	2	6	0/59/98/174/273/407	mg/kg bw/d	U	DR	14	d	8	w	JV	M	MOR	MORT	WO	273	407	N	0.0316	Y	0.006000	108	161	10	5	5	5	10	9	10	10	10	10	84
26	225	antimony trioxide	83.53	Mouse (*Mus musculus*)	1	4	0/400/666.67/1000	mg/kg bw/d	U	GV	21	d	8	w	JV	M	MOR	MORT	WO	667	1000	Y	0.03	N	0.003847	557	835	10	8	10	10	10	9	10	10	10	4	91
27	270	antimony trioxide	83.53	Short-tailed vole (*Microtus agrestis*)	2	3	0/500/6700	mg/kg diet	u	FD	21	d	NR	NR	NR	NR	MOR	MORT	WO	6700		N	0.043	N	0.005170	673		10	10	5	10	5	9	4	10	6	4	73
28	270	antimony trioxide	100	Mouse *(Mus musculus)*	2	3	0/500/6700	mg/kg diet	U	FD	18	d	NR	NR	NR	NR	MOR	MORT	WO	6700		N	0.0375	N	0.00462	826		10	10	5	10	5	9	4	10	6	4	73
29	189	antimony trioxide	83.53	Rat (*Rattus norvegicus*)	1	4	0/84/421/1686	mg/kg bw/d	UX	FD	90	d	NR	NR	AD	M	MOR	MORT	WO	1686		Y	0.491	N	0.03828	1410		10	10	10	10	7	9	8	10	6	10	86
30	221	antimony trioxide	100	Short-tailed vole (*Microtus agrestis*)	2	3	0/20000	mg/kg diet	U	FD	12	d	35	d	NR	M	MOR	MORT	WO	20000		Y	0.04	N	0.004874	2440		10	10	5	10	6	9	4	10	6	4	74
31	252	potassium antimony tartrate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	U	DR	784	d	21	d	JV	F	MOR	TDTH	WO		5	Y	0.475	N	0.005065		0.533	10	5	5	5	6	9	4	10	10	4	68
Data Not Used to Derive a Wildlife Toxicity Reference Value (TRV)																																							
32	238	antimony potassium tartrate	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	U	DR	548	d	21	d	JV	F	MOR	TDTH	WO	5		Y	0.0517	N	0.000688	0.660		10	5	5	5	6	9	4	1	10	4	59
39	3701	antimony potassium tartrate	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	U	DR	519	d	21	d	JV	B	HIS	GHIS	LI	5		Y	0.0531	N	0.007051	0.664		10	5	5	5	6	4	4	1	10	4	54
40	3701	antimony potassium tartrate	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	U	DR	519	d	21	d	JV	B	MOR	TDTH	WO	5		Y	0.0531	N	0.007051	0.664		10	5	5	5	6	9	4	10	1	4	59
41	252	antimony potassium tartrate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	U	DR	725	d	21	d	JV	M	ORW	SMIX	HE		5	Y	0.46	N	0.04922		0.535	10	5	5	5	6	4	4	10	10	4	63

The abbreviations and definitions used in coding data are provided in Attachment 4-3 of the Eco-SSL Guidance (U.S.EPA, 2003).

Ecological Soil Screening Levels for Arsenic

Interim Final

OSWER Directive 9285.7-62

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

March 2005

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR ARSENIC 2

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 3

4.0 ECO-SSL FOR SOIL INVERTEBRATES 3

5.0 ECO-SSL FOR AVIAN WILDLIFE 5
5.1 Avian TRV 5
5.2 Estimation of Dose and Calculation of the Eco-SSL 5

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 8
6.1 Mammalian TRV 8
6.2 Estimation of Dose and Calculation of the Eco-SSL 13

7.0 REFERENCES 14
7.1 General Arsenic References 14
7.2 References Used for Derivation of Plant and Soil Invertebrate Eco-SSLs 14
7.3 References Rejected for Use in Derivation of Plant and Soil Invertebrate Eco-SSLs 15
7.4 References Used for Derivation of Wildlife TRVs 27
7.5 References Rejected for Use in Derivation of Wildlife TRVs 31

LIST OF TABLES

Table 2.1 Arsenic Eco-SSLs (mg/kg dry weight in soil) 2

Table 3.1 Plant Toxicity Data - Arsenic 4

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Arsenic 6

Table 5.2 Calculation of the Avian Eco-SSLs for Arsenic 8

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Arsenic 9

Table 6.2 Calculation of the Mammalian Eco-SSLs for Arsenic 13

LIST OF FIGURES

Figure 2.1 Typical Background Concentrations of Arsenic in U.S. Soils 3

Figure 5.1 Avian TRV Derivation for Arsenic 7

Figure 6.1 Mammalian TRV Derivation for Arsenic 12

LIST OF APPENDICES

Appendix 5-1 Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Arsenic

Appendix 6-1 Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Arsenic

1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (U.S. EPA, 2003). The derivation procedures represent the collaborative effort of a multi-stakeholder group consisting of federal, state, consulting, industry, and academic participants led by the U.S. EPA, Office of Solid Waste and Emergency Response.

This document provides the Eco-SSL values for arsenic and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying arsenic concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR ARSENIC

Arsenic is naturally present in rock and soils with concentrations in soils reflecting the geology of the region as well as anthropogenic inputs. Higher concentrations are associated with igneous and sedimentary rocks, particularly with sulfidic ores (API, 1998). Extensive discussions of the sources, concentrations, and chemical species are presented in API (1998) and Cullen and Reimer (1989).

Arsenic is used in multiple manufacturing and industrial processes including the production of wood treating chemicals, herbicides, pesticides, desiccants, metal alloys, glass, pharmaceuticals, and semi-conductors. Elevated arsenic soil concentrations are often associated with mining activities, smelters, pesticide/herbicide manufacturing facilities and agricultural lands (API, 1998).

Arsenic can exist in four oxidation states: +5, +3, 0 and -3. In soil, arsenic is a constituent of numerous minerals and is found frequently associated with sulfur, most commonly as arsenopyrite (FeAsS). Inorganic arsenate can also be bound to iron and aluminum cations, or any other cation that may be present (e.g., calcium, zinc, magnesium, lead) as well as organic matter in soils (API, 1998).

Arsenic occurs in contaminated soils primarily as the inorganic arsenic (V) and arsenic (III) but soil microorganisms can produce organic forms (Cullen and Reimer, 1989; Huang, 1994; CCME, 1996). Transformations among inorganic and organic forms are controlled by the oxidation-reduction, precipitation/adsorption, and biomethylation processes in addition to the biological production and volatilization of the arsines (API, 1998). The availability or solubility of arsenic in soils depends on the source (natural vs. anthropogenic) and the soil's clay content, redox potential, and pH. Generally, factors that tend to increase arsenic availability are anthropogenic sources (e.g., pesticides), low clay content, low redox potential (reducing conditions), and high pH (alkaline conditions) (Cullen and Reimer, 1989, API, 1998).

The Eco-SSL values derived to date for arsenic are summarized in Table 2.1.

Table 2.1 Arsenic Eco-SSLs (mg/kg dry weight in soil)

Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
18	NA	43	46

NA = Not Available. Data were insufficient to derive an Eco-SSL.

Eco-SSL values for arsenic were derived for plants, avian wildlife, and mammalian wildlife. An Eco-SSL value for arsenic for soil invertebrates could not be derived as data were insufficient. The Eco-SSLs range from 18 mg/kg dry weight (dw) for plants to 46 mg/kg dw for avian wildlife. These concentrations are higher than the reported range of background

soil concentrations in eastern and western U.S. soils (Figure 2.1). Background concentrations of many metals in U.S. soils are described in Attachment 1-4 of the Eco-SSL guidance (U.S. EPA, 2003).

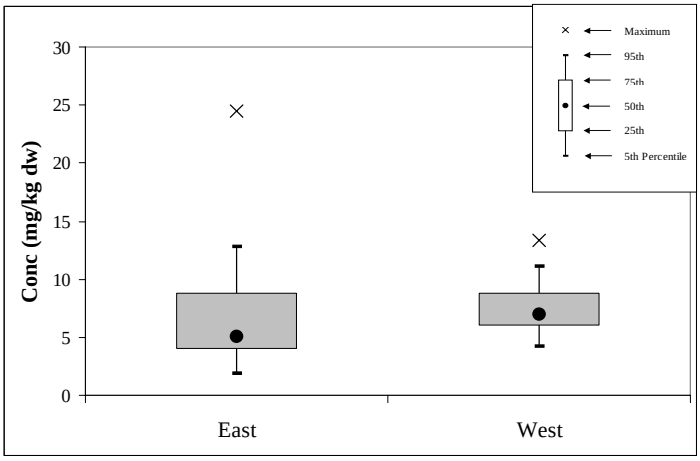


Figure 2.1 Typical Background Concentrations of Arsenic in U.S. Soils.

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 171 were selected for acquisition for further review. Of those papers acquired, 26 met all 11 Study Acceptance Criteria (U.S. EPA 2003; Attachment 3-1). Each of these papers was reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Seventeen studies received an Evaluation Score greater than ten. These studies are summarized in Table 3.1.

The data in Table 3.1 are sorted by bioavailability score. There are three study results with a bioavailability score of two used to derive the plant Eco-SSL for arsenic according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the maximum acceptable toxicant concentration (MATC) values reported for each of three test species under two separate test conditions (pH and % organic matter (OM)) and is equal to 18 mg/kg dw.

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, 35 were acquired for further review. Of those acquired, one met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). There were no studies that received an Evaluation Score greater than 10. A soil invertebrate Eco-SSL could not be derived for arsenic.

Table 3.1 Plant Toxicity Data - Arsenic

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value - Soil Concentration (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Jiang and Singh, 1994	4441	a	Ryegrass	*Lolium perenne*	5.6	0.7	2	GRO	MATC	22	13	Y	Y
Schweizer, 1967	9659	a	Cotton	*Gossypium hirsutum stoneville 7A*	7.9	1.1	2	GRO	MATC	69	16	Y	Y
Schweizer, 1967	9659	b	Rice	*Oryza sativa L. var. Nato*	7.9	1.1	2	GRO	MATC	4	15	Y	Y
									Geometric Mean	18			
Data not Used to Derive Plant Eco-SSL													
Jiang and Singh, 1994	4441	e	Barley	*Hordeum vulgare*	5.6	0.7	2	GRO	LOAEC	2	13	N	N
Jiang and Singh, 1994	4441	g	Barley	*Hordeum vulgare*	5.6	0.7	2	GRO	LOAEC	2	13	N	N
Jiang and Singh, 1994	4441	c	Ryegrass	*Lolium perenne*	5.6	0.7	2	GRO	MATC	22	13	N	N
Woolson and Isensee, 1981	56454	a	Radish	*Raphanus sativus*	5.1	1.5	1	POP	MATC	6	13	N	N
Woolson and Isensee, 1981	56454	b	Soybean	*Glycine Max (L.) Merr.*	5.1	1.5	1	POP	MATC	6	13	N	N
Jacobs et al., 1970	5577	b	Corn	*Zea mays*	5.5	1.2	1	GRO	MATC	40	12	Y	N
Jacobs et al., 1970	5577	c	Snap Bean	*Phaseolus vulgaris*	5.5	1.2	1	GRO	MATC	22	12	Y	N
Jacobs et al., 1970	5577	e	Pea	*Pisum sativum*	5.5	1.2	1	GRO	MATC	40	12	Y	N
Jacobs et al., 1970	5577	a	Potato	*Solanum tuberosum*	5.5	1.2	1	GRO	MATC	97	11	Y	N
Anastasia and Kender, 1973	11144	a	Blueberry	*Vaccinium angustifolium*	4.6	0.17-98.0	0	GRO	MATC	55	13	Y	N
Jiang and Singh, 1994	4441	b	Ryegrass	*Lolium perenne*	4.9	5.3	0	GRO	MATC	22	11	Y	N
Jiang and Singh, 1994	4441	d	Ryegrass	*Lolium perenne*	4.9	5.3	0	GRO	MATC	22	11	N	N
Jiang and Singh, 1994	4441	f	Barley	*Hordeum vulgare*	4.9	5.3	0	GRO	MATC	22	11	Y	N
Jiang and Singh, 1994	4441	h	Barley	*Hordeum vulgare*	4.9	5.3	0	GRO	MATC	22	11	N	N

ERE = Ecologically relevant endpoint
GRO = Growth
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration. Geometric mean of NOAEC and LOAEC.
N = No
NOAEC = No observed adverse effect concentration
OM = Organic matter
POP = Population
Y = Yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

5.0 ECO-SSL FOR AVIAN WILDLIFE

The derivation of the Eco-SSL for avian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

5.1 Avian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 1,173 papers with possible toxicity data for either avian or mammalian species. Of these papers, 1,110 were rejected for use as described in Section 7.5. Of the remaining papers, five contained data for avian test species. These papers were reviewed and data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 5.1. The complete results are included as Appendix 5-1.

Within the five reviewed papers, there are 16 results for biochemical (BIO), behavioral (BEH), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) effects that meet the Data Evaluation Score of >65 for use to derive the TRV (U.S. EPA 2003; Attachment 4-5). These data are plotted in Figure 5.1 and correspond directly with the data presented in Table 5.1. The no-observed adverse effect (NOAEL) values for growth and reproduction are used to calculate a geometric mean NOAEL. This result is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for growth and reproduction could not be calculated as only two values are available. The TRV is equal to 2.24 mg arsenic/kg bw/day which is the lowest NOAEL value for reproduction, growth, or survival.

5.2 Estimation of Dose and Calculation of the Eco-SSL

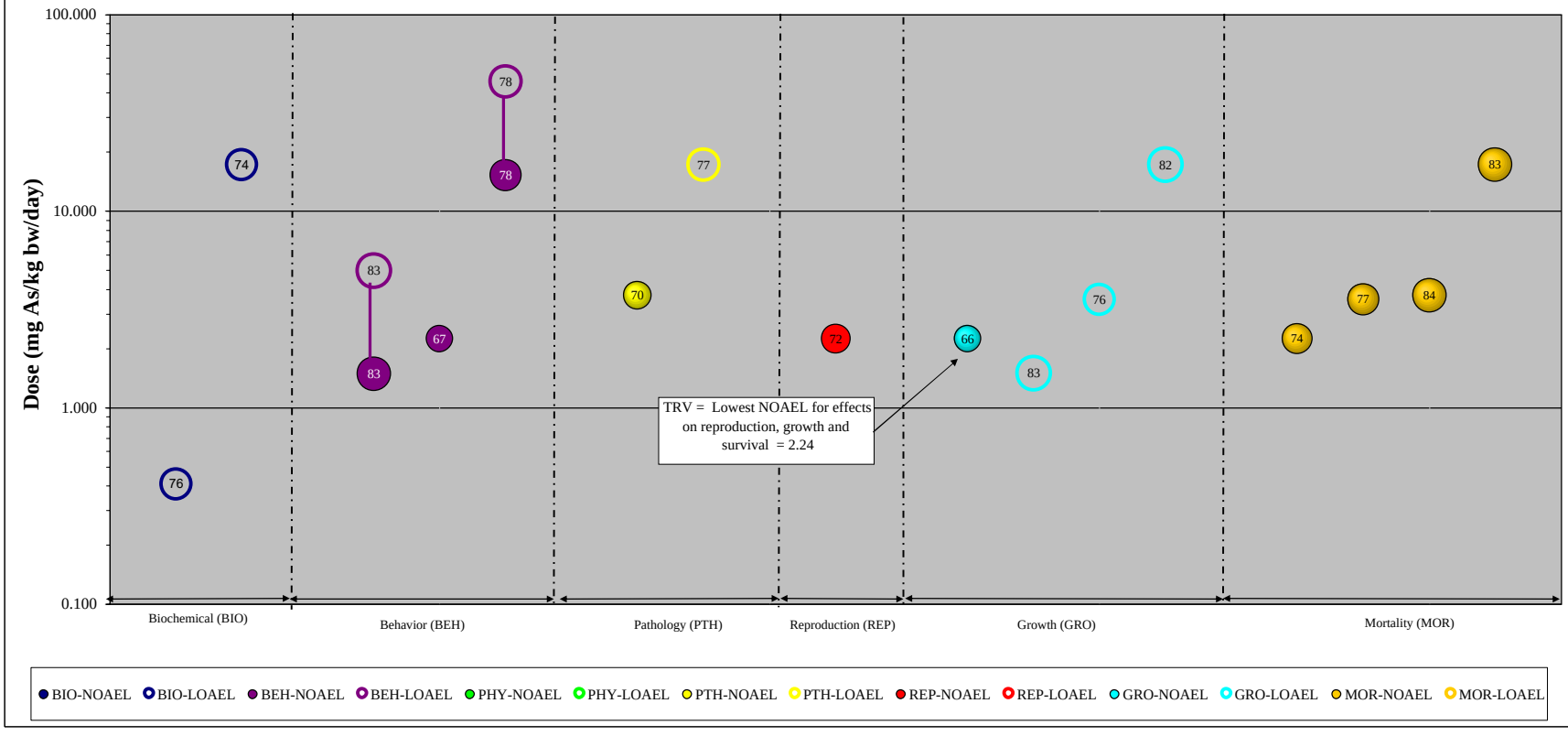
Three separate Eco-SSL values were calculated for avian wildlife, one each for three surrogate species representing different trophic groups. The avian Eco-SSLs for arsenic were calculated according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5) and are summarized in Table 5.2.

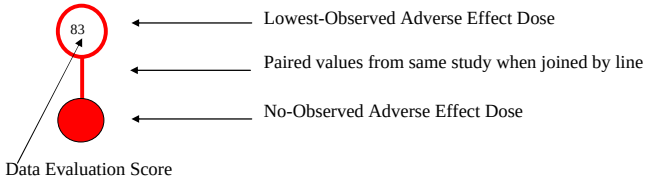
Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Biochemical (BIO)																		
1	Camardese et al, 1990	5747	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	10	w	1	d	JV	F	ENZ	ACHE	BR		0.410	76
2	Hoffman et al, 1992	1376	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	ENZ	GLPX	PL		17.3	74
Behavior (BEH)																		
3	Camardese et al, 1990	5747	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	2	w	1	d	JV	F	FDB	FCNS	WO	1.49	4.98	83
4	Holcman and Stibilj, 1997	5305	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	SM	F	FDB	FCNS	WO	2.24		67
5	Whitworth et al 1991	5690	Mallard duck (*Anas platyrhynchos*)	4	U	FD	9	w	1	d	JV	NR	BEH	ACTV	WO	15.2	45.7	78
Pathology (PTH)																		
6	Camardese et al, 1990	5747	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	10	w	1	d	JV	B	ORW	ORWT	LI	3.72		70
7	Hoffman et al, 1992	1376	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	ORW	ORWT	LI		17.3	77
Reproduction (REP)																		
8	Holcman and Stibilj, 1997	5305	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	LB	F	REP	PROG	WO	2.24		72
Growth (GRO)																		
9	Holcman and Stibilj, 1997	5305	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	SM	F	GRO	BDWT	WO	2.24		66
10	Camardese et al, 1990	5747	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	2	w	1	d	JV	F	GRO	GGRO	WO		1.49	83
11	Howell and Hill, 1978	1387	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		3.55	76
12	Hoffman et al, 1992	1376	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	GRO	BDWT	WO		17.3	82
Survival (MOR)																		
13	Holcman and Stibilj, 1997	5305	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	SM	F	MOR	MORT	WO	2.24		74
14	Howell and Hill, 1978	1387	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	3.55		77
15	Camardese et al, 1990	5747	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	10	w	1	d	JV	B	MOR	MORT	WO	3.72		84
16	Hoffman et al, 1992	1376	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	MOR	SURV	WO	17.3		83

ACHE = acetylcholinesterase; ACTV = general activity levels; B = both; BDWT = body weight changes; BEH = behavior; BR = brain; d = days; ENZ = enzyme changes; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; GGRO = general growth changes; GRO = growth; GLPX = gluathione peroxidase; JV = juvenile; LB = laying bird; LI = liver; LOAEL = lowest observed adverse effect level; MOR = mortality, MORT = mortality; NOAEL = no observed adverse effect level; NR = Not reported; ORW = organ weight changes; ORWT = organ weight; PL = plasma; PROG = progeny counts; REP = reproduction; SM = sexually mature; SURV = survival; U = unmeasured; UX = measured but results not reported; w = weeks; WO = whole organism

Figure 5.1 Avian TRV Derivation for Arsenic





Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are not three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.

3) There are no bounded LOAEL values for comparison.

3) The avian wildlife TRV for arsenic is equal to 2.24 mg arsenic/kg bw/day which is the lowest NOAEL value for effects on reproduction, growth or survival.

Table 5.2 Calculation of the Avian Eco-SSLs for Arsenic					
Surrogate Receptor Group	**TRV for Arsenic (mg dw/kg bw/d) [1]**	**Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)[2]**	**Arsenic in Biota Type (i)[2,3] (B_i) (mg/kg dw)**	**Eco-SSL (mg/kg dw)[4]**
Avian herbivore (dove)	2.24	0.190	0.139	$B_i = 0.03752 * Soil_j$ where i = plants	67
Avian ground insectivore (woodcock)	2.24	0.214	0.164	$\ln(B_i) = 0.706 * \ln(Soil_j) - 1.421$ where i = earthworms	43
Avian carnivore (hawk)	2.24	0.0353	0.057	$\ln(B_i) = 0.8188 * \ln(Soil_j) - 4.8471$ where i = mammals	1100

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV) solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First the TRV was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

6.1 Mammalian TRV

The literature search was completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) and identified 1,173 papers with possible toxicity data for arsenic for either avian or mammalian test species. Of these studies, 1,110 were rejected for use as described in Section 7.5. Of the remaining papers, 55 contained data for mammalian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 6.1. The complete results are provided in Appendix 6.1.

Within the 55 papers there are 138 results for biochemical (BIO), behavioral (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints with a total Data Evaluation Score >65 that were used to derive the TRV (U.S. EPA 2003; Attachment 4-3). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The NOAEL values for growth and reproduction are used to calculate a geometric mean NOAEL. This result is examined in relationship to the lowest bounded LOAEL for reproduction, growth and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-4).

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Biochemical (BIO)																		
1	Neiger and Osweiler 1989	14583	Dog (*Canis familiaris*)	4	U	FD	8	w	8	mo	JV	F	ENZ	ASAT	SR	1.04	1.66	80
2	Neiger and Osweiler, 1992	15703	Dog (*Canis familiaris*)	4	M	FD	58	d	8	mo	JV	F	CHM	GBCM	UR		0.500	79
3	Wood and Fowler, 1978	15387	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	ENZ	GENZ	LI		1.20	69
4	Mahaffey et al., 1977	14580	Rat (*Rattus norvegicus*)	2	UX	FD	10	w	NR	NR	AD	M	CHM	RBCE	BL		1.50	68
5	Ghosh et al 1999	15011	Rat (*Rattus norvegicus*)	3	U	GV	28	d	35	d	JV	F	ENZ	GENZ	AR		2.06	73
6	Itoh et al., 1990	14577	Mouse (*Mus musculus*)	3	U	OR	14	d	4	w	JV	M	CHM	TRYP	BR		2.51	77
7	Schroeder, 1968	15506	Rat (*Rattus norvegicus*)	2	U	DR	781	d	21-23	d	JV	B	CHM	CHOL	SR		3.78	69
8	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	GV	20	d	2	d	JV	B	ENZ	ACHE	BR		5.00	77
9	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	NR	HRM	DOPA	BR		5.00	68
10	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	GV	18	d	2	d	JV	B	HRM	DOPA	BR		5.00	77
11	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	B	ENZ	ACHE	BR		5.00	74
12	Glattre et. al.,	11361	Rat (*Rattus norvegicus*)	2	U	DR	4	w	NR	NR	JV	M	HRM	TRII	SR		6.36	69
13	Wood and Fowler, 1978	15387	Mouse (*Mus musculus)*	4	U	DR	6	w	NR	NR	JV	M	ENZ	GENZ	LI		6.60	69
14	Morrison and Chavez, 1983	15709	Pig (*Sus scrofa*)	2	U	FD	2	w	21	d	JV	B	ENZ	GLPX	PL		9.44	71
15	Biswas, et al, 2000	25916	Goat (*Ovis aries*)	2	U	OR	3	w	12	mo	AD	F	ENZ	ASAT	BL		14.4	70
16	Biswas et al, 1998	15322	Goat (*Capra hircus*)	2	U	DR	6	w	1	yr	JV	F	CHM	HMGL	BL		14.4	69
17	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	CHM	PORP	UR		24.6	66
18	Tripathi et al 1997	14590	Rat (*Rattus norvegicus*)	2	U	DR	16	w	NR	NR	JV	M	HRM	DOPA	BR		32.0	66
19	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	CHM	PORP	UR		42.1	66
Behavior (BEH)																		
20	Hunder et al, 1999	15007	Guinea pig (*Cavia porcellus*)	4	U	FD	3	w	NR	NR	JV	F	FDB	FCNS	WO	0.844	2.53	79
21	Bencko 1972	15471	Mouse (*Mus musculus*)	3	U	DR	64	d	NR	NR	JV	M	FDB	WCON	WO	0.880	6.00	73
22	Neiger and Osweiler 1989	14583	Dog (*Canis familiaris*)	4	U	FD	1	w	8	mo	JV	F	FDB	FCNS	WO	1.04	1.66	83
23	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	FDB	FCNS	WO	1.88		68
24	Fowler and Woods 1979	15358	Mouse (*Mus musculus*)	4	U	DR	6	w	NR	NR	JV	M	FDB	WCON	WO	2.84	5.69	74
25	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	FDB	FCNS	WO	3.22		68
26	Morrison and Chavez, 1983	15709	Pig (*Sus scrofa*)	2	U	FD	6	w	21	d	JV	B	FDB	FCNS	WO	3.59		74
27	Hunder et al, 1999	15007	Mouse (*Mus musculus*)	4	U	FD	3	w	NR	NR	JV	F	FDB	FCNS	WO	3.85	7.69	79
28	Benese and Bencko, 1981	15288	Mouse (*Mus musculus*)	4	U	DR	32	d	NR	NR	JV	M	FDB	WCON	WO	6.43	32.4	73
29	Coulson et al, 1935	14603	Rat (*Rattus norvegicus*)	2	M	FD	52	w	33-35	d	JV	B	FDB	FCNS	WO		0.472	79
30	Mahaffey et al., 1977	14580	Rat (*Rattus norvegicus*)	2	UX	FD	10	w	NR	NR	AD	M	FDB	FCNS	WO		1.50	71
31	Itoh et al., 1990	14577	Mouse (*Mus musculus*)	3	U	OR	14	d	4	w	JV	M	BEH	ACTV	WO		2.51	80
32	Brown et al., 1976	4	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	FDB	WCON	WO		4.70	68
33	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	GV	21	d	2	d	JV	B	FDB	FCNS	WO		5.00	80
34	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	B	BEH	ACTP	WO		5.00	73
35	Cabe, et al., 1979	1244	Rat (*Rattus norvegicus*)	2	U	DR	18	w	50	d	JV	M	FDB	WCON	WO		5.81	68
36	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	FDB	WCON	WO		24.6	69
37	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	FDB	WCON	WO		42.1	69
Physiology (PHY)																		
38	Bencko 1972	15471	Mouse (*Mus musculus*)	3	U	DR	32	d	NR	NR	JV	M	PHY	GPHY	LI	0.880	6.00	73
39	Kanisawa and Schroeder, 1969	15061	Rat (*Rattus norvegicus*)	2	U	DR	18	mo	21	d	JV	B	PHY	BLPR	WO		0.569	67
40	Carmignani et al, 1985	15174	Rat (*Rattus norvegicus*)	2	U	DR	18	mo	NR	NR	NR	M	PHY	GPHY	WO		2.55	67
41	Carmignani et al, 1985	15174	Rabbit (*Oryctolagus cuniculus*)	2	U	DR	10	mo	NR	NR	NR	F	PHY	BLPR	WO		2.61	67
42	Carmignani et al, 1985	15174	Rat (*Rattus norvegicus*)	2	U	DR	18	mo	NR	NR	NR	M	PHY	BLPR	WO		3.22	67
43	Morrison and Chavez, 1983	15709	Pig (*Sus scrofa*)	2	U	FD	6	w	21	d	JV	B	PHY	EXCR	WO		3.59	74
44	Brown et al., 1976	4	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	PHY	RPRT	KI		4.70	68
45	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	GV	18	d	2	d	JV	B	PHY	GPHY	HA		5.0	80
46	Carmignani et al 1983	15249	Rat (*Rattus norvegicus*)	2	U	DR	320	d	NR	NR	JV	M	PHY	GPHY	HA		5.65	67
47	Biswas et al, 1998	15322	Goat (*Capra hircus*)	2	U	DR	6	w	1	yr	JV	F	PHY	GPHY	BL		14.4	72
48	Biswas, et al, 2000	25916	Goat (*Ovis aries*)	2	U	OR	9	w	12	mo	AD	F	PHY	RPRT	WO		14.4	73
Pathology (PTH)																		
49	Hughes and Thompson, 1996	15160	Mouse (*Mus musculus*)	3	U	DR	28	d	96	d	SM	F	ORW	ORWT	LI	0.000859	0.0859	67
50	Coulson et al, 1935	14603	Rat (*Rattus norvegicus*)	2	M	FD	52	w	33-35	d	JV	B	HIS	GHIS	LI	0.447		69
51	Kanisawa and Schroeder, 1969	15061	Rat (*Rattus norvegicus*)	2	U	DR	42	mo	21	d	JV	B	HIS	GHIS	KI	0.569		67
52	Nemec et al, 1998	15057	Rabbit (*Oryctolagus cuniculus*)	4	M	GV	7	d	NR	NR	GE	F	GRS	BDWT	WO	0.750	3.0	84
53	Bencko 1972	15471	Mouse (*Mus musculus*)	3	U	DR	64	d	NR	NR	JV	M	ORW	ORWT	SP	0.880	6.00	73
54	Obermeyer et al, 1971	12934	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	ORW	SMIX	LI	0.913		73
55	Tice et al 1997	14589	Mouse (*Mus musculus*)	4	U	GV	4	d	12	w	JV	M	HIS	USTR	BL	1.44	2.88	86
56	Neiger and Osweiler 1989	14583	Dog (*Canis familiaris*)	4	U	FD	8	w	8	mo	JV	F	ORW	SMIX	LI	1.66		68
57	Fowler et al., 1977	14569	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	HIS	USTR	LI	2.22	4.43	74
58	Fowler and Woods 1979	15358	Mouse (*Mus musculus*)	4	U	DR	6	w	NR	NR	JV	M	HIS	USTR	LI	2.84	5.69	74

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic

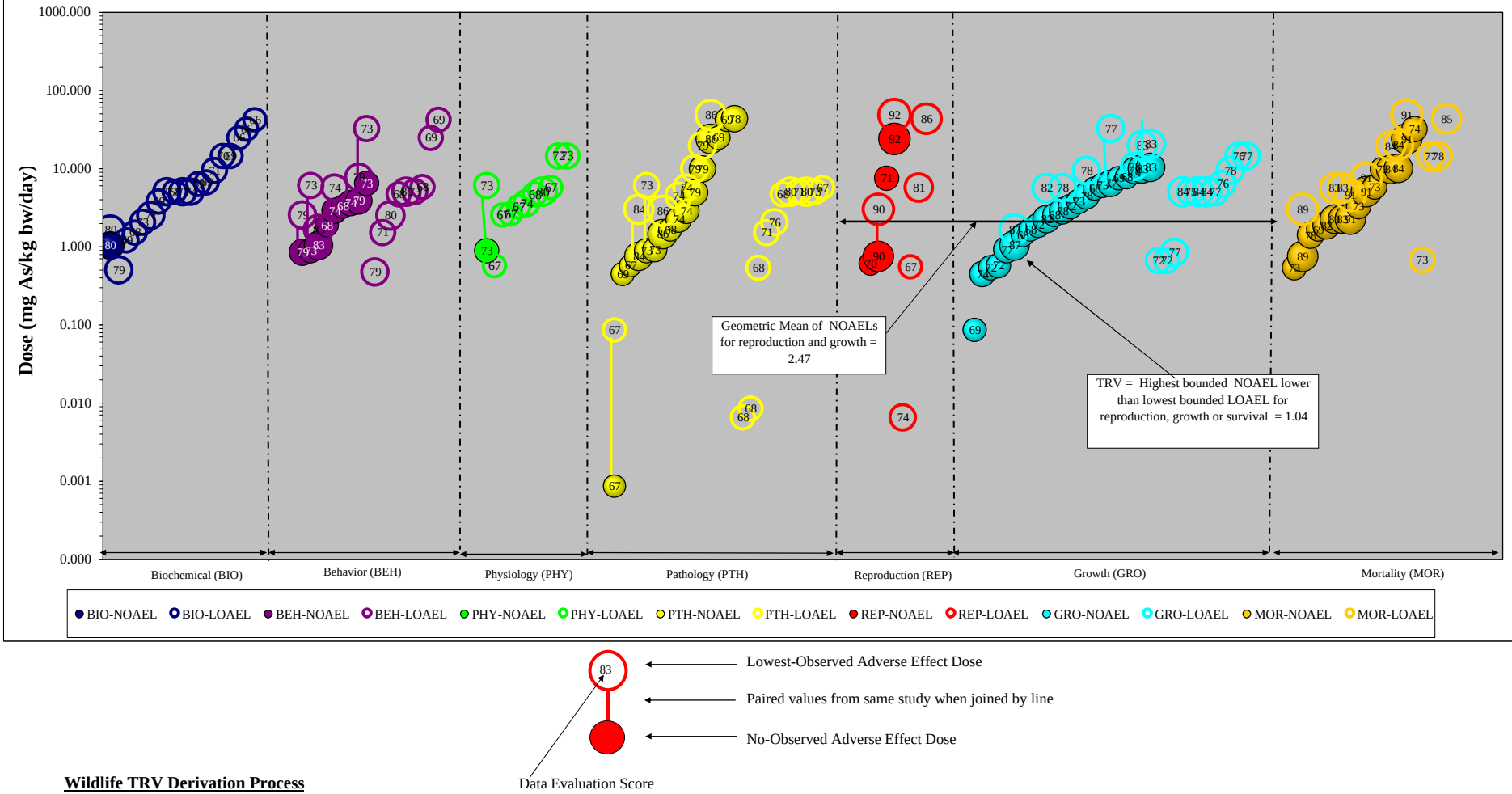
Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
59	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	2	yr	NR	NR	JV	B	HIS	GHIS	LI	4.91	9.81	79
60	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	2	yr	NR	NR	JV	B	HIS	GHIS	LI	9.84	19.7	79
61	Nemec et al, 1998	15057	Mouse (*Mus musculus*)	4	M	GV	6	d	NR	NR	GE	F	GRS	BDWT	WO	24.0	48.0	86
62	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	ORW	SMIX	LI	24.6		69
63	Garcia-Vargas et al, 1995	15530	Mouse (*Mus musculus*)	2	U	DR	6	w	NR	NR	JV	M	ORW	SMIX	LI	42.1		69
64	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	GE	F	GRS	BDWT	WO	43.4		78
65	Healy et al., 1998	14543	Mouse (*Mus musculus*)	3	U	DR	91	d	76	d	JV	M	ORW	ORWT	LI		0.00650	68
66	Healy et al., 1998	14543	Mouse (*Mus musculus*)	3	U	DR	32	d	76	d	JV	M	PTH	ORWT	KI		0.00850	68
67	Schroeder et al, 1968	7	Rat (*Rattus norvegicus*)	2	U	DR	1575	d	21-23	d	JV	M	ORW	SMIX	HE		0.533	68
68	Mahaffey et al., 1977	14580	Rat (*Rattus norvegicus*)	2	UX	FD	10	w	NR	NR	AD	M	GRS	BDWT	WO		1.50	71
69	Ghosh et al 1999	15011	Rat (*Rattus norvegicus*)	3	U	GV	28	d	35	d	JV	F	ORW	SMIX	AR		2.06	76
70	Brown et al., 1976	4	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	ORW	SMIX	KI		4.70	68
71	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	GV	20	d	2	d	JV	B	ORW	ORWT	BR		5.00	80
72	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	NR	ORW	ORWT	BR		5.0	71
73	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	GV	18	d	2	d	JV	B	ORW	ORWT	BR		5.0	80
74	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	B	ORW	ORWT	BR		5.00	73
75	Carmignani et al 1983	15249	Rat (*Rattus norvegicus*)	2	U	DR	320	d	NR	NR	JV	M	HIS	GHIS	KI		5.65	67
Reproduction (REP)																		
76	Savabieasfahani et al, 1998	14556	Cotton rat (*Sigmodon hispidus*)	3	U	DR	6	w	NR	NR	AD	M	REP	TEWT	TE	0.601		70
77	Nemec et al, 1998	15057	Rabbit (*Oryctolagus cuniculus*)	4	M	GV	12	d	NR	NR	GE	F	REP	RSEM	WO	0.750	3.0	90
78	Morris et al, 1938	15125	Rat (*Rattus norvegicus*)	3	U	FD	340	d	26-27	d	JV	M	REP	PRWT	WO	7.47		71
79	Nemec et al, 1998	15057	Mouse (*Mus musculus*)	4	M	GV	9	d	NR	NR	GE	F	REP	PROG	WO	24.0	48.0	92
80	Healy et al., 1998	14543	Mouse (*Mus musculus*)	3	U	DR	91	d	76	d	JV	M	REP	TEWT	TE		0.00650	74
81	Schroeder and Mitchener, 1971	66	Mouse (*Mus musculus*)	2	U	DR	6	mo	21	d	JV	F	REP	PROG	WO		0.548	67
82	Skalnaya et al, 1996	15167	Mouse (*Mus musculus*)	2	U	OR	30	d	NR	NR	GE	F	REP	PRWT	WO		5.66	81
83	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	GE	F	REP	PROG	WO		43.4	86
Growth (GRO)																		
84	Hughes and Thompson, 1996	15160	Mouse (*Mus musculus*)	3	U	DR	28	d	96	d	SM	F	GRO	BDWT	WO	0.0859		69
85	Coulson et al, 1935	14603	Rat (*Rattus norvegicus*)	2	M	FD	52	w	33-35	d	JV	B	GRO	BDWT	WO	0.447		74
86	Kanisawa and Schroeder, 1969	3701	Rat (*Rattus norvegicus*)	2	U	DR	519	d	21	d	JV	B	GRO	BDWT	WO	0.533		72
87	Schroeder et al, 1968	7	Rat (*Rattus norvegicus*)	2	U	DR	69	d	21-23	d	JV	B	GRO	BDWT	WO	0.571		72
88	Obermeyer et al, 1971	12934	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	0.913		77
89	Neiger and Osweiler 1989	14583	Dog (*Canis familiaris*)	4	U	FD	8	w	8	mo	JV	F	GRO	BDWT	WO	1.04	1.66	87
90	Palmer et al 1983	15262	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO	1.39		68
91	Palmer et al 1983	15262	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO	1.65		68
92	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	GRO	BDWT	WO	1.88		72
93	Byron et al, 1967	2	Dog (*Canis familiaris*)	5	U	FD	2	yr	6	mo	JV	B	GRO	BDWT	WO	2.25	5.62	82
94	Schmolke et al 1992	15264	Rat (*Rattus norvegicus*)	3	U	FD	15	w	7	w	JV	F	GRO	BDWT	WO	2.52		68
95	Fowler and Woods 1979	15358	Mouse (*Mus musculus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	2.84	5.69	78
96	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	GRO	BDWT	WO	3.22		72
97	Ghosh et al 1999	15011	Rat (*Rattus norvegicus*)	3	U	GV	28	d	35	d	JV	F	GRO	BDWT	WO	3.78		73
98	Fowler et al., 1977	14569	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	4.43	9.42	78
99	Hunder et al, 1999	15007	Rat (*Rattus norvegicus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO	5.52		68
100	Bencko 1972	15471	Mouse (*Mus musculus*)	3	U	DR	64	d	NR	NR	JV	M	GRO	BDWT	WO	6.00		73
101	Benese and Bencko, 1981	15288	Mouse (*Mus musculus*)	4	U	DR	32	d	NR	NR	JV	M	GRO	BDWT	WO	6.43	32.4	77
102	Morris et al, 1938	15125	Rat (*Rattus norvegicus*)	3	U	FD	340	d	26-27	d	JV	M	GRO	BDWT	WO	7.47		69
103	Hunder et al, 1999	15007	Mouse (*Mus musculus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO	7.69		68
104	Brown et al., 1976	4	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	9.40	10.7	78
105	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO	9.84	19.7	83
106	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	12	w	NR	NR	JV	M	GRO	BDWT	WO	10.3	20.6	83
107	Kanisawa and Schroeder, 1967	20979	Mouse (*Mus musculus*)	2	U	DR	338	d	20-22	d	JV	M	GRO	BDWT	WO		0.663	72
108	Schroeder and Balassa, 1967	3084	Mouse (*Mus musculus*)	2	U	DR	339	d	21	d	JV	B	GRO	BDWT	WO		0.665	72
109	Hunder et al, 1999	15007	Guinea pig (*Cavia porcellus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO		0.844	77
110	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	GV	20	d	2	d	JV	B	GRO	BDWT	WO		5.00	84
111	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	NR	GRO	BDWT	WO		5.0	75
112	Nagaraja and Desiraju 1993	14546	Rat (*Rattus norvegicus*)	2	U	GV	18	d	2	d	JV	B	GRO	BDWT	WO		5.0	84
113	Kiyono et al, 1974	15427	Rat (*Rattus norvegicus*)	4	U	GV	10	d	1	d	JV	M	GRO	BDWT	WO		5.0	84
114	Nagaraja and Desiraju, 1994	15216	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	B	GRO	BDWT	WO		5.00	77
115	Glattre et. al.,	11361	Rat (*Rattus norvegicus*)	2	U	DR	4	w	NR	NR	JV	M	GRO	BDWT	WO		6.36	76
116	Morrison and Chavez, 1983	15709	Pig (*Sus scrofa*)	2	U	FD	2	w	21	d	JV	B	GRO	BDWT	WO		9.44	78
117	Biswas et al, 1998	15322	Goat (*Capra hircus*)	2	U	DR	9	w	1	yr	JV	F	GRO	BDWT	WO		14.4	76
118	Biswas, et al, 2000	25916	Goat (*Ovis aries*)	2	U	OR	9	w	12	mo	AD	F	GRO	BDWT	WO		14.4	77

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic
Page 3 of 3

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Survival (MOR)																		
119	Schroeder et al, 1968	7	Rat (*Rattus norvegicus*)	2	U	DR	1575	d	21-23	d	JV	B	MOR	SURV	WO	0.533		73
120	Nemec et al, 1998	15057	Rabbit (*Oryctolagus cuniculus*)	4	M	GV	12	d	NR	NR	GE	F	MOR	MORT	WO	0.750	3.00	89
121	Palmer et al 1983	15262	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	1.39		78
122	Palmer et al 1983	15262	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	MOR	SURV	WO	1.65		69
123	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	MOR	MORT	WO	1.88		82
124	Byron et al, 1967	2	Dog (*Canis familiaris*)	5	U	FD	2	yr	6	mo	JV	B	MOR	MORT	WO	2.25	5.62	83
125	Byron et al, 1967	2	Dog (*Canis familiaris*)	5	U	FD	13.5	mo	6	mo	JV	B	MOR	MORT	WO	2.25	5.62	83
126	Nemec et al, 1998	15057	Rabbit (*Oryctolagus cuniculus*)	6	M	GV	12	d	NR	NR	GE	F	MOR	MORT	WO	2.25	4.50	91
127	Franke and Moxon 1937	14508	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	MOR	MORT	WO	3.22		73
128	Kiyono et al, 1974	15427	Rat (*Rattus norvegicus*)	4	U	GV	21	d	1	d	JV	M	MOR	MORT	WO	5.0	7.5	91
129	Cabe, et al., 1979	1244	Rat (*Rattus norvegicus*)	2	U	DR	18	w	50	d	JV	M	MOR	MORT	WO	5.81		73
130	Fowler et al., 1977	14569	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	MOR	MORT	WO	9.63		73
131	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	78	w	NR	NR	JV	B	MOR	SURV	WO	9.65	19.3	84
132	Byron et al, 1967	2	Rat (*Rattus norvegicus*)	6	U	FD	2	yr	NR	NR	JV	B	MOR	SURV	WO	9.99	20.0	84
133	Nemec et al, 1998	15057	Mouse (*Mus musculus*)	4	M	GV	9	d	NR	NR	GE	F	MOR	MORT	WO	24.0	48.0	91
134	Tripathi et al 1997	14590	Rat (*Rattus norvegicus*)	2	U	DR	16	w	NR	NR	JV	M	MOR	MORT	WO	32.0		74
135	Schroeder and Balassa, 1967	3084	Mouse (*Mus musculus*)	2	U	DR	519	d	21	d	JV	M	MOR	SURV	WO		0.675	73
136	Biswas et al, 1998	15322	Goat (*Capra hircus*)	2	U	DR	78	d	1	yr	JV	F	MOR	MORT	WO		14.4	77
137	Biswas, et al, 2000	25916	Goat (*Ovis aries*)	2	U	OR	12	w	12	mo	AD	F	MOR	MORT	WO		14.4	78
138	Seidenberg et al 1986	113	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	GE	F	MOR	MORT	WO		43.4	85

ACHE = acetylcholinesterase; ACTP = accuracy of learned behavior; ACTV = activity, general; AD = adult; AR = adrenal; ASAT = aspartate aminotransferase; B = both; BDWT = body weight changes; BEH = behavior; BL = blood; BLPR = blood pressure; BR = brain; bw = body weight; CHM = chemical changes; CHOL = cholesterol; d - day; DOPA = dopamine; DR = Drinking water; ENZ = enyzme level changes; EXCR = excretion; F = female; FCNS = food consumption; FD = food; FDB = feeding behavior; GBCM = general biochemical changes; GE = gestation; GENZ = general enzyme changes; GHIS = general histology; GLPX = glutathione peroxidase; GPHY = general pysiology changes; GRO = growth; GRS = gross body weight changes; GV = gavage; HA = hair; HE = heart; HIS = histological changes;HMGL = hemoglobin; HRM = hormone changes; JV = juvenile; kg = kilograms; KI = kidney; L = liter; LI = liver; LOAEL = lowest observed adverse effect level; mo = months; M = male; M = measured; MOR = effects on mortality and survival; MORT = mortality; NOAEL = No Observed Advese Effect Level; NR = Not reported; OR = other oral; ORW = organ weight changes; ORWT = organ weight changes; PHY = physiology; PL = plasma; PORP = porphyrin; PROG = progeny numbers/counts; PRWT = progeny weight; PTH = pathology; RBCE = red blood cell count; REP = reproduction; RPRT = respiratory rate; RSEM = resorbed embryo; SM = sexually mature; SMIX = weight relative to body weight; SP = spleen; SR = serum; SURV = survival; TE = testes; TEWT = testes weight; TRII = tridothyronine; TRYP = tryptophan; U = unmeasured; UR = urine; USTR = ultrastructural changes; UX = measured but values not reported; w = weeks; WCON = water consumption; WO = whole organism; yr = year.

Figure 6.1 Mammalian TRV Derivation for Arsenic



Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.
3) The geometric mean is equal to 2.47 mg arsenic /kg bw/d and is lower than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.
4) The mammalian wildlife TRV for arsenic is equal to 1.04 mg arsenic/kg bw/day which is the geometric mean of NOAEL values for reproduction and growth.

A geometric mean of the NOAEL values for growth and reproduction was calculated at 2.47 mg arsenic/kg bw/day. However, this value is higher than the lowest bounded LOAEL for reproduction, growth, or survival results. Therefore, the TRV is equal to 1.04 mg arsenic/kg bw/day which is the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth or survival.

6.2 Estimation of Dose and Calculation of the Eco-SSL

Three separate Eco-SSL values were calculated for mammalian wildlife, one each for three surrogate species representing different trophic groups. The mammalian Eco-SSLs for arsenic are calculated according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5) and are summarized in Table 6.2

Table 6.2 Calculation of the Mammalian Eco-SSLs for Arsenic

Surrogate Receptor Group	TRV for Arsenic (mg dw/kg bw/d) [1]	Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)	Soil Ingestion as Proportion of Diet (P_s)[2]	Arsenic in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Eco-SSL (mg/kg dw)[4]
Mammalian herbivore (vole)	1.04	0.0875	0.032	$B_i = 0.03752 * Soil_j$ where i = plants	170
Mammalian ground insectivore (shrew)	1.04	0.209	0.030	$\ln(B_j) = 0.706 * \ln(Soil_j) - 1.421$ where i = earthworms	46
Mammalian carnivore (weasel)	1.04	0.130	0.043	$\ln(B_i) = 0.8188 * \ln(Soil_j) - 4.8471$ where i = mammals	170

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] $HQ = FIR * (Soil_j * P_s + B_i) / TRV$ solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

This Page Intentionally Left Blank

7.0 REFERENCES

7.1 General Arsenic References

American Petroleum Institute (API). 1998. *Arsenic: Chemistry, Fate, Toxicity, and Wastewater Treatment Options.* Health and Environmental Sciences Department. Publication 4676.

Canadian Council of Ministers of the Environment (CCME). 1996. Recommended Canadian Soil Quality Guidelines for Arsenic: Environmental and Human Health, Supporting Document - Final Draft. December 1996.

Cullen, W.R. and K. J. Reimer. 1989. Arsenic speciation in the environment. Chem. Rev. 89: 713-764.

Huang, Y-C. 1994. Arsenic distribution in soils. In: Arsenic in the Environment. Part I: Cycling and Characterization, pp 17-49. J. O. Nriagu (ed.), John Wiley & Sons, Inc., New York.

United States Environmental Protection Agency (U.S. EPA). 2003. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs).* November. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-55.

United States Environmental Protection Agency (U.S. EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-28.P.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment*. Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

7.2 References Used for Derivation of Plant and Soil Invertebrate Eco-SSLs

Anastasia, F. B. and Kender, W. J. 1973. The Influence of Soil Arsenic on the Growth of Lowbush Blueberry. *J.Environ.Qual.* 2(3): 335-337

Jacobs, L. W., Keeney, D. R., and Walsh, L. M. 1970. Arsenic Residue Toxicity to Vegetable Crops Grown on Plainfield Sand. *Agron. J.* 62: 588-591.

Jiang, Q. Q. and Singh, B. R. 1994. Effect of different forms and sources of arsenic on crop yield and arsenic concentration. *Water Air Soil Pollut.* 74(3/4): 321-343.

Schweizer, E. E. 1967. Toxicity of DSMA Soil Residues to Cotton and Rotational Crops. *Weed Sci.* 15(1): 72-76.

Woolson, E. A. and Isensee, A. R. 1981. Soil Residue Accumulation from Three Applied Arsenic Sources. *Weed Sci.* 29(1): 17-21.

7.3 References Rejected for Use in Derivation of Plant and Soil Invertebrate Eco-SSLs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

No Tox Albert, W. B. and Arndt, C. H. 1931. The Concentration of Soluble Arsenic as an Index of Arsenic Toxicity to Plants. *South Carolina Agric Exp Sta Ann Rep* 44: 47-48 (1931)

OM, pH Amonoo-Neizer, E. H., Nyamah, D., and Bakiamoh, S. B. 1996. Mercury and Arsenic Pollution in Soil and Biological Samples Around the Mining Town of Obuasi, Ghana. *Water Air Soil Pollut.* 91(3/4): 363-373 (1996)

No Conc Amonoo-Neizer, Eugene H. and Amekor, Emmanuel M. K. 1983. Determination of Total Arsenic in Environmental Samples from Kumasi and Obusai, Ghana. *Environ. Health Perspect.* 101(1): 46-49 (1993)

pH, Anderson, L. W. J., Pringle, J. C., and Raines, R. W. 1978. Arsenic Levels in Crops Irrigated with Water Containing MSMA. *Weed Sci.* 26(4): 370-373.

No Conc Arnott, J. T. and Leaf, A. L. 1967. The Determination and Distribution of Toxic Levels of Arsenic in a Silt Loam Soil. *Weed Sci*. 15(2): 121-124.

Media Asher, C. J. and Reay, P. F. 1979. Arsenic Uptake by Barley Seedlings. *Aust. J. Plant Physiol.* 6: 459-466 (1979).

No Conc Baker, R. S., Barrentine, W. L., Bowman, D. H., Hawthorne, W. L., and Pettiet, J. V. 1976. Crop Response and Arsenic Uptake Following Soil Incorporation of MSMA. *Weed Sci*. 24(3): 322-326.

Mix Bardgett, R. D., Speir, T. W., Ross, D. J., Yeates, G. W., and Kettles, H. A. 1994. Impact of Pasture Contamination by Copper, Chromium, and Arsenic Timber Preservative on Soil Microbial Properties and Nematodes. Biol.Fertil.Soils 18(1): 71-79.

Media Barrachina, A. C., Carbonell, F. B., and Beneyto, J. M. 1995. Arsenic Uptake, Distribution and Accumulation in Tomato Plants: Human Health Risk. Fresenius Environ.Bull. 4: 395-400 (1995)

Mix Batjer, L. P. and Benson, N. R. 1958. Effect of Mtal Chelates in Overcoming Arsenic Toxicity to Peach Trees. Proc Am Soc Hort Sci 72: 74-78 (1958)

No Dur Bech, Jaume, Poschenrieder, Charlotte, Llugany, Merce, Barcelo, Juan, Tume, P., Tobias, F. J., Barranzuela, J. L., and Vasquez, E. R. 1997. Arsenic and heavy metal contamination of soil and vegetation around a copper mine in northern peru. *Science of the Total Environment.* 203(1): 83-91.

No Control Benson, L. M., Porter, E. K., and Peterson, P. J. 1981. Arsenic Accumulation, Tolerance and Genotypic Variation in Plants on Arsenical Mine Wastes in S.W.England. *J. Plant Nutr*. 3(1-4): 655-666 (1981)

OM Benson, N. R. 1953. Effect of Season, Phosphate and Acidity in Plant Growth in Arsenic-Toxic Soils. Soil Sci. 76: 215-224 (1953)

OM Benson, N. R. 1976. Retardation of Apple Tree Growth by Soil Arsenic Residues. *J. Am. Soc. Hortic. Sci*. 101(3): 251-253 (1976)

Media Bhattacharya, A. and Mandal, S. 1999. Loss of Pollen Viability of Cassia siamea Lamk, Following Treatment with Arsenic. *J. Environ. Biol.* 20(1): 67-69.

Rev Bibhas, R. 1975. Fate of Organic Arsenicals in Soils and Plants. Int. Pest. Control. 17: 9-14.

Score Biro, B., Koves-Pechy, K., Voros, I., and Kadar, I. 1998. Toxicity of Some Field Applied Heavy Metal Salts to the Rhizobial and Fungal Microsymbionts of Alfalfa and Red Clover. *Agrokem. Talajtan.* 47(1-4): 265-276.

OM Bishop, R. F. and Chisholm, D. 1962. Arsenic Accumulation in Annapolis Valley Orchard Soils. *Can. J. Soil Sci.* 42: 77-80.

ERE Blatt, C. R. - Effect of Arsenic and Molybdenum on Plant Response of Cauliflower (Brassica oleracea) Grown in Sand Culture. In: M.L.VanBuesichem, (Ed.), *Plant Nutr. Physiol. Appl.* 41: 303-306 (1990)

Species Bliss, C. I. 1936. The Size Factor in the Action of Arsenic upon Silkworm Larvae. *Exp. Biol.* 13: 95-110.

Mix Boisson, J., Ruttens, A., and Vangronsveld, J. 1999. Evaluation of Hydroxyapatite as a Metal Immobilizing Soil Additive for the Remediation of Polluted Soils. Part I. Influence of Hydroxyapatite on Metal Exchangeability in Soil, Plant Growth and Plant Metal Accumulation. *Environ. Pollut.* 104(2): 225-233.

Rev Braman, R. S. 1975. Arsenic in the Environment. In: E.A.Woolson (Ed.), Arsenical Pesticides, Chapter 8, ACS Symp.Ser.No.7, Washington, D.C. 108-123.

Media Brenchley, W. E. 1914. On the Action of Certain Compounds of Zinc, Arsenic, and Boron on the Growth of Plants. *Ann. Bot.* 28: 283-301.

OM, **pH** Burlo, F., Guijarro, I., Carbonell-Barrachina, A. A., Valero, D., and Martinez-Sanchez, F. 1999. Arsenic Species: Effects on and Accumulation by Tomato Plants. *J. Agric. Food Chem.* 47(3): 1247-1253.

Species Campbell, F. L. 1926. Relative Susceptibility to Arsenic in Successive Instars of the Silkworm. *Gen Physiol.* 9(6): 727-733.

OM, pH Carbonell-Barrachina, A. A., Burlo-Carbonell, F., and Mataix-Beneyto, J. 1997. Arsenic Uptake, Distribution and Accumulation in Bean Plants: Effect of Arsenite and Salinity on Plant Growth and Yield. *J. Plant Nutr* . 20(10): 1419-1430.

Media Carbonell-Barrachina, A. A., Aarabi, M. A., DeLaune, R. D., Gambrell, R. P., and Patrick, W. H., Jr. 1998. The influence of arsenic chemical form and concentration on Spartina patens and Spartina alterniflora growth and tissue arsenic concentration. *Plant Soil.* 198(1): 33-43 .

OM, pH Carbonell-Barrachina, A. A., Burlo, F., and Mataix, J. 1998. Response of Bean Micronutrient Nutrition to Arsenic and Salinity. *J. Plant Nutr.* 21(6): 1287-1299.

OM Carbonell-Barrachina, A. A., Burlo, F., Lopez, E., and Martinez-Sanchez, F. 1999. Arsenic Toxicity and Accumulation in Radish as Affected by Arsenic Chemical Speciation. *J. Environ. Sci. Health. Part B.* 34(4): 661-679.

Media Carbonell-Barrachina, A. A., Burlo, F., Valero, D., Lopez, E., Martinez-Romero, D., and Martinez-Sanchez, F. 1999. Arsenic Toxicity and Accumulation in Turnip as Affected by Arsenic Chemical Speciation. *J. Agric. Food Chem.* 47(6): 2288-2294 .

Media Carbonell Abrrachina, A., Burlo Carbonell, F., and Mataix Beneyto, J. 1995. Arsenic uptake, distribution, and accumulation in tomato plants: effect of arsenite on plant growth and yield. *J.Plant Nutr.* 18(6): 1237-1250.

Media Carbonell, A. A., Aarabi, M. A., DeLaune, R. D., Gambrell, R. P., and Patrick, W. H. 1998. Arsenic in wetland vegetation: Availability, phytotoxicity, uptake and effects on plant growth and nutrition. *Science of the Total Environment* . 217(3): 189-199.

OM, pH Carbonell, A. A., Aarabi, M. A., DeLaune, R. D., Gambrell, R. P., and Patrick, W. H., Jr. 1998. Bioavailability and uptake of arsenic by wetland vegetation: effects on plant growth and nutrition. *J.Environ.Sci.Health Part A* A33(1): 45-66.

Species Carriker, N. E., Gillespie, W. T., and Brezonik, P. L. 1976. Boron and Arsenic Studies in Florida Waters. Florida Water Resources Council, Publ.No.34, Gainesville, FL (Cited in Demayo et al 1979) : 3-48.

Score Carrow, R. N., Rieke, P. E., and Ellis, B. G. 1975. Growth of Turf grasses as Affected by Soil Phosphorus and Arsenic. *Soil Sci Am Proc.* 39: 1121-1124.

ERE Cataldo, D. A. and Wildung, R. E. 1978. Soil and Plant Factors Influencing the Accumulation of Heavy Metals by Plants. *Environ. Health Perspect.* 27: 149-159.

Abstract Chaney, R. and Ryan, J. 1995. Risk Based Standards For Arsenic, Lead And Cadmium In Urban Soils. Summary Of Information And Methods Developed To Estimate Standards For Cd, Pb And As In Urban Soils. Govt-Reports-Announcements-&-Index-(GRA&I) (19).

Media Chen, Shyi Hwan. 1997. An investigation on the effect of arsenic poisoning on humans, agriculture, and fisheries. *J. Chin. Chem. Soc.(Taipei).* 44(2): 115-121.

FL Chen, T. and Liu, G. 1993. Effects of Soil pH on Arsenic Adsorption in Soil and Its Toxicity to Rice (*Oryza sativa* L.*). Zhongguo Nongye Kexue (Beijing)* 26(1): 63-68 (CHI).

OM Chen, T. and and Liu, G. 1993. Effect of Arsenic on Rice (*Oryza sativa* L.) Growth and Development and Its Mechanism. Scientia Agricultura Sinica (*Zhongguo Nongye Kexue* (Beijing)) 26(6): 50-58.

OM, pH Chisholm, D. 1972. Lead, Arsenic, and Copper Content of Crops Grown on Lead Arsenate-Treated and Untreated Soils. *Can. J. Plant Sci.* 52: 583-588.

OM, pH Clements, H. F. and Munson, J. 1947. Arsenic Toxicity Studies in Soil and in Culture Solutions. *Pac Sci.* 1: 151-171.

Mix Codling, E. E. and Wright, R. J. 1998. Plant Uptake of Selenium Arsenic and Molybdenum From Soil Treated with Coal Combustion Byproducts. *Fresenius Environ. Bull.* 7(1-2): 118-125.

No Data Cooper, H. P., Paden, W. R., Hall, E. E., Albert, W. B., Rogers, W. B., and Riley, J. A. 1931. Effect of Calcium Arsenate on the Productivity of Certain Soil Types. *S.C. Agric. Exp. Stn. Ann. Rep.* No. 44 , 28-36.

Score Covey, R. P., Koch, B. L., and Larsen, H. J. 1981. Influence of Vesicular Arbuscular Mycorrhizae on the Growth of Apple and Corn in Low-Phosphorous Soil. *Phytopathology.* 71: 712-715.

Score Cox, M. S., Bell, P. F., and Kovar, J. L. 1996. Differential Tolerance of Canola to Arsenic when Grown Hydroponically or in Soil. *J. Plant Nutr.* 19(12): 1599-1610.

OM, pH Crafts, A. S. and Rosenfels, R. S. 1939. Toxicity Studies with Arsenic in Eighty California Soils. *Hilgardia.* 12(3): 177-200.

No Data Crafts, A. S. 1935. The Toxicity of Sodium Arsenite and Sodium Chlorate in Four California Soils. *Hilgardia*. 9: 462-498.

Species Crecelius, E. A., Johnson, C. J., and Hofer, G. C. 1974. Contamination of Soils Near a Copper Smelter by Arsenic, Antimony, and Lead. *Water Air Soil Pollut.* 3: 337-342.

Mix Da Costa, E. W. B. and Bezemer, L. D. 1973. Anti-Fungal Effectiveness of Copper-Chrome-Arsenic Preservatives in a Phosphatic Environment. *Int. Biodeterior. Bull.* 9(1/2): 44-48.

OM, pH Daris, B. T., Papadopoulou, C., Kleperis, J., and Grimanis, A. P. 1970. Herbicide Influence on the Arsenic Uptake of Grapes. A Study by Neutron Activation Analysis. *Proc. Br. Weed Control Conf.* 10(1): 429-433.

Mix Davis, R. D., Beckett, P. H. T., and Wollan, E. 1978. Critical Levels of Twenty Potentially Toxic Elements in Young Spring Barley. *Plant Soil* . 49: 395-408.

Mix De Koe, T. 1991. Arsenic in Water, Sediment and Vegetation of the Jales Gold Mine, North Portugal. In: J.Rozema and J.A.C.Verkleij (Eds.), *Ecological Responses to Environmental Stresses*, Chapter 5, Kluwer Acad.Publ., Netherlands : 42-47 (1991)

No Data Dorman, C., Tucker, F. H., and Coleman, R. 1939. The Effect of Calcium Arsenate upon the Productivity of Several Important Soils of the Cotton Belt. *J Am Soc Agron.* 31: 1020-1028.

No Conc Deuel, L. E. and Swoboda, A. R. 1972. Arsenic Toxicity to Cotton and Soybeans. *J. Environ. Qual*. 1(3): 317-320.

Rev Environment Canada. - Canadian Soil Quality Guidelines for Arsenic: (Environmental and Human Health). Draft Document.Guidelines Division, Evaluation and Interpretation Branch, Environmental Conservation Service, Environment Canada, Ottawa : 61 p. (1996)

ERE Escritt, J. R. 1955. Calcium Arsenate for Earthworm Control. *J Sports Turf Res Inst* 9: 28-34 .

Media Fargasova, A. 1994. Effect of Pb, Cd, Hg, As, and Cr on Germination and Root Growth of Sinapis alba Seeds. *Bull. Environ. Contam. Toxicol.* 52: 452-456 .

OM, pH Fergus, I. F. 1955. A Note on Arsenic Toxicity in Some Queensland Soils. Queensland J. *Agric. Sci.* 12(4): 95-100 (1955)

No Conc Fodor, L. 1998. Effect of Heavy Metals on Wheat and Maize Crop on Brown Forest Soil. *Agrokem.Talajtan.* 47(1-4): 197-206.

Rev Fowler, B. A. and Mahaffey, K. R. 1978. Interactions Among Lead, Cadmium, and Arsenic in Relation to Porphyrin Excration Patterns. Environ.Health Perspect. 25: 87-9.

OM, pH Gal, J. Y. and Bouche, M. B. 1988. Correlation of Lethal Concentrations of Heavy Metals with Tissue Levels of Earthworms. University of France, Montpellier, France (NTIS#ADA199269) : 34 (1988)

OM Geiszinger, A., Goessler, W., Kuehnelt, D., Francesconi, K., and Kosmus, W. 1998. Determination of arsenic compounds in earthworms. *Environ. Sci. Technol*. 32(15): 2238-2243 (8-1-1998).

OM, pH Gill, B. S. and Sandhu, S. S. 1992. Application of the tradescantia micronucleus assay for the genetic evaluation of chemical mixtures in soil and aqueous media. *Mutation Research* 270(1): 65-69.

OM, pH Girling, C. A., Peterson, P. J., and Minski, M. J. 1978. Gold and Arsenic Concentrations in Plants as an Indication of Gold Mineralization. *Sci Total Environ.* 10(1): 79-86 .

FL Guo, Y., Wang, Z., Lai, Q., Zhang, Y., Xia, W., Yan, H., and Deng, J. 1995. Soil Heavy Metal Pollution And Earthworm Isozymes. *Yingyong Shengtai Xuebao* 6(3): 317-322.

OM, pH Hall, I. V., Lockhart, C. L., Newbery, R. J., and Wood, G. W. 1971. Factors Affecting Arsenic Injury to Lowbush Blueberry Foliage. *Phytoprotection* 52(3): 95-99.

Media Hara, T., Sonoda, Y., and Iwai, I. 1977. Growth Response of Cabbage Plants to Arsenic and Antimony Under Water Culture Conditions. *Soil Sci.Plant Nutr*. 23(2): 253-256 .

Mix Helgesen, H. and Larsen, E. H. 1998. Bioavailability and Speciation of Arsenic in Carrots Grown in Contaminated. *Soil. Analyst*. 123(5): 791-796.

Mix Hiroko, Mikiya. 1993. Effect of Arsenic Pollution on Soil Microbial Population. *Soil Sci.Plant Nutr*. 39(2): 227-235.

FL Il'In, V. B. and Konarbaeva, G. A. 1993. Forms of arsenic in soil and its accumulation in tomato organs. *Agrokhimiya* : 54-57.

FL Il'In, V. B. 1994. Arsenic in orchard soils of kuzbas cities. *Agrokhimiya* : 82-85.

OM Jackson, B. P., Miller, W. P., Schumann, A. W., and Sumner, M. E. 1999. Trace Element Solubility from Land Application of Fly Ash/Organic Waste Mixtures. *J.Environ.Qual.* 28(2): 639-647.

No Control Johnson, L. R. and Hiltbold, A. E. 1969. Division S-4-Soil Fertility and Plant Nutrition. Arsenic Content of Soil and Crops Following Use of Methanearsonate Herbicides. *Soil Sci.Soc.Am.Proc*. 33(2): 279-282.

ERE Johnson, L. R. and Hiltbold, A. E. 1969. Arsenic Content of Soil and Crops Following Use of Methanearsonate Herbicides. *Soil Sci.Soc.Am.Proc* . 33(1): 279-282.

Mix Jones, J. S. and Hatch, M. B. 1945. Spray Residues and Crop Assimilation of Arsenic and Lead. Soil Sci. 60: 277-288.

ERE Kanabo, I. A. K. and Gilkes, R. J. 1992. Low-Contaminant Jarosite Waste as a Fertilizer Amendment. *J. Environ. Qual*. 21(4): 679-684 .

FL Kawashiro, I. and Kondo, T. 1962. Determination of Trace Amounts of Poisonous Metals in Foods. II. The Content of Arsenic, Cadmium, Copper, Manganese and Mercury in Rice, Wheat Flour and Soybeans. *Bull. Natl. Inst. Hyg. Sci*. 80: 75-87 (JPN).

Media Khattak, R. A., Haghnia, G. H., Mikkelsen, R. L., Page, A. L., and Bradford, G. R. 1989. Influence of Binary Interactions of Arsenate, Molybdate and Selenate on Yield and Composition of Alfalfa. *J. Environ. Qual.* 18(3): 355-360.

Media Khattak, R. A., Page, A. L., Parker, D. R., and Bakhtar, D. 1991. Accumulation and Interactions of Arsenic, Selenium, Molybdenum and Phosphorus in Alfalfa. *J. Environ. Qual.* 20(1): 165-168.

OM Kiss, A. S., Oncsik, M., Dombovari, J., Veres, S., and Acs, G. 1992. Dangers of arsenic drinking and irrigation water to plants and humans: antagonism of arsenic and magnesium. *Acta Agron. Hung.* 41(1/2): 3-9 .

FL Koseki, K. 1988. Suppression of arsenic injury of rice plants by the application of higher phosphate concn. in culture soln. *Gakujutsu Hokoku - Miyagi-ken Nogyo Tanki Daigaku* 36: 15-21.

FL Kulich, J. 1987. Basic Nutrition and Phytotoxicity Caused by Arsenic and Lead. Part II. *Agriculture* 33(10): 907-919 (RUS) (1987)

FL Kulich, J. and Kulichova, R. 1984. Comparison of the Phytotoxicity of Arsenic and Lead (Porovnanie Fytotoxicity Arzenu a Olova). *Agriculture* 30(2): 109-117 (RUS).

FL Kulich, Jozef. 1988. The response of cereals to arsenic and lead. *Rostl. Vyroba* 34(5): 491-498.

FL Kulich, Jozef. 1990. Detoxication of arsenic in cereals and legumes by sulfur. *Rostl. Vyroba 36(4): 395-405.*

Species Lancaster, R. J., Coup, M. R., and Hughes, J. W. 1971. Toxicity of Arsenic Present in Lakeweed. *N.Z.Vet.J.* 19(7): 141-145.

Media Lane, I. and Puckett, K. J. 1979. Responses of the Phosphatase Activity of the Lichen Cladina rangiferina to Various Environmental Factors Including Metals. *Can. J. Bot.* 57: 1534-1540.

Mix Langdon, C. J., Piearce, T. G., Black, S., and Semple, K. T. 1999. Resistance to Arsenic-Toxicity in a Population of the Earthworm *Lumbricus rubellus*. *Soil Biol Biochem.* 31: 1963-1967.

Mix Lejeune, Katherine, Galbraith, Hector, Lipton, Joshua, and Kapustka, Lawrence A. 1996. Effects of metals and arsenic on riparian communities in southwest Montana. *Ecotoxicology* . 5(5): 297-312.

FL Li, Xunguang and Li, Xiaoping. 1992. Critical concentration of arsenic in soils of Xiashu loess area. *Turang (Nanjing) (CHI*). 24(6): 302-305.

Media Liebig, G. F., Jr., Bradford, G. R., and Vanselow, A. P. 1959. Effects of Arsenic Compounds on Citrus Plants in Solution Culture. *Soil Sci.* 88(6): 342-348.

Rev Liebig, G. F. Jr. 1966. Arsenic. In: H.D.Chapman (Ed.), *Diagnostic Criteria for Plants and Soils*, University of California, Berkeley, CA : 13, 23 (1966)

Media Lindner, R. C. and Reeves, E. R. 1942. Arsenic Injury of Peach Trees: A Disorder Sometimes Confused with Western X-Disease. *Washington State Hort Assoc Proc* 38: 37-40.

No Dur Lindner, R. C. 1943. Arsenic Injury of Peach Trees. *Proc Am Soc Hort Sci.* 42: 275-279.

FL Luo, Jinfa, Xia, Zenglu, and Li, Senzhao. 1991. Chemical behavior of arsenic in purple soil and their effects on crops. *Huanjing Kexue Xuebao*. 11(3): 269-275.

Media Machlis, L. 1941. Accumulation of Arsenic in the Shoots of Sudan Grass and Bush Bean. *Plant Physiol*. 16: 521-543.

Species MacLauchlan, L. E., Borden, J. H., D'Auria, J. M., and Wheeler, L. A. 1988. Distribution of arsenic in MSMA-treated lodgepole pines infested by the mountain pine beetle Dendroctonus-ponderosae Coleoptera Scolytidae and its relationship to beetle mortality. .*Journal of Economic Entomology*. 81 (1): .274-280.

Media Marin, A. R., Pezeshki, S. R., Masschelen, P. H., and Choi, H. S. 1993. Effect of dimethylarsenic acid (DMAA) on growth, tissue arsenic, and photosynthesis of rice plants. *J. Plant Nutr.* 16(5): 865-880.

Conc Marin, A. R., Masscheleyn, P. H., and Patrick, W. H., Jr. 1993. Soil Redox-pH Stability of Arsenic Species and Its Influence on Arsenic Uptake by Rice. *Plant Soil.* 152(2): 245-253.

OM Martin, R. R., Tomlin, A., and Marsello, B. - Arsenic Uptake in Orchard Trees: Implications for Dendroanalysis. Chemosphere 41(5): 635-637 (2000)

OM, pH Mcbee, G. G., Johnson, P. R., and Holt, E. C. 1967. Arsenic Residue Studies on Coastal Bermudagrass. Weeds 15: 77-79.

OM, pH Mclean, H. C., Weber, A. L., and Joffe, J. S. 1944. Arsenic Content of Vegetables Grown in Soils Treated with Lead Arsenate. *J. Econ. Entomol.* 37(3): 315-316.

Score Meharg, A. A., Shore, R. F., and Broadgate, K. 1998. Edaphic Factors Affecting the Toxicity and Accumulation of Arsenate in the Earthworm *Lumbricus terrestris*. *Environ. Toxicol. Chem.* 17(6): 1124-1131.

Media Meharg, A. A. and Macnair, M. R. 1991. Uptake, Accumulation and Translocation of Arsenate in Arsenate-Tolerant and Non-Tolerant *Holcus lanatus* L. *New Phytol.* 117: 225-231.

Mix Merry, R. H., Tiller, K. G., and Alston, A. M. 1986. The Effects of Soil Contamination with Copper, Lead and Arsenic on the Growth and Composition of Plants. II. Effects of Source of Contamination, Varying soil pH, and Prior Waterlogging. *Plant Soil*. 95: 255-269.

No Control Merry, R. H., Tiller, K. G., and Alston, A. M. 1986. The Effects of Contamination of Soil with Copper, Lead and Arsenic on the Growth and Composition of Plants. I. Effects of Season, Genotype, Soil Temperature and Fertilizers. *Plant Soil*. 91: 115-128.

OM Miller, R. L., Bassett, I. P., and Yothers, W. W. 1933. Effect of Lead Arsenate Insecticides on Orange Trees in Florida. U.S.Dep.of Agric.Tech.Bull.No.350, Washington, D.C. 20 p.

Mix Morgan, A. J., Winters, C., and Yarwood, A. 1994. Speed-Mapping Of Arsenic Distribution In The Tissues Of Earthworms Inhabiting Arsenious Soil. *Cell Biol Int Rep.* 18(9): 911-914.

OM, pH Murphy, H. J. and Goven, M. J. 1966. Arsenic Residues in Potato Soils and Tubers. *Maine Farm Res*. 14(3): 4-8.

Rev National Academy of Sciences. Arsenic. Medical and Biologic Effects of Environmental Pollutants. Rep.of the Natl.Tech.Advisory Committee to the Secretary of the Interior, Washington, D.C. 277-321

Rev National Research Council of Canada. 1978. Effects of Arsenic in the Canadian Environment. NRCC No.15391, Associate Committee on Scientific Criteria for Environmental Quality, National Research Council of Canada, Ottawa: 352 p. 363.

Media Ngu, M., Moya, E., and Magan, N. 1998. Tolerance and uptake of cadmium, arsenic and lead by Fusarium pathogens of cereals. *International Biodeterioration & Biodegradation.* 42(1): 55-62.

Media Nissen, P. and Benson, A. A. 1982. Arsenic Metabolism in Freshwater and Terrestrial Plants. *Physiol. Plant.* 54: 446-450 .

pH Nyarai-Horvath, F., Szalai, T., Kadar, I., and Csatho, P. 1997. Germination characteristics of pea seeds originating from a field trial treated with different levels of harmful elements. *Acta Agron. Hung*. 452(147-154).

No Dur Olson, O. E., Sisson, L. L., and Moxon, A. L. 1940. Absorption of Selenium and Arsenic by Plants from Soils Under Natural Conditions. *Soil Sci.* 50: 115-118.

No Data Onken, B. M. and Hossner, L. R. 1995. Plant uptake and determination of arsenic species in soil solution under flooded conditions. *J. Environ. Qual*. 24(2): 373-381.

OM, pH Otte, M. L., Rozema, J., Beek, M. A., Ernst, W. H. O., and Broekman, R. A. 1988. Uptake of Arsenic by Vegetation of the Former Rhine Estuary. Proc.Third Int.Conf.Environ.Contam., Sept.1988, Venice, Italy : 529-531.

OM, pH Otte, M. L., Rozema, J., Beek, M. A., Kater, B. J., and Broekman, R. A. 1990. Uptake of Arsenic by Estuarine Plants and Interactions with Phosphate, in the Field (Rhine Estuary) and Under Outdoor Experimental Conditions. *Sci.Total Environ.* 97/98: 839-854.

Media Paivoke, A. 1983. Anatomical Response of the Roots of Pea Seedlings to Lead and Arsenate Ions. *Ann. Bot. Fenn.* 20: 307-315.

Media Paliouris, G. and Hutchinson, T. 1997. Arsenic, Cobalt and Nickel Tolerances in Two Populations of Silene vulgaris (Moench) Garcke from Ontario, Canada. *New Phytol.* 117: 449-459.

No COC Pavlikova, D., Tlustos, P., Szakova, J., and Balik, J. 1997. b The effect of application of potassium humate on the content of cadmium, zinc and arsenic in plants. *Rostl. Vyroba* 43(10): 481-486.

Media Pepper, I., Galanti, N., Sans, J., and Lopez-Saez, J. F. 1988. Reversible Inhibition of Root Growth and Cell Proliferation by Pentavalent Arsenic in *Allium cepa* L. *Environ. Exp. Bot.* 28(1): 9-18.

Rev Pershagen, G. and Vahter, M. 1979. Arsenic-A Toxicological and Epidemiological Appraisal. Naturvardsverket Rapp.SNV PM 1128, Liber Tryck, Stockholm : 265 .

Species Peryea, F. J. 1991. Phosphate-Induced Release of Arsenic from Soils Contaminated with Lead Arsenate. *Soil Sci. Soc. Am. J.* 55(5): 1301-1306.

Mix Pilgrim, W. 1995. Lead, Cadmium, Arsenic, And Zinc In The Ecosystem Surrounding The Belledune Lead Smelter. Gov.Rep.Announce.Index (24) (1995)

Mix Pitten, F. A., Muller, G., Konig, P., Schmidt, D., Thurow, K., and Kramer, A. 1999. Risk Assessment of a Former Military Base Contaminated with Organoarsenic-Based Warfare Agents: Uptake of Arsenic by Terrestrial Plants. *Sci Total Environ.* 226: 237-245.

Mix Porter, E. K. and Peterson, P. J. 1975. Arsenic Accumulation by Plants on Mine Waste (United Kingdom). *Sci Total Environ.* 4(4): 365-371.

Media Porter, E. K. and Peterson, P. J. 1977. Arsenic Accumulation by Plants on Mine Waste (United Kingdom). *Environ. Pollut. Ser. A Ecol. Biol.* 14(4): 255-265.

OM, pH Pyles, R. A. and Woolson, E. A. 1982. Quantitation and Characterization of Arsenic Compounds in Vegetables Grown in Arsenic Acid Treated Soil. *J.Agric.Food Chem*. 30(5): 866-870 .

No Data Reed, J. F. and M. B. Sturgis. 1936. Toxicity from Arsenic Compounds to Rice on Flooded Soils. *J. Am. Soc. Agron.* 28: 432-436.

Species Riedel, G. F. and Valette-Silver, N. 2002. Differences in the Bioaccumulation of Arsenic by Oysters from Southeast Coastal US and Chesapeake Bay: Environmental Versus Genetic Control. *Chemosphere.* 49(1): 27-37 (2002)

OM Robinson, E. L. 1975. Arsenic in Soil with Five Annual Applications of MSMA. *Weed Sci.* 23(5): 341-343.

Media Rocovich, S. E. and West, D. A. 1975. Arsenic Tolerance in a Population of the Grass *Andropogon scoparius Michx. Science* 188: 263-264 (1975)

OM, pH Rosehart, R. G. and Lee, J. Y. 1973. The Effect of Arsenic Trioxide on the Growth of White Spruce Seedlings. *Water Air Soil Pollut.* 2: 439-443.

Rev Sandberg, G. R. and Allen, I. K. 1975. A Proposed Arsenic Cycle in an Agronomic Ecosystem. In: E.A.Woolson (Ed.), *Arsenical Pesticides, ACS Symp.Ser.No.7* : 124-147 (1975)

FL Savory, J. and Wills, M. R. Arsenic. In: E.Merian (Ed.), Metals in the Environment: Distribution, Analysis and Biological Relevance, Chapter 3, Verlag: Weinheim, West Germany

OM, pH Sheppard, M. I., Thibault, D. H., and Sheppard, S. C. 1985 Concentrations and Concentration Ratios of U, As and Co in Scots Pine Grown in a Waste-Site Soil and an Experimentally Contaminated Soil. *Water Air Soil Pollut.* 26(1): 85-94 .

Rev Sheppard, S. C. 1992. Summary of Phytotoxic Levels of Soil Arsenic. *Water Air Soil Pollut.* 64(3/4): 539-550.

ERE Shinonaga, Taeko and Ambe, Shizuko. 1998. Multitracer study on absorption of radionuclides in atmosphere-plant model system. *Water Air Soil Pollut.* 10(1-4): 93-103.

OM, pH Sieczka, J. B. and Lisk, D. J. 1971. Arsenic Residues in Red Clover. *Am.Potato J.* 48: 395-397.

OM, pH Sihlbom, E. 1956. Arsenic in Potato Tubers. *Sveriges Utsadesforen Tids* 66: 199-201 (1956)

OM Sihlbom, E. and Fredriksson, L. 1960. Yield and Arsenic Content in Potatoes Grown in Soil with Different Amounts of Arsenite. *Sveriges Utsadesforen Tids* 70: 312-317 .

pH Simon, T., Mikanova, O., and Kubat, J. 1998. The Effect of Addition of Inorganic Ni and As Compounds on the Growth of Radish and Activities of Soil Microorganisms. *Rostl.Vyroba.* 44(4): 187-192.

OM, pH Singh, B. R. and Steinnes, E. 1976. Uptake of Trace Elements by Barley in Zinc-Polluted Soils: 2. Lead, Cadmium, Mercury, Selenium, Arsenic, Chromium and Vanadium in Barley. *Soil Sci.* 121(1): 38-43 .

Rev Slooff, W., Haring, B. J. A., Hesse, J. M., Janus, J. A., and Thomas, R. 1990. Integrated Criteria Document Arsenic. RIVM Rep.No.758701002, Natl.Inst.of Public Health and Environ.Prot., Bilthoven, Netherlands : 130 p. (DUT).

OM, pH Small, H. G., Jr. and McCants, C. B. 1962. Residual Arsenic in Soils and Concentration in Tobacco. *Tobacco Sci.* 6: 34-36.

ERE Small, H. G., Jr. and McCants, C. B. 1962. Influence of Arsenic Applied to the Growth Media on the Arsenic Content of Flue-Cured Tobacco. *Agron .J.* 54: 129-133.

Rev Smith, E., Naidu, R., and Alston, A. M. 1998. Arsenic in the Soil Environment: A Review. *Adv.Agron.* 64: 149-195 .

Mix Speir, T. W., Ross, D. J., Feltham, C. W., Orchard, V. A., and Yeates, G. W. 1992. Assessment of the Feasibility of Using CCA (Copper, Chromium and Arsenic)-Treated and Boric Acid-Treated Sawdust as Soil Amendments. II. Soil Biochemical and Biological Properties. *Plant Soil.* 142(2): 249-258.

No COC Speir, T. W., August, J. A., and Feltham, C. W. 1992. Assessment of the feasibility of using cca copper chromium and arsenic-treated and boric acid-treated sawdust as soil amendments i. Plant growth and element uptake. *Plant Soil* 142(2): 235-248.

Media Stakman, E. C., Stevenson, F. V., and Wilson, C. T. 1946. Adaptation of Monosporidial Lines of Ustilago zeae to Arsenic. *Phytopathology* 36: 411 (ABS).

OM, pH Steevens, D. R., Walsh, L. M., and Keeney, D. R. 1972. Arsenic Residues in Soil and Potatoes from Wisconsin Potato Fields - 1970. *Pestic.Monit.J.* 6(2): 89-90 .

Score Steevens, D. R., Walsh, L. M., and Keeney, D. R. 1972. Arsenic Phytotoxicity on a Plainfield Sand as Affected by Ferric Sulfate or Aluminum Sulfate. *J. Environ. Qual.* 1(3): 301-303.

OM, pH Stewart, J. and Smith, E. S. 1922. Some Relations of Arsenic to Plant Growth: Part 2. *Soil Sci.* 14(2): 119-126.

No Dur Stijve, T., Vellinga, E. C., and Herrmann, A. 1990. Arsenic Accumulation in Some Higher Fungi. *Persoonia* 14: 161-166.

No Tox Tang, T. and Miller, D. M. 1991. Growth and Tissue Composition of Rice Grown in Soil Treated with Inorganic Copper Nickel and Arsenic. *Commun .Soil Sci. Plant Anal.* 22(19/20): 2037-2046.

OM Thompson, A. H. and Batjer, L. P. 1950. Effect of Various Soil Treatments for Correcting Arsenic Injury of Peach Trees. *Soil Sci.* 69: 281-290.

No Tox Thompson, M. E. and Johnston, A. M. 1958. Total Sulphydryl Content of Embryos of Arsenic-Resistant and Sensitive Strains of the Blue Tick Boophilus decoloratus. *Nature.* 181: 647-648.

No Stats Tlustos, P., Balik, J., Szakova, J., and Pavlikova, D. 1998. The accumulation of arsenic in radish biomass when different forms of As were applied in the soil (Czech). *Rostlinna Vyroba*. 44(1): 7-13.

Mix Tlustos, P., Pavlikova, D., Balik, J., Szakova, J., Hanc, A., and Balikova, M. 1998. The accumulation of arsenic and cadmium in plants and their distribution [Czech]. *Rostlinna Vyroba* 44(10): 463-469.

Mix Tlustos, P., Balik, J., Pavlikova, D., and Szakova, J. 1997. The uptake of cadmium, zinc, arsenic and lead by chosen crops. *Rostl.Vyroba*. 43(10): 487-494.

Mix Tolle, D. A., Arthur, M. F., Chesson, J., and Van Voris, P. 1985. Comparison of Pots Versus Microcosms for Predicting Agroecosystem Effects due to Waste Amendment. *Environ.Toxicol.Chem.* 4(4): 501-509.

Media Tso, T. C., Sorokin, T. P., and Engelhaupt, M. E. 1973. Effects of Some Rare Elements on Nicotine Content of the Tobacco Plant. *Plant Physiol*. 51: 805-806.

Rev Tsutsumi, M. 1981. Arsenic Pollution in Arable Land. In: K.Kitagishi and I.Yamane (Eds.), Chapter 14, *Heavy Metal Pollutin in Soils of Japan*, Japan Scientific Soc.Press, Tokyo : 181-192 (1981)

Rev Valberg, P. A., Beck, B. D., Bowers, T. S., Keating, J. L., Bergstrom, P. D., and Boardman, P. D. 1997. Issues In Setting Health-Based Cleanup Levels For Arsenic In *Soil. Regul Toxicol Pharmacol.* 26(2): 219-229.

Rev *Vetter, J. 1994. Data on Arsenic and Cadmium Contents of Some Common Mushrooms.* Toxicon 32(1): 11-15.

Media Villalobos-Pietrini, R., Flores-Marquez, A. R., Sanchez, M., and Gomez-Arroyo, S. 1990. Micronuclei induced in tradescantia by arsenic. *Rev Int Contam Ambient.* 6(1): 75-78.

Mix Wang, Zhenzhong, Zhang, Youmei, Hu, Juelian, Zheng, Yunyou, Hu, Zhaoyang, Guo, Yongcan, Lai, Qing, Yan, Hengmei, and Deng, Jifu. 1994. Effect of heavy metals in soil on earthworms (Opisthopora). *Huanjing Kexue Xuebao*. 14(2): 236-243.

Score Weaver, R. W., Melton, J. R., Wang, D., and Duble, R. L. 1984. Uptake of Arsenic and Mercury from Soil by Bermuidagrass *Cynodon dactylon. Environ. Pollut.* 33: 133-142.

Media Wells, B. R. and Gilmour, J. T. 1977. Sterility in Rice Cultivars as Influenced by MSMA Rate and Water Management. *Agron.J.* 69: 451-454.

Media Wetzel, A. and Werner, D. 1995. Ecotoxicological Evaluation of Contaminated Soil Using the Legume Root Nodule Symbiosis as Effect Parameter. *Environ.Toxicol.Water Qual.* 10(2): 127-133.

Mix Wiersma, D., Van Goor, B. J., and Van der Veen, N. G. 1986. Cadmium, Lead, Mercury, and Arsenic Concentrations in Crops and Corresponding Soils in The Netherlands. *J. Agric. Food Chem*. 34: 1067-1074.

Mix Wilkins, C. 1997. The Uptake of Copper, Arsenic and Zinc by Miscanthus-Environmental Implications for Use as an Energy Crop. Biomass and Energy Crops, April 7-8, 1997, Royal Agricultural College, Cirencester : 335-340 (1997)

Score Woolson, E. A., Axley, J. H., and Kearney, P. C. 1973. The Chemistry and Phytotoxicity of Arsenic in Soils: II. Effects of Time and Phosphorus. *Proc. Soil Sci. Soc. Am.* 37: 254-259.

No Data Woolson, E. A. 1973. Arsenic Phytotoxicity and Uptake in Six Vegetable Crops. *Weed Sci.* 21(6): 524-527.

Score Woolson, E. A. 1972. Effects of Fertiliser Materials and Combinations on the Phytotoxicity, Availability and Content of Arsenic in Corn (Maize). *J. Sci. Food Agric.* 23: 1477-1481.

OM Woolson, E. A., Axley, J. H., and Kearney, P. C. 1971. Correlation Between Available Soil Arsenic, Estimated by Six Methods, and Response of Corn *(Zea mays* L.). *Soil Sci.Soc.Am.Proc*. 35(1): 101-105 (1971)

No Data Woolson, E. A., Axley, J. H., and Kearney, P. C. 1971. The Chemistry and Phytotoxicity of Arsenic in Soils: I. Contaminated Field Soils. *Soil Sci Am Proc.* 35: 938-943.

Mix Wyttenbach, A., Bajo, S., and Tobler, L. 1996. Arsenic Concentrations in Successive Needle Age Classes of Norway Spruce (*Picea abies* (L.) Karst.). *Fresenius' J.Anal.Chem.* 354(5/6): 668-671.

No Dur Wyttenbach, A., Bajo, S., Furrer, V., Langenauer, M., and Tobler, L. 1997. The accumulation of arsenic, bromine and iodine in needles of norway spruce *(Picea abies* (l.) Karst.) At sites with low pollution. *Water Air Soil Pollut.* 94(3-4): 417-430.

FL Xi, Yuying, Li, Feng, and Fan, Jiaren. 1989. Rule of accumulation and movement of chromium and arsenic in soil and the inside of plants. *Shanxi Daxue Xuebao, Ziran Kexueban.* 12(4): 472-480.

Media Xie, Zheng Miao and Huang, Chang Yong. 1998. Control of arsenic toxicity in rice plants grown on an arsenic-polluted paddy soil. *Commun. Soil Sci.Plant Anal*. 29(15/16): 2471-2477.

FL Xie, Zhengmiao, Zhu, Zuxiang, Yuan, Keneng, and Huang, Changyong. - Effect of birnessite (.delta.-MnO2) on oxidation of arsenic(III) in soils. Huanjing Huaxue 8(2): 1-6 (1989)

FL Xie, Zhengmiao, Zhu, Zuxiang, Yuan, Keneng, and Huang, Changyong. 1991. Study on critical arsenic contents causing toxicity towards rice plants in different soils. *Zhongguo Huanjing Kexue* 11(2): 105-108.

Mix Yeates, G. W., Orchard, V. A., and Speir, T. W. 1995. Reduction In Faunal Populations And Decomposition Following Pasture Contamination By A Cu-Cr-As Based Timber Preservative. *Acta Zool. Fenn*. (196): 297-300.

OM, pH Yothers, M. A. and Carlson, F. W. - Effect of DDT on the Green Peach Aphid and Its Coccinellid Predators. J.Econ.Entomol. 41(3): 515-516 (1948)

Species Zaman, K., MacGill, R. S., Johnson, J. E., Ahmad, S., and Pardini, R. S. - An Insect Model for Assessing Oxidative Stress Related to Arsenic Toxicity. Arch.Insect Biochem.Physiol. 29(2): 199-209 (1995)

FL Zyrin, N. G., Kovnatskii, E. F., Roslyakov, N. P., Ryakhovskii, A. V., and Samonov, A. M. - Determination of Arsenic and Antimony in Plants. Yad.-Fiz.Metody Anal.Kontrole Okruzh.Sredy, Tr.Vses.Soveshch. 228-231 (1985)

7.4 References Used for Derivation of Wildlife TRVs

Bencko, V. 1972. oxygen consumption by mouse liver homogenate during drinking water arsenic exposure. ii. *J. Hyg. Epidemiol., Microbiol., Immunol.* 16(1): 42-6. Ref ID: 15471

Benes, B. and Bencko, V. 1981. content of lipids and esterified fatty acids in the liver of mice exposed to arsenic in drinking water. *J. Hyg. Epidemiol., Microbiol., Immunol.* 25(4): 384-92. Ref ID: 15288

Biswas, U., Sarkar, S., Bhowmik, M. K., and Roy, S. clinicopathological profile of induced chronic arsenic toxicity in Goats. *Indian Journal of Animal Sciences; 68 (4). 1998. 320-323.* Ref ID: 15322

Biswas, U. S. Sarkar M. K. Bhowmik A. K. Samanta and S. Biswas. 2000. chronic toxicity of arsenic in goats: clinicobiochemical changes pathomorphology and tissue residues. *Small Ruminant Research* 38(3): 229-235. Ref ID: 25916

Blakley, BR, Sisodia, CS, and Mukkur, TK. 1980. the effect of methylmercury, tetraethyl lead, and sodium arsenite on the humoral immune response in mice. *Toxicol. Appl. Pharmacol.* 52(2): 245-254. Ref ID: 14598

Brown, M. M., Rhyne, B. C., and Goyer, R. A. 1976. intracellular effects of chronic arsenic administration on renal proximal tubule cells. *J Toxicol Environm Health.* 1(3): 505-514. Ref ID: 4

Byron, W. R., Bierbower, G. W., Brouwer, J. B., and Hansen, W. H. 1967. pathologic changes in rats and dogs from two-year feeding of sodium arsenite or sodium arsenate. *Toxicol.Appl.Pharmacol.* 10(1): 132-147. Ref ID: 2

Cabe, P. A., Carmichael, N. G., and Tilson, H. A. 1979. effects of selenium, alone and in combination with silver or arsenic, in rats. *Neurobehav Toxicol.* 1(4): 275-8. Ref ID: 1244

Camardese, Michael B. , Hoffman, David J., LeCaptain, Leonard J., and Pendleton, Grey W. effects of arsenate on growth and physiology in mallard ducklings. *Environ. Toxicol. Chem. (1990)* 9(6): 785-95. Ref ID: 5747

Carmignani, M., Boscolo, P., and Castellino, N. 1985. metabolic fate and cardiovascular effects of arsenic in rats and rabbits chronically exposed to trivalent and pentavalent arsenic. *Arch. Toxicol. Suppl.* (8): (Recept. Other Targets Toxic Subst.), 452-5. Ref ID: 15174

Carmignani, M., Boscolo, P., and Iannaccone, A. effects of chronic exposure to arsenate on the cardiovascular function of rats. *Br. J. Ind. Med. (1983)* 40(3): 280-4. Ref ID: 15249

Chaudhuri, Aditi Nag, Basu, Srabanti, Chattopadhyay, Sukumar, and Gupta, S. Das. effect of high arsenic content in drinking water on rat brain. *Indian J. Biochem. Biophys. (1999)* 36(1): 51-54. Ref ID: 15033

Chiou WenShyg, P., Chen, K. L., and Yu, B. 1998. effect of dietary organic arsenicals and cupric sulfate on copper toxicity, liver accumulation and residue in eggs and excreta of laying Hens. *Animal Feed Science and*

Technology. 73(1-2) Ref ID: 2049

Cobo, Jose M., Aguilar, Maria V., and Martinez, Maria C. effect of chronic cr3+ administration and its interaction with dietary as3+ on glucose tolerance in wistar rats . *Nutr. Res. (N. Y.) (1995)* 15(4): 555-64. Ref ID: 15198

Coulson, EJ, Remington, RE, and Lynch, KM. 1935. metabolism in the rat of the naturally occurring arsenic of shrimp as compared with arsenic trioxide. *J. Nutr.* 10: 255-270. Ref ID: 14603

Fowler, BA, Woods, JS, and Schiller, CM. 1977. ultrastructural and biochemical effects of prolonged oral arsenic exposure on liver mitochondria of rats. *Environ. Health Perspect.* 19: 197-204. Ref ID: 14569

Fowler, Bruce A. and Woods, James S. the effects of prolonged oral arsenate exposure on liver mitochondria of mice : morphometric and biochemical studies. *Toxicol. Appl. Pharmacol. (1979)* 50(2): 177-87. Ref ID: 15358

Franke, KW and Moxon, AL. 1937. the toxicity of orally ingested arsenic, selenium, tellurium, vanadium and molybdenum. *J. Pharmacol. Exp. Ther.* 61: 89. Ref ID: 14508

Fuentes, N, Zambrano, F, and Rosenmann, M. 1981. arsenic contamination: metabolic effects and localization in rats. *Comp. Biochem. Physiol.* 70C: 269-272. Ref ID: 14570

Garcia-Vargas, G., Cebrian, M. E., Albores, A., Lim, C. K., and De Matteis, F. 1995. time-dependent porphyric response in mice subchronically exposed to arsenic. *Human & Experimental Toxicology* 14(6): 475-83. Ref ID: 15530

Ghosh, Debidas, Chattopadhyay, Sandip, and Debnath, Jogen. effect of sodium arsenite on adrenocortical activity in immature female rats : evidence of dose-dependent response. *J. Environ. Sci. (China) (1999)* 11(4): 419-422 . Ref ID: 15011

Glattre, E., Mravcova, A., Lener, J., Vobecky, M., Egertova, E., and Mysliveckova, M. 1995. study of distribution and interaction of arsenic and selenium in rat thyroid. *Biol Trace Elem Res.* 49(2-3): 177-86. Ref ID: 11361

Healy, Sm, Casarez, Ea, Ayala-Fierro, F, and Aposhian, HV. 1998. enzymatic methylation of arsenic compounds. *Toxicol. Appl. Pharmacol.* 148: 65-70. Ref ID: 14543

Hoffman, D. J., Sanderson, C. J., LeCaptain, L. J., Cromartie, E. , and Pendleton, G. W. 1992. interactive effects of arsenate, selenium, and dietary protein on survival, growth, and physiology in mallard ducklings. *Arch Environ Contam Toxicol.* 22(1): 55-62. Ref ID: 1376

Holcman, A. and Stibilj, V. arsenic residues in eggs from laying hens fed with a diet containing arsenic (iii) oxide. *Arch. Environ. Contam. Toxicol. (1997)* 32(4): 407-410. Ref ID: 5305

Howell, G. O. and Hill, C. H. 1978. biological interaction of selenium with other trace elements in chicks. *Environ Health Perspect.* 25: 147-50. Ref ID: 1387

Hughes, Michael F. and Thompson, Daniel J. subchronic dispositional and toxicological effects of arsenate administered in drinking water to mice. *J. Toxicol. Environ. Health (1996)* 49(2): 177-196. Ref ID: 15160

Hunder, G., Schaper, J., Ademuyiwa, O., and Elsenhans, B. species differences in arsenic-mediated renal copper accumulation: a comparison between rats , mice and guinea pigs. *Hum. Exp. Toxicol. (1999)* 18(11): 699-705. Ref ID: 15007

Itoh, T, Zhang, YF, Murai, S, Saito, H, Nagahama, H, Miyate, H, Saito, Y, and Abe, E. 1990. the effect of arsenic trioxide on brain monoamine metabolism and locomotor activity of mice. *Toxicol. Letters.* 54: 345-353. Ref ID: 14577

Kanisawa, M. and Schroeder, H. A. 1969. life term studies on the effect of trace elements on spontaneous tumors in mice and rats. *Cancer Res.* 29(4): 892-895. Ref ID: 3701

Kanisawa, M. and Schroeder, H. A. 1969. renal arteriolar changes in hypertensive rats given cadmium in drinking water. *Experimental and Molecular Pathology* 10(1): 81-98. Ref ID: 15061

Kanisawa, M. and H. A. Schroeder. 1967. life term studies on the effects of arsenic, germanium, tin, and vanadium on spontaneous tumors in mice. *Cancer Research.* 27: 1192-1195. Ref ID: 20979

Kiyono, S., Hasui, K., Takasu, K., and Seo, M. toxic effect of arsenic trioxide in infant rats. *J. Physiol. Soc. Jpn. 36(7): 253-254; 1974.(5 References)* Ref ID: 15427

Mahaffey, KR and Fowler, BA. 1977. effects of concurrent administration of lead, cadmium, arsenic in the rat. *Environ. Health Perspect.* 19: 165-171. Ref ID: 14580

Mercado, R. C. and Bibby, B. G. 1973. trace element effects on enamel pigmentation incisor growth and molar morphology in rats. *ARCH ORAL BIOL.* 18(5): 629-635 . Ref ID: 757

Morgareidge, K. 1963. metabolism of two forms of dietary arsenic by the rat. *J. Agric. Food Chem.* 11: 377. Ref ID: 14414

Morris, H. P., Laug, E. P., Morris, H. J., and Grant, R. L. growth and reproduction of rats fed diets containing lead acetate and arsenic trioxide and the lead and arsenic content of newborn and suckling Rats. *J Pharmacol Exp Ther 64:420-445,1938* Ref ID: 15125

Morrison, L. L. and Chavez, E. R. 1983. selenium-arsenic interaction in the weanling pig. *Canadian Journal of Animal Science* 63(1): 239-246. Ref ID: 15709

Nagaraja, T. N. and Desiraju, T. effects on operant learning and brain acetylcholine esterase activity in rats following chronic inorganic arsenic intake. *Hum. Exp. Toxicol. (1994)* 13(5): 353-6. Ref ID: 15216

Nagaraja, TN and Desiraju, T. 1993. regional alterations in the levels of brain biogenic amines, glutamate, gaba, and gad activity due to chronic consumption of inorganic arsenic in developing and adult rats/. *Bull. Environ. Contam. Toxicol.* 50: 100-107. Ref ID: 14546

Neiger, R. D. and Osweiler, G. D. 1992. arsenic concentrations in tissues and body fluids of dogs on chronic low-level dietary sodium arsenite. *Journal Of Veterinary Diagnostic Investigation.* 4(3): 334-337. Ref ID: 15703

Neiger, RD and Osweiler, GD. 1989. effect of subacute low level dietary sodium arsenite on dogs. *Fund. Appl. Toxicol.* 13: 439-451. Ref ID: 14583

Nemec, Mark D., Holson, Joseph F., Farr, Craig H., and Hood, Ronald D. developmental toxicity assessment of arsenic acid in mice and rabbits. *Reprod. Toxicol. (1998)* 12(6): 647-658. Ref ID: 15057

Nielsen, F. H., Hunt, C. D., and Uthus, E. O. 1980. interactions between essential trace and ultratrace elements. *Annals of the New York Academy of Sciences* 355: 152-64. Ref ID: 15690

Obermeyer, B. D., Palmer, I. S., Olson, O. E., and Halverson, A. W. 1971. toxicity of trimethylselenonium chloride

in the rat with and without arsenite. *Toxicol Appl Pharmacol.* 20(2): 135-46. Ref ID: 12934

Palmer, I. S., Thiex, Nancy, and Olson, O. E. dietary selenium and arsenic effects in rats. *Nutr. Rep. Int. (1983)* 27(2): 249-57. Ref ID: 15262

Savabieasfahani, M, Lochmiller, RL, Rafferty, DP, and Sinclair, JA. 1998. sensitivity of wild cotton rats (sigmodon hispidus) to the immunotoxic effects of low-level arsenic exposure. *Arch. Environ. Contam. Toxicol.* 34: 289-296. Ref ID: 14556

Schiller, Carol M., Fowler, Bruce A., and Woods, James S. effects of arsenic on pyruvate dehydrogenase activation. *Environ. Health Perspect. (1977)* : 19, 205-7. Ref ID: 15397

Schiller, Carol M., Walden, Ramsey, and Fowler, Bruce A. interaction between arsenic and alloxan-induced diabetes. effects on rat urinary enzyme levels. *Biochem. Pharmacol. (1981)* 30(2): 168-70. Ref ID: 15324

Schmolke, G., Elsenhans, B., Ehtechami, C., and Forth, W. arsenic-copper interaction in the kidney of the rat. *Hum. Exp. Toxicol. (1992)* 11(5): 315-21. Ref ID: 15264

Schroeder, H. A. and Balassa, J. J. 1967. arsenic, germanium, tin and vanadium in mice: effects on growth, survival and tissue levels. *J. Nutr.* 92(2): 245-252. Ref ID: 3084

Schroeder, H. A., Kanisawa, M., Frost, D. V., and Mitchener, M. 1968. germanium, tin, and arsenic in rats: effects on growth, survival, pathological lesions, and life span. *J Nutr.* 96: 37-45. Ref ID: 7

Schroeder, H. A. and Mitchener, M. 1971. toxic effects of trace elements on the reproduction of mice and rats. *Arch.Environ.Health.* 23: 102-106. Ref ID: 66

Schroeder, Henry A. 1968. serum cholesterol levels in rats fed thirteen trace elements. *J. Nutr.* 94(4): 475-80 . Ref ID: 15506

Seidenberg, J. M., Anderson, D. G., and Becker, R. A. 1986. validation of an in vivo developmental toxicity screen in the mouse. *Teratog Carcinog Mutagen.* 6: 361-374. Ref ID: 113

Skalnaya, M. G., Zhavoronkov, A. A., Kalinina, I. I., and Skalny, A. V. characteristic of thymus in newborn mice after chronic exposure of their mothers to sodium arsenite. *Trace Elem. Electrolytes (1996)* 13(2): 88-91 Ref ID: 15167

Stanley, T. R. Jr., Spann, J. W., Smith, G. J., and Rosscoe, R. 1994. main and interactive effects of arsenic and selenium on mallard reproduction and duckling growth and survival. *Archives of Environmental Contamination and Toxicology.* 26(4): 444-451. Ref ID: 1570

Tice, RR, Yager, JW, Andrews, P, and Crecelius, E. 1997. effect of hepatic metyl donor status on urinary excretion and dna damage in bc3f1 mice treated with sodium arsenite. *Mutation Res.* 386: 315-334. Ref ID: 14589

Tripathi, N, Kannan, GM, Pant, BP, Jaiswal, DK, Malhotra, PR, and Flora, SJS. 1997. arsenic-induced changes in certain neurotransmitter levels and their recoveries following chelation in rat whole brain. *Toxicol. Letters.* 92: 201-208. Ref ID: 14590

Uthus, Eric O. and Nielsen, Forrest H. 1985. effects in chicks of arsenic, arginine, and zinc and their interaction on body weight, plasma uric acid, plasma urea, and kidney arginase activity. *Biol. Trace Elem. Res.* 7(1): 11-20 . Ref ID: 6188

Valkonen, S, Savolainen, J, and Javisalo, J. 1983. arsenic distribution and neurochemical effects in peroral sodium arsenite exposure of rats. *Bull. Environ. Contam. Toxicol.* 30(3): 303-308. Ref ID: 14593

Vreman, K., Van, D. E. R. Veen Ng, Van, D. E. R. Molen Ej, and De, Ruig Wg. 1988. transfer of cadmium lead mercury and arsenic from feed into tissues of fattening bulls chemical and pathological data. *Neth J Agric Sci* . 36(4): 327-338. Ref ID: 471

Whitworth, Molly R., Pendleton, Grey W., Hoffman, David J., and Camardese, Michael B. effects of dietary boron and arsenic on the behavior of mallard ducklings. *Environ. Toxicol. Chem. (1991)* 10(7): 911-16: 0730-7268. Ref ID: 5690

Woods, James S. and Fowler, Bruce A. altered regulation of mammalian hepatic heme biosynthesis and urinary porphyrin excretion during prolonged exposure to sodium arsenate. *Toxicol. Appl. Pharmacol. (1978)* 43(2): 361-71. Ref ID: 15387

7.5 References Rejected for Use in Derivation of Wildlife TRVs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Diss Arsenic: an analytical procedure to determine its total content in biological samples and signs of its deprivation in rats and chicks. *788794 ORDER NO: AAD82-20750*

Diss Characterization and comparison of mitochondrial atpase and adenine nucleotide transport activity in mitochondria from rat liver and neoplastic tissues of different growth rates. *760425 ORDER NO: AAD81-23882*

Diss Characterization, fate and environmental risk assessment of microbial, elemental and toxic components of fractionated broiler litter during storage and reutilization. *01295605 ORDER NO: AAD93-16361*

Diss Crystallographic studies of transport proteins and ligands (thiobacillus ferrooxidans, didelphins virginiana, multiplewavelength anomalous dispersion). *01695894 ORDER NO: AAD99-23629*

Diss Ecology and toxicology of arsenic in contaminated grassland. *0996661 ORDER NO: Not Available from University Microfilms Int'l.*

Diss effects of chronic dietary inorganic arsenic in dogs. *0966997 ORDER NO: AAD87-21915*

Diss effects of stripped oil shale retort water on fishes, birds, and mammals. *01265899 ORDER NO: AAD84-08915*

Diss electrochemical synthesis and structural characterization of zintl anion clusters produced via the cathodic dissolution of telluride electrodes. *01378472 ORDER NO: AAD94-29162*

Diss factors affecting the toxicity and metabolism of organic arsenicals (roxarsone, copper, cysteine). *1003496 ORDER NO: AAD85-02122*

Diss heavy metal bioaccumulation in great basin submersed aquatic macrophytes. *01363274 ORDER*

NO: AAD94-18488

No Oral letter from smelter environmental research association to usepa submitting two research reports on arsenic compounds, cadmium compounds and calcium sulfate with attachments. *EPA/OTS; Doc #88-7800150*

Unrel *Multielement Geochemical Exploration Data for the Cove Known Geothermal Resource Area, Beaver and Millard Counties, Utah| AU-*

CP newer trace elements - vanadium (v) and arsenic (as) : deficiencyand possible metabolic roles. .| au. *<Document Title>Trace Element Metabolism in Man and Animals - 3*

No COC news about chemicals. *IRPTC Bull. V8, N1, P17(16)*

Diss processes controlling arsenic mobility in natural and engineered systems (drinking water, los angeles, water treatment, geothermal. *01603177 ORDER NO: AAD98-03506*

No Oral Tadlock, Charles H. and Aposhian, H. Vasken. protection of mice against the lethal effects of sodium arsenite by 2,3 dimercapto-1-propanesulfonic acid and dimercaptosuccinic acid. *Biochem. Biophys. Res. Commun. (1980)* 94(2): 501-7.

Diss the role of activated charcoal in the treatment of acute arsenic poisoning: an in vivo study. *01201519 ORDER NO: AAD13-46055*

Diss Stress-induced proteins in rat myoblasts (arsenic, heat shock, phosphorylation, gel electrophoresis, two-dimensional. *887311 ORDER NO: AAD85-14020*

FL Study on the maximum permissible concentration of arsenic compounds in drinking water. *Huan Ching K'o Hsueh (1981)* 2(3): 184-8 CODEN: HCKHDV; ISSN: 0250-3301.

Unrel Synergistic teratogenic effects of arsenic and hyperthermia in.

Diss systemic indicators of inorganic arsenic toxicity in several species. *1015071 ORDER NO: AAD13-33254*

No COC 1949.*Thiouracil Administration and Thyroidectomy in Experimental Polyarthritis of Rats* : 8p.

Surv 1958.*Regional Monitoring Activities, May 1958. HW-56226*

Surv 1976.*Rocky Mountain Arsenal Bird Kill (Entomological Special Study). RMA-83020R03*

An Prod 1980. market milk technology and equipment; milk products microbiology,physico-chemical properties and analysis. <document title>india, national dairy research institute: annualreport 1979. 211-219.

FL 1980. [a study on the combined toxicity of ddt, 666, as, hg and cr (author's transl)]. *Chung-Hua Yu Fang i Hsueh Tsa Chih* 14(2): 86-8.

Unrel 1982.*Use of Isotopes to Detect Moderate Mineral Imbalances in Farm Animals. Results of a CO-Ordinated Research Programme on the Use of Isotope Techniques for Detection of Moderate Mineral Imbalances in Farm Animals Organized by the Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development and Presented*

at a Research CO-Ordination Meeting Held in Nicosia, Cyprus, 6-10 October 1980. IAEA-TECDOC-267; CONF-8010327-

Unrel 1987. Toxicology and biochemistry of acaricides. <document title>report 1984-86, division of tropical animal sciences,csiro. 25-31.

No Dose 1989. *Superfund Record of Decision (EPA Region 5): Ott/Story/Cordova Chemical Site, North Muskegon, Michigan (First Remedial Action), September 1989. EPA/ROD/R05-89/111*

Mix 1993. NTP technical report on toxicity studies of a chemical mixture of 25 groundwater contaminants administered in drinking water to f344/n rats and b6c3f1 mice. *Natl. Toxicol. Program Toxic. Rep. Ser.* 35: 184 pp.

Unrel 1996. *Environmental Cleanup: Progress in Resolving Long-Standing Issues at the Rocky Mountain Arsenal*

Drug aAbdul-Ghani, A. S., Attwell, P. J., and Bradford, H. F. 1998. the effect of 2-amino-3-arsonopropionate and 2-amino-4-arsonobutyrate on the development and maintenance of amygdala kindled seizures. *International Journal of Neuroscience* 96(3-4): 255-67.

Org met Abdo, K. M., Elwell, M. R., Montgomery, C. A., Thompson, M. B., Thompson, R. B., and Prejean, J. D. 1989. toxic responses in f344 rats and b6c3f1 mice given roxarsone in their diets for up to 13 weeks. *Toxicology Letters* 45(1): 55-66.

FL Abdrashitova, S. A., Mynbaeva, B. N., Aidarkhanov, B. B., Abdullina, G. G., and Ilialetdinov, A. N. 1989. relationship between arsenite oxidation and lipid oxidation during arsenite-oxidizing microorganism growth. *Doklady Akademii Nauk Sssr* 304(3): 737-740.

An Prod Abrahams, P. W. and Thornton, I. 1994. the contamination of agricultural land in the metalliferous province of southwest England: implications to livestock. *Agriculture Ecosystems & Environment; 48 (2): 125-137.*

FL Adachi, S., Kawai, H., Hosogai, Y., Takahashi, T., Yoshimura, H., Katayama, H., and Takemoto, K. 1980. Toxicity of hijiki (*Hizikia fusiforme*) extract containing unidentified arsenic compound. *J Food Hyg Soc Jpn. 21 (6): (RECD. 1981). 425-434.*

CP <Additional> Su, L. C., Csallany, A. S., Tangney, C. C., Driskell, J. A., Chow, C. K., Howell, G., Hill, C. H., Prohaska, J. R., Ganther, H. E., Oh, S. H., Hoekstra, W. G., Burk, R. F., Nishiki, K., Lawrence, R. A., Chance, B., Ullrey, D. E., Shelle, J. E., Brady, P. S., Miller, E. R., Ayaz, K. L., Machlin, L. J., Gabriel, E., Horn, L. R., Spiegel, H. E., Nelson, J., Brin, M., Catignani, G. L., Bieri, J. G., Thorp, S. L., Tolliver, T. J., Shih, J. C. H., Scott, M. L., Schloss, J., Corwin, L. M., Ferretti, R. J., Morris, V. C., Levander, O. A., Soares, J. H. Jr., Swerdel, M., Sleet, R. B., Chou, A. C., Broun, G. O. Jr., Fitch, C. D., Heffron, J. J. A., Chan, A. C., Hegarty, P. V. J., and Fisher, M. 1977. federation of american societies for experimental biology; 61st annualmeeting, chicago, illinois april 1 - 8, 1977. selenium and vitamin e. *Federation Proceedings* 36(3): 1094-1095, 1167-1168.

FL Ado, V. A. and Horyachkina, L. A. modeling of chemical allergoses and their selective and nonspecific inhibition. *Fiziol Zh (Kiev); 21 (4). 1975 481-485*

Fate Aguilar, M. V., Martinez-Para, M. C., and Gonzalez, M. J. 1997. effects of arsenic (v)-chromium (iii) interaction on plasma glucose and cholesterol levels in growing rats. *Ann Nutr Metab.*

41(3): 189-95.

CP Aguilar, M. V., Martinez-Para, M. C., and Gonzalez, M. J. 1998. effect of as(v)-cr(iii) interaction on body weight, plasma protein, urea, uric acid and creatinine levels in growing rats. *Met. Ions Biol. Med. Proc. Int. Symp., 5th* : 280-284. Editor(s): Collery, Phillipe. Publisher: Libbey Eurotext, Montrouge, Fr..

FL Aguilar, M. Victorina, Martinez-Para, M. Carmen, and Gonzalez, M. Jose. 1997. effects of arsenic(v)-chromium(iii) interaction on plasma glucose and cholesterol levels in growing rats. *Ann. Nutr. Metab.* 41(3): 189-195.

An Prod Akhtar, M. H., Patterson, J. R., Salisbury, C. D. C., Ho, S. K., Jui, P. Y., and Hartin, K. E. effects of feeding 3 nitro-4-hydroxyphenylarsonic acid on growing-finishing pigs.. *Canadian Journal of Animal Science. 72 (2). 1992. 389-394.*

Org met Al-Timimi, A. A. and Sullivan, T. W. 1972. safety and toxicity of dietary organic arsenicals relative to performance of young turkeys part 1 arsanilic-acid and sodium arsanilate. *Poultry Science. 51* (1): 1972 111-116.

Gene Ali, A., Krone, P. H., Pearson, D. S., and Heikkila, J. J. 1996. evaluation of stress-inducible hsp90 gene expression as a potential molecular biomarker in xenopus laevis. *Cell Stress & Chaperones* 1(1): 62-9.

Dead Allen, G. T., Blackford, S. H., and Welsh, D. 1998. arsenic, mercury, selenium, and organochlorines and reproduction of interior least terns in the northern great plains, 1992-1994. *Colonial Waterbirds.* 21(3): 356-366.

Abstract Alvarez-Barrera L(A), Corona-Martinez A(A), Rodriguez-Aguilera, E., Betancourt-Rule, M., and Altamirano-Lozano, M. A(A). 2000. dna damage in leukocytes and testicular cells in male mice after chronic or acute treatments with sodium arsenate. *Environmental and Molecular Mutagenesis.* 35(Suppl. 31): 10.

No Oral Aly, S., Mousa, S., el-Kahky, M., Saleh, A., and el-Mofty, A. 1975. toxic deafness. i. histological study of the effect of arsenic, salicylates and quinine, on the organ of corti of guinea pigs. *Journal of the Egyptian Medical Association.* 58(3-4): 144-57.

In Vit Amacher, D. E. and Paillet, S. C. 1980. induction of trifluorothymidine-resistant mutants by metal ions in l5178y/tk-plus/minus Cells. *Mutat Res. 78 (3): 279-288.*

Diss Amann, R. P. reproductive toxicology of chemical mixtures. *Crisp Data Base National Institutes Of Health*

No Dose Amano, Ryohei, Oishi, Shigeo, Lit, B., Enomoto, Shuichi, and Ambe, Fumitoshi. biodistribution of trace elements in normal, aluminum-overloaded and cadmium-overloaded mice. *Ann. Clin. Lab. Sci. (1996)* 26(6): 531-541.

HHE Ambrose, K. R., Butler, T. A., Callahan, A. P., and Ferren, L. A. 1987. in vivo toxicity of arsenic trioxide for human cells in diffusion chambers. *Govt Reports Announcements & Index (GRA&I)*

FL Anca, Zoe, Gabor, Silvia, and Bordas, E. arsenic and lead interaction with glucose metabolism and acetylcholinesterase activity in the rat brain. *Stud. Cercet. Biochim. (1985)* 28(1): 3-8.

Unrel Andersen, F. A. 1996. amended final safety assessment of polyvinyl acetate. *Vol. 15, No. 2, Pp. 166-176* J. Am. Coll. Toxicol.

Org met Anderson Brian and Chamblee, T. N. 1998. the effect of dietary 3-nitro-4-phenylarsonic acid on growth, processing yield fecal arsenic and litter arsenic in broiler chickens. *Poultry Science* 77(SUPPL. 1): 149.

FL Angelow, L. Institut fuer Tierzucht Kostinbrod Bulgaria, Petrova, I., Yanchev, I., Anke, M., Groppel, B., Guertler, H., Gruen, M., Lombeck, I., and Schneider, H. J. 1992. the influence of a copper, zinc, arsenic, molybdenum and sulphur supply on the flora and fauna, 1: the influence on the trace element content of the flora. <original> die wirkung einer kupfer-, zink-, arsen-, molybdaen- und schwefelbelastung auf die flora und fauna, 1: der einfluss auf den spurenelementgehalt der flora. macro and trace elements. <original> mengen- und spurenelemente. *P. 395-402*

Rev Anke, M., Dorn, W., Gunstheimer, G., Arnhold, W., Glei, M., Anke, S., and Losch, E. 1998. effect of trace and ultratrace elements on the reproduction performanceof ruminants. *Veterinarni Medicina.* 43(9): 272-282.

FL Anke, M., Hennig, A., Grun, M., Partschefeld, M., Groppel, B., and Ludke, H. arsenic, a new essential trace element. *Archiv Fur Tierernahrung| PY- 1976| VO- 26| IS- 10| PG- P.742-743| LA- Miniature Pigs Given As-Deficient and Normal Diets, With As 50 or 350 Mu G/Kg Diet, Respectively, Indicate That the Fertility, Number of Live Births, Survival to Weaning and Total Weight of Offspring Were Adversely Affected in Both Species Deprived of As; Differences in the Total Weight of Young at Birth Were Highly Significant and There Was a Pronounced Retardation of Growth (24%) in the Lambs Born to Ewes Deprived of As During the Sucking Period. Growth Rates After Weaning Were Adversely Affected in the Second Generation Only. During the Experiment There Was a 30% Adult Mortality in the Controls Which Increased to 71% in Those Deprived of As, Chiefly During the Period of Lactation, and Mostly Accompanied by Histological Evidence of Myocardial Lesions.*

Bio Acc Anke, M., Hoffmann, G., Gruen, M., Groppel, B., and Riedel, E. Karl-Marx-Universitaet Leipzig German D. R. Sektion Tierproduktion und Veterinaermedizin. 1982. absorption, distribution and excretion of arsenic-76 in hens and ruminants. the use of isotopes to detect moderate mineral imbalances in farm animals. <subtitle> results of a co-ordinated research programme on the use of isotope techniques for detection of moderate mineral imbalances in farm animals organized by the joint fao/iaea division of isotope and radiation applications of atomic energy for food and agricultural development and presented at a research co-ordination meeting held in nicosia, cyprus, 6-10 october 1980. *P. 135-146*

Diss Anke, M., Krause, U., and Groppel, B. 1987. the effect of arsenic deficiency on growth, reproduction, lifeexpectancy and disease symptoms in animals. 533-550.

CP Anke, M., Schmidt, A., Groppel, B., and Kronemann, H. 1983. further evidence for the essentiality of arsenic. *Spurenelement-Symposium* 4: 97-104.

CP Anke, M., Schmidt, A., Kronemann, H., Krause, U., and Gruhn, K. 1985. new data on the essentiality of arsenic. *Trace Elem. Man Anim. -- TEMA 5 Proc. Int. Symp., 5th* : Meeting Date 1984, 151-4. Editor(s): Mills, C. F.; Bremner, I.; Chesters, J. K. Publisher: CAB, Farnham Royal, Slough, UK.

No Oral Anon. controlling the cattle tick in new-south-wales. *AGR GAZ N S W. 80 (6). 1969 356-368*

Reg Anon. 1935. report for 1990 of a study committee for testing the toxicity and other aspects of dangerous exotic chemicals used in the ic industry and elsewhere. japan industrial safety and health association.

Unrel Anon. 1990 . regional monitoring activities, may 1958. *Govt Reports Announcements & Index (GRA&I)*

No Oral Anon. 1996. thiouracil administration and thyroidectomy in experimental polyarthritis of rats. *Govt Reports Announcements & Index (GRA&I)*

FL Antoniuk, M. V., Ivanova, I. L., and Khasina, E. I. 1996. [the effect of the internal intake of carbonate mineral waters on lipid and carbohydrate metabolism in the development of experimental obesity]. <original> vliianie vnutrennego priema uglekislykh mineral'nykh vod na obmen lipidov i uglevodov pri razvitii eksperimental'nogo ozhireniia. *Voprosy Kurortologii, Fizioterapii, i Lechebnoi Fizicheskoi Kultury;*

In Vit Aoki, Y., Lipsky, M. M., and Fowler, B. A. 1990. alteration in protein synthesis in primary cultures of rat kidney proximal tubule epithelial cells by exposure to gallium, indium, and arsenite. *Toxicology and Applied Pharmacology* 106(3): 462-8.

In Vit Aoki, Yasunobu, Lipsky, Michael M., and Fowler, Bruce A. altered protein synthesis in rat kidney cells exposed to semiconductor materials. *Appl. Organomet. Chem. (1994)* 8(3): 253-8

Acu Aposhian, H. V. 1981.*Prevention and Treatment of Vesication and Poisoning Caused by Arsenicals. <NOTE> Annual Summary Rept. Feb 80-Jan 81*

Drug Aposhian, H. V. 1982. biological chelation: 2,3-dimercapto-propanesulfonic acid and meso-dimercaptosuccinic acid. *Advances in Enzyme Regulation* 20: 301-19.

No Oral Aposhian, H. V., Tadlock, C. H., and Moon, T. E. 1981. protection of mice against lethal effects of sodium arsenite--a quantitative comparison of a number of chelating agents. *Toxicology and Applied Pharmacology* 61(3): 385-92.

Acu Aposhian, H. Vasken, Tadlock, Charles H., and Moon, Thomas E. protection of mice against the lethal effects of sodium arsenite - a quantitative comparison of a number of chelating agents. *Toxicol. Appl. Pharmacol. (1981)* 61(3): 385-92 CODEN: TXAPA9; ISSN: 0041-008X.

Diss Arnold, R. L. 1971. effects of various levels of dietary selenium and arsenic on chickens .

Abstract Arnold, R. L. and Carlson, C. W. life cycle studies with chickens using selenium and arsenic Supplements. *Poultry Sci. 49 (5). 1970 1364-1365.*

Mix Arnold, R. L., Olson, O. E., and Carlson, C. W. 1973. dietary selenium and arsenic additions and their effects on tissue and egg selenium. *Poultry Sci.* 52: 847-854.

HHE Atalla, L. T., Silva, C. M., and Lima, F. W. 1965. activation analysis of arsenic in human hair--some observations on the problem of external contamination. *An. Acad. Brasil. Cien.; 37(3/4): 433-441*

Acute Atkins, C. E. and Johnson, R. K. 1975. clinical toxicities of cats. *Vet. Clin. N. Am.* 5(4): 623-652.

Surv Augspurger, Tom, Franson, J. C., Converse, Kathryn A., Spitzer, Paul R., and Miller, Erica A. an epizootic of common loons in coastal waters of north carolina: concentrations of elemental contaminants and results of necropsies. *Environ. Toxicol. Chem. (1998)* 17(2): 205-209.

Phys Bacchi, C. J., Nathan, H. C., Livingston, T., Valladares, G., Saric, M., Sayer, P. D., Njogu, A. R., and Clarkson, A. B. Jr. 1990. differential susceptibility to dl-alpha-difluoromethylornithine in clinical isolates of trypanosoma brucei rhodesiense. *Antimicrobial Agents and Chemotherapy* 34(6): 1183-8.

Drug Bacchi, C. J., Nathan, H. C., Yarlett, N., Goldberg, B., McCann, P. P., Sjoerdsma, A., Saric, M., and Clarkson, A. B. Jr. 1994. combination chemotherapy of drug-resistant trypanosoma brucei rhodesiense infections in mice using dl-alpha-difluoromethylornithine and standard trypanocides. *Antimicrobial Agents and Chemotherapy* 38(3): 563-9.

Unrel Badakhsh, F F and Foster, J W. endotoxin-containing preparations of brucella abortus: biological studies. *Am J Vet Res.* Feb 1970 31(2): 365-369

Mix Bai, K. M., Bhavnagary, H. M., and Majumder, S. K. enhancement of magnesium ammonium arsenate toxicity to rats. *Pestic. Sci. 5(5): 527-534; 1975.(13 References)*

Rev Baker, D. H. and Czarnecki-Maulden, G. L. 1987. pharmacologic role of cysteine in ameliorating or exacerbating mineraltoxicities. *Journal of Nutrition* 117(6): 1003-1010.

Drug Baker, D. H., Robbins, K. R., and Willis, G. M. 1982. amino acid utilization as influenced by antibacterial and anticoccidial drugs. *Federation Proceedings* 41(11): 2824-7.

Surv Baker, F. D., Tumasonis, C. F., Stone, W. B., and Bush, B. 1976. levels of pcb and trace metals in waterfowl in new york state. *N. Y. Fish Game J.* 23(1): 82-91.

CP Balatincz, J., Ajtony, Z., and Tamasy, V. 1997. prenatal protein-energy malnutrition: its effects on mineral concentrations in rats ' brain. *Mengen- Spurenelem. Arbeitstag., 17th* : 525-535. Editor(s): Anke, Manfred. Publisher: Verlag Harald Schubert, Leipzig, Germany.

FL Balatskii, K. P. new aspects in the toxic effect of arsenic compounds and antidote therapy during poisoning of animals by them. *Visn. Sil's'Kogospod. Nauki (1978)* (4): 58-62

FL Balatskii, K. P. 1976. arsenic poisoning in animals (experimental sodium arsenite or calciumarsenate poisoning in cattle, treated with dimercaprol). *Veterinariya, Moscow, USSR* (No.9): 84-86.

Unrel Baozhen, Wang. 1987. the development of ecological wastewater treatment and utilization systems (EWTUS) in China. *Water Sci. Technol. (1987)* 19(1-2, Water Pollut. Res. Control, Rio de Janeiro, 1986, Pt. 1): 51-63 .

Unrel Barbour, A. G. 1981. vaginal isolates of staphylococcus aureus associated with toxic shock syndrome. *Infection and Immunity* 33(2): 442-9.

In Vit Barchowsky Aaron(A), Klei Linda R, Dudek Edward J, Swartz Harold M, and James Philip E. 1999. stimulation of reactive oxygen, but not reactive nitrogen species, in vascular endothelial cells exposed to low levels of arsenite. *Free Radical Biology & Medicine* 27(11-12): 1405-1412.

Chem Meth Barnett, N. W., Chen, L. S., and Kirkbright, G. F. 1984. the rapid-determination of arsenic by optical-emission spectroscopy using a microwave induced plasma source and a miniature hydride generation device. *Spectrochimica Acta Part B-Atomic Spectroscopy* 39(9-11): 1141-1147.

HHE Baron, P. and Schweinsberg, F. 1989. a literature-review on concentrations of arsenic, cadmium, lead and mercury in human-body fluids and tissues to localize normal levels and to detect expositions .4. lead, summary of medium levels for As, Cd, Hg, Pb and references. *Zentralblatt Fur Hygiene Und Umweltmedizin* 188(3-4): 195-239.

FL Battistis, P. de and Giordano, A. 1972. studies on arsenic in livers of slaughtered cows. *Zooprofilassi* 27(1/2): 47-50.

In Vit Bauman, J. W., Liu, J., and Klaassen, C. D. 1993. production of metallothionein and heat-shock proteins in response to metals. *Fundamental and Applied Toxicology* 21(1): 15-22.

Acute Baxley, M. N., Hood, R. D., Vedel, G. C., Harrison, W. P., and Szczech, G. M. 1981. prenatal toxicity of orally administered sodium arenite in mice. *Bull.Environm.Contam.Toxicol.* 26(6): 749-756.

Dup Baxley M.N., Hood R.D., Vedel G.C., Harrison W.P., and Szczech G.M. 1981. prenatal toxicity of orally administered sodium arsenite in mice. *Bull. Environ. Contam. Toxicol* Vol. 26, No. 6: pp. 749-756.

Abstract Baxley, M. N., Vedel, G. C., Harrison, W. P., and Hood, R. D. 1980. effects of oral sodium arsenite on mouse development. *Teratology* 21: A27.

Abstract Beaudoin, A. R. 1973. lack of teratogenic action of sodium arsenate in rats. *Teratology 7:12A.*

No Oral Beaudoin, A. R. 1974. teratogenicity of sodium arsenate in rats. *Teratology 10: 153-158,1974*

FL Beletskii, V. I. and Govyadin, V. G. 1979. tin arsenate poisoning in sheep. *Veterinariya, Moscow, USSR* (9): 43-45.

Acute Bell, J. 1972. the acute toxicity of four common poisons to the opossum, *Trichosurus vulpecula*. *New Zealand Vet. J.* 20: 212-214.

In Vit Belton, J. C., Benson, N. C., Hanna, M. L., and Taylor, R. T. growth inhibitory and cytotoxic effects of 3 arsenic compounds on cultured chinese hamster ovary cells. *J ENVIRON SCI HEALTH PART A ENVIRON SCI ENG. Journal of Environmental Science and Health Part A Environmental Science and Engineering. 20 (1). 1985. 37-72.*

In Vit Belton, John C., Benson, Nancy C., Hanna, M. Leslie, and Taylor, Robert T. growth inhibitory and cytotoxic effects of three arsenic compounds on cultured chinese hamster ovary cells. *J. Environ. Sci. Health* Part A (1985): A20(1), 37-72.

FL Bencko, V. 1972. tissue respiration of a mouse liver homogenate during poisoning by arsenic administered with drinking water . ii. *Zh. Gig. Epidemiol., Mikrobiol. Immunol.* 16(1): 41-4.

FL Bencko, V. and Benes, B. changes in blood glucose and the content of glucose and glycogen in liver of mice exposed to arsenic in drinking water. *Cesk. Hyg. (1978)* 23(9): 377-82.

Fate Bencko, V, Benes, B, and Cikrt, M. 1976. biotransformation of as (iii) to as (v) and arsenic tolerance . *Arch. Toxicol.* 36(2): 159-162.

FL Bencko, V., Benes, B., and Hajek, V. the content of free sulfhydryl groups and the activity of glutathione reductase in the liver of mice exposed to arsenic in drinking water. *Cesk. Hyg. (1978)* 23(5): 209-14.

No control Bencko, V., Benes, B., Jechova, S., and Symon, K. 1980. the effect of a milk diet on the retention of arsenic-74 in mice. *J. Hyg. Epidemiol., Microbiol., Immunol.* 24(4): 389-95.

No Oral Bencko, V., Dvorak, V., and Symon, K. 1973. organ retention of parenterally administered arsenic labeled with arsenic-74 in mice preliminarily exposed to the element in drinking water arsenic tolerance. *J. Hyg. Epidemiol., Microbiol., Immunol.* 17(2): 165-8.

No Oral Bencko, V., Dvorak, V., and Symon, K. 1973. organ retention of parenterally administered arsenic (labelled with74as) in mice preliminarily exposed to the element in drinking water: astudy in arsenic tolerance. *Journal of Hygiene, Epidemiology, Microbiology and Immunology* 17(No.2): 165-168.

FL Bencko, V., Dvorak, V., and Symon, K. 1973. retention of parenterally administered arsenic-74-labeled arsenic in organs of mice having previously received arsenic in drinking water in relation to arsenic tolerance. *Zh. Gig. Epidemiol., Mikrobiol. Immunol.* 17(2): 153-6.

FL Bencko, V., Mokry, Z., and Nemeckova, H. 1970. metabolic oxygen consumption by mouse liver homogenate during ingestion of arsenic. *Cesk. Hyg. (1970)* 15(9/10): 305-8.

FL Bencko, V., Nejedly, K., and Somora, J. 344. histological picture of certain organs following peroral administration of arsenic in hairless mice. *Cesk. Hyg.; 13(6)*

FL Bencko, V., Nejedly, K., Somora, J., and Symon, K. 1969. analytical and histological findings in hairless mice exposed to arsenic. *Cesk. Hyg. (1969)* 14(7-8): 266-71 CODEN: CEHYAN.

In Vitro Bencko, V. and Nemeckova, H. 1971. oxygen consumption by mouse live homogenate during drinking - water arsenic exposure. i. *J. Hyg. Epidemiol., Microbiol., Immunol.* 15(1): 104-10

In Vit Bencko, V. and Nemeckova, H. 1971. oxygen consumption by mouse liver homogenate during drinking water arsenic exposure. i. *Journal of Hygiene, Epidemiology, Microbiology, and Immunology* 15(1)

In Vitro Bencko, V., Rossner, P., and Mokry, M. 1975. dehydrogenase activity of liver parenchyma in mice exposed to arsenic in drinking water. *Journal of Hygiene, Epidemiology, Microbiology, and Immunology* 19(1)

FL Bencko, V. and Simane, Z. the effect of chronic intake of arsenic on the liver tissue respiration in mice. *Experientia (1968)* 24(7): 706.

FL Bencko, V. and Simane, Z. tissue respiration of liver parenchyma in hairless mice exposed to arsenic. *Cesk. Hyg. (1968)* 13(5): 271-5.

Alt Bencko, V. and Symon, K. 1969; (REF:27). suitability of hairless mice for experimental work and their sensitivity to arsenic. *J. Hyg. Epidemiol. Microbiol. Immunol. ; 13(1): 1-6*

Alt Bencko, V. and Symon, K. 1953. dynamics of arsenic cumulation in hairless mice after peroral administration. *J. Hyg. Epidemiol. Microbiol. Immunol.* 13(2): 248.

Alt Bencko, V. and Symon, K. 1969. suitability of hairless mice for experimental work and their sensitivity of arsenic. *J. Hyg. Epidemiol., Microbiol., Immunol.* 13(1): 1-6.

FL Benes, B. and Bencko, V. excretion of tri- and pentavalent arsenic in the urine of mice exposed to a toxic concentration of trivalent arsenic in potable water (study of arsenic tolerance). *Cesk. Hyg. (1976)* 21(2): 56-9.

Gene Benes, B. and Bencko, V. 1985. incorporation of c14-thymidine and c14-uridine nucleosides into nucleic acid molecules in the liver of mice exposed to trivalent arsenic in drinking water. *J. Hyg. Epidemiol., Microbiol., Immunol.* 29(4): 347-51.

Mix Benjamin, S. A., Constan, A. A., Yang, R. S. H., Tessari, J. D., Baker, D. C., and Chubb, L. 1995. lack of correlation between liver cell proliferation and preneoplastic foci in rats exposed to a mixture of groundwater contaminants. *Toxicologic Pathology* 23(6): 756.

Mix Bennett, DG Jr and Schwartz, TE. 1971. cumulative toxicity of lead arsenate in phenothiazine given to sheep. *Am J Vet Res.* 32(5): 727-730.

FL Benzko, W. 1970. hygienic and toxicological problems of air pollution by arsenic. *Wiss. Z. Humboldt-Univ. Berlin Math.-Naturwiss. Reihe* 19(5): 499-501.

Surv Bergeland, M. E., Ruth, G. R., Stack, R. L., and Emerick, R. J. arsenic toxicosis in cattle associated with soil and watercontamination from mining operations.

CP Bernardini, P., Boscolo, P., Carelli, G., Iannaccone, A., and Sacchettoni-Logroscino, G. 1980. effect of chronic arsenic exposure on the liver and on the peripheral nervous system. *Spurenelem.-Symp.: Arsen 3rd* : 199-204. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

In Vit Berry, J. P. and Galle, P. 1994. selenium-arsenic interaction in renal cells: role of lysosomes. electron microprobe study. *J Submicrosc Cytol Pathol.* 26(2): 203-10.

No Dose Berry, J. P., Zhang, L., and Galle, P. 1995. interaction of selenium with copper, silver, and gold salts. electron microprobe study. *Journal of Submicroscopic Cytology and Pathology* 27(1): 21-8.

Surv Beyer, W. Nelson, Miller, Gary, and Simmers, John W. trace elements in soil and biota in confined disposal facilities for dredged material. *Environ. Pollut. (1990)* 65(1): 19-32

Unrel Bezuidenhout, J. D. and Stutterheim, C. J. 1980. a critical evaluation of the role played by the red-billed oxpeckerbuphagus erythrorhynchus in the biological control of ticks. *Onderstepoort Journal of Veterinary Research* 47(2): 51-75.

FL Bires, J. 1989. interactions between copper, iron, zinc, arsenic, cadmium, and lead in the liver of sheep after experimental poisoning with copper oxide. *Veterinarni Medicina.* 34(11): 665-674.

Bio Acc Bires, J. and Vrzgula, L. 1990. wool as an indicator of sheep exposure to copper iron zinc molybdenum arsenic lead cadmium and selenium from the industrial emission source. *Ekologia-CSSR.* 9(4): 419-428.

FL Bires, J., Vrzgula, L., and Mudron, P. 1990. the influence of experimental and spontaneous copper intoxication on the contents of copper, iron, zinc, cadmium, arsenic and lead in the liver and kidneys of ewes and their foetuses. *Zivocisna Vyroba - UVTIZ.* 35(2): 159-168.

FL Bires, J. Ustav Experimentalnej Veterinarnej Mediciny Kosice Czechoslovakia, Vrzgula, L., and Mudron, P. 1990. the influence of experimental and spontaneous copper intoxication on the contents of copper, iron, zinc, cadmium, arsenic and lead in the liver and kidneys of ewes and their foetuses. <original> vplyv experimentalnej a spontannej intoxikacie medou na obsah medi, zeleza, zinku, kadmia, arzenu a olova v peceni a oblickach bahnic a ich plodov. *Zivocisna Vyroba - UVTIZ. V. 35(2) P. 159-168*

FL Bires, J. Vysoka Skola Veterinarska Kosice CSFR, Vrzgula, L., and Juhasova, Z. 1991. distribution of harmful metals in ewes after experimental industrial contaminant intake. <original> distribucia rizikovych kovov v organizme oviec po prijme priemyselnej emisie v experimente. *Veterinarni Medicina - UVTIZ. V. 36(6) P. 361-371*

No Oral Birge, W. J. and Just, J. J. sensitivity of vertebrate embryos to heavy metals as a criterion of water quality. *NTIS PB REPORT (PB-226 850):20 PP,1973*

Herp Birge, W. J. and Just, J. J. 1975.*Sensitivity of Vertebrate Embryos to Heavy Metals As a Criterion of Water Quality. Phase II. Bioassay Procedures Using Developmental Stages As Test Organisms. <NOTE> Research Rept. RR-84; W75-06352; OWRT-B-039-KY(1)*

No Oral Birge, W. J. and Roberts, O. W. 1976. toxicity of metals to chick embryos. *Bull. Environ. Contam. Toxicol.* 16: 319-324.

No Oral Birge, W. J., Westerman, A. G., and Roberts, O. W. lethal and teratogenic effects of metallic pollutants on vertebrate embryos. *Trace Contam. Environ.* Proc. Annu. NSF-RANN Trace Contam. Conf., 2nd (1974): Issue LBL-3217, 316-20 Publisher: NTIS, Springfield, Va.

No COC Birnboim, H. C. 1985. dna clastogenic activity of diethylstilbestrol. *Biochemical Pharmacology* 34(18): 3251-7.

Mix Bishop, Christine A., Boermans, Herman J. , Ng, Peggy, Campbell, G. Douglas, and Struger, John. health of tree swallows (tachycineta bicolor) nesting in pesticide-sprayed apple orchards in ontario, canada. i. immunological parameters. *J. Toxicol. Environ. Health* Part A (1998): 55(8), 531-559.

Surv Bishop, Christine A., Van Der Kraak, Glen J., Ng, Peggy, Smits, Judit E. G., and Hontela, Alice. health of tree swallows (tachycineta bicolor) nesting in pesticide-sprayed apple orchards in ontario, canada. ii. sex and thyroid hormone concentrations and testes development. *J. Toxicol. Environ. Health* Part A (1998): 55(8), 561-581.

Rev Biswas, N. M., Roychowdhury, G., and Sarkar, M. 1995. effect of sodium arsenite on adrenocortical activities in male rats: dose- and duration-dependent responses. *Vol. 23, No. 3, Pp. 153-154* Med. Sci. Res.

No Oral Biswas, NM, Roychowdhury, G, and Sarkar, M. 1995. effect of sodium arsenite on adrenocortical activities in male rats: dose- and duration-dependant responses. *Med. Sci. Res.* 23: 153-154.

Acute Biswas, S, Taluka, G, and Sharma, A. 1999. prevention of cytotoxic effects of arsenic by short-

term dietary supplementation with selenium in mice in vivo. *Mutation Res.* 441: 155-160.

Acute Biswas, Sonali, Talukder, Geeta, and Sharma, Archana. 1999. prevention of cytotoxic effects of arsenic by short-term dietary supplementation with selenium in mice in vivo. *Mutat. Res. (1999)* 441(1): 155-160.

Org met Bjoernstad, J., Opstvedt, J., and Lunde, G. 1974. unidentified growth factors in fish meal. organic arsenic compounds in broiler diets. *Br. Poult. Sci. (1974).* 15(5): 481-7.

Mix Blakley, B. R. 1987. alterations in urethane-induced adenoma formation in mice exposed to selenium and arsenic. *Drug-Nutr. Interact. (1987)* 5(2): 97-102.

Mix Blakley, B. R. 1987. the effect of arsenic on urethane-induced adenoma formation in swiss mice. *Can. J. Vet. Res. (1987)* 51(2): 240-3.

Org met Blakley, B. R., Clark, E. G., and Fairley, R. 1990. roxarsone (3-nitro-4-hydroxyphenylarsonic acid) poisoning in pigs. *Canadian Veterinary Journal* 31(5): 385-387.

Rev Blus, L. J., Henny, C. J., and Grove, R. A. 1985. effects of pelletized anticoagulant rodenticides on california quail. *Journal Of Wildlife Diseases* 21(4): 391-395.

Dead Blus, L. J., Stroud, R. K., Reiswig, B., and Mceneaney, T. 1989. lead poisoning and other mortality factors in trumpeter swans. *Environ Toxicol Chem.* 8(3): p263-271.

Chem Meth Boerma, D. O., Smit, E. P., and Roosnek, N. 1989. pixe trace-element determination and its accuracy in the analysis of bile. *Nucl. Instrum. Methods Phys. Res. Sect. B* B36(1): 60-73.

FL Bogos, V., Aureliu, C., Gheorghe, M., Chirila, C., and Blendea, G. 1987. increasing fecundity and natality in pigs by nutritional therapy. *Productia Animala, Zootehnie Si Medicina Veterinara* 37(8): 25-30.

Method Bolton, B. A. and Hopke, P. K. 1975. the use of instrumental neutron activation analysis for the determination of arsenic concentrations in Poultry. *J Radioanal Chem. Journal of Radioanalytical Chemistry. 25 (2): 299-302.*

No Org Boon, D. Y. 1989. potential selenium problems in great plains soils. *SSSA (Soil Sci Soc Am) Spec Publ Ser; 23.*: 107-122.

FL Boscolo, P., Carmignani, M., Porcelli, G., L'abbate, N., and Ripanti, G. 1980. cardiovascular function and urinary kallikrein excretion in rats chronically exposed to mercury, arsenic, lead, cadmium or cadmium and lead. *Acta Med Rom; 18 (2). 1980 (RECD. 1981). 211-217.*

FL Boscolo, Paolo, Carmignani, Marco, Sacchettoni-Logroscino, Gabriella, Carelli, Giovanni, and Bernardini, Pierluigi. 1982. chronic exposure of rats to arsenic: morphological and functional comparisons. *G. Ital. Med. Lav. (1982)* 4(4-5): 169-74.

No Oral Bosque, M. A., Domingo, J. L., Llobet, J. M., and Corbella, J. 1991. effects of meso-2,3-dimercaptosuccinic acid (DMSA) on the teratogenicity of sodium arsenate in mice. *Bull. Environ. Contam. Toxicol.* 47(5): 682-8.

Drug Bosque, M. A., Paternain, J. L., Domingo, J. L., Llobet, J. M., and Corbella, J. 1990. prevention by meso-2,3-dimercaptosuccinic acid (DMSA) of sodium arsenite-induced embryotoxic and

teratogenic effects in mice. *Trace Elem Med. 7(2): 69-70.*

Acute Bosque, M. A., Paternain, J. L., Domingo, J. L., Llobet, J. M., and Corbella, J. 1990. prevention by meso-2,3-dimercaptosuccinic acid (dmsa) of sodium arsenite-induced embryotoxic effects in mice. *Met. Ions Biol. Med. Proc. Int. Symp., 1st* : 345-7. Editor(s): Collery, Philippe. Publisher: Libbey, Paris, Fr..

No Oral Bosque, M. A., Piera, V., Domingo, J. L., and Corbella, J. 1991. meso-2,3-dimercaptosuccinic acid (dmsa) alleviation of arsenite-induced embryofetotoxicity in mice: effectiveness with time. *Toxicologist. Feb;11(1): 295.*

Surv Bourne, W. R. P. 1976. the mass mortality of common murres in the irish sea in 1969. *J. Wildl. Manage. 40(4): 789-792 1976 (35 References)*

No Org Boyer, Kenneth W. and Capar, Stephen G. 1977. fortification variability in rat diets fortified with arsenic, cadmium, and lead . *J. Toxicol. Environ. Health* 3(4): 745-53 .

Unrel Briones, Annabelle V., Ambal, Wilhelmina O., Monroyo, Evangelina C., Bonifacio, Teresita S., and Sison, Fe M. 1997. seaweed tablet: a natural source of iodine. *Philipp. J. Sci. (1997)* 126(3): 221-232

QAC Brostrom, C. O., Prostko, C. R., Kaufman, R. J., and Brostrom, M. A. 1996. inhibition of translational initiation by activators of the glucose-regulated stress protein and heat shock protein stress response systems. role of the interferon-inducible double-stranded rna-activated eukaryotic initiation factor 2alpha kinase. *Journal of Biological Chemistry* 271(40): 24995-5002.

Org met Brown, T. P., Larsen, C. T., Boyd, D. L., and Allen, B. M. 1991. ulcerative cholecystitis produced by 3 nitro-4-hydroxyphenylarsonic acid toxicosis in turkey Poults. *Avian Dis; 35 (1). 1991. 241-243.*

Abstract Brumm, M. C., Sutton, A. L., and Mayrose, V. B. dietary arsenic effects on stored swine waste. *Journal of Animal Science. 42 (5). 1976 1340*

Org met Brumm, M. C., Sutton, A. L., Mayrose, V. B., and Krider, J. L. 1979. effect of dietary arsonic acids on fresh swine waste composition andanaerobic decomposition. *Journal of Animal Science* 48(6): 1305-1311.

Org met Brumm, M. C., Sutton, A. L., Mayrose, V. B., Nye, J. C., and Jones, H. W. 1977. effect of arsanilic-acid in swine diets on fresh waste production composition and anaerobic decomposition. *Journal of Animal Science. 44 (4): 521-531.*

Rev Buck, WB. toxicity of inorganic aliphatic organic arsenicals. *in Oehme, FW (Ed) Toxicity of Heavy Metals in the Environment.*: 357-374.

No Dose Bucy, LL, Garrigus, US, Forbes, RM, Norton, HW, and James, MF. 1954. arsenical supplements in lamb fattening rations. *J. Anim. Sci.* 13: 668.

n = 1 Bucy, L.L., Garrigus, U.S., Forbes, R.M, Norton, HW, and Moore, W.W. 1955. toxicity of some arsenicals to growing-fattening lambs. *J. Anim. Sci.* 14: 435.

Surv Bukovjan, K., Wittlingerova, Z., and Cerna, E. 1997. chemical elements in tissues and histological changes in tissues ofhares (l. europaeus pall.). *Scientia Agriculturae Bohemica.*

28(3): 215-226.

Bio Acc Burger, J. and Gochfeld, M. 1997. age differences in metals in the blood of herring gull (*Larus argentatus)* and franklin's (*Larus pipixcan*) gulls. *Arch Environ Contamin Toxicol.* 33(4): 436-440.

Surv Burger, J. and Gochfeld, M. 1997. age differences in metals in the blood of herring (*Larus argentatus*) and franklin's (*Larus pipixcan*) gulls. *Archives of Environmental Contamination and Toxicology* 33(4): 436-440.

Bio Acc Burger, J., Woolfenden, G. E., and Gochfeld, M. 1999. metal concentrations in the eggs of endangered florida scrub-jays from central florida. *Archives of Environmental Contamination and Toxicology* 37(3): 385-388.

Abstract Burk, D. T. 1976. arsenic induced renal agenesis in the wistar rat. *Teratology. 13 (2). 1976 19a*

No Oral Burk, Dorothy and Beaudoin, 1977. Allan R. arsenate-induced renal agenesis in rats. *Teratology (1977)* 16(3): 247-59.

Diss Burk, Dorothy Thamah. 1976. inorganic arsenic: placental transfer and effect on embryogenesis of the urogenital system of the rat. *Avail.: Xerox Univ. Microfilms. Ann Arbor, Mich., Order No. 77-7884 From: Diss. Abstr. Int. B 1977, 37. 10. 4805-6.* 89 pp.

Drug Burns, Leigh Ann, McCay, J. Ann, Brown, Ronnetta, and Munson, Albert E. 1993. arsenic in the sera of gallium arsenide-exposed mice inhibits bacterial growth and increases host resistance. *J. Pharmacol. Exp. Ther.* 265(2): 795-800.

Surv Butler, D. L., Krueger, R. P., Osmundson, B. C., and Thompson, A. J. 1993.*Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage in the Pine River Project Area, Southern Ute Indian Reservation, Southwestern Colorado and Northwestern New Mexico, 1988-89* : 105 pp.

Bio Acc Cahill, T. M., Anderson, D. W., Elbert, R. A., Perley, B. P., and Johnson, D. R. 1998. elemental profiles in feather samples from a mercury-contaminated lake in central California. *Arch. Environ. Contam. Toxicol.* 35(1): 75-81 .

Abstract Calvert, CC and Smith, LW. 1972. arsenic in milk and blood of cows fed organic arsenic compounds. *J. Dairy Sci.* 55: 706.

Org met Calvert, CC and Smith, LW. 1981. arsenic in tissues of sheep and milk of dairy cows fed arsanilic acid and 3-nitro-4-hydroxyphenylarsonic acid. *J. Anim. Sci.* 51(2): 414-421.

No Control Calvery, H. O. E. P. Laug and H. J. Morris. 1938. the chronic effects on dogs of feeding diets containing lead acetate, lead arsenate and arsenic trioxide in varying concentrations. *J. Pharmacol. Exp. Ther.* 64: 364-387.

No Oral Cannon, J. R., Saunders, J. B., and Toia, R. F. isolation and preliminary toxicological evaluation of arsenobetaine: the water-soluble arsenical constituent from the hepatopancreas of the western rock lobster (*Panulirus cygnus*). *Sci Total Environ; 31 (2). 1983. 181-186.*

No Dose Cannon, J. R., Saunders, J. B., and Toia, R. F. 1983. isolation and preliminary toxicological evaluation of arsenobetaine - the water-soluble arsenical constituent from the hepatopancreas of

the western rock lobster. *Science of the Total Environment* 31(2): 181-5.

In Vit Cantoni, Orazio, Hussain, Saber, Guidarelli, Andrea, and Cattabeni, Flaminio. 1994. cross-resistance to heavy metals in hydrogen peroxide-resistant cho cell variants. *Mutat. Res.* 324(1-2): 1-6 .

Mix Capar, Stephen G. and Boyer, Kenneth W. 1977. fortification variability in rat diet fortified with arsenic, cadmium, and lead. *Journal of Toxicology and Environmental Health.* 3(4): 745.

CP Carmignani, M., Carelli, G., Sacchettoni-Logroscino, G., Gioia, A., and Boscolo, P. 1983. chronic exposure of rats to sodium arsenite or arsenate: cardiovascular function and tissue metal levels. *Spurenelem.-Symp. 4th* : 119-26. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

No Oral Carpenter, S. J. 1987. development analysis of cephalic axial dysraphic disorders in arsenic-treated hamster Embryos. *Anat Embryol. 176 (3): 345-366.*

No Oral Carpenter, S. J. 1987. developmental analysis of cephalic axial dysraphic disorders in arsenic-treated hamster embryos. *Anatomy and Embryology* 176(3): 345-65.

Abstract Carpenter, S. J. and Ferm, V. H. 1977. early stages in development of exencephaly in arsenic-treated hamster embryos. *Teratology* 15: A23.

Drug Castejon, M., Tagliaferro, M., and Cedeno, G. 1987. use of anabolics in the finishing of cattle. <document title>informe anual, instituto de produccion animal,universidad central de venezuela. 155.

Alt Chaineau, E., Binet, S., Pol, D., Chatellier, G., and Meininger, V. embryotoxic effects of sodium arsenite and sodium arsenate on mouse embryos in culture. *Teratology. 41 (1). 1990. 105-112.*

Mix Chapin, Robert E., Phelps, Jerry L., Schwetz, Bernard A., and Yang, Raymond S. H. toxicology studies of a chemical mixture of 25 groundwater contaminants. iii. male reproduction study in b6c3f1 mice . *Fundam. Appl. Toxicol. (1989)* 13(3): 388-98 .

Prim Charbonneau, S. M., Spencer, K., Bryce, F., and et, a. l. 1978. arsenic excretion by monkeys dosed with arsenic-dosed fish or with inorganic Arsenic. *Bulletin of Environmental Contamination and Toxicology* 20(4): 470-477.

Org met Chen, H, Yoshida, K, Wanibuchi, H, Fukushima, S, Inoue, Y, and Endo, G. 1996. methylation and demethylation of dimethylarsinic acid in rats following chronic oral expossure. *Appl. Organometallic Chem.* 10: 741-745.

No Org Chen, M, Ma, LQ, and Harris, WG. 1999. baseline concentrations of 15 trace elements in florida surface soils. *J. Environ. Quality.* 28: 1173-1181.

In Vit Chen, M. L., King, R. S., and Armbrecht, H. J. 1990. sodium-dependent phosphate transport in primary cultures of renal tubule cells from young and adult rats. *Journal of Cellular Physiology* 143(3): 488-93.

FL Choe, R. S., Boo, M. J., and Kim, H. H. 1990. studies on the properties of intracellular arsenic binding substances in the rat liver. *Korean J Zool.* 33(4): 476-492.

Unrel Choi Wahn Soo(A), Chung Kae Jong, Chang Man Sik, Chun Kae Kwang, Lee Hyang Woo, and Hong Sung Youl. 1993. a turbidimetric determination of protein by trichloroacetic acid. *Archives of Pharmacal Research (Seoul)* 16(1): 57-61.

No Oral Choudhury, A. R., Das, T., and Sharma, A. 1997. mustard oil and garlic extract as inhibitors of sodium arsenite-induced chromosomal breaks in vivo. *Cancer Letters* 121(1): 45-52.

No Oral Choudhury Arati Roy(A), Das Tandra, Sharma Archana, and Talukder Geeta. 1997. inhibition of clastogenic effects of arsenic through continued oral administration of garlic extract in mice in vivo. *Mutation Research* 392(3): 237-242.

Diss Cibulka, J., Slamova, A., Szakova, J., Miholova, D., Mader, P., Svatos, Z., <Editors> Anke, M., Meissner, D., and Mills, C. F. 1993. cadmium status in rats contaminated with cadmium and arsenic from theirdiet. 579-580.

Mix Cikrt, M., Mravcova, A., Malatova, I., and Bencko, V. 1988. distribution and excretion of 74as and 75se in rats after their simultaneous administration. the effect of arsenic, selenium and combined pretreatment. *Journal of Hygiene, Epidemiology, Microbiology, and Immunology* 32(1)

Herp Clark, D. R. Jr., Cantu, R., Cowman, D. F., and Maxson, D. J. 1998. uptake of arsenic and metals by tadpoles at an historically contaminated texas site. *Ecotoxicology.* 7(2): 61-67.

Rev Clarkson, T. W. 1977. factors involved in heavy metal Poisoning. *Fed Proc.* 36(5): 1634-1639.

Rev Clements, HF and Munson, J. 1947. arsenic studies in soil and in culture solution. *Pacific Sci.* 1: 151-171.

FL Cobo, J. M., Gonzalez, M. J., Perez Piqueras, J. L., Aguilar, M. V., and Martinez Para, M. C. 1990. effect of chromium over insulin levels and its interaction with the arsenic of the diet. *Anales De Bromatologia* 42(1): 133-138.

FL Cobo, J. M., Gonzalez, M. J., Perez Piqueras, J. L., Aguilar, M. V., and Martinez Para, M. C. Alcala de Henares Univ. Madrid Spain Facultad de Farmacia. 1990. effect of chromium over insulin levels and its interaction with the arsenic of the diet. <original> efecto del cromo sobre los niveles de insulina: interaccion con el arsenico de la dieta. *Anales De Bromatologia. V. 42(1) P. 133-138*

Diss Cobo, J. M., Valdez, J. G., and Gurley, L. R. 1994. *Inhibition of Mitotic-Specific Histone Phophorylation by Sodium Arsenite. LA-UR-94-3210; CONF-9409234-1*

Acu Colomina, M. T., Albina, M. L., Domingo, J. L., and Corbella, J. influence of maternal restraint stress on arsenic-induced pre- and postnatal alterations in mice. *Psychobiology 1996 Sep;24(3):227-34*

Acute Colomina, MT, Albina, ML, Domingo, JL, and Corbella, J. 1997. influence of maternal sress on the effects of prenatal exposure to methylmercury and arsenic on postnatal development and behavior in mice: a preliminary evaluation. *Physiol. Behav.* 61(3): 455-459.

No Dose Confer, Anthony W., Ward, Billy C., and Hines, Fred A. arsanilic acid toxicity in rabbits. *Lab. Anim. Sci. (1980)* 30(2, Pt. 1): 234-6

Org met Confer, AW, Ward, BC, and Hines, FA. 1980. arsanilic acid toxicity in rabbits. *Lab. Anim. Sci.* 30(2 (part 1)): 234-236.

Abstract Conner, EA, Yamauchi, H, and Fowler, BA. 1992. effects of indium and arsenide on heme biosynthetic pathway. *The Toxicologist.* 12(1): 360.

No Oral Conner, EA, Yamauchi, H, and Fowler, BA. 1995. alterations in the heme biosynthetic pathway from the iii-v semiconductor metal, indium arsenide (inas). *Chemico Biol. Interact.* 96(3): 273-285.

Mix Constan, A. A., Benjamin, S. A., Tessari, J. D., Baker, D. C., and Yang, R. S. 1996. 1995 STP young investigator award recipient. increased rate of apoptosis correlates with hepatocellular proliferation in fischer-344 rats following long-term exposure to a mixture of groundwater contaminants. *Toxicologic Pathology* 24(3): 315-22.

Mix Constan, A. A., Yang, R. S., Baker, D. C., and Benjamin, S. A. 1995. a unique pattern of hepatocyte proliferation in f344 rats following long-term exposures to low levels of a chemical mixture of groundwater contaminants. *Carcinogenesis* 16(2): 303-10.

Mix Constan, A. A(A), Benjamin, S. A., Yang, R. S. H., Tessari, J. D., and Baker, D. C. 1995. increased rate of apoptosis correlates with hepatocellular proliferation in fischer-344 rats following long-term, low-level exposure to a mixture of groundwater contaminants. *Toxicologic Pathology* 23(6): 755-756.

Mix Constan Alexander A(A), Benjamin Stephen A, Tessari John D, Baker Dalec. , and Yang Raymond S H. 1996. increased rate of apoptosis correlates with hepatocellular proliferation in fischer-344 rats following long-term exposure to a mixture of groundwater contaminants. *Toxicologic Pathology* 24(3): 315-322.

FL Costa, Maria R. M., Da Fonseca, Maria I. C., and Do Paco, Natalia M. 1970. arsenic content of meat and viscera in chickens. *Rev. Port. Farm.* 20(1): 1-7..

Unrel Crans Debbie C(A), Simone Carmen M, Holz Richard C, and Que Lawrence Jr. 1992. interaction of porcine uterine fluid purple acid phosphatase with vanadate and vanadyl cation. *Biochemistry* 31(47): 11731-11739.

Unrel Creffield, J. W. and Tam Mun Kwong. 1979. laboratory assessments of the efficacy of cca and pcp-treated dyeracostulata (jelutong) against two species of australian termites. *Malaysian Forester.* 42(3): 230-239.

Chem Meth Croteau, L. G., Akhtar, M. H., Belanger, J. M. R., and Pare, J. R. J. 1994. high performance liquid chromatography determination followingmicrowave assisted extraction of 3-nitro-4-hydroxyphenylarsonic acidfrom swine liver, kidney and muscle. *Journal of Liquid Chromatography* 17(13): 2971-2981.

Unrel Crowder, M. W., Vincent, J. B., and Averill, B. A(A). 1992. electron paramagnetic resonance studies on the high-salt form of bovine spleen purple acid phosphatase. *Biochemistry* 31(40): 9603-9608.

Surv Custer, T. W. and Mitchell, C. A. 1991. contaminant exposure of willets feeding in agricultural drainages of the lower rio grande valley of south texas (Usa). *Environ Monit Assess.* 16(2): 189-200.

Surv Custer, T. W. and Mitchell, C. A. 1993. trace elements and organochlorines in the shoalgrass community of the lower laguna madre, texas. *Environ Monit Assess* 25(3): 235-246.

Surv Custer, Thomas W. and Hohman, William L. trace elements in canvasbacks (*Aythya valisineria*) wintering in louisiana, usa, 1987-1988. *Environ. Pollut. (1994)* 84(3): 253-9 .

Surv Custer, Thomas W. and Mitchell, Christine A. 1991. contaminant exposure of willets feeding in agricultural drainages of the lower rio grande valley of south Texas. *Environ. Monit. Assess. (1991)* 16(2): 189-200.

Org met Czarnecki, G. L. and Baker, D. H. 1985. reduction of liver copper concentration by the organic arsenical, 3-nitro-4-hydroxyphenylarsonic acid. *Journal of Animal Science* 60(2): 440-50.

Org met Czarnecki, G. L., Baker, D. H., and Garst, J. E. 1984. arsenic-sulfur amino acid interactions in the chick. *J. Anim. Sci. (1984).* 59(6): 1573-81 .

Bio Acc Daghir, N. J. and Hariri, N. N. 1977. determination of total arsenic residues in chicken Eggs. *J Agric Food Chem. 25 (5). 1977 1009-1010.*

Chem Meth Dal Lago, A. and Lucke, S. 1973. a method of fixing rat testis for light and electron microscopy. *Stain Technology* 48(6): 289-95.

Mix Dam Trung Bao and Nguyen Quang Thuong. 1985. effect of arsenic and selenium on the nonprotein sulfhydryl and disulfide content of the liver and the brain of mice. *Rev. Pharm. (1985) 92-102*

Surv Danielsson, B. R., Dencker, L., Lindgren, A., and Tjalve, H. 1984. accumulation of toxic metals in male reproduction organs. *Arch Toxicol Suppl.* 7: 177-80.

Plant Darmody, Robert G., Green, William P., and Dreher, Gary B. 1998. coal slurry solids/coal fluidized bed combustion byproduct mixtures as plant growth media. *Int. J. Surf. Min.* (Reclam. Environ.): 12(3), 111-115 .

FL Das, P. M., Sadana, J. R., Gupta, R. K. P., and Kumar, K. 1989. experimental selenium toxicity in guinea pigs: biochemical studies. *Annals Of Nutrition And Metabolism.* 33(1): 57-63.

FL Das, P. M., Sadana, J. R., Gupta, R. K. Paul, and Gupta, R. P. experimental selenium toxicity in guinea pigs : hematological studies. *Ann. Nutr. Metab. (1989)* 33(6): 347-53.

CP Das, T., Roychoudhury, A., and Sharma, A. 1997. bio-anticlastogenic effects of mustard oil and garlic in the first-generation offsprings of sodium arsenite treated mice. *Mutation Research* 379(1 SUPPL. 1): S89.

No Oral Das, T., Roychoudhury, A., Sharma, A., and Talukder, G. 1993. modification of clastogenicity of three known clastogens by garlic extract in mice in vivo. *Environmental and Molecular Mutagenesis* 21(4): 383-8.

Gene Datta, Supriti, Talukder, Geeta, and Sharma, Archana. 1986. cytotoxic effects of arsenic in dietary oil primed rats. *Sci. Cult. (1986)* 52(6): 196-8.

Bio Acc Dauwe, T., Bervoets, L., Blust, R., Pinxten, R., and Eens, M. 1999. are eggshells and egg contents of great and blue tits suitable as indicators of heavy metal Pollution? *Belgian Journal of*

Zoology; 129 (2). 1999. 439-447.

CP Davies, N. T. 1981. an appraisal of the newer trace elements. *Philosophical Transactions of the Royal Society of London. Series B:*

Unrel Davis, S. D., Gibbons, D. F., Martin, R. L., Levitt, S. R., Smith, J., and Harrington, R. V. biocompatibility of ceramic implants in soft tissue. *J Biomed Mater Res.* 6 (5): 1972 425-449.

No Oral De Kimpe, J., Cornelis, R., Wittevrongel, L., and Vanholder, R. 1999. dose dependent changes in 74as-arsenate metabolism of flemish giant rabbits. *Journal of Trace Elements in Medicine and Biology* 12(4): 193-200.

Abstract De Ruiter N, Mailaender, V., and Kappus, H. 1984. effect of heavy metals on cellular growth metabolism and integrity of cultured chinese hamster kidney cells. *3rd International Workshop on Tissue Culture Application in Toxicology*

Dup Debidas Ghosh, Sandip Cattopadhyay, and Jogen Debnath. 1999. effect of sodium arsenite on adrenocortical activity in immature femalerats: evidence of dose dependent response. *Journal of Environmental Sciences* 11(4): 419-422.

Carcin Deknudt, G., Leonard, A., Arany, J., Jenar-du Buisson G, and Delavignette, E. 1984. in-vivo studies on the mutagenicity of arsenic. *14th Annual Meeting of the European Environmental Mutagen Society*

In Vitro Deknudt, G., Leonard, A., Arany, J., Jenar-Du Buisson, G., and Delavignette, E. 1986. in vivo studies in male mice on the mutagenic effects of inorganic arsenic. *Mutagenesis* 1(1): 33-4.

In Vit Delnomdedieu, Marielle, Basti, Mufeed M., Styblo, Miroslav, Otvos, James D., and Thomas, David J. 1994. complexation of arsenic species in rabbit erythrocytes. *Chem. Res. Toxicol. (1994)* 7(5): 621-7.

CP Den Tonkelaar E M, Kroes, R., and Van Logten M J. comparative toxicity studies of lead arsenate and lead acetate in Rats. Int Union Pharmacol. Proceedings of the International Congress of Pharmacology, 6th. Abstract. Helsinki, Finland, 1975. 632p. Illus. Pergamon Press: Oxford, Engl.; New York, N.y., Usa. Isbn 0-08-021308-1. 1977 33

Bio Acc Denneman, W. D. and Douben, P. E. T. 1993. trace metals in primary feathers of the barn owl (*Tyto alba guttatus*) in the netherlands. *Environ. Pollut.* 82(3): 301-10 .

Abstract DeSesso, JM, Jacobson, CF, Scialli, AR, Farr, CH, and Holson, JF. 1998. inorganic arsenic is not likely to be a developmental toxicant at environmentally relevant exposures. *Toxicology.* 57(4/5): 216.

Aquatic Desgranges, J. L., Rodrigue, J., and Champoux, L. 1993. outline of an exotoxicological surveillance network for fauna of the saint lawrence the role of the Canadian wildlife service. *Twentieth Annual Aquatic Toxicity Workshop*

Dead DeSloovere, J., Debackere, M., and Hoorens, J. 1971. poisoning of domestic animals. *Vlaams Diergeneesk. Tijdschr. 40(1): 8-29; 1971(REF:18)*

FL Dinu, I., Boghianu, L., Botescu, E., and Sporn, A. 1972. effect of some metals on carbohydrate metabolism. *Igiena.* 21(8): 469-476.

CP Diplock, A. T. and Mehlert, A. 1980. the effect of arsenic and vitamin e on the uptake and distribution in the rat of selenium-75-labeled sodium selenite. *Spurenelem.-Symp.: Arsen 3rd* : 75-81. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

Unrel Disa, S., Manilla, A. C., and Scher, C. D. 1989. purification and characterization of a platelet-derived growth factor and heavy metal-modulated nuclear protein. *Journal of Biological Chemistry* 264(27): 15993-9.

Surv Divers, T. J., Crowell, W. A., Duncan, J. R., and Whitlock, R. H. 1982. acute renal disorders in cattle: a retrospective study of 22 cases. *Journal of the American Veterinary Medical Association* 181(7): 694-699.

In Vit Dix, D. J. and Hunter, E. S. function of hsp70s during embryogenesis. *1996. Dev Biol 1996 May 1;175(2):394* .

No Dose Dogan, A. 1996. amounts of arsenic in goose embryos that died during incubation. *Etlik Veteriner Mikrobiyoloji Dergisi* 8(3): 84-89.

Unrel Dolan, T. T. 1999. dogmas and misunderstandings in east coast fever. *Tropical Medicine and International Health* 4(9): A3-A11.

In Vit Dolzhanskaya, Natalia, Goncharova, Ekaterina, and Rossman, Toby G. 1998. isolation and properties of lead-resistant variants of rat glioma cells. *Biol. Trace Elem. Res. (1998)* 65(1): 31-43 .

No Oral Domingo, J. L., Bosque, M. A., and Piera, V. 1991. meso-2,3-dimercaptosuccinic acid and prevention of arsenite embryotoxicity and teratogenicity in the mouse. *Fundam. Appl. Toxicol. (1991)* 17(2): 314-20.

No Oral Domingo, J. L., Gomez, M., Sanchez, D. J., and Llobet, J. M. 1995. effects of monoisoamyl meso-2,3-dimercaptosuccinate on arsenite-induced maternal and developmental toxicity in mice. *Vol. 89, No. 3, Pp. 389-400* Res. Commun. Mol. Pathol. Pharmacol.

Abstract Domingo, J. L., Llobet, J. M., Ortega, A., Paternain, J. L., and Corbella, J. 1990. effects of meso-2,3-dimercaptosuccinic acid (dmsa) in the pregnant rat: teratogenicity and tissue trace elements. *Teratology.* 42(2): 23A.

No COC Domingo, J. L., Ortega, A., Paternain, J. L., Llobet, J. M., and Corbella, J. 1990. oral meso-2,3-dimercaptosuccinic acid in pregnant sprague-dawley rats: teratogenicity and alterations in mineral metabolism. i. teratological evaluation. *Journal of Toxicology and Environmental Health* 30(3): 181-90.

Abstract Domingo, JL, Llobet, JM, Ortega, A, Paternain, JL, and Corbella, J. 1990. effects of meso-2,3-dimercaptosuccinic acid (dmas) in the pregnant rat: teratogenicity and tissue trace elements. *Teratology.* 42(2): 23A.

No COC Domingo, JL, Ortega, A, Paternain, JL, and Llobet, JM. 1990. oral meso-2,3-dimercaptosuccinic acid in pregnant sprague-dawley rats: teretogenaity and alterations in mineral metabolism. i. teratological evaluation. *J. Toxicol. Environ. Health.* 30(3): 181-190.

No COC Domingo Jose L. 1995. prevention by chelating agents of metal-induced developmental toxicity.

Reproductive Toxicology 9(2): 105-113.

No Oral Domingo, Jose O., Bosque, M. Angeles, Llobet, Juan M., and Corbella, Jacinto. 1992, amelioration by bal (2,3-dimercapto-1-propanol) and dmps (sodium 2,3-dimercapto-1-propanesulfonic acid) of arsenite developmental toxicity in mice. *Ecotoxicol. Environ. Saf. (1992)* 23(3): 274-81

Org met Donoghue, D. J., Hairston, H., Cope, C. V., Bartholomew, M. J., and Wagner, D. D. 1994. incurred arsenic residues in chicken eggs. *Journal of Food Protection.* 57(3): 218-223 .

Rev Doyle, J. J. 1979. toxic and essential elements in bone. a review. *J. Anim. Sci.* 49(2): 482-497 .

Rev Doyle, J. J. and Spaulding, J. E. 1978. toxic and essential trace elements in meat - a review. *Journal of Animal Science.* 47(2): 398-419.

FL Droumev, D. and Stojanova, L. 1976. efficacy of sodium arsanilate and its influence on immunity in chickensexperimentally infected with borrelia anserina. *Deutsche Tierarztliche Wochenschrift* 83(5): 221-224.

Unrel Dube, Benoit, Dunning, Greg, and Lauziere, Kathleen. 1998. geology of the hope brook mine, newfoundland, canada: a preserved late proterozoic high-sulfidation epithermal gold deposit and its implications for exploration. *Econ. Geol. (1998)* 93(4): 405-436 .

In Vit Dubrow, R., Riddle, V. G. H., and Pardee, A. B. 1979. different responses to drugs and serum of cells transformed by various means. *Cancer Research. 39 (7 Part 1). 1979. 2718-2726.*

Abstract Earnest, N. M. and Hood, R. D. 1981. effects of chronic prenatal exposure to sodium arsenite on mouse development and Behavior. *Teratology 24(1):53A,1981*

Surv Edwards, W. C. and Clay, B. R. 1980. an investigation of an arsenic poisoning case. *Bovine Practitioner. 0 (15). 1980. 157-158.*

FL Efthymiou, M. L., Cristofini, P., Pierron, E., and Djezzar, S. 1995. diagnosis of toxic or drug induced pancreatitis. *Therapie (Paris).* 50(5): 467-468.

Unrel Egan, H. 1972. pesticides and toxic chemicals. *Proc. Nutr. Soc.*. 31(1): p23-32.

Rev Eisler, R. 1927. a review of arsenic hazards to plants and animals with emphasis on fishery and wildlife resources. *Nriagu* : Art Ii: Human Health and Ecosystem Effects. Xv+293p. John Wiley and Sons, Inc.: New York, New York, Usa; Chichester, England, UK. ISBN 0-471-30436-0.; 0 (0). 1994. 185-259.

Mix El-Begearmi, M. M., Ganther, H. E., and Sunde, M. L. 1982. dietary interaction between methylmercury, selenium, arsenic, and sulfur amino acids in Japanese quail. *Poult. Sci. (1982)* 61(2): 272-9.

Abstract El-begearmi, M. M., Ganther, H. E., and Sunde, M. L. 1975 . more evidence for a selenium arsenic interaction in modifying mercury toxicity. *Poult Sci.* 49(5): 1756-1757.

Mix Elgerwi, A. Al-Fateh Univ. Tripoli Libya Faculty of Veterinary Medicine and Bires, J. 1999. distribution of minerals in organs of sheep after intoxication with copper from industrial emissions. *Czech Journal of Animal Science. V. 44(11) P. 487-495*

Diss Elliott, S. C., Pedersen, N. D., Weswig, P. H., and Whanger, P. D. 1973. arsenic tissue levels in rats supplemented with dietary arsenic. *Proc Oreg Acad Sci. 9. 1973 (RECD 1974) 28*

CP Elsenhans, B., Ademuyiwa, O., Schmolke, G., Schaper, J., and Hunder, G. 1993. arsenic-copper interactions in the kidneys of laboratory animals. *Met.-Met. Interact. [Symp.]* : 110-28. Editor(s): Elsenhans, Bernd; Forth, Wolfgang; Schuemann, Klaus. Publisher: Bertelsmann Found. Publ., Guetersloh, Germany. CODEN: 60IEAS.

Mix Elsenhans, B., Schmolke, G., Kolb, K., Stokes, J., and Forth, W. 1987. metal-metal interactions among dietary toxic and essential trace metals in the rat. *Ecotoxicol. Environ. Saf.* 14(3): 275-287.

CP Elsenhans, B., Schuemann, K., Schaefer, S., and Forth, W. interactions among cadmium arsenic lead nickel and essential trace elements in rat tissue after dietary Exposure. *Second Joint Meeting of the Nederlandse Vereniging Voor Toxicologie (Toxicological Society of the Netherlands) and the British Toxicology Society, Leyden, Netherlands, May 17-19, 1987. Hum Toxicol. 7 (1). 1988. 78.*

No Oral Erickson, Norman E. 1966. *Arsenic in Hair. U. S. At. Energy Comm. (1966)*

Bio Acc Erry, B. V., Macnair, M. R., Meharg, A. A., Shore, R. F., and Newton, I. 1999. arsenic residues in predatory birds from an area of britain with naturally and anthropogenically elevated arsenic levels. *Environ. Pollut. (1999)* 106(1): 91-95.

Surv Erry, BV, Macnair, MR, Meharg, AA, and Shore, RF. 1999. seasonal variaition in dietary and body organ arsenic concentrations in wood mice apodemus sylvaticus and bank voles clethrionomys glareolus. *Bull. Environ. Contam. Toxicol.* 63(5): 567-574.

In Vit Espevik, T., Lamvik, M. K., Sunde, A., and Eik-Nes, K. B. 1982. effects of cadmium on survival and morphology of cultured rat sertoli cells. *Journal of Reproduction and Fertility* 65(2): 489-95.

Unrel Essig, T. H. 1967.*Environmental Status of the Hanford Reservation for January-February 1967. BNWL-CC-1197-1*

Unrel Essig, T. H. 1967.*Environmental Status of the Hanford Reservation for March-April 1967. BNWL-CC-1197-2*

Unrel Ewer, T. K. animal Husbandry. *Grunsell, C.s.g. (Ed.). the Veterinary Annual, Issue 11. Xvi+361p. Illus. John Wright & Sons, Ltd.: Bristol, England; (Dist. In U.S.A.. by Williams & Wilkins Co.: Baltimore, Md.). 1971 310-335.*

Org met Exon, J. H., Harr, J. R., and Claeys, R. R. 1974. the effects of long term feeding of monosodium acid methanearsenate(msma) to rabbits. *Nutrition Reports International* 9(5): 351-357. Ref ID: 15382

Surv Fairbrother, A., Fix, M., O'Hara, T., and Ribic, C. A. 1994. impairment of growth and immune function of avocet chicks from sites with elevated selenium, arsenic, and boron. *J. Wildl. Dis.* 30(2): 222-233.

No Oral Falandysz, J. 1986. metals and organochlorines in adult and immature males of white-tailed eagle Haliaeetus-albicilla. *Environ Conserv.* 13(1): p69-70.

FL Falandysz, J. and Jakuczun, B. 1986. polychlorinated compounds and trace elements in tissues and organs of white-tailed eagle haliaeetus-albicilla. *Bromatol Chem Toksykol.* 19(2): 131-133.

FL Fang, J. F., Kitagawa, Y., Ishikawa, S., Yanagisawa, H., Nakajima, K., Manabe, S., and Wada, O. 1986. [toxicity assessments of chemical substances using primary culture of rat hepatocytes]. *Sangyo Igaku* 28(6): 438-44.

Phys Fawcett, T. W., Eastman, H. B., Martindale, J. L., and Holbrook, N. J. 1996. physical and functional association between gadd153 and ccaat/enhancer-binding protein beta during cellular stress. *Journal of Biological Chemistry* 271(24): 14285-9.

Rev Feldman, B. F. and Kruckenberg, S. M. clinical toxicities of domestic and wild caged birds. *Vet. Clin. N. Am. 5(4): 653-673; 1975.(40 References).*

In Vit Feldmann, K. and Helmreich, E. J. 1976. the pyridoxal 5' -phosphate site in rabbit skeletal muscle glycogen phosphorylase b: an ultraviolet and 1h and 31p nuclear magnetic resonance spectroscopic study. *Biochemistry* 15(11): 2394-401.

In Vit Feldmann, K. and Helmreich, E. J. M. the pyridoxal 5 phosphate site in rabbit skeletal muscle glycogen phosphorylase ec-2.4.1.1 an uv and proton nmr and phosphorus-31 NMR spectroscopic study. *Biochemistry. 15 (11). 1976 2394-2401.*

Bio Acc Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. element content in tissues of four rodent species sampled in the geysers geothermal steamfield california usa. *Environ Pollut.* 58(2-3): 155-178.

Mix Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. element content in tissues of four rodent species sampled in the geysers geothermal steamfield. *Environ. Pollut. (1989)* 58(2-3): 155-78 .

Unrel Feng, J. 1995. improving the iodine supply to humans by iodination of pig feed. 57 pp.

No Oral Ferm, V. H. 1977. arsenic as a teratogenic agent. *Environmental Health Perspectives* 19: 215-7.

No Oral Ferm, V. H. and Carpenter, S. J. 199-201. malformations induced by sodium arsenate. *J. REprod. Fertility.; 17(1)*

No Oral Ferm, V. H. and Hanlon, D. P. 1985. constant rate exposure of pregnant hamsters to arsenate during early gestation. *Environmental Research* 37(2): 425-432.

No Oral Ferm, V. H. and Hanlon, D. P. 1986. arsenate-induced neural tube defects not influenced by constant rate administration of folic acid. *Pediatric Research* 20(8): 761-2.

Rev Ferm, V. H., Hanlon, D. P., Clarkson, T. W., Nordberg, G. F., and Sager, P. R. eds. 1983. metal-induced congenital malformations. *Reproductive and Developmental Toxicity of Metals.* 383-398.

Rev Ferm, V. H., Hanlon, D. P., Clarkson, T. W., Nordberg, G. F., and Sager, P. R. eds. 1983. metal-induced congenital malformations. reproductive and developmental toxicity of metals. *Pp. 383-398*

No Oral Ferm, Vergil H., Saxon, Andrew, and Smith, Bruce M. teratogenic profile of sodium arsenate in the golden hamster. *Arch. Environ. Health (1971)* 22(5): 557-60.

No Oral Ferm, VH and Kilham, L. 1977. synergistic teratogenic effects of arsenic and hyperthermia in hamsters. *Environ. Res.* 14: 483-486.

No Oral Ferm, VH, Saxon, A, and Smith, BM. 1971. the teratogenic profile of sodium arsenate in the golden hamster. *Arch. Environ. Health.* 22: 557-560.

Org met Ferslew, K. E. and Edds, G. T. 1979. effects of arsanilic acids on growth, serum enzymes, hematologicvalues, and residual arsenic in young swine. *American Journal of Veterinary Research* 40(10): 1365-1369.

Drug Finnell, R. H. folate receptor knockouts, arsenate and birth defects. *Crisp Data Base National Institutes Of Health*

In Vit Fisher, D. L. cultured rat embryo accumulation of dna, rna and protein following maternal administration of sodium Arsenate. *Environ Res. 28 (1). 1982. 1-9.*

No Oral Flora, S. J. S., Pant, S. C., Malhotra, P. R., and Kannan, G. M. biochemical and histopathological changes in arsenic-intoxicated rats coexposed to ethanol. *Alcohol (N. Y.) (1997)* 14(6): 563-568

No Oral Flora, SJS, Kannan, GM, and Kumar, P. 1999. selenium effects on gallium arsenide induced biochemical and immunotoxicological changes in rats. *Chemico-Biological Interactions.* 122: 1-13.

No Dose Flora, Swaran J. S. 1999. arsenic-induced oxidative stress and its reversibility following combined administration of n-acetylcysteine and meso 2,3-dimercaptosuccinic acid in rats. *Clin. Exp. Pharmacol. Physiol. (1999)* 26(11): 865-869

Rev Fonseca, M. I., Lunt, G. G., and Aguilar, J. S. 1991. inhibition of muscarinic cholinergic receptors by disulfide reducing agents and arsenicals differential effect on locust and rat. *Biochemical Pharmacology. 41 (5). 1991. 735-742.*

Invert Fonseca, MI, Lunt, GG, and Aguilar, JS. 1991. inhibition of muscarinic cholinergic receptors by disulfide reducing agents and arsenicals. *Bichem. Pharmacol.* 41(5): 735-742.

Abstract Fowler, B. A. and Woods, J. S. 1976. ultrastructural and biochemical effects of ingested arsenic on rat liver Mitochondria. *Toxicol Appl Pharmacol.* 37(1): 121. Ref ID: 15161

In Vit Fowler, B. A. ultrastructural and biochemical alterations of cellular organelles by prenatal exposure to toxic trace metals. *Reprod Dev Toxic Met(proc Jt Meet 1982) :437-451,1983*

Rev Fowler, B. A. and Mahaffey, K. R. 1978. interactions among lead, cadmium, and arsenic in relation to porphyrin excretion patterns. *Environ Health Perspect.* 25: 87-90.

In Vitro Fowler, B. A., Woods, J. S., and Schiller, C. M. 1979. studies of hepatic mitochondrial structure and function: morphometric and biochemical evaluation in in vivo perturbation by arsenate. *Lab Invest. 41 (4). 1979. 313-320.*

Abstract Fowler, B. A., Woods, J. S., and Schiller, C. M. 1978. effects of arsenic on mitochondrial and

microsomal oxidative interactions. *Society of Toxicology Seventeenth Annual Meeting: Abstracts of Papers. In Toxicology and Applied Pharmacology* 45(1): 308-309.

Surv Franson J.C., Augspurger T.P., Converse K.A., Spitzer P.R., Miller E.A., Bachmann R.W., Jones J.R., Peters R.H., and Soballe, D. M. (eds.). 1995. necropsy results and concentrations of mercury, lead, arsenic, and selenium in emaciated loons from the coast of north carolina in 1993. *Lake Reserv. Manage* Vol. 11, NO. 2: p. 139^.

Bio Acc Franson, J. Christian, Koehl, Philip S., Derksen, Dirk V., Rothe, Thomas C., Bunck, Christine M., and Moore, John F. 1995. heavy metals in seaducks and mussels from misty fjords national monument in southeast Alaska. *Environ. Monit. Assess.* 36(2): 149-67 .

Acute Freeman, GB, Johnson, JD, Killinger, JM, Liao, SC, Davis, Ao, Ruby, MV, Chaney, RL, Lovre, SC, and Bergstrom, PD. 1993. bioavailability of arsenic in soil impacted by smelter activities following oral administration in rabbits. *Fund. Appl. Toxicol.* 21: 83-88.

Prim Freeman, GB, Schoof, RA, Ruby, MV, Davis, AO, Dill, JA, Liao, SC, Lapin, CA , and Bergstrom, PD. 1995. bioavailability of arsenic in soil and house dust impacted by smelter activities following oral administration in cynomolgus monkeys. *Fund. Appl. Toxicol.* 28(2): 215-222.

Reg Frey, Michelle M., Owen, Douglas M., Chowdhury, Zaid K., Raucher, Robert S., and Edwards, Marc A. 1998. cost to utilities of a lower mcl for arsenic. *J. - Am. Water Works Assoc. (1998)* 90(3): 89-102.

No Oral Friedheim, E. A. H. 1974. therapeutic field trial of a macro- and microfilaricidal agent incanine filariasis. *Bulletin of the World Health Organization* 50(No.6): 572-574.

Unrel Froseth, A. J. 1979. selenium and vitamin e: blood and tissue levels in pigs. *Acta Agriculturae Scandinavica.*(Suppl. 21): 219-231.

Rev Frost, DV, Overby, LR, and Spruth, HC. 1955. studies with arsanilic acid and related compounds. *J. Agric. Food Chem.* 3: 235.

Drug Funderburk, William H., Foxwell, M., and Ward, John W. 1969. inhibition of release of slow-reacting substance by arsenic. *Eur. J. Pharmacol. (1969)* 5(2): 203-8..

Gene Gabis Kimberly K(A), Gildemeister Otto S, Pepe Joyce A, Lambrecht Richard W, and Bonkovsky Herbert L. 1996. induction of heme oxygenase-1 in lmh cells. comparison of lmh cells to primary cultures of chick embryo liver cells. *Biochimica Et Biophysica Acta* 1290(1): 113-120.

FL Gabrashanskii, P., Koichev, K. B., and Troev, T. 1986. some diseases in fallow deer in northeast bulgaria and their prevention. *Veterinarno Meditsinski Nauki. 23 (10). 1986 (Recd. 1987). 83-88.*

Phys Gainer, J. H. 1973. activation of the rauscher leukemia virus by metals. *J. Nat. Cancer Inst. (1973)* 51(2): 609-13.

Acu Gainer, J. H. 1977. effects of interferon of heavy metal excess and zinc deficiency. *AM J VET RES.* 38(6): 863-867.

In Vit Gainer, J. H. 1977. effects on interferon of heavy metal excess and zinc deficiency. *American Journal of Veterinary Research* 38(6): 863-7.

No Oral Gainer, J. H. and Pry, T. W. 1972. effects of arsenicals on viral infections in mice. *Amer. J. Vet. Res. (1972)* 33(11): 2299-307.

Bact Galperin, M. Y., Noll, K. M., and Romano, A. H. 1996. the glucose transport system of the hyperthermophilic anaerobic bacterium thermotoga neapolitana. *Vol. 62, No. 8, Pp. 2915-2918* Appl. Environ. Microbiol.

Rev Gebel, T. 1997. arsenic and antimony: comparative approach on mechanistic toxicology. *Chem.Biol.Interact.* 107(3): 131-144.

FL Gencik, Andrej, Szokolayova, Jana, and Cerey, Karol. dominant lethal test after peroral administration of arsenic. *Bratisl. Lek. Listy (1977)* 67(2): 179-87.

Chem Meth George, G. M. and Frahm, L. J. 1986. graphite furnace atomic absorption spectrophotometric determination of 4 hydroxy-3-nitrobenzenearsonic-acid in finished animal feed collaborative study. *Journal of the Association of Official Analytical Chemists. 69 (5). 1986. 838-843.*

Unrel Gerard, C. and Troncoso, J. 1980. use of fresh water hyacinth by the broiler rabbit. *Revue D'Elevage Et De Medecine Veterinaire Des Pays Tropicaux* 33(1): 91-96.

Mix Gerber, G. B., Maes, J., and Eykens, B. 1982. transfer of antimony and arsenic to the developing organism. *Arch Toxicol.* 49(2): 159-68.

Alt German, J., Louie, E., and Banerjee, D. 1986. the heat-shock response in vivo: experimental induction during mammalian organogenesis. *Teratogenesis, Carcinogenesis, and Mutagenesis* 6(6): 555-62.

Mix Germolec, Dori R., Yang, Raymond S. H., Ackermann, Michael F., Rosenthal, Gary J., Boorman, Gary A., Blair, Patricia, and Luster, Michael I. 1989. toxicology studies of a chemical mixture of 25 groundwater contaminants. ii. immunosuppression in b6c3f1 mice. *Fundam. Appl. Toxicol. (1989)* 13(3): 377-87.

No Dose Ghergariu, S., Roca, R., Mezei, E. , and Toth, E. 1994. comparative epidemiology in an area with endemic goitre in man andanimals. *Revista Romana De Medicina Veterinara* 4(1): 17-23.

Phys Ghishan, F. K. and Dykes, W. 1993. ontogeny of phosphate transport by rat liver plasma membrane vesicles. *Journal of Developmental Physiology* 19(5): 197-201.

CP Gibbs, P. J. 1992-31820. heavy metal and organochlorine concentrations in tissues of the little penguin eudyptula minor. *DANN*

HHE Gibson, R. S. and Gage, L. A. 1982. changes in hair arsenic levels in breast and bottle fed infants during the 1st year of infancy. *Science Of The Total Environment* 26(1): 33-40.

CP Gilani, S. H. and Alibai, Y. 1985. the effects of heavy metals on the chick embryo development. *American Association of Anatomists 98th Annual Meeting and the Association Canadienne Des Anatomistes (Canadian Association of Anatomists) 29th Annual Meeting*

Acu Gilani, Shamshad H. New Jersey Medical School Newark and Alibhai, Yasmin New Jersey Inst of Technology Newark. teratogenicity of metals to chick embryos. *J Toxicol Environ Health. V30, N1, P23(9)*

Mix Gilbert, F. R., Wells, G. A. H., and Gunning, R. F. 1981. 3-nitro-4-hydroxyphenylarsonic acid toxicity in pigs. *Veterinary Record* 109(8): 158-160.

Surv Gill, J. M. and Darby, J. T. 1993. deaths in yellow-eyed penguins (megadyptes antipodes) on the otagopeninsula during the summer of 1990. *New Zealand Veterinary Journal.* 41(1): 39-42.

Mix Gilmartin, JE, Alo, DK, Richmond, ME, Bache, CA, and Lisk, DJ. 1985. lead in tissues of cats fed pine voles from lead arsenate-treated orchards. *Bull. Environ. Contam. Toxicol.* 34(2): 291-294.

No Oral Gladney, W. J. and Dawkins, C. C. 1976. the brown dog tick: laboratory tests of acaricides. *Southwestern Entomologist* 1(4): 184-189.

Surv Goede, A. A., Nygard, T., de Bruin, M., and Steinnes, E. 1989. selenium, mercury, arsenic and cadmium in the lifecycle of the dunlin, calidris alpina, a migrant wader. *Science of the Total Environment.* 78(1): 205-218.

Bio Acc Goede, AA. 1985. mercury, selenium, arsenic and zinc in waders from the dutch wadden sea. *Environ. Pollution (Series A).* 37: 287-309.

CP Goeneches, S., Fischer, B., Fischer, K., and Koehler, F. 1983. dose-related incorporation of arsenic into organs in pregnant mice following chronic oral administration of arsenic. *Anorg. Stoffe Toxikol. Krim. Symp.* 91-9 Publisher: Verlag Dr. Dieter Helm, Heppenheim, Fed. Rep. Ger. CODEN: 52GUAX.

Aquatic Goldberg, E. D. 1972.*Baseline Studies of Pollutants in the Marine Environment and Research Recommendations. NSF/IDOE-74-26*

No COC Goldman, M. and Dacre, J. C. 1989. lewisite: its chemistry, toxicology, and biological effects. *Reviews of Environmental Contamination and Toxicology* 110: 75-115.

FL Golikov, S. N., Gur'yanov, G. A., and Kozlov, V. K. 1986. specific antibodies as modulators of the effects of physiologically active substances and xenobiotics the principle phenomena. *Uspekhi Sovremennoi Biologii. 102 (2). 1986 (Recd. 1987). 193-206.*

Rev Golub, M. S. 1994. maternal toxicity and the identification of inorganic arsenic as a developmental toxicant. *Reproductive Toxicology. 8 (4): 283-295.*

Mix Golub, Mari S., Keen, Carl L., Commisso, Joel F., Salocks, Charles B., and Hathaway, T. R. 1999. arsenic tissue concentration of immature mice one hour after oral exposure to gold mine tailings. *Environ. Geochem. Health (1999)* 21(3): 199-209.

Rev Golub, Mari S., MacIntosh, Michael S., and Baumrind, Nikki. 1998. developmental and reproductive toxicity of inorganic arsenic: animal studies and human concerns. *J. Toxicol. Environ. Health* Part B (1998): 1(3), 199-241.

Fate Gonzalez, M. J., Aguilar, M. V., and Martinez, Para Mc. 1995. gastrointestinal absorption of inorganic arsenic v the effect of concentration and interactions with phosphate and dichromate. *Veterinary and Human Toxicology.* 37(2): 131-136.

HHE Goyer, R. A. 1976. toxicology of lead on kidney and other organs. *Health Effects of Occupational Lead and Arsenic Exposure: a Symposium; Carnow B.W., Ed.*

No COC Gray, L. Earl Jr(A) and Ostby Joseph S. 1993. the effects of prenatal administration of azo dyes on testicular development in the mouse: a structure activity profile of dyes derived from benzidine, dimethylbenzidine, or dimethoxybenzidine. *Fundamental and Applied Toxicology* 20(2): 177-183.

No COC Gray, LE and Ostby, JS. 1993. the effects of prenatal administration of azo dyes on testicular development in the mouse: a structure activity profile of dyes derived from benzidine, dimetylbenzidine, or dimethoxybenzidine. *Fundamental Appl. Toxicol.* 20: 177-183.

Drug Graziano, J. H., Cuccia, D., and Friedheim, E. 1978. the pharmacology of 2,3-dimercaptosuccinic acid and its potential use in arsenic poisoning. *Journal of Pharmacology and Experimental Therapeutics* 207(3): 1051-5.

Unrel Greaves, T., McInnes, R. S., and Dowse, J. E. 1966.*The Control of Termites (Coptotermes Spp.) in Blackbutt (Eucalyptus Pilularis)*

CP Green, E., Inns, R. H., and Bright, J. E. 1990. pyruvate measurement in rabbit tissues as a measure of arsenic Intoxication. *Proceedings of the British Toxicology Society*

Gene Groff, J. L. and Haurowitz, F. 1963.*Comparison of the Peptide Maps of Anti= Bodies Against an Acidic and a Basic Determinant Group* : 2p.

No oral Groth, D. H., Stettler, L. E., and Burg, J. R. 1986. carcinogenic effects of antimony trioxide and antimony ore concentrate in rats. *J Toxicol Environ Health.* 18: 607-626.

Mix Gry, J., Bille, N., Kristiansen, E., Madsen, C., Meyer, O., Olsen, P., Roswall, K., Thorup, I., and Wurtzen, G. 1988. thermally oxidized soya bean oil interacted with mono- and diglycerides of food fatty acids (esters of glycerol and thermally oxidized soybean fatty acids): a long-term study in rats. *Publ. - Levnedsmiddelstyr. (Den.) (1988)* : 172, 154 pp. CODEN: PULEE4; ISSN: 0901-4322.

Surv Guitart, R., Torra, M., Cerradelo, S., Puig-Casado, P., Mateo, R., and To-Figueras, J. 1994. pb, cd, as, and se concentrations in livers of dead wild birds from the ebro delta, spain. *Bull. Environ. Contam. Toxicol.* 52(4): 523-529.

In Vit Gurley, L. R., Walters, R. A., Jett, J. H., and Tobey, R. A. 1980. response of cho cell proliferation and histone phosphorylation to sodium arsenite. *Journal of Toxicology and Environmental Health* 6(1): 87-105.

Unrel Haas, A. L., Warms, J. V., and Rose, I. A. 1983. ubiquitin adenylate: structure and role in ubiquitin activation. *Biochemistry* 22(19): 4388-94.

No COC Hackett, P. L., Sasser, L. B., Rommereim, R. L., Cushing, J. A., and Buschbom, R. L. 1987. *Teratology Studies of Lewisite and Sulfur Mustard Agents: Effects of Lewisite in Rats and Rabbits. <NOTE> Final Rept. 15 May 83-28 Feb 8. PNL-6408*

Acu Haegele, M. A. and Tucker, R. K. 1974. effects of 15 common environmental pollutants on eggshell thickness in mallards and coturnix. *Bull Environ Contam Toxicol.* 11(1): 98-102.

Surv Halbrook, R. S., Brewer, R. L., and Buehler, D. A. 1999. ecological risk assessment in a large river-reservoir. 7. environmental contaminant acccumulation and effects in great blue heron. *Environmental Toxicology And Chemistry /* 18(4): 641-648.

Surv Hall, L. W. Jr and Burton, D. T. 1982. effects of power plant coal pile and coal waste runoff and leachate on aquatic biota: an overview with research recommendations. *Crit Rev Toxicol.* 10(4): 287-301 (REF: 116).

Bio Acc Halverson, A. W., Tsay, D. T., Triebwasser, K. C., and Whitehead, E. I. 1970. development of hemolytic anemia in rats fed selenite. *Toxicol. Appl. Pharmacol.* 17(1): 151-159.

Mix Halverson, Andrew W., Tsay, Ding-Tsair, Triebwasser, K. C., and Whitehead, E. I. 1970. development of hemolytic anemia in rats fed selenite. *Toxicol. Appl. Pharmacol. (1970)* 17(1): 151-9.

Carcin Hanlon, D. P. and Ferm, V. H. 1986. teratogen concentration changes as the basis of the heat stress enhancement of arsenate teratogenesis in hamsters. *Teratology. 34 (2). 1986. 189-194.*

No Oral Hanlon, David P. and Ferm, Vergil H. 1986. concentration and chemical status of arsenic in the blood of pregnant hamsters during critical embryogenesis. *Environ. Res. (1986)* 40(2): 380-90

No Oral Hanlon, David P. and Ferm, Vergil H. 1986. concentration and chemical status of arsenic in the blood of pregnant hamsters during critical embryogenesis. 1. subchronic exposure to arsenate utilizing constant rate administration. *Environ. Res. (1986)* 40(2): 372-9.

No oral Hanlon, DP and Ferm, VH. 1986. concentration and chemical status of arsenic in the blood of pregnant hamsters during critical embryogenesis. 2. acute exposure. *Environ. Res.* 40(2): 380-390.

Abstract Hanna, L., Peters, J. M., Wiley, L. M., Clegg, M. S., and Keen, C. L. 1996. comparative effects of essential and nonessential metals on preimplantation mouse embryo development. *Experimental Biology 96*

FL Hapke, H. J. 1971. (general toxicological viewpoints in the use of pesticides, particularly weedkillers.). *Tieraerztl. Umschau; 26(4): 149-52 1971*

Unrel Harris, T. K., Cole, R. N., Comer, F. I., and Mildvan, A. S. 1998. proton transfer in the mechanism of triosephosphate isomerase. *Biochemistry* 37(47): 16828-38.

Abstract Harrison, W. P. and Hood, R. D. 1981. prenatal effects following exposure of hamsters to sodium arsenite by oral or intraperitoneal routes. *Teratology. 23:40A,1981*

CP Hartig, P. C. and Hunter, E. S. 1998. effects of overexpression of human p53 on arsenite-induced dysmorphology on mouse embryos in Culture. *Thirty-eighth Annual Meeting of the Teratology Society and the 22nd Annual Meeting of the Neurobehavioral Teratology Society and 11th International Conference of the Organization of Teratology Information*

In Vit Hatayama, T., Takahashi, H., and Yamagishi, N. 1997. reduced induction of hsp70 in pc12 cells during neuronal differentiation. *Journal of Biochemistry* 122(5): 904-10.

Acu Hatch, R. C., Clark, J. D., and Jain, A. V. 1978. use of thiols and thiosulfate for treatment of experimentally inducedacute arsenite toxicosis in cattle. *American Journal of Veterinary Research* 39(9): 1411-1414.

No Oral Hattori, K., Nishikawa, M., Fujita, K., Mashiko, M., Arima, T., and Ichiki, Y. 1983. epidermal

and follicular changes on the mouse skin induced by arsenic trioxide solution (arsenous acid) administration as drinking water: microscopic and ultrastructural Studies. *J Natl Def Med Coll. 8 (2). 1983. 132-138.*

Phys Hauser, G. J., Dayao, E. K., Wasserloos, K., Pitt, B. R., and Wong, H. R. 1996. hsp induction inhibits inos mrna expression and attenuates hypotension in endotoxin-challenged rats. *American Journal of Physiology* 271(6 Pt 2): H2529-35.

In Vit Haveman, J., Li, G. C., Mak, J. Y., and Kipp, J. B. A. 1986. chemically induced resistance to heat treatment and stress protein synthesis in cultured mammalian cells. *International Journal of Radiation Biology & Related Studies in Physics Chemistry & Medicine. 50 (1). 1986. 51-64.*

Mix Haynes, R., Minyard, J., Collins, J., Sparks, T., and Hill, J. 1980. weight gains and arsenic depletion rate in steers fed broiler litter. *Res. Rep. - Miss. Agric. For. Exp. Stn. (1980).* 5(5): 4 pp.

Phys Head Mark W(A), Corbin Elaine, and Goldman James E. 1994. coordinate and independent regulation of alpha-b-crystallin and hsp27 expression in response to physiological stress. *Journal of Cellular Physiology* 159(1): 41-50.

Rev Healy, Sheila M., Wildfang, Eric, Zakharyan, Robert A., and Aposhian, H. Vasken. 1999. diversity of inorganic arsenite biotransformation. *Biol. Trace Elem. Res. (1999)* 68(3): 249-266

No COC Hedlund, B., Norin, H., Christakopoulos, A., Alberts, P., and Bartfai, T. 1982. acetylarsenocholine: a cholinergic agonist. *Journal of Neurochemistry* 39(3): 871-3.

Mix Heindel, J. J., George, J. D., and Fail, P. A. 1990. final report on the reproductive toxicity of a chemical mixture in cd-1-swiss mice: volume 2, laboratory supplement. *NTIS Technical Report (NTIS/PB91-158451) 1990 Nov;:189 Pp.*

Mix Heindel, Jerold J., Chapin, Robert E., George, Julia, Gulati, Dushyant K., Fail, Patricia A., Barnes, Leta H., and Yang, Raymond S. H. 1995. assessment of the reproductive toxicity of a complex mixture of 25 groundwater contaminants in mice and rats. *Fundam. Appl. Toxicol.* 25(1): 9-19.

HHE Henderson, P., Hale, T. W., Shum, S., and Habersang, R. W. 1985. n-acetylcysteine therapy of acute heavy metal poisoning in mice. *Veterinary and Human Toxicology* 27(6): 522-5.

No Oral Henderson, P., Hale, T. W., Shum, Shu, and Habersang, R. W. 1985. n-acetylcysteine therapy of acute heavy metal poisoning in mice. *Vet. Hum. Toxicol. (1985)* 27(6): 522-5.

In Vit Henle, K. J., Norris, J. S., and Lumpkin, C. K. 1990. heat-induced protein dephosphorylation in chinese hamster ovary cells. *Biomedica Biochimica Acta* 49(1): 35-44.

Surv Henny, C. J., Blus, L. J., and Grove, R. A. western grebe, aechmophorus occidentalis, wintering biology and contaminant accumulation in commencement bay, Puget sound, Washington (usa). *Can Field-nat; 104 (3). 1990. 460-472.*

Phys Henriksen, E. J. 1991. effects of phenylarsine oxide on insulin-stimulated system a amino acid uptake in skeletal muscle. *American Journal of Physiology* 261(4 Pt 1): C608-13 .

Aquatic Herbel, M. J., Tanji, K. K., Dahlgren, R. A., and Gao, S. 1996. acidification of agricultural evaporation ponds: effects on traceelement chemistry in sediment-water core microcosms. *Journal of Environmental Quality* 25(4): 732-742.

Abstract Hermayer, K. L., Stake, P. E., and Shippe, R. L. 1977. evaluation of dietary zinc, cadmium, tin, lead, bismuth and arsenictoxicity in hens. *Poult. Sci.* 56(5): 1721-1722.

Prim Heywood, R. and Sortwell, R. J. arsenic intoxication in the rhesus monkey. *Toxicol. Lett. (1979)* 3(3): 137-44..

CP Hill, C. H. reductions in mortality of phosphorus deficient chicks by vanadium arsenic selenium and cadmium. *Meeting of the Federation of American Societies for Experimental Biology (Faseb) Part Ii, Anaheim, California, Usa, April 5-9, 1992. Faseb (Fed Am Soc Exp Biol) J. 6 (5). 1992. A1651.*

Rev Hill, C. H. 1975. interrelationships of selenium with other trace elements. *Fed. Proc.* 34(11): 2096-2100.

Rev Hill, C. H. and Matrone, G. 1970. chemical parameters in the study of in vivo and in vitro interactions of transition elements. *Federation Proceedings.* 29(4): 1474-81.

Acu Hill, E. F., Heath, R. G., Spann, J. W., Spann, J. W., and Williams, J. D. 1975.

Mix Hilliard, E. P. and Pearce, G. R. 1978. limitations of guidelines governing rates of application of pig manure to land. *Agriculture and Environment. 4 (1). 1978 65-76.*

No Dose Hilliard, E. P. and Pearce, G. R. 1936. variability in the composition of commercial pig diets with particularreference to minerals. *Australian Journal of Experimental Agriculture and Animal Husbandry*

Acu Hilmy, A. M., El-Domiaty, N. A., Kamal, M. A., Mohamed, M. A., and Abou Samra, W. E. 1991. effect of some arsenic antagonists on the toxicity, distribution and excretion of arsenite and arsenate in rats. *Comp. Biochem. Physiol. C: Comp. Pharmacol. Toxicol.* 99C(3): 357-62

Acute Hirata, M, Tanaka, A, Hisanaga, A, and Ishinishi, N. 1990. effects of glutathione depletion on the acute nephrotoxic potential of arsenite and on arsenic metabolism in hamsters. *Toxicol Applied Pharmacol.* 106: 496-481.

Acute Hirata, Miyuki, Tanaka, Akiyo, Hisanaga, Akira, and Ishinishi, Noburu. 1990. effects of glutathione depletion on the acute nephrotoxic potential of arsenite and on arsenic metabolism in hamsters. *Toxicol. Appl. Pharmacol. (1990)* 106(3): 469-81.

Nut def Hirunuma, R., Sotogaku, N., Endo, K., Enomoto, S., Ambe, S., and Ambe, F. 1999. time dependence of distribution of radioactive trace elements in se-deficient rats . application of the multitracer technique. *J. Radioanal. Nucl. Chem. (1999)* 239(1): 213-215.

Acu Hochadel, J. F. and Waalkes, M. P. 1997. sequence of exposure to cadmium and arsenic determines the extent of toxic effects in male fischer rats. *Toxicology* 116(1-3): 89-98.

Diss Hodel, M. 1994.*Untersuchungen Zur Festlegung Und Mobilisierung Der Elemente As, Cd, Ni Und Pb an Ausgewaehlten Festphasen Unter Besonderer Beruecksichtiguung Des Einflusses Von Huminstoffen. (Investigation into the Immobilization and Mobilization of the Elements As, Cd, Ni*

and Pb at Selected Solid Phases With Special Regard to the Influence of Humic Matter). <NOTE> Diss. (Dr.Rer.Nat.)

Surv Hoernfeldt, Birger and Nyholm, N. Erik I. 1996. breeding performance of tengmalm's owl in a heavy metal pollution gradient. *J. Appl. Ecol.* 33(2): 377-386 .

Rev Hoffman, D. J. measurements of toxicity and critical stages of development. wildlife toxicology and population modeling: integrated studiesof agroecosystems . *(SETAC Special Publications Series) 1994;:47-7*

Rev Hoffman, D. J. 1994. measurements of toxicity and critical stages of development. *Wildlife Toxicology and Population Modeling: Integrated Studies of Agroecosystems (SETAC Special Publications Series) .*: 47-7.

No Oral Holmberg, R. Jr. 1969. interrelationships of selenium, cadmium and arsenic in mammalian teratogenesis. *Arch. Environ. Health.* 18(6): 837-7.

No Oral Holmberg REFermVH Jr. 837. interrelationships of selenium, cadmium and arsenic in mammalian teratogenesis. *Arch. Environ. Health; 18(6)*

No Oral Holson, J. F., Stump, D. G., Ulrich, C. E., and Farr, C. H. 1999. absence of prenatal developmental toxicity from inhaled arsenic trioxide in Rats. *Toxicological Sciences. 51 (1). 1999. 87-97.*

No Oral Holson, JF, Stump, DG, Urlich, CE, and Farr, CH. 1999. absence of prenatal developmental toxicity from inhaled arsenic trioxide in rats. *Toxicological Sciences.* 51(1): 87-97.

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. residual damage to hematopoietic system in mice exposed to a mixture of groundwater contaminants. *Toxicol. Lett. (1991)* 57(1): 101-11 .

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. 1992. alterations in hematopoietic responses in b6c3f1 mice caused by drinking a mixture of 25 groundwater contaminants. *J. Environ. Pathol. Toxicol. Oncol.* 11(2): 65-74 .

Mix Hong, H. L., Yang, R. S. H., and Boorman, G. A. 1993. enhancement of myelotoxicity induced by repeated irradiation in mice exposed to a mixture of groundwater contaminants. *Arch. Toxicol.* 67(5): 358-64.

Acu Hood, R. D., Thacker, G. T., Patterson, B. L., and et, a. l. 1978. prenatal effects of oral versus intraperitoneal sodium arsenate in Mice. *Journal of Environmental Pathology and Toxicology* 1(6): 857-864.

CP Hood, R. D. 1981. toxicology of prenatal exposure to arsenic. *Arsenic:ind Biomed Environ Perspect Proc Arsenic Symp 1981 134-150,1983*

No Oral Hood, R. D. 1998. developmental effects of methylated arsenic metabolites in mice. *Bulletin Of Environmental Contamination And Toxicology.* 61(2): 231-238.

Abstract Hood, R. D., Baxley, M. N., and Harrison, W. P. 1979. evaluation of chromated copper arsenate(cca)for Teratogenicity. *Teratology 19:31A,1979*

Abstract Hood, R. D., Baxley, M. N., and Harrison, W. P. 1979. evaluation of chromated copper arsenate

for teratogenicity. *Teratology. 19 (2). 1979 31a*

No Oral Hood, R. D., Harrison, W. P., and Vedel, G. C. 1982. evaluation of arsenic metabolites for prenatal effects in the Hamster. *Bull Environ Contam Toxicol 29:679-687,1982*

Abstract Hood, R. D., Harrison, W. P., and Vedel, G. C. 1982. prenatal effects of arsenic metabolites in the Hamster. *Teratology 25(2):50A,1982*

Abstract Hood, R. D., Nemec, M. D., Holson, J. F., and Farr, C. H. 1988. effects of mid-gestational exposure of mice and rabbits to arsenic acid. *Toxicologist 1998 Mar;42(1-S):258*

Dup Hood, R. D., Thacker, G. T., Patterson, B. L., and Szczech, G. M. 1978. pre natal effects of oral vs intra peritoneal sodium arsenate in mice.. *Journal of Environmental Pathology and Toxicology. 1 (6). 1978. 857-864.*

Mix Hood, R. D. and Vedel-Macrander, G. C. 1984. evaluation of the effect of bal (2,3-dimercaptopropanol) on arsenite-induced teratogenesis in mice. *Toxicology and Applied Pharmacology* 73(1): 1-7.

Acute Hood, RD. 1972. effects of sodium arsenite on fetal development. *Bull. Environ. Contam. Toxicol.* 7(4): 216-222.

Org met Hood, RD. 1998. developmental effects of methylated arsenic metrabolites in mice. *Bull. Environ. Contam. Toxicol.* 61: 231-238.

No Oral Hood, RD and Bishop, SL. 1972. teratogenic effects of sodium arsenate in mice. *Arch, Environ. Health.* 24(1): 62-65.

No oral Hood, RD, Harrison, WP, and Vedel, GC. 1982. evaluation of arsenic metabolites for prenantal effects in the hamster. *Bull. Environ. Contam. Toxicol.* 29(6): 679-687.

Acute Hood, RD, Thacker, GT, and Patterson, BL. 1977. effects in the mouse and rat of prenatal exposure to arsenic. *Env Health Perspect.* 19: 219-222.

CP Hood, Ronald D. arsenic as a teratogen. *DOE Symp. Ser. (1978)* Volume Date 1977, 47(Dev. Toxicol. Energy-Relat. Pollut.): 536-44.

No Oral Hood, Ronald D. 1972. effects of sodium arsenite on fetal development. *Bull. Environ. Contam. Toxicol. (1972)* 7(4): 216-22.

No Oral Hood, Ronald D. embryonic, placental, and maternal uptake and retention of dimethylarsinic acid by species relatively sensitive (rat) or resistant (mouse) to its developmental toxicity. *Res. Commun. Pharmacol. Toxicol. (1998)* 3(3 & 4): 99-104 CODEN: RCPTFY; ISSN: 1087-1101.

No Oral Hood Ronald D. 1972. effects of solium arsenite on fetal development. *Bulletin of Environmental Contamination and Toxicology,7(4): 216-222, April 1972*

No Oral Hood, Ronald D. and Bishop, Sally L. 1972. teratogenic effects of sodium arsenate in mice. *Arch. Environ. Health (1972)* 24(1): 62-5.

Acute Hood, Ronald D. and Harrison, William P. 1982. effects of prenatal arsenite exposure in the hamster. *Bull. Environ. Contam. Toxicol. (1982)* 29(6): 671-8.

No Oral Hood, Ronald D. and Pike, Charles T. 1972. bal [2,3-dimercaptopropanol] alleviation of arsenate-induced teratogenesis in mice. *Teratology (1972)* 6(2): 235-7.

Dup Hood, Ronald D., Thacker, Gary T., Patterson, Barbara L., and Szczech, George M. 1978. prenatal effects of oral versus intraperitoneal sodium arsenate in mice. *J. Environ. Pathol. Toxicol. (1978)* 1(6): 857-64.

Unrel Hooghe, R. J., Maisin, J. R., Vander Plaetse, F., Urbain, J., and Urbain-Vansanten, G. 1988. the effect of prenatal or early postnatal irradiation on the production of anti-arsonate antibodies and cross-reactive idiotypes. *International Journal of Radiation Biology and Related Studies in*

Herp Hopkins, W. A., Mendonca, M. T., Rowe, C. L., and Congdon, J. D. 1998. elevated trace element concentrations in southern toads, bufo terrestris, exposed to coal combustion waste. *Arch Environ Contam Toxicol.* 35(2): 325-9.

Surv Hornfeldt, B. and Nyholm, N. EI. 1996. breeding performance of tengmalm's owl in a heavy metal pollution gradient. *Journal of Applied Ecology.* 33(2): 377-386.

No Oral Horovitz, C. T. and ZIV, G. 1988. susceptibility of staphylococcus-aureus of bovine udder origin to antimicrobial drugs and heavy Metals. *Isr J Vet Med.* 44 (2). 119-123.

Surv Hothem, R. L. and Ohlendorf, H. M. 1989. contaminants in foods of aquatic birds at kesterson reservoir california usa 1985. *Arch Environ Contam Toxicol.* 18(6): 773-786.

Surv Hothem, R. L. and Welsh, D. 1994. contaminants in eggs of aquatic birds from the grasslands of central california. *Arch Environ Contam Toxicol.* 27(2): 180-5.

Abstract Howell, G and Hill, CH. 1977. effects of arsenic in chicks. *Fed. Proc.* 36: 1094.

Rev Howell, J. M., <Editors> Masters, D. G., and White, C. L. 1996. toxicities and excessive intakes of minerals. <book>detection and treatment of mineral nutrition problems in grazingsheep. 95-117.

Rev Howell, J. M., Masters, D. G., and White, C. L. 1996. toxicities and excessive intakes of minerals. *Detection and Treatment of Mineral Nutrition Problems in Grazing Sheep.* 95-117.

Unrel Howick, C. D. and Creffield, J. W. 1975. the development of a standard laboratory bio-assay technique with *Mastotermes darwiniensis froggatt* (isoptera: mastotermitidae). *Zeitschrift Fur Angewandte Entomologie.* 78(2): 126-138.

In Vit Huang, H., Huang, C. F., Wu, D. R., Jinn, C. M., and Jan, K. Y. 1993. glutathione as a cellular defence against arsenite toxicity in cultured chinese hamster ovary cells. *Toxicology (1993)* 79(3): 195-204..

Surv Hudec, K., Kredl, F., Pellantova, J., Svobodnik, J., and Svobodova, R. 1988. residues of chlorinated pesticides pcb and heavy metals in the eggs of water birds in southern moravia Czechoslovakia. *Folia Zool.* 37(2): p157-166.

Acu Hudson, R, Tucker, R, and Haegele M. 1984. handbook of toxicity of pesticides to wildlife. *US Fish and Wildlife Service Resource Publication. 153.*: 90.

Rev Hueper, WC and Payne, WW. 1962. experimental studies in metal carcinogenesis. *Arch.*

Environ. Health. 5: 445-462.

Surv Hui, Clifford A. 1998. metal and trace element burdens in two shorebird species at two sympatric wintering sites in southern california. *Environ. Monit. Assess. (1998)* 50(3): 233-247.

Mix Hullinger, G., Sangster, L., Colvin, B., and Frazier, K. 1998. bovine arsenic toxicosis from ingestion of ashed copper-chrome-arsenatetreated timber. *Veterinary and Human Toxicology* 40(3): 147-148.

CP Hunter, E. S. 1998. selenite prevents the dysmorphology and early phase cell cycle changes produced by arsenite in mouse embryos in Culture. *Thirty-eighth Annual Meeting of the Teratology Society and the 22nd Annual Meeting of the Neurobehavioral Teratology Society and 11th International Conference of the Organization of Teratology Information*

CP Hunter, E. S Iii, Elstein, K. H., and Zucker, R. M. 1997. studies of the pathogenesis of arsenite-induced Dysmorphology. *Joint Meeting of the Teratology Society Thirty-seventh Annual Meeting and Tenth International Conference of the Organization of Teratology Information Services*

Acute Inamasu, T. 1983. arsenic metabolites in urine and feces of hamsters pretreated with pcb. *Toxicol Appl Pharmacol.* 71: 142-152.

Acu Inns, R. H., Bright, J. E., and Marrs, T. C. 1988. comparative acute systemic toxicity of sodium arsenite and dichloro(2-chlorovinyl)arsine in rabbits. *Toxicology (1988)* 51(2-3): 213-22 .

CP Inns, R. H., Bright, J. E., and Marrs, T. C. 1986. comparative acute toxicity of sodium arsenite and dichloro-2-chlorovinylarsine. *British Toxicology Society Meeting*

Drug Inns, R. H., Rice, P., Bright, J. E., and Marrs, T. C. 1990. evaluation of the efficacy of dimercapto chelating agents for the treatment of systemic organic arsenic poisoning in rabbits. *Human & Experimental Toxicology* 9(4): 215-20.

FL Inouye, M. 1989. teratology of heavy metals: mercury and other contaminants. *Senten Ijo 1989;29:333-44* 29: 333-344.

Rev Int Task Group Metal Interact. 1978. factors influencing metabolism and toxicity of metals a consensus Report. *Environ Health Perspect. (25). 1978 3-41*

Abstract Irgolic, KJ and Irvin, TR. 1987. arsenic compounds in water and organisms. *Abstr. Pap. Am. Chem. Soc.* 194: 3264.

FL Isar, M., Isar, O., Poleacu, I., Bellea, S., Groza, I., Nemteanu, S., Popescu, V., Raducanescu, H., Popii, V. B., Togoe, I., Borhan, G., Popescu, I., Bosinceanu, M., Iacoban, N., and Boier, L. 1983. effect of biological sludge given to piglets and fattening pigs. *Lucrarile Stiintifice Ale Institutului De Biologie Si Nutritie Animala* 12: 59-72.

Acu Ishida, Kazuo and Shirakawa, Takako. 1969. histopathological studies of liver and kidney of mice injected with lethal doses of pesticides. *Niigata Norin Kenkyu (1969)* : No. 21, 183-201..

FL Ishinishi, Noburu, Tomita, Masako, and Hisanaga, Akira. 1980. chronic toxicity of arsenic trioxide in rats with special reference to liver damages. *Fukuoka Igaku Zasshi (1980)* 71(1):

27-40

FL Ishizaki, Mutsuo. 1980. studies on pharmacokinetics of arsenicals in rats. *Nippon Eiseigaku Zasshi (1980)* 35(3): 584-96.

CP Ishizaki, Mutsuo, Ueno, Seiichi, Oyamada, Noritaka, Kubota, Kaoru, Yamaguchi, Seiya, and Fujiki, Motoo. 1979. studies on arsenical behavior in rats. *Kankyo Osen Busshitsu to Sono Tokishikorojii Shinpojumu [Koen Yoshishu], 6th* : 93-4 Publisher: Nagasaki-shi Ishi Kaikan, Nagasaki, Japan.

In Vit Jacobs, J., Roussel, R., Roberts, M., Marek, D., Wood, S., Walton, H., Dwyer, B., Sinclair, P., and Sinclair, J. 1998. effect of arsenite on induction of cyp1a and cyp2h in primary cultures of chick Hepatocytes. *Toxicology and Applied Pharmacology. 150 (2). 1998. 376-382.*

Reg Jacobson-Kram, D. and Montalbano, D. 1985. the reproductive effects assessment group's report on the mutagenicity of inorganic arsenic. *Environmental Mutagenesis* 7(5): 787-804.

Org met Jaghabir, MTW, Abdelghani, AA, and Anderson, AC. 1989. histopathological effects of monosodium methanearsonate on new zealand white rabbits (*Oryctalagus cuniculus*). *Bull. Environ. Contam. Toxicol.* 42: 289-293.

No Control James, L. F., Lazar, V. A., and Binns, W. 1966. effects of sublethal doses of certain minerals on pregnant ewes and fetal development. *Am J Vet Res.* 27(116): 132-135.

Unrel Japenga, J., Zschuppe, K. H., De Groot, A J., and Salomons, W. 1990. heavy metals and organic micropollutants in floodplains of the river waal (netherlands) a distributary of the river rhine, (netherlands), 1958-1981. *NETH J AGRIC SCI.* 38(3A): 381-397.

HHE Jelovsek, Frederick R., Mattison, Donald R., and Chen, James J. 1989. prediction of risk for human developmental toxicity: how important are animal studies for hazard identification? *Obstet. Gynecol. (N. Y.) (1989)* 74(4): 624-36 .

FL Jennings, F. W. 1988. the potentiation of arsenicals with difluoromethylornithine (DFMO): experimental studies in murine trypanosomiasis. *Bulletin De La Societe De Pathologie Exotique Et De Ses Filiales; 81 (3*

Unrel Jennings, F. W., Gichuki, C. W., Kennedy, P. G., Rodgers, J., Hunter, C. A., Murray, M., and Burke, J. M. 1997. the role of the polyamine inhibitor eflornithine in the neuropathogenesis of experimental murine african trypanosomiasis. *Neuropathology and Applied Neurobiology* 23(3): 225-34.

Surv Johnson, E. V., Mack, G. L., and Thompson, D. Q. 1976. effects of orchard pesticide applications on breeding Robins. *Wilson Bull* . 88: 16-35.

Drug Johnson, P. W., Boray, J. C., and Plant, J. W. 1989. itchmite in sheep. *Wool Technology and Sheep Breeding* 37(3): 136-145.

Rev Jones-Davies, W. J. 1972. tick control and a history of tick resistance. *Rhodesian Veterinary Journal* 2(No.4): 53-59.

No Oral Jorgensen, M., Grosvik, B. E., Hamre, K., and Goksoyr, A. 1998. induction of heme oxygenase in fish by heavy metals, phenylhydrazineand high lipid diets. *Marine Environmental Research*

46(1/5): 559-561.

Mix Kaalaas, John Atle, Ringsby, Thor Harald, and Lierhagen, Syverin. 1995. metals and selenium in wild animals from norwegian areas close to russian nickel smelters. *Environ. Monit. Assess. (1995)* Volume Date 1995, 36(3): 251-70.

Org met Kailaswar, S. A., Burte, R. G., Pawar, S., and Toro, V. A. 1997. effect of dietary supplementation of roxarsone and livol on the performance of broilers. *Indian Journal of Animal Nutrition* 14(4): 279-280.

Surv Kalas, JA, Ringsby, TH, and Lierhagen, S. 1995. metals and slenium in wild animals from norwegian areas close to nickel smelters. *Environ. Monitoring Assess.* 36: 251-270.

Unrel Kalra, R. A. 1977. pesticides residues - their implications and the job of a residue analyst. *Pesticides 11(10): 13-17 1977 (17 References).*

FL Kamil'dzhanov, A. Kh, Ubaidullaev, R. U., and Akbarov, A. A. 1986. studying the combined effect of arsenic trioxide and germanium dioxide during their hygienic standardization in the atmospheric air. *Gigiena i Sanitariya. 0 (8). 1986. 82-84.*

FL Kamkin, A. B. 1982. reevaluation of maximum permissible concentrations of arsenic trioxide in the environmental air of inhabited Areas. *Gig Sanit (1):6-9,1982*

FL Kamkin, A. B. review of the maximum permissible concentration of arsenic trioxide in the atmosphere of populated places. *Gig Sanit (1):6-9,1982*

In Vit Kanti, A. and Smith, M. A. 1997. effects of heavy metals on chondrogenic differentiation of embryonic chick limb Cells. *In Vitro Toxicology.* 10(3): 329-338.

In Vit Kapahi, P., Boulton, M. E., and Kirkwood, T. B. 1999. positive correlation between mammalian life span and cellular resistance to stress. *Free Radical Biology & Medicine* 26(5-6): 495-500.

No Oral Karnofsky, D. A. 1955. assay of chemotherapeutic agents on the developing chick embryo. *Cancer Res 15(suppl 3):83-85,1955*

Mix Karunski, A. I., Kryuchkova, E. F., and Niki'burskii, N. I. 1993. wastes from sugarbeet production in the feeding of pigs and chickens. *Zootekhniya.*(9): 15-18.

Acu Katayama, Masayuki, Sugawa-Katayama, Yohko, and Nakano, Yukihiro. study on arsenic metabolism in animals by neutron activation analysis. *Kyoto Daigaku Genshiro Jikkensho Gakujutsu Koenkai Hobunshu (1994)* 28: 67-72.

Acu Katayama, Masayuki, Sugawa-Katayama, Yohko, and Otsuki, Kazuko. 1994. effects of hijiki feeding on arsenic distribution in rats administered large doses of arsenate. *Appl. Organomet. Chem. (1994)* 8(3): 259-64.

Acu Katayama, Masayuki, Sugawa-Katayama, Yohko, and Tamura, Tomoko. 1992. arsenic distribution in rats fed a hijiki diet. *Appl. Organomet. Chem. (1992)* 6(4): 389-92.

Acu Kato, Y., Maki S-I, Matano, O., and Goto, S. 1980. trans placental bio accumulation of organo arsenate in rat fetal blood after ferric methane arsonate Administration. *J Pestic Sci (Nihon Noyakugaku Kaishi). 5 (3). 1980. 427-430.*

No Oral Katsnel'son, B. A., Neizvestnova, Ye. M., and Blokhin, V. A. 1986. stomach carcinogenesis induction by chronic treatment with arsenic. *Vopr. Onkol. (1986)* 32(3): 68-73.

In Vit Kawasaki, Hiroshi, Moriguchi, Tetsuo, Matsuda, Satoshi, Li, Hong Zen, Nakamura, Shun, Shimohama, Shun, Kimura, Jun, Gotoh, Yukiko, and Nishida, Eisuke. 1996. ras-dependent and ras-independent activation pathways for the stress-activated-protein-kinase cascade. *Eur. J. Biochem. (1996)* 241(2): 315-321.

In Vitro Keith, R. L., Gandolfi, A. J., McIntyre, L. C. Jr., Ashbaugh, M. D., and Fernando, Q. 1999. analysis of heavy metal deposition in renal tissue by sectional mapping using pixe. *Nucl. Instrum. Methods Phys. Res.* Sect. B (1999): 149(1,2), 167-176.

Unrel Kelley, Timothy R., Pancorbo, Oscar C., Merka, William C., Thompson, Sidney A., Cabrera, Miguel L., and Barnhart, Harold M. 1998. accumulation of elements in fractionated broiler litter during re-utilization. *J. Appl. Poult. Res.* 7(1): 27-34 .

Org Met Kennedy, S., Rice, D. A., and Cush, P. F. 1986. neuropathology of experimental 3-nitro-4-hydroxyphenylarsonic acidtoxicosis in pigs. *Veterinary Pathology* 23(4): 454-461.

Acute Kenyon, E. M., Hughes, M. F., Del Razo, L. M., Edwards, B. C., Mitchell, C. T., and Levander, O. A. 1999. influence of dietary selenium on the disposition of arsenate and arsenite in the female b6c3f1 mouse. *Environ. Nutr. Interact. (1999)* 3(2): 95-113.

Nut def Kenyon, E. M., Hughes, M. F., and Levander, O. A. 1997. influence of dietary selenium on the disposition of arsenate in the female b6c3f1 mouse. *J Toxicol Environ Health.* 51(3): 279-99.

Carc Kerkvliet, N. Isaacson and Steppan, L. Baecher. 1980. immunotoxicology studies of sodium arsenate - effects of exposure on tumor growth and cell-mediated tumor immunity. *J. Environ. Pathol. Toxicol. (1980)* 4(5-6): 65-79.

Org met Kerr, KB, Narveson, JR, and Lux, FA. 1969. toxicity of an organic arsenical, 3-nitro-4-hydroxyphenylarsonic acid: residues in chicken tissues. *J. Agr. Food Chem.* 17(6): 1400-1402.

Mix Kienholz, E. W., Ward, G. M., Johnson, D. E., Baxter, J., Braude, G., and Stern, G. 1979. metropolitan denver colorado usa sewage sludge fed to feedlot steers. *Journal of Animal Science. 48 (4): 735-741.*

In Vit Kim, Y. J., Shuman, J., Sette, M., and Przybyla, A. 1983. arsenate induces stress proteins in cultured rat myoblasts. *Vol. 96, No. 2, Pp. 393-400* J. Cell Biol.

An Prod Kinabo, L. D. B. 1993. pharmacology of existing drugs for animal trypanosomiasis. *Acta Tropica* 54(3-4): 169-183.

No Oral King, J. R., Peters, B. P., and Monteiro-riviere, N. A. laminin in the cutaneous basement membrane as a potential target in lewisite vesication. *Toxicology and Applied Pharmacology. 126 (1). 1994. 164-173.*

FL Kirilenko, A. V. 1975. avitellina arctica in rangifer tarandus. *Veterinariya, Moscow* (7): 58-59.

Drug Kirilenko, A. V. 1975. trials of some anthelmintics for monieziasis in rangifer tarandus. *<Document Title>Bor'Ba s Boleznyami Sel'Skokhozyaistvennykh Zhivotnykhv Zabaikal'e i Na Dal'Nem Vostoke, Vyp. 2.* 77-80.

Acu Kitagawa, H., Saito, H., Sugimoto, T., Yanaura, S., Kitagawa, H., Hosokawa, T., and Sakamoto, K. 1982. effects of diiospropyl-1,3-dithiol-2-ylidene malonate (nkk-105) on acute toxicity of various drugs and heavy metals. *Journal of Toxicological Sciences* 7(2): 123-34.

Rev Klaassen, C. D. and Liu, Jie. 1997. role of metallothionein in cadmium-induced hepatotoxicity and nephrotoxicity: new horizons in chemical-induced liver injury. *Drug Metab. Rev.* 29(1-2): 79-102.

Drug Klakow F-J, Mueller, M., and Jonas, K. 1986. use of magnesium chloride brine in drinking water for prophylaxis against grass tetany of cattle. *Monatshefte Fuer Veterinaermedizin. 41 (15). 1986. 505-509.*

Unrel Klee, S. R., Tzschaschel, B. D., Falt, I., Karnell, A., Lindberg, A. A., Timmis, K. N., and Guzman, C. A. 1997. construction and characterization of a live attenuated vaccine candidate against shigella dysenteriae type 1. *Infection and Immunity* 65(6): 2112-8.

BioX Klee, S. R., Tzschaschel, B. D., Singh, M., Falt, I., Lindberg, A. A., Timmis, K. N., and Guzman, C. A. 1997. construction and characterization of genetically-marked bivalent anti-shigella dysenteriae 1 and anti-shigella flexneri y live vaccine candidates. *Microbial Pathogenesis* 22(6): 363-76.

CP Kluge-Berge, S., <Editors> Ingkaninun, P., and Poomvises, P. 1993. residues of potentially harmful substances in norwegian slaughteranimals. *<Document Title>Proceedings, 11th International Symposium of the WorldAssociation of Veterinary Food Hygienists, 24-29 October 1993, Bangkok,Thailand.* 471-474.

In Vit Knapp, F. F. 1981.*Nuclear Medicine Technology Progress Report for Quarter Ending June 30, 1980*

Unrel Knapp, F. F. Jr. 1981. nuclear medicine technology. progress report, quarter ending march 31, 1980. *Govt Reports Announcements & Index (GRA&I)*

Meth Kobayashi, Yoshinori. 1989. development of an x-ray fluorescence element mapping spectrometer and its application to biological samples. *Kagaku Gijutsu Kenkyusho Hokoku (1989)* 84(12): 643-54.

Method Kogure, K. and Alonso, O. F. 1978. a pictorial representation of endogenous brain atp by a bioluminescent method. *Brain Research* 154(2): 273-84.

Surv Kohiyama Masatake, Kanematsu Hiromu, and Niiya Isao. 1992. studies on the behavior of trace components in oils and fats during processing for edible use: iv. decrease of trace metals in oils and fats during deacidifying, bleaching and deodorizing. *Journal of the Japan Oil Chemists' Society* 41(12): 1180-1184.

Phys Koizumi, T., Yamauchi, R., Irie, A., Negishi, M., and Ichikawa, A. 1991. induction of a 31,000-dalton stress protein by prostaglandins d2 and j2 in porcine aortic endothelial cells. *Biochemical Pharmacology* 42(4): 777-85.

FL Kojima, H. studies on developmental pharmacology of arsenite part 2 effect of arsenite on pregnancy nutrition and hard tissue.. *Folia Pharmacologica Japonica. 70 (2). 1974 149-163*

FL Kojima, H. 1974. [developmental pharmacology of arsenic. 2. effect of arsenic on pregnancy,

nutritional state and hard tissue]. *Nippon Yakurigaku Zasshi* 70(2): 149-63 .

BioAcc Kollmer, W. E. arsenic in induced hair of the rat and its relation to the content in various organs during chronic exposure. *J. Trace Elem. Electrolytes Health Dis. (1992)* 6(1): 11-14.

Acu Kollmer, W. E. the dose response of arsenic in induced hair of the rat and its relation to the content in various organs following acute exposure. *J. Trace Elem. Electrolytes Health Dis. (1990)* 4(2): 79-85

Acute Kondo, M and Ichikawa, I. 1999. acute effects of orally administered sodium arsenate on heme biosynthetic enzymes in the tissues of three strains of mice. *Applied Organometallic Chem.* 13: 649-654.

Acute Kondo, Masao and Ichikawa, Isamu. 1999. acute effects of orally administered sodium arsenate on heme biosynthetic enzymes in the tissues of three strains of mice. *Appl. Organomet. Chem. (1999)* 13(9): 649-654 .

Acu Kondo, Masao and Ichikawa, Isamu. 1994. different acute effects of oral and intratracheal administration of disodium arsenate and gallium arsenide on heme synthesis in rats. *Appl. Organomet. Chem. (1994)* 8(3): 215-21.

FL Kopbosynov, B. 1976. prophylaxis of anoplocephalata infections in sheep. *Veterinariya, Moscow* (6): 60-61.

Abstract Koropatnick Jim(A), Pearson-Sharpe Jane, and Fisman Michael. 1994. arsenic treatment induces accumulation of proteins derived from amyloid precursor protein (app) in rat liver and brain. *Neurobiology of Aging* 15(SUPPL. 1): S66.

FL Koshkina, N. G., Logachev, E. D., and Tishchenko, L. G. 1978. fine morphology of the genital organs of moniezia when normal andaction of some anthelmintics. *Trudy Kazakhskogo Nauchno-Issledovatel'Skogo Veterinarnogo Instituta (Voprosy Veterinarnoi Parazitologii v Kazakhstane)* 17: 100-102.

FL Kozlov, V. I., Pugachev, M. K., and Terman, O. A. 1990. [direct action of low-intensity laser irradiation on the morphofunctional status of the zona fasciculata of the adrenal cortex of white rats]. <original> napravlennoe vozdeistvie nizkointensivnogo lazernogo izlucheniia na morfofunktsional'noe sostoianie puchkovoi zony kory nadpochechnikov u beloi krysy. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 109(6): 598-600.

Unrel Kradel, J. 1971. (the environment and plant protection.). *Prakt. Schaedlingsbekaempfer; 23(5): 64-9 1971*

FL Krasovskii, G. N. and Pozhidaeva, N. V. 1984. [comparative toxicity of inorganic compounds containing 3- and 5-valent arsenic with respect to health standards for water]. <original> sravnitel'naia toksichnost' neorganicheskikh soedinenii, soderzhashchikh trekh- i piativalentnyi mysh'iak, v sviazi s ikh gigienicheskim reglamentirovaniem v vode. *Gigiena i Sanitariia* (4): 9-11.

No Oral Kraus, R. J. and Ganther, H. E. 1989. synergistic toxicity between arsenic and methylated selenium compounds. *Biol Trace Elem Res.* 20(1-2): 105-114.

FL Krause, U and Anke, M. 1988. (arsenic intake by man and animals). *Zent. Bl. Pharm.*

Pharmakother. Lab. Diagn. 127: 363-364.

No Oral Kreppel, H. 1993. metallothionein and arsenic toxicity. *Met.-Met. Interact. [Symp.]* : 129-48. Editor(s): Elsenhans, Bernd; Forth, Wolfgang; Schuemann, Klaus. Publisher: Bertelsmann Found. Publ., Guetersloh, Germany..

Acu Kreppel, H., Kolb, K., Reichl, F. X., Fichtl, B., and Forth, W. 1988. pretreatment with low doses of cadmium or zinc decreases lethality in mice acutely poisoned with arsenic. *Trace Elem. Anal. Chem. Med. Biol.* Proc. Int. Workshop, 5th (1988): 594-600. Editor(s): Braetter, Peter; Schramel, Peter. Publisher: de Gruyter, Berlin, Fed. Rep. Ger.

No Oral Kreppel, Helmut, Liu, Jie, Liu, Yaping, Reichl, Franz Xaver, and Klaassen, Curtis D. 1994. zinc-induced arsenite tolerance in mice. *Fundam. Appl. Toxicol. (1994)* 23(1): 32-7.

No Oral Kreppel, Helmut, Paepcke, Uwe, Thiermann, Horst, Szinicz, Ladislaus, Reichl, Franz X., Singh, Pramod K., and Jones, Mark M. 1993. therapeutic efficacy of new dimercaptosuccinic acid (dmsa) analogs in acute arsenic trioxide poisoning in mice. *Arch. Toxicol. (1993)* 67(8): 580-5

No Oral Kreppel, Helmut, Reichl, Franz X., Kleine, Andreas, Szinicz, Ladislaus, Singh, Pramod K., and Jones, Mark M. 1995. antidotal efficacy of newly synthesized dimercaptosuccinic acid (dmsa) monoesters in experimental arsenic poisoning in mice. *Fundam. Appl. Toxicol. (1995)* 26(2): 239-45

No Dose Kruckenberg, S. M., Cook, J. E., and Feldman, B. F. 1975. clinical toxicities of pet and caged rodents and rabbits. *Vet. Clin. N. Am. 5(4): 675-684; 1975.*

Surv LaDelfe, C. M. 1981.*Detailed Geochemical Survey Data Release for the San Andres-Oscura Mountains Special Study Area, New Mexico. GJBX-215-81; LA-8016-MS*

Surv Lagally, H. R., Biddle, G. N., and Siewicki, T. C. 1980.*Cadmium Retention in Rats Fed Either Bound Cadmium in Scallops or Cadmium Sulfate*

Surv Lagally, H. R., Biddle, G. N., and Siewicki, T. C. 1980. cadmium retention in rats fed bound cadmium in scallops or cadmium sulfate. *Nutr Rep Int.* 21(3): 351-364.

HHE Lagerkvist, B. E. and Linderholm, H. 1986. cold hands after exposure to arsenic or vibrating tools - effects of ketanserin on finger blood-pressure and skin temperature. *Acta Pharmacologica Et Toxicologica* 58(5): 327-332.

Bio Acc Lakso, JU and Peoples, SA. 1975. methylation of inorganic arsenic by mammals. *J. Agric. Food Chem.* 23(4): 674-676.

Unrel Lambert, H., Charette, S. J., Bernier, A. F., Guimond, A., and Landry, J. 1999. hsp27 multimerization mediated by phosphorylation-sensitive intermolecular interactions at the amino terminus. *Journal of Biological Chemistry* 274(14): 9378-85.

In Vit Landry, J. and Chretien, P. 1983. relationship between hyper thermia induced heat shock proteins and thermo tolerance in morris hepatoma cells.. *Canadian Journal of Biochemistry and Cell Biology. 61 (6). 1983. 428-437.*

Rev Langlands, J. P., Bowles, J. E., Donald, G. E., and Smith, A. J. 1986. Commonwealth Scientific

and Industrial Research Organization Armidale Australia Div. of Animal Production. 1986. selenium excretion in sheep. *Australian Journal of Agricultural Research. V. 37(2) P. 201-209*

Unrel Lanks, K. W., Kasambalides, E. J., Chinkers, M., and Brugge, J. S. 1982. a major cytoplasmic glucose-regulated protein is associated with the rous sarcoma virus pp60src protein. *Journal of Biological Chemistry* 257(15): 8604-7.

No Oral Lappas, G. D., Karl, I. E., and Hotchkiss, R. S. 1994. effect of ethanol and sodium arsenite on hsp-72 formation and on survival in a murine endotoxin model. *Shock* 2(1): 34-9; discussion 40.

Carcin Larsson, Sture, Karlberg, Ingvar, Selin, Eva, Daneryd, Peter, and Peterson, Hans Inge. 1987. trace element changes in serum and skeletal muscle compared to tumor tissue in sarcoma-bearing rats. *In Vivo (1987)* 1(3): 131-40.

In Vit Laszlo, A. 1988. the relationship of heat-shock proteins thermotolerance and protein synthesis. *Experimental Cell Research. 178 (2). 1988. 401-414.*

Unrel Laszlo Andrei. 1992. the thermoresistance state: protection from initial damage or better repair? *Experimental Cell Research* 202(2): 519-531.

Phys Laszlo Andrei(A) and Li Gloria C. 1993. effect of amino acid analogs on the development of thermotolerance and on thermotolerant cells. *Journal of Cellular Physiology* 154(2): 419-432.

FL Laukova, A. 1994. metal ion resistance in rumen staphylococci. *Veterinarni Medicina* 39(7): 389-395.

Unrel Laukova A(A) and Kmet, V. 1993. metal ion resistance of the bacteriocin producing enterococci. *Asian-Australasian Journal of Animal Sciences* 6(3): 441-445.

FL Lebedeva, N. V. 1996. population ecotoxicology of Birds. *Doklady Akademii Nauk.* 351(3): 425-429.

Org met Ledet, A. E. and Buck, W. B. AU <Editors> F. W. Oehme CS State Univ. toxicity of organic arsenicals in feedstuffs. *<Document Title>Toxicity of Heavy Metals in the Environment. Part 1*

Rev Ledet, AE and Buck, WB. toxicity of organic arsenicals in feedstuffs. *in Oehme, FW (Ed) Toxicity of Heavy Metals in the Environment. Part 1.*: 375-391.

Org met Ledet, AE, Duncan, JR, Buck, WB, and Ramsey, FK. 1973. clinical, toxicological, adn pathological aspects of arsanilic acid poisoning in swine. *Clin. Toxicol.* 6: 439.

In Vit Lee, T. C., Huang, R. Y., and Jan, K. Y. 1985. sodium arsenite enhances the cytotoxicity, clastogenicity, and 6-thioguanine-resistant mutagenicity of ultraviolet light in chinese hamster ovary cells. *Mutation Research* 148(1-2): 83-9.

In Vit Lee, T. C., Kao, S. L., and Yih, L. H. 1991. suppression of sodium arsenite-potentiated cytotoxicity of ultraviolet light by cycloheximide in chinese hamster ovary cells. *Archives of Toxicology* 65(8): 640-5.

In Vit Lee, T. C., Lee, K. Cc, Chang, C., and J Wo, W. L. cell cycle dependence of the cytotoxicity and clastogenicity of sodium arsenite in chinese hamster ovary cells. *Bull Inst Zool Acad Sin*

(Taipei); 25 (1). 1986. 91-98.

In Vit Lee, T. C., Oshimura, M., and Barrett, J. C. 1985. comparison of arsenic-induced cell transformation, cytotoxicity, mutation and cytogenetic effects in syrian hamster embryo cells in culture. *Carcinogenesis* 6(10): 1421-6.

In Vit Lee, Y. J. and Dewey, W. C. 1987. effect of cycloheximide or puromycin on induction of thermotolerance by sodium arsenite in chinese hamster ovary cells: involvement of heat shock proteins. *Journal of Cellular Physiology* 132(1): 41-8.

Unrel Lee, Y. J., Perlaky, L., Dewey, W. C., Armour, E. P., and Corry, P. M. 1990. differences in thermotolerance induced by heat or sodium arsenite cell killing and inhibition of protein synthesis. *RADIAT RES. Radiation Research. 121 (3). 1990. 295-303.*

Surv Lehn, P. J., Pate, B. D., King, D. R., and Voigt, R. C. 1972. evaluation of the effects of defoliants on the animal communities oftest area c-52a, Eglin air force base, Florida. 90.

No Oral Leikin, J. B., Goldman-Leikin, R. E., Evans, M. A., Wiener, S., and Hryhorczuk, D. O. 1991. immunotherapy in acute arsenic poisoning. *Journal of Toxicology. Clinical Toxicology* 29(1): 59-70.

Mix Levander, L. C. OAArgrett. effects of arsenic, mercury, thallium and lead on selenium metabolism in rats. *Toxicol. Appl. Pharmacol.; 14(2)* 308-1914.

Rev Levander, O. A. 1972. metabolic interrelationships and adaptations in selenium toxicity. *Ann N Y Acad Sci.* 192: 181-92.

CP Levander, O. A. and Morris, V. C. effect of arsenite on the metabolism of excess selenium fed to rats as selenite or high-selenium yeast. *Spurenelem.-Symp.: Arsen* 3rd (1980): 69-74. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

In Vit Levander, O. A., Morris, V. C., and Higgs, D. J. 1973. acceleration of thiol-induced swelling of rat liver mitochondria by selenium. *Biochemistry* 12(23): 4586-90.

Mix Levander, Orville A. and Argrett, L. C. 1969. effects of arsenic, mercury, thallium, and lead on selenium metabolism in rats. *Toxicol. Appl. Pharmacol. (1969)* 14(2): 308-14.

No Dose Levkutova, M., Revajova, V., Levkut, M. 1998. and Leng, L.. 1998. subpopulations of lymphocytes in cattle naturally infected with papillomavirus. *Acta Veterinaria Hungarica. V. 46(1) P. 13-18*

No Oral Lewis, S. C. 1975. acute lethality of selected heavy metals in spontaneously hypertensive rats. *Toxicology and Applied Pharmacology. 33 (1). 1975 128*

No Dose Li, D., Cutress, T. W., and Li, X. 1996. [an experimental study on effects of arsenic on dental fluorosis in rats]. *Chung-Hua Yu Fang i Hsueh Tsa Chih* 30(6): 354-6.

In Vit Li, G. C. 1983. induction of thermotolerance and enhanced heat-shock protein-synthesis in chinese-hamster fibroblasts by sodium arsenite and by ethanol. *Journal Of Cellular Physiology* 115(2): 116-122.

In Vit Li, Gloria C. 1983. induction of thermotolerance and enhanced heat shock protein synthesis in chinese hamster fibroblasts by sodium arsenite and by ethanol. *J. Cell. Physiol. (1983)* 115(2): 116-22.

In Vit Li, Gloria C. and Werb, Zena. 1982. correlation between synthesis of heat shock proteins and development of thermotolerance in chinese hamster fibroblasts. *Proc. Natl. Acad. Sci. U. S. A. (1982)* 79(10): 3218-22.

No Dose Li, W., Chien, P. K., and Furst, A. 1994. evaluation of three antidotes on arsenic toxicity in the common earthworm (*Lumbricus terrestris*). *Journal of Applied Toxicology* 14(3): 181-3.

FL Li, Y. and Zhu, H. 1997. [a study on the relation between nitric oxide and abnormal development of embryos]. *Wei Sheng Yen Chiu* 26(3): 162-6.

FL Li, Yong, Sun, Mianling, Wu, Desheng, and Chen, Xing. 1999. toxicity of combination of selenium, fluoride and arsenic on rat embryos. *Weisheng Yanjiu (1999)* 28(2): 74-75.

No Oral Li, Yong, Yu, Zaifang, and Zhu, Huigang. 1998. role of programmed cell death in mediating arsenic-induced rat embryo anomalies. *Weisheng Yanjiu (1998)* 27(2): 91-94.

Sed Liber K(A) and Sobey S(A). 1999. toxicity of uranium, nickel and arsenic to hyalella azteca in spiked-sediment toxicity tests. *Canadian Technical Report of Fisheries and Aquatic Sciences* (2293): 107.

Surv Lipa, J. J. and Trojanowski, H. 1977. study on the effect of pesticides on the useful microflora and fauna of farmlands and gardens in Poland. *Postepy Nauk Roln. 24(2): 77-94 1977 (77 References).*

Plant Liu Donghua(A), Jiang Wusheng(A), and Li Deshen. 1993. effects of aluminium ion on root growth, cell division, and nucleoli of garlic (*Allium sativum l.*). *Environmental Pollution* 82(3): 295-299.

In Vit Liu, Y. signal transduction pathways in response to stress. *Crisp Data Base National Institutes Of Health*

Org met Lowry, K. R. and Baker, D. H. 1989. amelioration of selenium toxicity by arsenicals and cysteine. *J Anim Sci.* 67(4): 959-65. Ref ID: 1445

Unrel Lu, Fung Jou. 1990. fluorescent humic substances and blackfoot disease in taiwan. *Appl. Organomet. Chem. (1990)* 4(3): 191-5.

Gene Lu, T. Hong, Pepe, J., Lambrecht, R. W., and Bonkovsky, H. L(A). 1996. regulation of metallothionein gene expression. studies in transfected primary cultures of chick embryo liver cells. *Biochimie (Paris)* 78(4): 236-244.

Unrel Luthman, M. and Holmgren, A. 1982. rat liver thioredoxin and thioredoxin reductase ec-1.6.4.5 purification and characterization. *Biochemistry. 21 (26). 1982 (Recd. 1983). 6628-6633.*

Unrel Luthman, M. and Holmgren, A. 1982. rat liver thioredoxin and thioredoxin reductase: purification and characterization. *Biochemistry* 21(26): 6628-33.

Gene Lynn, S., Lai, H. T., Gurr, J. R., and Jan, K. Y. 1997. arsenite retards dna break rejoining by

inhibiting dna ligation. *Mutagenesis* 12(5): 353-8.

FL Ma, Long, Zhang, Chen, Liu, Wenjie, Wang, Huaixing, and Jiang, Ping. 1994. effects of arsenic on the offspring development in mice. *Zhonghua Yufang Yixue Zazhi (1994)* 28(1): 20-3 CODEN: CHYCDW; ISSN: 0253-9624.

No Oral Machado, A. F., Hovland, D. N. Jr, Pilafas, S., and Collins, M. D. 1999. teratogenic response to arsenite during neurulation: relative sensitivities of c57bl/6j and swv/fnn mice and impact of the Splotch Allele. *Toxicological Sciences* 51(1): 98-107 .

Cp Machado, A. F., Hovland, D. N Jr, Scott, W. J., and Collins, M. D. 1997. teratogenic responses to cadmium and arsenite relative sensitivity of c57bl-6 and swv mice. *Joint Meeting of the Teratology Society Thirty-seventh Annual Meeting and Tenth International Conference of the Organization of Teratology Information Services*

No Oral Machado, AF, Hovland, DN Jr, Pilafas, S, and Collins, MD. 1999. teratogenic response to arsenite during neurulation: relative sensitivities of c57bl/6j and swv/fnn mice and impact of the splotch allela. *Toxicol. Sci.* 51(1): 98-107.

Abstract Machado, AF, Hovland, DN Jr., Scott, WJ, and Collins, MD. 1997. teratogenic responses to cadmium and arsenite: relative sensitivity to c57bl/6 and swv mice. *Teratology.* 55(1): 40.

Surv MacNeil, J. D., Patterson, J. R., Salisbury, C. D. C., and Tessaro, S. V. 1990. an investigation of the trace element status of bison in wood buffalonational park and of ranch-raised bison in saskatchewan, canada. *International Journal of Environmental Analytical Chemistry.* 41(3 + 4): 99-104.

No Oral Macquillan, M. J. and Shipp, E. 1976. evaluation of chlorpyrifos and chlorpyrifos-methyl for control of dermestes-maculatus coleoptera dermestidae on sheep skins.. *Journal of Stored Products Research. 12 (2). 1976 93-96.*

FL Maehashi, H. 1974. studies on arsenic metabolism .8. effects of polytamin and polypepton in diet on absorption, cumulation and excretion of arsenic in rats. *Folia Pharmacologica Japonica* 70: P89.

FL Maehashi, Hiroshi. 1997. toxicology of metals with a special emphasis on the biotransformation of arsenic and metal chelating agents, dmsa and dmps. *Matsumoto Shigaku (1997)* 23(3): 145-153.

Acu Maehashi, Hiroshi and Yamaguchi, Yuriko. 1983. treatment of arsenic poisoning with heavy metal antagonists in mice. *Matsumoto Shigaku (1983)* 9(1): 47-51.

Unrel Mahaffey, K. R. 1977. mineral concentrations in animal tissues certain aspects of federal drug administration regulatory role. *Journal of Animal Science 44 (3): 509-515.*

Dup Mahaffey, K. R., Capar, S. G., Gladen, B. C., and Fowler, B. A. 1981. concurrent exposure to lead, cadmium, and arsenic. effects on toxicity and tissue metal concentrations in the rat. *J Lab Clin Med.* 98(4): 463-481.

Chem Method Maher, W. A. 1989. some observations on the determination of total arsenic in biological tissues. *Microchemical Journal* 40(1): 132-135.

No Dose Maitai, C. K., Kamau, J. A., Gacuhi, D. M., and Njoroge, S. 1975. an outbreak of arsenic and toxaphene poisoning in kenyan cattle. *Veterinary Record* 96(No.7): 151-152.

Acute Maitani, T, Saito, N, Abe, M, Uchiyama, S , and Saito, Y. 1987. chemical form-dependent induction of hepatic zinc-thionein by arsenic administration and effect of co-administered selenium in mice. *Toxicol. Letters.* 39(1): 63-70.

Acute Maitani, Tamio, Saito, Nobuko, Abe, Mayumi, Uchiyama, Sadao, and Saito, Yukio. 1987. chemical form-dependent induction of hepatic zinc-thionein by arsenic administration and effect of co-administered selenium in mice. *Toxicol. Lett. (1987)* 39(1): 63-70.

Acu Malishevskaya, A. S., Grudina, L. M., and Laisheva, M. M. 1966. distribution of arsenic and mercury in the blood and organs of animals during acute poisoning. *Tr. Kaz. Nauch.-Issled. Vet. Inst. (1966)* : 12, 281-4.

Gene Mandel, H. G., Triester, S. R., and Szapary, D. 1970. interference of barbiturates with pyrimidine incorporation. 3. studies on the mechanism of the amobarbital-orotate relationship. *Biochemical Pharmacology* 19(6): 1879-92.

CP Marafante, E., Rade, J., Pietra, R., Sabbioni, E., and Bertolero, F. 1980. metabolic fate of inorganic arsenic in laboratory animals. *Spurenelem.-Symp.: Arsen 3RD* : 49-55. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep..

Org met Marafante, E. and Vahter, M. 1986. the effect of dietary and chemically induced methylation deficiency on the metabolism of arsenate in the rabbit. *Acta Pharmacol. Toxicol. Suppl.* 59(7): 35-8.

Acute Marafante, E., Vahter, M., and Dencker, L. 1984. metabolism of arsenocholine in mice, rats and rabbits (presence in seafood products). *The Science Of The Total Environment.* Mar 15, 1984. v. 34 (3) p. 223-240. ill.

Unrel Marin-Padilla, M. 1980. morphogenesis of experimental encephalocele cranioschisis occulta. *J NEUROL SCI. Journal of the Neurological Sciences. 46 (1). 1980. 83-100.*

Unrel Markovits, Andres, Conejeros, Raul, Lopez, Luis, and Lutz, Mariane. 1992. evaluation of marine microalga nannochloropsis sp. as a potential dietary supplement. chemical, nutritional and short term toxicological evaluation in rats. *Nutr. Res. (N. Y.) (1992)* 12(10): 1273-84.

Mix Marshall, SP, Hayward, FW, and Meagher, WR. 1963. effects of feeding arsenic and lead upon their secretion in milk. *J. Dairy Sci.* 46: 580.

HHE Mascolo, N., Summa, V., and Tateo, F. 1999. characterization of toxic elements in clays for human healing use. *Appl. Clay Sci.* 15(5-6): 491-500.

Acu Mason, R. W. and Edwards, I. R. 1989. acute toxicity of combinations of sodium dichromate, sodium arsenate and copper sulfate in the rat. *Comp. Biochem. Physiol. C: Comp. Pharmacol. Toxicol.* 93C(1): 121-5 .

No Oral Mason, R. W., Edwards, I. R., and Fisher, L. C. 1987. fetotoxicity and teratogenicity of sodium dichromate sodium arsenate and copper sulfate in rats. *Proc Univ Otago Med Sch.* 65(3): 59-60.

No Oral Mason, R. W., Edwards, I. R., and Fisher, L. C. 1989. teratogenicity of combinations of sodium dichromate sodium arsenate and copper sulfate in the rat. *Comp Biochem Physiol C Comp Pharmacol Toxicol.* 93(2): 407-412.

Surv Mathews N E and Porter W F. 1989. acute arsenic toxication of a free-ranging white-tailed deer in new york. *Journal of Wildlife Diseases* 25. 126(1): 132-135.

FL Matsumoto, N., Iijima, S., and Katsunuma, H. 1975. fetal body burden of chemicals and its effect on fetal Growth. *Congen Anom.* 15: 245-246.

Abstract Matsumoto, N., Okino, T., Katsunuma, H., and Iijima, S. 1973. effects of na-arsenate on the growth and development of fetal Mice. *Teratology. 8:98,1973*

FL Matsumoto, N., Okino, T., Katsunuma, H., and Iijima, S. 1974. effect of sodium arsenite on growth and development of fetal mice. *; 13 (3). 1973 (RECD 1974) Congenital Anomalies.* 13(3): 175-176.

Unrel Mattingly, M. E., Mattingly, J. R. Jr, and Martinez-Carrion, M. 1982. phosphorus-31 nmr of mitochondrial aspartate amino transferase ec-2.6.1.1 the effects of solution ph and ligand binding. *Journal of Biological Chemistry. 257 (15). 1982. 8872-8878.*

Nut def Maurice, D. V., Jensen, L. S., and Tojo, H. 1979. comparison of fish meal and soybean meal in the prevention of fattyliver-hemorrhagic syndrome in caged layers. *Poultry Science* 58(4): 864-870.

FL Mayer, Gabor, Csorba, Erzsebet, Dura, Gyula, Vincze, Istvan, Vargha, Laszlo, and Deak, Zsuzsanna. 1989. experimental examination of dermal absorption of arsenic. *Egeszsegtudomany (1989)* 33(3-4): 265-74.

Abstract McDorman, EW, Collins, BW, Moore, T, George, MH, DeAngelo, AB, Mass, MJ, and Allen, JW. 1989. micronucleus analysis in mice chronically exposed to arsenic in drinking water. *Environ. Molecular Mutagenesis.* 31(Supp. 29): 39.

Alt Mcdowell, L. R., Froseth, J. A., and Piper, R. C. 1978. influence of arsenic sulfur cadmium tellurium silver and selenium on the selenium vitamin e deficiency in the pig. *NUTR REP INT.* 17(1): 19-34.

Abstract Mcdowell, L. R., Froseth, J. A., Piper, R. C., and Dyer, I. A. 1971. selenium retention in the pig. *Journal of Animal Science. 33 (1). 1971 235-236*

HHE McGown, E. L., van Ravenswaay, T., and Dumlao, C. R. 1987. histologic changes in nude mouse skin and human skin xenografts following exposure to sulfhydryl reagents: arsenicals. *Toxicologic Pathology* 15(2): 149-56.

FL Medovar, E. N. and Grigor'eva, V. A. 1973. effect of microsome fractions on glycolysis in skeletal muscles of normal rabbits and those with dystrophy. *Ukr. Biokhim. Zh. (1973)* 45(4): 387-92.

FL Merenyuk, G. V. and Burdenko, T. A. 1969. toxicology of copper-containing pesticides. *Zdravookhranenie (1969)* 12(5): 23-6.

Unrel Merry, R. H. and Tiller, K. G. 1986. the effects of contamination of soil with copper, lead and

arsenic on the growth and composition of plants. i. effects of season, genotype, soil temperature, and fertilizers. *Plant and Soil* . 91: 115-128.

Gene Mertens, F., Urbain, J., and Slaoui, M. 1989. in vivo induction of a/j anti-ars responses with different ranges of affinities: correlation between affinity and cria idiotype dominance. *Molecular Immunology* 26(9): 859-64.

FL Mertin, D., Hanusova, E., Suvegova, K., and Stepanok, V. 1995. concentration of some trace elements in the fur of greenland nutriaduring ontogenesis. *Scientifur* 19(4): 277-280.

Mix Meshkov, N. V. and Gadzhieva, Z. M. 1949-1954. pathomorphological changes in the peroral action of the arsenic - containing pesticies, zinc fluoroarsenate and barium fluoroarsenate. *Vopr. Pitaniya; 28(4)*

In Vit Meunier J-C and Dalziel, K. 1978. kinetic studies of glyceraldehyde 3 phosphate dehydrogenase ec-1.2.1.12 from rabbit muscle. *European Journal of Biochemistry. 82 (2). 1978 483-492.*

In Vit Meunier, J. C. and Dalziel, K. 1978. kinetic studies of glyceraldehyde-3-phosphate dehydrogenase from rabbit muscle. *European Journal of Biochemistry* 82(2): 483-92.

Unrel Miera, F. R., Langhorst, G., McEllin, S., and Montoya, C. 1984. *Environmental Studies Conducted at the Fenton Hill Hot Dry Rock Geothermal Development Site. LA-9967-MS*

Unrel Miera, F. R. Jr, Langhorst, G., McEllin, S., and Montoya, C. 1984. environmental studies conducted at the fenton hill hot dry rock geothermal development site. *Govt Reports Announcements & Index (GRA&I).*(Issue 24,)

Surv Mikkelsen, R. L., Page, A. L., and Bingham, F. T. 1986. geochemistry and health in california: recent experiences with selenium. *Trace Subst. Environ. Health (1986)* : 20, 413-23 .

Unrel Miller, J. J. a, Read, B. J., Wentz, D. J., and Heaney, D. J. 1996. major and trace element content of shallow groundwater associated with dryland saline soils in southern alberta. *Water Quality Research Journal of Canada.* 31(1): 101-117.

Carcin Milner, John E. 1969. effect of ingested arsenic on methylcholanthrene-induced skin tumors in mice. *Arch. Environ. Health (1969)* 18(1): 7-11.

Unrel Mirkes, Philip E. and Little, Sally A. 1998. teratogen-induced cell death in postimplantation mouse embryos: differential tissue sensitivity and hallmarks of apoptosis. *Cell Death Differ. (1998)* 5(7): 592-600.

In Vit Mirkes, Philip E a, Doggett, Barbar, and Cornel, Leanne. 1994. induction of a heat shock response (hsp 72) in rat embryos exposed to selected chemical teratogens. *Teratology*. 49(2): 135-142.

No oral Mitchell, RD, Ayala-Fierro, F, and Carter, DE. 2000. systemic indicators of inorganic arsenic toxicity in four animal species. *J. Toxicol Environ Health, Part A.* 59(2): 119-134.

Acute Mitchell Roger D, Ayala-Fierro Felix, and Carter Dean E(A). 2000. systemic indicators of inorganic arsenic toxicity in four animal species. *Journal of Toxicology and Environmental Health Part A* 59(2): 119-134.

Acu Mitra, K., Kundu, S. N., and Khuda Bukhsh, A. R. 1999. efficacy of a potentized homoeopathic drug (arsenicum album-30) in reducing toxic effects produced by arsenic trioxide in mice: ii. on alterations in body weight, tissue weight and total protein. *Complementary Therapies in Medicine* 7(1): 24-34.

In Vit Mivechi, N. F. and Dewey, W. C. 1985. DNA polymerase alpha and beta activities during the cell cycle and their role in heat radiosensitization in chinese hamster ovary cells.. *Radiation Research. 103 (3). 1985. 337-350.*

In Vitro Mohelska, H., Bencko, V., Smetana, K., and Hyncica, V. 1980. ultrastructural changes in hepatocytes of mice exposed to arsenic in drinking water. *Experimentelle Pathologie* 18(5): 275-81.

No Dose Monies, R. J. 1997. arsenic poisoning in a dairy heifer following contamination of aredundant industrial site with a wood tanalising (preserving) compound(copper sulfate, potassium dichromate, and arsenic pentoxide). *Cattle Practice* 5(4): 307-312.

Nut def Montessuit, C, Bonjour, JP, and Caverzasio, J. 1994. pi transport regulation by chicken growth plate chondrocytes. *Am. J. Physiol.* 267: E24-31.

Bio Acc Mora, M. A. and Anderson, D. W. 1995. selenium, boron, and heavy metals in birds from the mexicali valley baja california mexico. *Bul Environ Contamin Toxicol* . 54(2): p198-206.

Abstract Morimoto, Hiroshi, Noro, Harunobu, Otaki, Hiroyasu, and Takagi, Hisao. 1978. influence of dietary minerals on their distribution in broilers. *Nippon Kakin Gakkaishi (1978)* 15(6): 296-301.

No Dose Morris, HP, Lang, EP, Morris, HJ, and Grant, RL. 1938.*J. Pharmacol. Exp. Ther.* 64: 420.

Organic Morrison, JL. 1969. distribution of arsenic from poultry litter i broiler chickens, soil, and crops. *J. Agr. Food Chem.* 17(6): 1288-1290.

Coded Morrison, L. L. and Chavez, E. R. 1983. selenium-arsenic interaction in the weanling pig. *Canadian Journal of Animal Science* 63(1): 239-246.

No Oral Morrissey, R. E., Fowler, B. A., Harris, M. W., Moorman, M. P., Adkins, B., and Schwetz, B. A. 1989. effect of arsine on prenatal development of swiss (cd-1) mice and fischer 344 rats. *Toxicologist 1989 Feb/Mar;9(1):32*

No Oral Morrissey, Richard E. and Mottet, N. Karle. 1983. arsenic-induced exencephaly in the mouse and associated lesions occurring during neurulation. *Teratology (1983)* 28(3): 399-411.

Aquatic Motas, C. 1970. pesticides. their effects on animals and man. water pollution aspects. *Ocrotirea Nat.; 14(1): 21-33; 1970 ; (REF:41)*

FL Mourek, Jindrich, Trojan, S., Trojanova, M., Pruzkova, V., and Jilek, L. 1970. changes in the resistance of central nervous system to anoxia produced by some metabolic substrates and enzyme inhibitors during ontogenesis. *Sb. Lek. (1970)* 72(11-12): 302-11.

Surv Moxham, JW and Coup, MR. 1968. arsenic poisoning of cattle and other domestic animals. *New Zealand Vet J.* 16: 161-165.

FL Mravcova, A. 1985. combined effect of arsenic and selenium administered to mice in drinking water. *Cesk. Hyg. (1985)* 30(5): 257-68.

Mix Mueller W-U and Streffer, C. 1987. risk to preimplantation mouse embryos of combinations of heavy metals and radiation. *European Late Effects Project (Eulep) Symposium on Effects after Combined Exposure to Ionizing Radiation and Chemical Substances Held in Connection with the Annual Meeting of the European Society for Radiation Biology, Pisa, Italy, September 19, 1986. Int J Radiat Biol Relat Stud Phys Chem Med. 51 (6). 1987. 997-1006.*

Unrel Mukherjee Paramita, Poddar Sandeep, Talukder Geeta, and Sharma Archana(A). 1999. protection by black tea extract against chromosome damage induced by two heavy metals in mice. *Pharmaceutical Biology* 37(3): 243-247.

Unrel Murphy, B. J. and Brosnan, M. E. 1976. subcellular localization of ornithine decarboxylase in liver of and growth-hormone-treated rats. *Biochemical Journal* 157(1): 33-9.

No Dose Mutenda, E. K., Sparkes, M. J., and Dixon, H. B. 1995. arsenite release on enzymic transformation of arsonomethyl substrate analogues: a potentially lethal synthesis by glycerol-3-phosphate dehydrogenase. *Biochemical Journal* 310(Pt 3): 983-8.

Unrel Mylona, Photini V., Polidoros, Alexios N., and Scandalios, John G. 1998. modulation of antioxidant responses by arsenic in maize. *Free Radical Biol. Med. (1998)* 25(4/5): 576-585.

FL Nadeenko, V. G. and Lenchenko, V. G. 1977. nature of the combined action of small doses of certain elements-antagonists. *Gig Sanit (8):30-34,1977*

FL Nadeenko, V. G. and Lenchenko, V. G. regularities of the combined action of small doses of certain antagonistic elements. *Gigiena i Sanitariya. (8). 1977 30-34.*

FL Nadeenko, V. G. and Lenchenko, V. G. 1977. (on the nature of the combined effects of small doses of some antagonists). *Gigiena i Sanitariya* No. 8: 30-34.

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. effect of tungsten, molybdenum, copper and arsenic on the intrauterine development of the fetus. *Farmakol. Toksikol. (Moscow) (1978)* 41(5): 620-3.

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. 1978. the influence of tungsten, molibdenum, copper and arsenic on the intrauterine development of the fetus. *Farmakol Toksikol(moscow) 41:620-623,1978*

FL Nadeenko, V. G., Lenchenko, V. G., Genkina, S. B., and Arkhipenko, T. A. 1978. [effect of wolfram, molybdenum, copper and arsenic on intrauterine fetal development]: <original> vliianie vol'frama, molibdena, medi i mysh'iaka na vnutriutrobnoe razvitie ploda. *Farmakol Toksikol.* 41(5): 620-3.

FL Nadeenko, V. G., Lenchenko, V. G., and Krasovskii, G. N. 1987. combined effect of metals during their intake with drinking water. *Gig. Sanit. (1987)* (12): 9-12.

Fate Naegle, S. R., Yousef, M. K., and Barton, J. T. 1983. biokinetics of arsenic-74, cadmium-109, and lead-203: effects of age, ambient temperature and previous exposure. *Trace Subst. Environ. Health (1983)* : 17, 344-9.

No Oral Nagymajtenyi, L., Selypes, A., and Berencsi, G. 1985. chromosomal-aberrations and fetotoxic effects of atmospheric arsenic exposure in mice. *Journal Of Applied Toxicology* 5(2): 61-63.

Rev NAS, Subcommittee on Mineral Toxicity Committee on Animal Nutrition. 1980.: 588.

Org met Naveen, P. K., Ananthasubramaniam, C. R., and Devasia, P. A. 1977. studies on the use of arsenicals in layer poultry rations. *Indian J. Nutr. Diet.* 14(2): 47-51 .

Org met Naveen, P. K., Ananthasubramaniam, C. R., and Devasia, P. A. Kerala 1977. Agricultural Univ. Mannuthy India Coll. of Veterinary and Animal Sciences. Dept. of Nutrition. 1977. effects of feeding arsenicals on growth in poultry [chickens, india]. *Kerala Journal of Veterinary Science. V. 8(1) P. 31-36*

CP Nedkova, L. and <Editors> Botev, N. 1996. effects of arsenic supply on the growth, health and some biochemicalparameters in pheasants (phasianus colhicus mongolicus). <. *Document Title>The Game and the Man. Proceedings International Unionof Game Biologists 22nd Congress Sofia, Bulgaria, 4-8 September 1995.* 461-467.

Diss Neiger R.D. 1988. effects of chronic dietary inorganic arsenic in dogs. *DISS. ABST. INT. PT. B - SCI. & ENG* VOL. 48, NO. 7: 189 pp^.

Diss Neiger, Regg Darwyn. 1987. effects of chronic dietary inorganic arsenic in dogs. *Avail.: Univ. Microfilms Int. Order No. DA8721915 From: Diss. Abstr. Int. B 1988, 48. 7. 1910.* 189 pp.

Acu Neklesova, I. E., Egorova, N. V., and Kudrina, M. A. 1966. fungicidal properties and toxicity with respect to warm-blooded animals or thioesters of certain acids of trivalent arsenic. *Proc. Acad. Sci. USSR*

No Oral Newman, J. R. 1980. *Effects of Air Emissions on Wildlife Resources. <NOTE> Air Pollution and Acid Rain Rept. No. 1. FWS/OBS-80/40.1*

Unrel Ngu Mary, Moya Elena, and Magan Naresh(A). 1998. tolerance and uptake of cadmium, arsenic and lead by fusarium pathogens of cereals. *International Biodeterioration & Biodegradation* 42(1): 55-62.

Unrel Nielsen, F. H. 1981. consideration of trace element requirements for preparation of chemically defined media. *The Growth Requirements of Vertebrate Cells in Vitro* : 68-81.

Nut Def Nielsen, F. H. 1990. new essential trace elements for the life sciences. *Biol Trace Elem Res.* 26-27: 599-611.

Diss Nielsen, F. H., Myron, D. R., and Uthus, E. O. 1978. newer trace elements - vanadium (v) and arsenic (as) deficiency signs and possible metabolic roles. *Trace Elem. Metab. Man Anim. Proc. Int. Symp., 3rd* : Meeting Date 1977, 244-7. Editor(s): Kirchgessner, M. Publisher: Arbeitskreis Tierernaehrungsforschung Weihenstephan Inst. Ernaehrungsphysiol., Freising-Weihenstephan, Ger..

Abstract Nielsen, FH, Givand, SH, and Myron, DR. evidence of a possible requirement for arsenic by the rat. *Fed. Proc.* 34: 923.

Rev Nielsen, Forrest H., Hunt, Curtiss D., and Uthus, Eric O. 1980. interactions between essential

trace and ultratrace elements. *Ann. N. Y. Acad. Sci. (1980)* 355(Micronutr. Interact.: Vitam., Miner., Hazard. Elem.): 152-64/

HHE Nishino, Y. Shimane Univ. Matsue Japan Faculty of Agriculture, Bairinji, M., Tanikawa, M., Takahashi, A., Nakao, T., and Tanaka, C. 1992. effect of wood treated with wood preservatives on living body. *Bulletin of the Faculty of Agriculture - Shimane University. (No.26) P. 91-95*

An Prod Niven, D. R. and Pritchard, D. A. 1985. effects of control of the sheep body louse (*Damalinia ovis*) on woolproduction and quality. *Australian Journal of Experimental Agriculture* 25(1): 27-31.

Surv Norheim, G., Skaare, J. U., and Wiig, O. 1992. some heavy metals, essential elements, and chlorinated hydrocarbons in polar bear (*Ursus maritimus*) at Svalbard. *Environ Pollut.* 77(1): 51-57.

Phys Nosek, T. M., Leal-Cardoso, J. H., Mclaughlin, M., and Godt, R. E. 1990. inhibitory influence of phosphate and arsenate on contraction of skinned skeletal and cardiac muscle.. *American Journal of Physiology. 259 (6 Part 1). 1990. C933-C939.*

In Vit Novgorodov, S. A., Kultayeva, E. V., Yaguzhinsky, L. S., and Lemeshko, V. V. 1987. ion permeability induction by the sh cross-linking reagents in rat liver mitochondria is inhibited by the free radical scavenger butylhydroxytoluene. *Journal of Bioenergetics and Biomembranes. 19 (3). 1987. 191-202.*

FL Novikov, Yu. V., Plitman, S. I., Levin, A. I., Shniger, N. Kh., Ershova, T. N., Kagirov, V. N., Tsareva, L. G., Kochetkova, T. A., Lastochkina, K. O., Tyuleneva, I. S., and Noarov, Yu. A. 1980. health status of the population in relation to use of soft drinkingwater low in minerals. *Gigiena i Sanitariya* (12): 3-6.

FL Nozaki, S. 1973. studies on the arsenic metabolism part 7 added arsenite in diet and resulting content in each organ as well as the effect on Diet. *Folia Pharmacol JAP. 69 (1). 1973 201-212*

FL Nozaki, S. 1973. [arsenic metabolism. 7. relation of arsenite in the diet of arsenic content of different organs, with different diets]. *Nippon Yakurigaku Zasshi* 69(1): 201-12.

FL Nozaki, S. 1974. [arsenic metabolism. (ii). arsenic content in the diet and increase in arsenic levels in various organs]. *Nippon Yakurigaku Zasshi* 70(5): 707-18.

FL Nozaki, Shigeru. 1972. arsenic metabolism. vi. effect of components of milk on arsenic tolerance in the digestive tract. *Nippon Yakurigaku Zasshi (1972)* 68(6): 857-68.

Surv Nyholm, Erik. 1986. uptake and effects of metals on birds and mammals in heavy metal contaminated areas. *Inst. Vatten- Luftvaardsforsk. [Publ.] B* IVL B 820, 50 pp.

Mix Nyholm, N. E. I. Umea University Umea Sweden. influence of heavy metal exposure during different phases of the. *Arch Environ Contam Toxicol. V35, N4, P632(6)*

Surv Nyholm, N. EI. 1998. influence of heavy metal exposure during different phases of the ontogeny on the development of pied flycatchers, ficedula hypoleuca, in natural populations. *Arch Environ Contamin Toxicol* . 35(4): p632-637.

Drug O'brien Dermot J(A). 1999. treatment of psoroptic mange with reference to epidemiology and

history. *Veterinary Parasitology* 83(3-4): 177-185.

FL Ochi, T., Kaise, T., and Oya-Ohta, Y. 1994. glutathione plays different roles in the induction of the cytotoxic effects of inorganic and organic arsenic compounds in cultured balb/c 3t3 cells. *Experientia* 50(2): 115-20.

In Vit Ochi, T., Nakajima, F., Shimizu, A., and Harada, M. 1999. induction of multinucleated cells in v79 chinese hamster cells exposed to dimethylarsinic acid, a methylated derivative of inorganic arsenics: mechanism associated with the formation of aberrant mitotic spindles. *Vol. 13, No. 1, Pp. 11-25* Toxicology In Vitro

In Vit Ochi, Takafumi, Nakajima, Fumie, and Fukumori, Nobutaka. 1998. different effects of inorganic and dimethylated arsenic compounds on cell morphology, cytoskeletal organization, and dna synthesis in cultured chinese hamster v79 cells. *Arch. Toxicol. (1998)* 72(9): 566-573.

Bio Acc Odanaka, Y, Matano, O, and Goto, S. 1980. biomethylation of inorganic arsenic by the rat and some laboratory animals. *Bull. Environ. Contam. Toxicol.* 24: 452-459.

Drug Odunuga, O. O., Okunade, G. W., and Olorunsogo, O. O. 1999. reversal of sodium arsenite inhibition of rat liver microsomal ca2+ pumping atpase by vitamin c. *Bioscience Reports* 19(1): 11-5.

Surv Ohlendorf, Harry M., Hothem, Roger L., Aldrich, Thomas W., and Krynitsky, Alexander J. 1987. selenium contamination of the grasslands, a major california waterfowl area. *Sci. Total Environ.* 66, 169-83.

Nut def Ohmori, S. and Takagi, Y. 1991. elemental concentrations in hair of protein malnourished rats and zinc deficient rats. *Biomed. Res. Trace Elem.* 2(2): 203-4 .

No Dose Ohtsuka, K., Nakamura, H., and Sato, C. 1986. intracellular distribution of 73,000 and 72,000 dalton heat shock proteins in hela cells. *International Journal of Hyperthermia* 2(3): 267-75.

Unrel Ohtsuka K(A), Liu Y-C, and Kaneda, T. 1993. cytoskeletal thermotolerance in nrk cells. *International Journal of Hyperthermia* 9(1): 115-124.

HHE Okui, T. and Fujiwara, Y. 1986. inhibition of human excision dna repair by inorganic arsenic and the co-mutagenic effect in v79 chinese hamster cells. *Mutation Research* 172(1): 69-76.

In Vit Okui, Toyo. 1987. cytotoxicity and effects of arsenic compounds on dna repair in cho cells. *Eisei Kagaku (1987)* 33(1): 20-4.

HHE Okui, Toyo and Fujiwara, Yoshisada. inhibition of human excision dna repair by inorganic arsenic and the co-mutagenic effect in v-79 chinese hamster cells. *Mutat. Res. (1986)* 172(1): 69-76 CODEN: MUREAV; ISSN: 0027-5107.

Aquatic Oleson S.G. and Carr J.R. 1990. correspondence analysis of water quality data: implications for fauna deaths at stillwater lakes, nevada. *Math. Geol* VOL. 22, NO. 6: pp. 665-698.

No Oral Omura, M., Tanaka, A., Hirata, M., Zhao, M., Makita, Y., Inoue, N., Gotoh, K., and Ishinishi, N. 1996. testicular toxicity of gallium arsenide, indium arsenide, and arsenic oxide in rats by repetitive intratracheal Instillation. *Fundamental and Applied Toxicology; 32 (1). 1996. 72-78.*

No Oral Omura Minoru(A), Hirata Miyuki, Tanaka Akiyo, Zhao Mangen, Makita Yuji, Inoue Noahide, Gotoh Kaoru, and Ishinishi Noburu. 1996. testicular toxicity evaluation of arsenic-containing binary compound semiconductors, gallium arsenide and indium arsenide, in hamsters. *Toxicology Letters (Shannon)* 89(2): 123-129.

Fate Ong, Colin G. and Tanji, Kenneth K. 1993. evaporative concentration of trace elements in a multicell agricultural evaporation pond. *J. Agric. Food Chem. (1993)* 41(9): 1507-10 CODEN: JAFCAU; ISSN: 0021-8561.

In Vit Opanashuk, L. A. and Finkelstein, J. N. 1995. relationship of lead-induced proteins to stress response proteins in astroglial cells. *Journal of Neuroscience Research* 42(5): 623-32.

FL Orlova AkinchevaMYa, N. V. 1967. hygienic characterizations of certain arsenic-containing pesticides. *Vop. Pitaniya; 26(1): 63-9*

Bio Acc Osowski, S. L., Brewer, L. W., Baker, O. E., and Cobb, G. P. 1995. the decline of mink in georgia, north carolina, and south carolina: the role of contaminants. *Arch Environ Contam Toxicol.* 29(3): 418-23.

In Vit Ovelgonne Hans H, Wiegant Fred A, Souren Jan E M, Van Rijn Han, and Van Wijk Roeland. 1995. enhancement of the stress response by low concentrations of arsenite in arsenite-pretreated reuber h35 hepatoma cells. *Toxicology and Applied Pharmacology* 132(1): 146-155.

Lead Shot Pain, D. J., Amiard-Triquet, C., and Sylvestre, C. 1992. tissue lead concentrations and shot ingestion in nine species of waterbirds from the camargue (france). *Ecotoxicol Environ Saf.* 24(2): 217-33.

Unrel Pain, D. J., Sanchez, A., and Meharg, A. A. 1998. the donana ecological disaster: contamination of a world heritage estuarine marsh ecosystem with acidified pyrite mine waste. *Sci. Total Environ. (1998)* 222(1,2): 45-54.

No Oral Palmer, I. S., Arnold, R. L., and Carlson, C. W. 1973. toxicity of various selenium derivatives to chick Embryos. *Poult Sci.* 52: 1841-1846.

HHE Papp, J. P., Gay, P. C., Dodson, V. N., and Pollard, H. M. 119-1923. potassium chloride treatment in thallotoxicosis. *Ann. Internal Med.; 71(1)*

Acu Paramita Mukherjee, Sandeep Poddar, Geeta Talukder, and Archana Sharma. 1999. protection by black tea extract against chromosome damage induced bytwo heavy metals in mice. *Pharmaceutical Biology* 37(3): 243-247.

CP Park, J. H(A), Chung, H. J., Kim, Y. O., Chung, S. T., Kim, J. H., Han, S. S., and Cho, D. H. 1999. hematopoietic effects in mice exposed to sodium arsenite. *FASEB Journal* 13(4 PART 1): A358.

In Vit Paschin, Y. V., Kozachenko, V. I., and Toropzev, S. N. 1983. suppression by arsenic trioxide of the induction of mutations in the mouse bone marrow and male germ cells by an alkylating agent. *Int. J. Environ. Stud. (1983)* 21(3-4): 317-24.

Surv Pascoe, GA, Blanchet, RJ, and Linder, G. 1994. bioavailability of metals and arsenic to small mammals at a mining waste-contaminated wetland . *Arch. Environ. Contam. Toxicol.* 27: 44-50.

In Vit Pashin, I. u. V., Kozachenko, V. I., and Toroptsev, S. N. 1984. [arsenic trioxide inhibition of the thiophosphamide induction of mutations in mouse germ and somatic cells]. <original> ingibirovanie trioksidom mysh'iaka induktsii mutatsii tiofosfamidom v polovykh i somaticheskikh kletkakh myshi. *Genetika* 20(2): 365-6.

In Vit Pashin, Y. U. V, Kozachenko, V. I., and Toroptsev, S. N. inhibition by arsenic trioxide of induction of mutations with thiotepa in mouse somatic and germ cells. *Genetika; 20 (2). 1984. 365-366.*

Gene Pashin, Yu. V., Kozachenko, V. I., and Toroptsev, S. N. 1984. inhibition by arsenic trioxide of the induction of mutations with thiophosphanide in mouse somatic and germ cells. *Genetika (Moscow) (1984)* 20(2): 365-6.

No COC Paternain, J. L. Univ of Barcelona Reus Spain, Ortega, A., Domingo, J. L., Llobet, J. M., and Corbella, J. oral meso-2,3-dimercaptosuccinic acid in pregnant sprague-dawley rats. *J Toxicol Environ Health. V30, N3, P191(7)*

Chem Meth Peisach, M., Pineda, C. A., Casimiro, E., Gulumian, M., and Pillay, A. E. 1993. studies by pixe on the removal of trace metals from the heart, liver and kidneys of the rat by chelating agents. *Nucl. Instrum. Methods Phys. Res. Sect. B* B75(1-4): 191-4.

Bio Acc Peles, J. D. and Barrett, G. W. 1997. assessment of metal uptake and genetic damage in small mammals. *Bull Environ Contam Toxicol.* 59(2): 279(6).

Surv Peles, J. D. Savannah River Ecology Laboratory Aiken SC and Barrett, G. W. University of Georgia Athens. assessment of metal uptake and genetic damage in small mammals. *Bull Environ Contam Toxicol. V59, N2, P279(6)*

Bio Acc Pendleton, Grey W., Whitworth, Molly R., and Olsen, Glenn H. 1995. accumulation and loss of arsenic and boron, alone and in combination, in mallard ducks. *Environ. Toxicol. Chem. (1995)* 14(8): 1357-64.

CP Peoples, S. A. the mechanisms of action of arsenicals in feed on performance and health of Animals. *National Academy of Sciences. National Academy of Sciences. National Research Council Publication. No. 1679. The Use of Drugs in Animal Feeds. Proceedings of a Symposium. Viii + 407p. Illus. National Academy of Sciences: Washington, D.c. U.s.a. 1969 77-86*

Unrel Peoples, S. A. Jr. 1970. the pharmacology of rodenticides. *Proc. Vertebrate Pest; Conf. No. 4.*: 15-8.

In Vit Perlaky, L., Lee, Y., and Dewey, W. C. 1991. heat-induced morphological alterations in non-tolerant and thermotolerant cells. *International Journal of Radiation Biology* 60(5): 819-32.

Unrel Pernfuss, B., Ebner, C., Pumpel, T., Diels, L., Macaskie, L., Tsezos, M., Keszthelyi, Z., and Glombitza, F. 1999. the " behavior " of five metal biosorbing and bioprecipitating bacterial strains, inoculated in a moving-bed sand filter. *Process Metall. (1999)* 9B(Biohydrometallurgy and the Environment Toward the Mining of the 21st Century, Pt. B): 373-382..

Rev Pershagen, G. and Vahter, M. 1979.

No Oral Peterkova, R. and Puzanova, L. 1976. effect of trivalent and pentavalent arsenic on early developmental stages of the chick embryo. *Folia Morphol(prague) 24:5-13,1976*

In Vit Pfeifer, F. and Schacht, S. development and validation of genotoxicological and ecotoxicological tests for evaluating soil retention. *Forschungsverbund: Biol. Verfahren Bodensanierung (1998)* : A76-A85 Publisher: Umweltbundesamt, Berlin, Germany..

Chem Meth Pietra, R., Sabbioni, E., and Marafante, E. 1981. comparative metallobiochemical studies on present environmental levels of arsenic in mammals. i. neutron activation analysis of nanogram levels of arsenic in tissues of laboratory animals. *J. Radioanal. Chem. (1981)* 62(1-2): 41-52

No Oral Pipkin, J. L Jr, Anson, J. F., Hinson, W. G., Duffy, P. H., Burns, E. R., and Casciano, D. A. 1987. the turnover of radiolabeled nuclear proteins in rats exposed to environmental and chemical stress. *Toxicol Lett (AMST); 39 (1). 1987. 15-26.*

FL Plitman, S. I., Novikov, I. u. V., Tulakina, N. V., Mete'lskaia, G. N., Kochetkova, T. A., and Khvastunov, R. M. 1989. [problem of correction of hygienic standards with special reference to the hardness of drinking water]. <original> k voprosu korrektirovki gigienicheskikh normativov s uchetom urovnia zhestkosti pi'tevykh vod. *Gigiena i Sanitariia* (7): 7-10.

Acute Poma, K., Degraeve, N., and Susanne, C. 1987. cytogenetic effects in mice after chronic exposure to arsenic followed by a single dose of ethyl methanesulfonate. *Cytologia (1987)* 52(3): 445-9.

Carc Pories, W. J., Mansour, E. G., and Strain, W. H. 1972. trace elements that act to inhibit neoplastic growth. *Annals of the New York Academy of Sciences* 199: 265-73.

Unrel Prall, R. C. the physician's role in prevention of mental and emotional disorders. *Pa. Med.; 75: 71-78; 1972 ; (REF:40)*

Unrel Pratap Singh, <Editors> Agrawal, O. P., and Shashi Dhawan. 1991. insect pests of different art and cultural materials and their control. 54-65.

Bio Acc Prestrud, P., Norheim, G., Sivertsen, T., and Daae, H. L. 1994. levels of toxic and essential elements in arctic fox in svalbard. *Polar Biology.* 14(3): 155-159.

Bio Acc Prestrud P(A), Norheim, G., Sivertsen, T., and Daae, H. L. 1994. levels of toxic and essential elements in arctic fox in svalbard. *Polar Biology* 14(3): 155-159.

Acu Pribyl, E. 1927. nitrogen metabolism in experimental subacute arsenic and antimony poisoning. *J. Biol. Chem.* 74: 775.

Rev Pritsos, C. A. National Technical Information Service (NTIS). environmental transformation, exposure & effects of pesticide residues. *FEDRIP DATABASE*

Bio Acc Prouty, R. M., Pattee, O. H., and Schmeling, S. K. 1982. ddt poisoning in a cooper's hawk collected in 1980. *Vol. 28, No. 3, Pp. 319-321* Bull. Environ. Contam. Toxicol.

Acu Pryor, G. T., Uyeno, E. T., Tilson, H. A., and Mitchell, C. L. 1983. assessment of chemicals using a battery of neurobehavioral tests: a comparative study. *Neurobehavioral Toxicology and Teratology* 5(1): 91-117.

No Oral Puzanova, L. 1980. teratogenic effect of different toxic elements on young chick embryos. *Folia Morphol.* 28: 354-356.

No Oral Puzanova, L. 1983. effect of lithium on the developing chicken embryo. *Spurenelem.-Symp. 4th* (Issue Lithium,): 295-9. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

No COC Puzanova, L. and Doskocil, M. 1979. teratogenic effect of lithium salts on young chick embryos. *Folia Morphol(prague)* 27: 26-30.

Plant Qian, JH, Zayed A, Zhu, YL, Yu, M, and Terry, N. 1999. phytoaccumulation of trace elements by wetland plants: iii. uptake and accumulation of ten trace elements by twelve plant species. *J. Environ. Qulaity.* 28: 1448-1455.

Plant Qian, Jin-Hong, Zayed, Adel, Zhu, Yong-Liang, Yu, Mei, and Terry, Norman. 1999. phytoaccumulation of trace elements by wetland plants: iii. uptake and accumulation of ten trace elements by twelve plant species. *J. Environ. Qual. (1999)* 28(5): 1448-1455.

Unrel Quin, J. I., Rimington, C., and Roets, G. C. S. 463-478. studies on the photosensitisation of animals in south africa. viii. the biological formation of phylloerythrin in the digestive tracts of various domesticated animals. *Onderstepoort J Vet Sci An Indust*

Fate Quinn, T. L. and Ondov, J. M. 1998. influence of temporal changes in relative humidity on dry deposition velocities and fluxes of aerosol particles bearing trace elements. *Atmos. Environ. (1998)* 32(20): 3467-3479.

Invert Ramos-Morales, P and Rodriguez-Arnaiz, R. 1995. genotoxicity of two arsenic compounds in germ cells and somatic cells of drosophila melanogaster. *Environ. Molec. Mutagenesis.* 25(4): 288-299.

Mix Rao, Ghanta N. and Knapka, Joseph J. contaminant and nutrient concentrations of natural ingredient rat and mouse diet used in chemical toxicology studies. *Fundam. Appl. Toxicol. (1987)* 9(2): 329-38.

Nutrition Rao, GN and Knapka, JJ. 1987. contaminant and nutrient concentrations of natural ingredient rat and mouse diet used in chemical toxicolgy studies. *Fund. Appl. Toxicol.* 9(2): 329-338.

No Oral Rasco, J. F. and Hood, R. D. 1994. effects of maternal restraint stress and sodium arsenate in mice. *Reproductive Toxicology* 8(1): 49-54.

Diss Rasco, Jane Fraser. 1993. enhancement of the developmental toxicity of sodium arsenate and all-trans-retinoic acid by maternal restraint stress in mice. *Avail.: Univ. Microfilms Int. Order No. DA9417155 From: Diss. Abstr. Int. B 1994, 55. 2. 258.* 129 pp.

Surv Reece, R. L., Beddome, V. D., and Barr, D. A. 1985. diseases diagnosed in broiler chicken flocks in victoria, australia, 1977 to 1984. *Veterinary Record.* 116(12): 315-20.

Acu Reichl, F. X., Kreppel, H., Szinicz, L., Fichtl, B., and Forth, W. 1989. effect of glucose in mice after acute experimental poisoning withas203. 1025-1031.

CP Reichl, F. X., Szinicz, L., and Kreppel, H. 1990. effect of glucose on survival of mice after poisoning with arsenic trioxide. *31st Spring Meeting of the Deutsche Gesellschaft Fuer Pharmakologie Und Toxikologie (German Society for Pharmacology and Toxicology)*

No Oral Reichl, F. X., Szinicz, L., Kreppel, H., Fichtl, B., and Forth, W. effect of glucose in mice after

acute experimental poisoning with arsenic trioxide (as2o3). *Arch. Toxicol. (1990)* 64(4): 336-8

No Oral Reichl, FX, Hunder, G, Liebl, B, Fichtl, B, and Forth, W. 1995. effect of dmps and various absorbents on the arsenic excretion in guinea-pigs after injection with as2o3. *Arch Toxicol.* 69: 712-717.

No Oral Relchl, F. X., Kreppel, H., Szinicz, L., Fichtl, B., and Forth, W. effect of glucose treatment on carbohydrate content in various organs in mice after acute arsenic trioxide poisoning. *Vet. Hum. Toxicol. (1991)* 33(3): 230-5.

n = 1 Rhian, M and Moxon, AL. 1943. chronic selenium poisoning in dogs and its prevention by arsenic. *J. Pharmacol. Exp. Ther.* 78: 249. Ref ID: 14494

Acu Rhoads, K. and Sanders, C. L. 1985. lung clearance, translocation, and acute toxicity of arsenic, beryllium, cadmium, arsenic, lead, selenium, vanadium, and ytterbium oxides following deposition in rat lung. *Environmental Research* 36(2): 359-378.

QAC Ribeiro Sergio P, Villar Jesus, Downey Gregory P, Edelson Jeffrey D, and Slutsky Arthur S(A). 1994. sodium arsenite induces heat shock protein-72 kilodalton expression in the lungs and protects rats against sepsis. *Critical Care Medicine* 22(6): 922-929.

Org met Rice, D. A., Kennedy, S., McMurray, C. H., and Blanchflower, W. J. 1985. experimental 3-nitro-4-hydroxyphenylarsonic acid toxicosis in pigs. *Research in Veterinary Science* 39(1): 47-51.

No Oral Ridgway, L. P. and Karnofsky, D. A. 1952. the effects of metals on the chick embryo: toxicity and production of abnormalities in development. *Ann N Y Acad Sci.* 55: 203-215.

CP Riggs, B. S., Kulig, K., Knapp, G., and Rumack, B. H. 1988-1989. arsenic poisoning comparison of iv nac vs im bal vs po d Penicillamine. *Scientific Meeting of the American Association of Poison Control Centers*

Rev Riviere, J. E., Boosinger, T. R., and Everson, R. J. 1981. inorganic arsenic toxicosis in cattle. a review of selected cases. *Modern Veterinary Practice* 62(3): 209-211.

No Oral Robertson, I. D., Harms, W. E., and Ketterer, P. J. 1984. accidental arsenical toxicity of cattle. *Australian Veterinary Journal* 61(11): 366-367.

Rev Robinson, J. 1973. industrial and agricultural pollution and the environment. *Roy. Soc. Health J.93(2): 62-68,106*

CP Robinson, P. W., Boul, H. L., Joyce, N. I. , and Reid, T. C. 1998. residue monitoring in wool, and the environmental impacts of pesticideresidues. *ACIAR Proceedings Series* (85): 100-114.

Abstract Rodriguez, V. M(A), Diaz-Barriga, F., Jimenez-Capdeville, M. E., Carrizales, L., and Giordano M(A). 1999. the effects of arsenic (as) on neurobehavioral parameters. *Society for Neuroscience Abstracts.* 25(1-2): 1830.

Org met Rogers, E. H., Chernoff, N., and Kavlock, R. J. 1981. the teratogenic potential of cacodylic acid in the rat and mouse. *Drug Chem Toxicol.* 4(1): 49-61.

Aquatic Roper, J. M., Cherry, D. S., Simmers, J. W., and Tatem, H. E. 1997. bioaccumulation of toxicants in the zebra mussel, *Dreissena polymorpha,* at the times beach confined disposal facility, buffalo,

new york. *Environ. Pollut.* 94(2): 117-129 .

Aquatic Roper, J. M(A), Cherry, D. S., Simmers, J. W., and Tatem, H. E. 1996. bioaccumulation of toxicants in the zebra mussel, dreissena polymorpha, at the times beach confined disposal facility, buffalo, new york. *Environmental Pollution* 94(2): 117-129.

Bio Acc Roper, JM, Cherry, Ds, Simmer, JW, and Tatem, HE. 1996. bioaccumulation of toxicants in the zebra mussel, dreissena polymorpha, at the times beach confined disposal facility, buffalo, new york. *Environ. Pollution.* 94(2): 117-129.

No Dose Rosenberg, M. A., Wilcox, A. H., Chase, C. H. III, and Chase, C. H. Jr. 1976. a mathematical formula as an aid in the treatment and prognosis ofcanine heartworm disease. *Veterinary Medicine and Small Animal Clinician* 71(4): 496, 498-503.

Unrel Roux, D. J., Badenhorst, J. E., Du Preez, H. H., and Steyn, G. J. 1994. note on the occurrence of selected trace metals and organic compounds in water, sediment and biota of the crocodile river, eastern transvaal, south Africa. *Water S a.* 20(4): 333-340.

Herp Rowe, C. L. a, Kinney, O. M., Fiori, A. P., and Congdon, J. D. 1996. oral deformities in tadpoles (rana catesbeiana) associated with coal ash deposition: effects on grazing ability and growth. *Freshwater Biology.* 36(3): 723-730.

Org met Roy, S., Ghosh, R. C., and Misra, S. K. 1991. effect of sodium arsanilate on the growth rate of broilers. *Indian Veterinary Journal.* 68(9): 855-857.

Drug RoyChoudhury, Arati, Das, Tandra, Sharma, Archana, and Talukder, Geeta. 1996. dietary garlic extract in modifying clastogenic effects of inorganic arsenic in mice : two-generation studies. *Mutat. Res. (1996)* 359(3): 165-70.

No Oral Sabbioni, E., Marafante, E., Bertolero, F., and Foa, V. 1979. inorganic arsenic: metabolic patterns and identification of arsenic binding components in the rabbit. *Manage. Control Heavy Met. Environ. Int. Conf.* 167-70 Publisher: CEP Consultants Ltd., Edinburgh, Scot.

FL Sagner, G. 1973. [the toxicology of arsenic in drinking water]. <original> zur toxikologie des arsens im trinkwasser. *Schriftenreihe Des Vereins Fur Wasser-, Boden- Und Lufthygiene; 40*

Surv Sahli, BP. 1982. arsenic concentrations in cattle liver, kidney and milk. *Vet Hum Toxicol.* 24(3): 173-174.

FL Salahi, A. 1982.*Fast Transport Facility for Activation Analysis With High-Energy Neutrons. <NOTE> Thesis (Dr. Techn.). INIS-MF-8945*

Mix Salbe, A. D., Morris, V. C., and Levander, O. A. 1993. selenium content of rat hair , nails , and other tissues as affected by concurrent exposure to toxic Elements. *Nutr Res.* 13(1): 31-36.

Surv Salisbury, C. D. C., Chan, W., and Saschenbrecker, P. W. 1991. multi-element concentrations in liver and kidney tissues from five species of canadian slaughter Animals. *J Assoc off Anal Chem.* 74(4): 587-591.

Rev Salmon, T. P. and Marsh, R. E. So- Vertebrate Pest Control and Managementsociety for Testing and Materials, 1979. PP. 84-98. age as a factor in rodent susceptibility to rodenticides--a review.

No Dose Salplachta, J. and A. Vinkler. 2001. lactate dehyrogenase pattern in tissues of pigs exposed to arsenic and cadmium - a pilot study. *Acta. Vet. BRNO.* 70: 285-299.

Phys Salt, A. N. and DeMott, J. 1994. time course of endolymph volume increase in experimental hydrops measured in vivo with an ionic volume marker. *Hearing Research* 74(1-2): 165-72.

Surv Sample, B. E. and Suter, G. W. II. 1999. ecological risk assessment in a large river-reservoir : 4. piscivorous wildlife. *Environmental Toxicology and Chemistry* 18(4): 610-620.

No Dose Sample, Bradley E. and Suter, Glenn W. II. ecological risk assessment in a large river-reservoir: 4. piscivorous wildlife. *Environ. Toxicol. Chem. (1999)* 18(4): 610-620.

No Oral Sarkar, M., Ghosh, D., Biswas, H., and Biswa, N. M. 1992. effect of sodium arsenite on haematology in male albino rats. *Indian Journal of Physiology and Allied Sciences* 46(3): 116-120.

No Dose Satoh, H., Hashimoto, and Yamagiwa, J. 1971. pathological features of osmose poisoning in a cow: neurological observation.). *Jap. J. Vet. Sci.; 33: 89-105; 1971 ; (REF:49)*

Chem Meth Savage, I. and Haswell, S. J(A) . 1998. the development of analytical methodology for simultaneous trace elemental analysis of blood plasma samples using total reflection x-ray fluorescence spectrometry. *Journal of Analytical Atomic Spectrometry* 13(10): 1119-1122.

Acu Saxena, S. N., Sharma, K. M., and Singh, C. P. 1972. field trials on calcium arsenate as anthelmintic against commontapeworms of bikaneri, rampur bushair and cross-bred lambs under farmlevels of feeding. *Indian Veterinary Journal* 49(4): 336-340.

Acute Schafer, EW Jr and Bowles, WA Jr. 1985. acute oral toxicity and rpellency of 933 chemicals to house and deer mice. *Arch. Environ. Contam. Toxicol.* 14: 111-129.

No Oral Schaumburg, H. H. 1980.*Failure to Produce Arsenic Neurotoxicity in the Rat. An Experimental Study. <NOTE> Final Rept. EPA-560/11-80-022*

No Oral Schaumburg, Herbert H. 1980.. failure to produce arsenic neurotoxicity in the rat . an experimental study. *Report (1980) EPA-560/11-80-022; Order No. PB80-209505, Avail.: NTIS From: Gov. Rep. Announce. Ind U. S.) 1980, 80(24. 5061.* 17 pp.

HHE Schaupen, J. L., Fesmire, F. M., Roberge, R. J., Wears, R. L., and Sandroni, S. massive arsenic ingestion in humans a characterization of 2 survivors. *1987 Meeting of the American Academy of Clinical Toxicology, American Association of Poison Control Centers, American Board of Medical Technology, Canadian Association of Poison Control Centers, Vancouver, British Columbia, Canada, September 27-october 2, 1987. Vet Hum Toxicol. 29 (6). 1987. 479-480.*

Abstract Schiller, C. M., Walden, R., Kee, T. E., Curley, W. H., Gafford, G. M., Shirkey, R. J., Lucier, G. W., and Fowler, B. A. 1978. development of a model to investigate interaction between alloxan-induced diabetes and exposure to arsenic - elevated levels of rat urinary enzymes. *Federation Proceedings* 37: 505.

No COC Schiller, CM, Fowler, BA, and Woods, JS. 1977. effects of arsenic on pyruvate dehydrogenase activation. *Environ Health Perspect.* 19: 205-207.

Abstract Schiller, CM, Walden, R, Kee, TE, Curley, WH, Gafford, GM, Shirkey, RJ, Lucier, GW, and

Fowler, BA. 1978. development of a model to investigate the interaction between alloxan-induced diabetes and exposure to arsenic: elevated levels of rat urinary enzymes. *Fed. Proc.* 37: 505.

FL Schmid, A. 1983. pharmacological and toxicological evaluation of arsanilic acid andsodium arsanilate. *Deutsche Tierarztliche Wochenschrift* 90(1): 10-13.

Meth Schmidt, P. F. and Barckhaus, R. H. 1991. how can toxic elements be localized in histological sections by laser microprobe mass analysis (lamma)? *Progress in Histochemistry and Cytochemistry* 23(1-4): 342-54.

In Vit Schrader, T., Rienhofer, A., and Andreesen, J. R. 1999. selenium-containing xanthine dehydrogenase from eubacterium barkeri. *European Journal of Biochemistry* 264(3): 862-71.

HHE Schrauzer, G. N., White, D. A., and Schneider, C. J. 1976. inhibition of the genesis of spontaneous mammary tumors in c3h mice : effects of selenium and of selenium-antagonistic elements and their possible role in human breast cancer. *Bioinorg. Chem. (1976)* 6(3): 265-70.

Dup Schroeder, H. A. 1970. *Metallic Micronutrients and Intermediary Metabolism: Progress Rept. No. 3 (Final).*: 22 p.

Dup Seidenberg, J. M. and Becker, R. A. 1987. a summary of the results of 55 chemicals screened for developmental toxicity in mice. *Teratog Carcinog Mutagen.* 7(1): 17-28.

Rev Selby, L. A., Case, A. A., Dorn, C. R., and Wagstaff, D. J. 1974. public health hazards associated with arsenic poisoning in cattle. *Journal of the American Veterinary Medical Association* 165(No.11): 1010-1014.

Surv Selby, L. A., Case, A. A., Osweiler, G. D., and Hayes, H. M. Jr. CS Environmental Epidemiology Branch National Cancer Institute Bethesda. epidemiology and toxicology of arsenic poisoning in domestic animals.

Rev Selby, LA, case, AA, Osweiler, GD, and Hayes, HM Jr. 1977. epidemiology and toxicology of arsenic poisoning in domestic animals. *Environ Health Perspect.* 19: 183-189.

Gene Serbolisca, L., de Ferra, F., and Margarit, I. 1999. manipulation of the dna coding for the desulphurizing activity in a new isolate of arthrobacter sp. *Applied Microbiology and Biotechnology* 52(1): 122-6.

In Vit Seymour, C. B. and Mothersill, C. 1987. the effect of glycolysis inhibitors on the recovery of cho-k1 cells from split-dose irradiation. *Acta Oncologica* 26(5): 367-71.

Surv Shahin, Usama, Yi, Seung-Muk, Paode, Rajendra D., and Holsen, Thomas M. 2000. long-term elemental dry deposition fluxes measured around lake michigan with an automated dry deposition sampler. *Environ. Sci. Technol. (2000)* 34(10): 1887-1892 .

Rev Shalat, Stuart L., Walker, Dana B., and Finnell, Richard H. 1996. role of arsenic as a reproductive toxin with particular attention to neural tube defects. *J. Toxicol. Environ. Health* 48(3): 253-272 .

Alt Shaw, J. H. 1973. relation of arsenic supplements to dental caries and the periodontalsyndrome in experimental rodents. *Journal of Dental Research* 52(3): 494-507.

HHE Sheabar, F. Z. and Yannai, S. 1989. invitro effects of cadmium and arsenite on glutathione-peroxidase, aspartate and alanine aminotransferases, cholinesterase and glucose-6-phosphate-dehydrogenase activities in blood. *Veterinary And Human Toxicology* 31(6): 528-531.

No Oral Shiomi, Kazuo, Chino, Makoto, and Kikuchi, Takeaki. 1990. metabolism in mice of arsenic compounds contained in the red alga porphyra yezoensis. *Appl. Organomet. Chem. (1990)* 4(3): 281-6.

Acute Shum, Shu, Skarbovig, Jens, and Habersang, Rolf. 1981. acute lethal arsenite poisoning in mice : effect of treatment with n-acetylcysteine, d-penicillamine and dimercaprol on survival time. *Vet. Hum. Toxicol. (1981)* 23(Suppl. 1): 39-42.

Drug Siddiqui Rumana, Vohora Divya, and Vohora, S. B(A). 1999. proconvulsant effects of calcined arsenic preparations used in unani medicine. *Indian Journal of Pharmacology* 31(2): 150-152.

Drug Siebert, T. 1982. selection of e. coli with plasmid-coded drug resistance by metal ionsin farm animals. 118pp.

Org met Siewicki, T. C. 1981. tissue retention of arsenic in rats fed witch flounder (glyptocephalus cynoglossus) or cacodylic acid. *J Nutr; 111 (4). 1981. 602-609.*

Org met Siewicki, T. C. 1981. tissue retention of arsenic in rats fed witch flounder or cacodylicacid. *Journal of Nutrition* 111(4): 602-609.

Org met Siewicki, T. C. and Leffel, E. C. 1980.*Effects of Dietary Cysteine on Arsenic Toxicity in the Rat* : 12p.

Org met Siewicki, T. C. and Sydlowski, J. S. excretion of arsenic by rats fed witch flounder (glyptocephalus cynoglossus) or cacodylic acid. *Nutr Rep Int; 24 (1). 1981. 121-128.*

Org met Siewicki, T. C. and Sydlowski, J. S. 1981. excretion of arsenic by rats fed witch flounder or cacodylic acid. *Nutrition Reports International* 24(1): 121-127.

Org met Siewicki, Thomas C. and Leffel, Emory C. effects of dietary cysteine on arsenic toxicity in the rat. *Nutr. Rep. Int. (1980)* 22(1): 123-33.

Org met Siewicki, Thomas C. and Sydlowski, Jane S. 1981. excretion of arsenic by rats fed witch flounder or cacodylic acid. *Nutr. Rep. Int. (1981)* 24(1): 121-7.

FL Silaev, A. A. and Lemeshevskaya, E. P. 1980. experimental data on the gonadotropic effect of cesium arsenate. *Gig. Tr. Prof. Zabol. (1980)* (9): 46-8.

HHE Silbergeld, E. K. 1976. neurochemical and pharmacological studies of central nervous system lead toxicology. *Health Effects of Occupational Lead and Arsenic Exposure: a Symposium; Carnow, B.W., Ed.*

No Oral Siller, F. R., Quintanilla-Vega, B., Cebrian, M. E., and Albores, A. 1997. effects of arsenite pretreatment on the acute toxicity of parathion. *Toxicology* 116(1-3): 59-65 .

FL Simek, M., Dvorak, R., Zendulka, I., Musil, V., and Krasa, A. 1990. effect of supplementary dolomite on rumen fermentation and metabolicindicators in cattle during fattening. *Sbornik Vedeckych Praci Vyzkumneho Ustavu Vyzivy Zvirat Pohorelice* (23): 27-31.

Mix Simmons, Jane Ellen, Yang, Raymond S. H., Svendsgaard, David J., Thompson, Morrow B., Seely, John C., and McDonald, Anthony. 1994. toxicology studies of a chemical mixture of 25 groundwater contaminants: hepatic and renal assessment, response to carbon tetrachloride challenge, and influence of treatment-induced water restriction. *J. Toxicol. Environ. Health* 43(3): 305-25.

No Oral Sinclair, A. N. 1976. fleece derangement of merino sheep infested by the itch mitepsorergates ovis. *New Zealand Veterinary Journal* 24(7): 149-152.

FL Sinkovics, G. 1974. therapeutic experiments and intestinal flora studies in swinedysentery. *Zentralblatt Fur Veterinarmedizin* 21B(Heft 9): 706-714.

FL Skal'naia, M. G., Zhavoronkov, A. A., Skal'nyi, A. V., and Riabchikov, O. P. 1995. [morphologic characteristics of the thymus in pregnant and newborn mice exposed to sodium arsenite]. <original> morfologicheskaia kharakteristika timusa beremennykh i novorozhdennykh myshei pri ekspozitsii arsenitom natriia. *Arkhiv Patologii* 57(2): 52-8.

FL Skal'naya, M. G., Zhavoronkov, A. A., Skal'nyi, A. V., and Ryabchikov, O. R. 1995. morphological characteristics of the thymus of pregnant and newborn mice exposed to sodium arsenite. *Arkhiv Patologii; 57 (2). 1995. 52-58.*

FL Skare, J. U. 1995. environmental toxicology research at a veterinary college-veterinary institute. *Norsk Veterinaertidsskrift.* 107(4): 363-376.

Bio Acc Slejkovec, Z, Byrne, AR, and Smodis, B. 1996. preliminary studies on arsenic species in some environmental samples. *Fresenius J. Anal. Chem.* 354: 592-595.

Drug Snider, T. H., Wientjes, M. G., Joiner, R. L., and Fisher, G. L. 1990. arsenic distribution in rabbits after lewisite administration and treatment with british anti-lewisite (bal). *Fundamental and Applied Toxicology* 14(2): 262-72.

Sed Snitz, F. L., Weber, W. J Jr., Barney, J. L., and Posner, J. C. 1977. effects of calcium and sediment concentrations on the release of metals and nutrients from dredge spoil dispersions. *ASTM Spec. Tech. Publ. (1979) Volume Date 1977, STP 667, Aquat. Toxicol., 322-41.*

Acu Sonali Biswas, Geeta Talukder, and Archana Sharma. 1999. prevention of cytotoxic effects of arsenic by short-term dietarysupplementation with selenium in mice in vivo. *Mutation Research, Genetic Toxicology and Environmental Mutagenesis* 441(1): 155-160.

Acu Sonali Biswas, Geeta Talukder, and Archana Sharma. 1999. protection against cytotoxic effects of arsenic by dietarysupplementation with crude extract of emblica officinalis fruit. *Phytotherapy Research* 13(6): 513-516.

Acu Sporn, Alfred and Cirstea, Adriana. 1969. determination of the concomitant action of arsenic, copper, zinc, lead, and tin; acute toxicity. *Igiena (1969)* 18(2): 81-90.

FL Sporn, Alfred, Dinu, Ileana, and Stoenescu, Liana. 1968. toxicity of zinc, copper, lead, and arsenic. *Igiena (1968)* 17(12): 717-24.

Mix Sporn DinnIStoenescuL, A. 1965-1973. influence of concomitant administration of arsenic, lead, copper and zinc on the activity of some hepatic enzymes and on the (sic) oxidative phosphorylation. *Rev. Roumaine Biochim.; 6(1)*

Abstract Sram, R. J. 1975. changes in the activity of chemical mutagens caused by various Compounds. *Mutat Res 29:195,1975*

Carcin Sram, R. J. 1976. relation between acute and chronic exposures in mutagenicity studies in mice. *Mutat. Res. (1976)* 41(1): 25-42.

FL Sram, R. J. 1977. subacute and chronic effects of chemical mutagens on the frequency of dominant lethals in mice. *Genet. Posledstviya Zagryaz. Okruzhayushchei Sredy (1977)* : 141-7. Editor(s): Dubinin, N. P. Publisher: "Nauka", Moscow, USSR. CODEN: 37BFAA.

In Vitro Sram, R. J. 1976. relationship between acute and chronic exposures in mutagenicity studies in mice. *Mutation Research* 41(1 spel. no): 25-42.

FL Sram, R. J. and Bencko, V. 1974. a contribution to the evaluation of the genetic risk of exposure to arsenic. *Cesk. Hyg. 19(6-7): 308-315; 1974.(14 References)*

FL Sram, R. J. and Bencko, V. 1974. evaluation of the genetic risk of exposure to arsenic. *Cesk. Hyg. (1974)* 19(6-7): 308-15.

Bio Acc Stadelman, W. J. 1973. record of some chemical residues in poultry products. *BioScience23(7): 424-428; 1973(REF:38)*

Unrel Stainki, D. R., Raiser, A. G., Graca, D. L., and Becker, C. 1995. the effect of galium arsenate laser radiation on peripheral nerveregeneration in dogs after surgery. *Arquivo Brasileiro De Medicina Veterinaria e Zootecnia* 47(6): 763-771.

Acu Steinrauf, L. 1976. the effect of thiocholesterol on the acute lethality of selected heavy metals in the mouse. *Society of Toxicology: Fifteenth Annual Meeting:Abstracts. London: Academic Press, 1976. Pp. 129, 131*

Mix Stendell, R. C., Beyer, W. N., and Stehn, R. A. 1989. accumulation of lead and organochlorine residues in captive american kestrels fed pine voles from apple orchards. *J Wildl Dis.* 25(3): 388-391.

Surv Stevens, J. B. 1991. disposition of toxic metals in the agricultural food chain: 1. steady-state bovine milk biotransfer Factors. *Environ Sci Technol.* 25(7): 1289-1294.

Rev Stump, D. G., Clevidence, K. J., Knapp, J. F., Holson, J. F., and Farr, C. H. an oral developmental toxicity study of arsenic trioxide in rats. *Teratology 1998 Apr/May;57(4/5):216-7*

CP Stump, D. G., Fleeman, T. L., Nemec, M. D., Holson, J. F., and Farr, C. H. 1998 . evaluation of the teratogenicity of sodium arsenate and arsenic trioxide following single oral intraperitoneal administration in rats. *Thirty-eighth Annual Meeting of the Teratology Society and the 22nd Annual Meeting of the Neurobehavioral Teratology Society and 11th International Conference of the Organization of Teratology Information*

Acu Stump, D. G., Holson, J. F., Fleeman, T. L., Nemec, M. D., and Farr, C. H. comparative effects of single intraperitoneal or oral doses of sodium arsenate or arsenic trioxide during in utero Development. *Teratology; 60 (5). 1999. 283-291.*

Abstract Stump, DG, Clevidence, KJ, Knapp, JF, Holson, JF, and Farr, CH. 1998. an oral developmental study of arsenic trioxide in rats. *Terratology.* 57(4/5): 216-217.

Abstract Stump, DG, Fleeman, TL, Nemec, MD, Holson, JF, and Farr, CH. 1998. evaluation of the teratogenaity of sodium arsenate and arsenic trioxide following single oral or intraperitoneal administration in rats. *Teratology.* 57(4/5): 217.

Abstract Stump, DG, Urlich, CE, Holson, JF, and Farr, CH. 1998. an inhalation developmental toxicity study of arsenic trioxide in rats. *Teratology.* 57(4/5): 216.

Abstract Su, L and Csallany, AS. unknown. relationships of age, vitamin e, dppd and selenium to glutathione peroxidase activity and lipofuscin pigment concentration in mice. *Fed. Proc.* unknown: 1094.

Org met Sullivan, T. W. and Al-Timimi, A. A. 1972. safety and toxicity of dietary organic arsenicals relative toperformance of young turkeys. 2. carbarsone. 3. nitarsone. 4.roxarsone. *Poultry Science* 51(No.5): 1498-1501; 1582-1586; 1641-1644.

Org met Sullivan, T. W. and Al-Timimi, A. A. 1972. safety and toxicity of dietary organic arsenicals relative toperformance of young turkeys, 4. roxarsone. *Poultry Science* 51(5): 1641-1644.

Org met Sullivan, T. W. and Al-Timimi, A. A. 1972. safety and toxicity of dietary organic arsenicals relative toperformance of young turkeys. 3. nitarsone. *Poultry Science* 51(5): 1582-1586.

FL Surcel, Didi, Gabor, Silvia, Anca, Zoe, and Ciugudeanu, Maria. 1981. interactions between lead, arsenic and selenium on some immunological parameters. *Rev. Ig. Bacteriol., Virusol., Parazitol., Epidemiol., Pneumoftiziol., Ig.* 30(2): 123-30.

FL Suren, K. and Kreuzer, W. CS Inst. Hygiene Univ. Veterinarstrasse 13 Federal Republic. 1979. arsenic residues in slaughter pigs after consumption of feed withvarious contents of arsanilic acid. *Schlachten Und Vermarkten* 49(7): 203-209.

Unrel Sutton, A. L., Brumm, M. C., Kelly, D. T., Henderson, C. A., and Mayrose, V. B. 1980. effect of dietary salt, arsenic and copper additions and wastemanagement systems on selected microbial organisms in swine wastes. *Journal of Animal Science* 51(4): 791-797 .

In Vit Suzuki, Keiji, Kawaharada, Umeko, Tamura, Yuji, and Nakajima, Katsuyuki. 1991. effects of metals on rat glioma cells (c6). *Biomed. Res. Trace Elem* 2(2): 111-12 .

Unrel Swanson, S. M. and Roest, N. 1997. biophysical effects of uranium mining in canada and some suggestions for biomarkers of effects. *Canadian Technical Report of Fisheries and Aquatic Sciences* 0(2144): 33.

Surv Swiggart, RC, Whitehead, CJ Jr., Curley, A, and Kellogg, FE. 1972. wildlife kill resulting from the misuse of arsenic acid herbicide. *Bull. Environ. Contam. Toxicol.* 8(2): 122-128.

In Vit Szczepanska-Konkel, M., Yusufi, A. N., VanScoy, M., Webster, S. K., and Dousa, T. P. 1986. phosphonocarboxylic acids as specific inhibitors of na+-dependent transport of phosphate across renal brush border membrane. *Journal of Biological Chemistry* 261(14): 6375-83.

No Oral Tadlock, C. H. and Aposhian, H. V. 1980. protection of mice against the lethal effects of sodium arsenite by 2,3 dimercapto-1-propane-sulfonic acid and dimercaptosuccinic acid. *Biochemical and Biophysical Research Communications* 94(2): 501-7.

Abstract Tadlock, C. H., Rovner, B. A., and Aposhian, H. V. 1980. water soluble analogs of british

antilewisite are more potent than penicillamine analogs in preventing arsenic lethality. *64th Annual Meeting of the Fed. Am. Soc. Exp. Biol.*

No Oral Takahashi, K., Yamauchi, H., Mashiko, M., and Yamamura, Y. 1990. [effect of s-adenosylmethionine on methylation of inorganic arsenic]. *Nippon Eiseigaku Zasshi* 45(2): 613-8.

No Oral Takeuchi, I. K. embryo toxicity of arsenic-acid light microscopy and electron microscopy of its effect on neurulation stage rat embryo. *Journal of Toxicological Sciences. 4 (4). 1979 (Recd. 1980). 405-416.*

Meth Tamborini, P., Sigg, H., and Zbinden, G. 1990. acute toxicity testing in the nonlethal dose range: a new approach. *Regulatory Toxicology and Pharmacology* 12(1): 69-87.

FL Tamura, S. 1978. metabolism of arsenic: 20. effect of arsenic on the developing brain of rat. *Folia Pharmacol Jpn; 74 (1). 1978 1-14*

FL Tamura, S. 1978. metabolism of arsenic part 22 effect of arsenic on the spontaneous motor activity avoidance conditioning extinction and swimming record in rats. *Folia Pharmacologica Japonica. 74 (7). 1978 (Recd. 1979). 783-796.*

FL Tamura, S. 1974. [studies on the arsenic metabolism (report 11). acute toxicity of arsenic trioxide (author's transl)]. *Shika Gakuho* 74(10): 1478-81.

FL Tamura, S., Kobayashi, K., and Kojima, H. 1974. studies on arsenic metabolism part 10 effect of arsenite upon the spontaneous activity in rats. *Folia Pharmacologica Japonica. 70 (2). 1974 193-197*

FL Tamura, S. and Nozaki, S. 1972. [arsenic metabolism. 5. blood brain barrier and arsenite, with special reference to the effect of the feed]. *Nippon Yakurigaku Zasshi* 68(6): 800-8.

Abstract Tamura, S. and Tanaka, I. placental transfer of arsenic tri oxide. *Jpn J Pharmacol; 25 (SUPPL). 1975 (RECD 1976) 133P-134P*

FL Tamura, Shikichi, Nozaki, Shigeru, and Tsuzuki, Shitaro. 1972. arsenic metabolism. iv. effect of food on arsenic tolerance in the digestive tract. *Nippon Yakurigaku Zasshi (1972)* 68(5): 586-601

FL Tamura, Shunkichi. 1978. metabolism of arsenic. effect of arsenic on the spontaneous motor activity, avoidance condition, extinction and swimming record in rats. *Nippon Yakurigaku Zasshi (1978)* 74(7): 783-95.

FL Tamura, Shunkichi. 1978. metabolism of arsenic. part 20. effect of arsenic on the developing brain of rat. *Nippon Yakurigaku Zasshi (1978)* 74(1): 1-14..

FL Tamura, Shunkichi, Maehashi, Hiroshi, Nozaki, Shigeru, and Mizukami, Reiko. 1974. arsenic metabolism. xii. effects of polypeptone and polyamine on arsenic accumulation in certain organs and on the excretion. *Nippon Yakurigaku Zasshi (1974)* 70(6): 831-6..

FL Tamura, Shunkichi, Maehashi, Hiroshi, Ozawa, Reiko, and Goto, Kazuyoshi. 1977. studies on arsenic metabolism. xx. arsenic accumulation in the organs and excretion into the feces and urine of rats chronically poisoned with arsenic. *Nippon Yakurigaku Zasshi (1977)* 73(8): 877-85.

FL Tamura, Shunkichi, Mizukami, Reiko, and Tanaka, Izumi. 1974. arsenic metabolism. xiv. effects of lactalbumin, egg albumin on arsenic excretion and storage. *Nippon Yakurigaku Zasshi (1974)* 70(6): 843-7.

FL Tamura, Shunkichi, Nozaki, Shigeru, Maehashi, Hiroshi, and Tanaka, Izumi. 1974. arsenic metabolism. xiii. effects of methionine, taurine, and cysteine on arsenic accumulation in certain organs and on the excretion rates. *Nippon Yakurigaku Zasshi (1974)* 70(6): 837-41.

Dup Tanaka, I. studies on arsenic metabolism. 17. studies of placental transfer andantidotes and diets on placental transfer.

FL Tanaka, I. 1976. [arsenic metabolism. (17) studies of placental transfer of arsenic and the effects of antidotes and diet]. *Nippon Yakurigaku Zasshi* 72(6): 673-87.

FL Tanaka, Izumi. studies on arsenic metabolism. (xvii). studies on placental transfer and the effects of antidotes and diets on placental transfer. *Nippon Yakurigaku Zasshi (1976)* 72(6): 673-87

No Oral Tandra Das, Choudhury, A. R., Archana Sharma, and Geeta Talukder. 1993. modification of cytotoxic effects of inorganic arsenic by a crudeextract of allium sativum l. in mice. *International Journal of Pharmacognosy* 31(4): 316-320.

FL Taranov, G. S. 1994. feed yeasts (for feeding mink). *Krolikovodstvo i Zverovodstvo* (3): 8.

Alt Tariq, M. A. and Preiss, I. L. 1994. fluctuations in fe, cu, zn, br, as, se, and rb concentrations in c57l/j mice bearing bw7756 murine hepatoma using radioisotope-induced x-ray fluorescence. *Biol Trace Elem Res.* 42(2): 97-114.

No Oral Tariq, Muhammad Ashraf and Preiss, Ivor L. fluctuations in fe, cu, zn, br, as, se, and rb concentrations in c57l/j mice bearing bw7756 murine hepatoma using radioisotope-induced x-ray fluorescence. *Biol. Trace Elem. Res. (1994)* 42(2): 97-114.

Rev Task Group Metal Interact, Int. 1978. factors influencing metabolism and toxicity of metals a consensus Report. *Environ Health Perspect.* 25: 3-41.

Abstract Taubeneck, M. W., Daston, G. P., Rogers, J. M., and Keen, C. L. evidence for a common pathway of developmental toxicity of urethane, melphalan and arsenic: impact on maternal and embryonic zinc status. *Teratology 1991 May;43(5):469*

Acu Taubeneck, Marie Weldon, Daston, George P., Rogers, John M., and Keen, Carl L. altered maternal zinc metabolism following exposure to diverse developmental toxicants. *Reprod. Toxicol. (1994)* 8(1): 25-40.

Abstract Taubeneck, MW, Daston, GP, Rogers, JM, and Keen, CL. 1991. evidence for a common pathway of developmental toxicity of urethane, melphalan and arsenic: impact on maternal and emryonic zinc status. *Teratology* . 43(5): 371-542.

Unrel Taylor, J. D., Gibson, J. A., and Yeates, C. E. F. 1991. furazolidone toxicity in dairy calves. *Australian Veterinary Journal* 68(5): 182-183.

FL Teuscher, E., Sauvageau, R., and Tellier, P. 1985. case of accidental arsenic poisoning in cattle, with reference todevelopment of histopathological lesions. *Schweizer Archiv Fur Tierheilkunde* 127(4): 257-266.

Abstract Thacker, G. T., Patterson, B. L., and Hood, R. D. 1977. effects of administration route on arsenate teratogenesis in mice. *Teratology; 15 (2). 1977 30A-31A*

Mix Thapar, N. T., Guenthner, E., Carlson, C. W., and Olson, O. E. 1969. dietary selenium and arsenic additions to diets for chickens over a life cycle. *Poult Sci.* 48(6): 1987-93.

Thapar, NT, Guenther, E, Carlson, CW, and Olson, OE. 1969. dietary selenium and arsenic additions to diets for chickens over a half cycle. *Poult. Sci.* 48: 1988.

Bio Acc Theis, M and Gregory, D. 1994. residues of lead, cadmium, and arsenic in livers of mexican free-tailed bats. *Bull. Environ. Contam. Toxicol.* 52(5): 641-648.

Rev Thompson, L. J., Hall, J. O., and Meerdink, G. L. 1991. toxic effects of trace element excess. *Veterinary Clinics of North America, Food Animal Practice.* 7(1): 277-306.

FL Tishchenko, L. G. 1983. histological studies of anoplocephalids after the action ofanthelmintics and experimental bio-control. *Byulleten' Vsesoyuznogo Instituta Gel'Mintologii Im. K.I. Skryabina* (No.35): 72-73.

Drug Tobey, R. A., Enger, M. D., Griffith, J. K., and Hildebrand, C. E. 1982. inducible protective proteins: a potentially novel approach to chemotherapy. *Govt Reports Announcements & Index (GRA&I)*

No Oral Tripathi, Neelima, Kannan, G. M., Pant, B. P., Jaiswal, D. K., Malhotra, P. R., and Flora, S. J. S. 1977. arsenic-induced changes in certain neurotransmitter levels and their recoveries following chelation in rat whole brain. *Toxicol. Lett. (1997)* 92(3): 201-208 .

An Prod Troeger, K., Reuter, G., and Schneider, D. 1983. use of dried chicken manure in cattle feeding, from the aspects of meathygiene and feed technology. i. microorganisms, nutrients and residuesin battery-hen manure and maize silage used as basal feed. *Berliner Und Munchener Tierarztliche Wochenschrift* 96(11): 388-397.

FL Trojan, S. 1980. [adaptation of newborn rats to repeated exposure to histotoxic hypoxia (author's transl)]. <original> adaptace novorozenych krys na opakovane vystaveni histotoxicke hypoxii. *Bratislavske Lekarske Listy* 73(6): 662-70.

FL Trojan, S., Jilek, L., and Mourek, J. 1967. [effect of repeated sodium arsenite administration on oxygen consumption in the rat brain and liver during development]. <original> vliv opakovaneho podavani arzenitanu sodneho na spotrebu kysliku v mozku a v jatrech krys behem ontogeneze. *Sbornik Lekarsky* 69(12): 361-5.

FL Trojan, S., Jilek, L., and Travnickova, E. 1968. effect of repeated administration of sodium arsenate on the developing organism abstract rat ischemia development retardation. *CESK FYSIOL. Ceskoslovenska Fysiologie. 17 (1). 1968 32*

FL Trojan, Stanislav and Jilek, L. 1967. influence of repeated administration of sodium arsenite on the reflex activity of rats. *Sb. Lek. (1967)* 69(6): 175-80.

Unrel True Anne E, Scarrow Robert C, Randall Clayton R, Holz Richard C, and Que Lawrence Jr(A). 1993. exafs studies of uteroferrin and its anion complexes. *Journal of the American Chemical Society* 115(10): 4246-4255.

Surv Trust, K. A., Rummel, K. T., Scheuhammer, A. M., Brisbin, I. L. Jr., and Hooper, M. J. 2000. contaminant exposure and biomarker responses in spectacled eiders (somateria fischeri) from st. lawrence island, alaska. *Arch. Environ. Contam. Toxicol. (2000)* 38(1): 107-113.

No Oral Tsukamoto, H, Parker, HR, Gribble, DH, Mariassy, A, and Peoples, SA. 1983. nephrotoxicity of sodium arsenate in dogs. *Am. J. Vet. Res.* 44(12): 2324-2330.

No Oral Tsukamoto, H, Parker, HR, and Peoples SA. 1983. metabolism and renal handling of sodium arsenate in dogs. *Am. J. Vet. Res.* 44(12): 2331-2335.

FL Tsuneishi, E., Takeshita, K., Yoshida, S., and Nishimura, K. Tohoku National Agricultural Experiment Station Morioka Japan. 1981. accumulation and excretion of dietary arsenic (as) in cattle, and survey of as content in organs of cattle produced in tohoku district [japan]. *Bulletin of the Tohoku National Agricultural Experiment Station. (No.65) P. 167-174*

FL Tsutsumi, S., Usui, Y., and Matsumoto, Y. 1974. [arsenic metabolism. (report no. 8) inhibition of succinic acid dehydrogenase activity of arsenic trichloride in rats; influence of different types of diet]. *Nippon Yakurigaku Zasshi* 70(4): 515-22 .

FL Tsutsumi, Shoji. 1972. fundamental studies on arsenic metabolism. fate of radioisotope arsenic-74 administered to experimental animals and the pharmacodynamic action of the antidotes on the arsenic poisoning. *Shika Gakuho (1972)* 72(5): 1-25

In Vit Tuena De Gomez-Puyou M(A), Sandoval Francisca, and Gomez-Puyou, A. 1995. synthesis of medium pyrophosphate by soluble mitochondrial f-1 through dimethyl sulfoxide-water transitions. *Journal of Biological Chemistry* 270(28): 16820-16825.

FL Tulakina, N. V., Novikov, Yu. V., Plitman, S. I., Kochetkova, T. A., Lastochkina, K. O., and Khvastunov, R. M. 1987. standards for arsenic in drinking water of different hardness. *Gigiena i Sanitariya* (1): 21-24.

Surv Turner, J. C., Solly, S. R. B., Mol-Krijnen, J. C. M., and Shanks, V. 1978. organochlorine, fluorine, and heavy-metal levels in some birds from newzealand estuaries. *New Zealand Journal of Science* 21(1): 99-102.

Phys Ullrich, K. J. and Murer, H. 1982. sulphate and phosphate transport in the renal proximal tubule. *Philosophical Transactions of the Royal Society of London. Series B:*

Phys Ullrich, K. J., Papavassiliou, F., Rumrich, G., and Fritzsch, G. 1985. contraluminal phosphate transport in the proximal tubule of the rat kidney. *Pflugers Archiv* 405 Suppl 1: S106-9.

Phys Ullrich, K. J., Rumrich, G., and Kloss, S. 1984. contraluminal sulfate transport in the proximal tubule of the rat kidney. i. kinetics, effects of k+, na+, ca2+, h+, and anions. *Pflugers Archiv* 402(3): 264-71.

Abstract Umpierre, C. C. 1981. embryo lethal and teratogenic effects of sodium arsenite in Rats. *21st Annual Meeting of the Teratology Society*

Unrel Underwood, E. J. 1976. mineral imbalances in farm animals and their study and diagnosis with isotopic tracers. *Atomic Energy Review* 14(4): 591-619.

Rev Underwood, E. J. 1981.: ix + 180pp.

BioAcc US Army. 1976.: 9.

Rev USDOI. 1988.

USEPA. 1998.

Rev Uthus, E. O. evidence for arsenic essentiality. *ENVIRON GEOCHEM HEALTH; 14 (2). 1992. 55-58.*

Abstract Uthus, E. O. 1997. arsenic deprivation decreases the specific activity of betaine homocysteine methyltransferase (bhmt) in rats fed diets low in folic acid but supplemented with choline. *FASEB Journal* 11(3): A148.

Mix Uthus, E. O. and Kang, Y. J. effect of buthionine sulfoximine on the response to arsenic deprivation in female rats. *J. Trace Elem. Exp. Med. (1998)* 11(1): 29-36.

CP Uthus, E. O. and Neilsen, F. H. 1983. zinc status affects the induction of arsenic deficiency in chicks. *67th Annual Meeting of the Federation of American Societies for Experimental Biology, Chicago, Ill., Usa, April 10-15, 1983. Fed Proc. 42 (4). 1983. Abstract 3108.*

CP Uthus, E. O. and Nielsen, F. H. arsenic-zinc interactions in chicks. *Proc. N. D. Acad. Sci. (1980)* : 34, 54.

CP Uthus, E. O. and Nielsen, F. H. 1980. arsenic deprivation and arsenic-zinc interactions in the chick . *Spurenelem.-Symp.: Arsen 3rd* : 33-9. Editor(s): Anke, Manfred; Schneider, Hans-Joachim; Brueckner, Chr. Publisher: Friedrich-Schiller- Univ. Jena Abt. Wiss. Publ., Jena, Ger. Dem. Rep.

CP Uthus, E. O. and Nielsen, F. H. 1983. influence of arsenic on arginine metabolism in chicks . *Spurenelem.-Symp. 4th* : 105-10. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep..

Abstract Uthus, E. O. and Nielsen, F. H. 1987. effects of dietary taurine on arsenic deprivation in the spontaneously hypertensive rat. *Federation Proceedings* 46: 1007.

No COC Uthus, E. O. and Nielsen, F. H. 1987. methyl depletion affects the response of rats to arsenic deprivation. *Nutrition Research* 7(10): 1061-1072.

CP Uthus, E. O. and Poellot, R. effects of dietary methionine on signs of arsenic deprivation in rats. *Proceedings Of The North Dakota Academy Of Science.* Apr 1990. v. 44 p. 90.

CP Uthus, E. O. and Poellot, R. A. 1998. high dietary sodium arsenite affects kidney trace element concentrations. *FASEB Journal* 12(4): A221.

Abstract Uthus, EO and Nielson, FH. 1987. effects of dietary taurine on arsenic deprivation in the spontaneously hypertensive rat. *Fed Proc.* 46(3): 1007.

Nut def Uthus, Eric and Poellot, Rhonda. effect of dietary pyridoxine on arsenic deprivation in rats. *Magnesium Trace Elem. (1993)* Volume Date 1992, 10(5-6): 339-47.

Nut def Uthus, Eric and Poellot, Rhonda. effect of methionine deficiency on arsenic deprivation in rats : growth , blood parameters, organ weight/body weight ratios, and tissue trace element

concentration. *J. Trace Elem. Exp. Med. (1992)* 5(3): 153-64.

Nut def Uthus, Eric O. diethyl maleate, an in vivo chemical depletor of glutathione, affects the response of male and female rats to arsenic deprivation. *Biol. Trace Elem. Res. (1994)* 46(3): 247-59

Nut def Uthus, Eric O. effects of arsenic deprivation in hamsters. *Magnesium Trace Elem. (1991)* Volume Date 1990, 9(4): 227-32.

Rev Uthus, Eric O. evidence for arsenic essentiality. *Environ. Geochem. Health (1992)* 14(2): 55-8

Nut def Uthus, Eric O. and Nielsen, Forrest H. methyl depletion affects the response of rats to arsenic deprivation. *Nutr. Res. (N. Y.) (1987)* 7(10): 1061-72.

Bio Acc Vadhanavikit, S., Ip, C., and Ganther, H. E. metabolites of sodium selenite and methylated selenium compounds administered at cancer chemoprevention levels in the rat. *Xenobiotica (1993)* 23(7): 731-45.

Prim Vahter, M, Couch, R, Nermell, B, and Nilsson, R. 1995. lack of methylation of inorganic arsenic in the chimpanzee. *Toxicol. Appl. Pharmacol.* 133(2): 262-268.

No Oral Vahter, M and Marafante, E. 1987. effects of low dietary intake of methionine, chlorine or proteins on the biotransformation of asenite in the rabbit. *Toxicol. Letters.* 37: 41-46.

CP Vahter, M. and Marafante, E. 1988. intracellular distribution and chemical forms of arsenic in rabbits exposed to Arsenate. *First International Meeting on Molecular Mechanisms of Metal Toxicity and Carcinogenicity*

Rev Vahter, Marie. 1999. methylation of inorganic arsenic in different mammalian species and population groups. *Sci. Prog. (Northwood U. K.)* 82(1): 69-88

Acu Van den Heuvel, M. J., Clark, D. G., Fielder, R. J., Koundakjian, P. P., Oliver, G. J. A., Pelling, D., Tomlinson, N. J., and Walker, A. P. 1990. the international validation of a fixed-dose procedure as an alternative to the classical ld50 test. *Food Chem. Toxicol. (1990)* 28(7): 469-82.

Surv Van Der Veen, N. G. and Vreman, K. 1986. transfer of cadmium lead mercury and arsenic from feed into various organs and tissues of fattening lambs. *NETH J AGRIC SCI.* 34(2): 145-154.

Abstract Van Gelder, G. A., Buck, W. B., Osweiler, G. D., and Stahr, H. M. 1972. research activities of a veterinary toxicology laboratory. *Clinical Toxicology* 5(2): 271-81.

Drug van Praag, M. C., Tseng, L. N., Mommaas, A. M., Boom, B. W., and Vermeer, B. J. 1993. minimising the risks of puva treatment. *Drug Safety* 8(5): 340-9.

Mix Van Vleet, J. F. 1982. amounts of twelve elements required to induce selenium vitamin e deficiency in ducklings. *Am. J. Vet. Res.* 43(5): 851-857.

Dead VanUlsen, F. W. one hundred poisoned dogs. *Tijdschr. Diergeneesk. 99(18): 947-948; 1974.(2 References)*

Abstract Vedel, G. C., Harrison, W. P., Baxley, M. N., and Hood, R. D. influence of an arsenic chelating

agent (bal) on the outcome of prenatal arsenite exposure in mice. *Teratology. 21:72A-73A,1980*

Mix Veen, N. G. van der and Vreman, K. 1986. transfer of cadmium, lead, mercury and arsenic from feed into variousorgans and tissues of fattening lambs. *Netherlands Journal of Agricultural Science* 34(2): 145-153.

Mix Veeramachaneni, D. N. R. and Amann, J. S. Palmer And R P. 1995. sexual dysfunction and abnormal acrosomes in rabbits following infantile exposure to a mixture of chemical contaminants in drinking water. *Biology of Reproduction* 52(SUPPL. 1): 171.

Rev Venugopal, B. and Luckey, T. D. 1978.*Metal Toxicity in Mammals* 2

Surv Vermeer, K and Thompson, JAJ. 1992. arsenic and copper residues in waterbirds and their food down inlet from the island copper mill. *Bull Environ Contam Toxicol.* 48(5): 733-738.

FL Vibe, P. P. 1976. parasitic coenoses in sheep. *Veterinariya, Moscow* (6): 58-60.

Mix Vijchulata, Pravee, Henry, P. R., Ammerman, C. B., Becker, H. N., and Palmer, A. Z. performance and tissue mineral composition of ruminants fed cage layer manure in combination with monensin. *J. Anim. Sci. (1980).* 50(1): 48-56.

No COC Vincent, J. B., Crowder, M. W., and Averill, B. A. 1991. spectroscopic and kinetics studies of a high-salt-stabilized form of the purple acid phosphatase from bovine spleen. *Biochemistry. 30 (12). 1991. 3025-3034.*

FL Viuf, B. T. 1992. report, 4: department of chemical analyses (additives and undesirable substances). <original> 4: meddelelser fra kemisk afdeling. *Plantedirektoratets Beretning. Foder, Goedning, Voksemedier, EF-Stoetteordninger. (No.1) P. 59-79*

Mix Vodela, J. K., Lenz, S. D., Renden, J. A., and Kemppainen, B. W. 1996. reproductive performance altered by chemical mixture. *Toxicologist 1996 Mar;30(1 Pt 2):192*

Mix Vodela, J. K., Lenz, S. D., Renden, J. A., Mcelhenney, W. H., and Kemppainen, B. W. 1997. drinking water contaminants (arsenic, cadmium, lead, benzene, and trichloroethylene): 2. effects on reproductive performance, egg quality, and embryo toxicity in broiler breeders. *Poultry Science.* 76(11): 1493-1500.

Mix Vodela, J. K., Renden, J. A., Lenz, S. D., Mcelhenney, W. H., and Kemppainen, B. W. 1997. drinking water contaminants (arsenic, cadmium, lead, benzene, and trichloroethylene): 1. interaction of contaminants with nutritional status on general performance and immune function in broiler chickens. *Poultry Science.* 76(11): 1474-1492.

FL Vogler, G. 1967. [intoxication of man and animals with phytoplankton toxins from surface waters]. <original> intoxikationen von mensch und tier durch phytoplanktontoxine aus oberflachengewassern. *Archiv Fur Hygiene Und Bakteriologie* 151(1): 1-22.

Abstract Vreman, K. and De Ruig W G. 1980. supplementation of diet with arsenic lead cadmium and mercury in lactating dairy cows and young fattening bulls appearance of various heavy metals in various edible tissues. *34th Convention of the Society for the Nutritional Physiology of Domestic Animals, Goettingen, West Germany, March 12-14, 1980. Z Tierphysiol Tierernaehr Futtermittelk. 44 (1). 1980. 10-11.*

FL Vreman, K. and Ruig, W. G. de. 1980. supplements of arsenic, lead, cadmium and mercury for lactating dairycows and young fattening bulls. the transfer (of the heavy metals) todifferent edible tissues. *Zeitschrift Fur Tierphysiologie, Tierernahrung Und Futtermittelkunde* 44(1): 10-11.

Mix Vreman, K., Van Der Veen, N. G., Van Der Molen, E. J., and De Ruig, W. G. 1986. transfer of cadmium lead mercury and arsenic from feed into milk and various tissues of dairy cows chemical and pathological Data. *Neth J Agric Sci.* 34(2): 129-144.

Diss Vreman, K. and Veen, N. G. van der. 1981. carry-over of lead, cadmium, mercury and arsenic from animal feed toedible products of fattening lambs. <document title>rapport, instituut voor veevoedingsonderzoek "hoorn". (136): 17 pp.

Unrel Vyaizenen, G. N., Tokar', A. I., Gulyaev, V. A, Marinets, R. M., and Struchkov, A. A. 1998. conifer extract for obtaining ecologically clean product. *Kormoproizvodstvo* (1): 28-29.

Abstract Wagstaff, D. J. 1972. arsenic trioxide: stimulation of liver enzyme detoxication activity. *Toxicol. Appl. Pharmacol.; 22(2): 310; 1972*

Mix Wagstaff, D. J. alteration of hepatic de toxication enzyme activity by dietary arsenic tri oxide. *Food and Cosmetics Toxicology. 16 (5). 1978. 423-426.* Ref ID: 15190

Unrel Waheed, A. and Van Etten R L. 1980 the structural basis of the anomalous kinetics of rabbit liver aryl sulfatase a ec-3.1.6.1. *Archives of Biochemistry and Biophysics. 203 (1). 1980. 11-24.*

Bio Acc Waheed, S., Fatima, I., Mannan, A., Chaudhary, M. S., and Qureshi, I. H. 1985. trace element concentration in egg- yolk and egg-white of farm and domestic chicken eggs. *Int. J. Environ. Anal. Chem. (1985)* 21(4): 333-44.

FL Wan, B., Wang, C., Liou, S., and Ren, J. 1984. toxicity and teratogenicity studies of arsenite in chicken Embryos. *Zhonghua Laodong Weisheng Zhiyebing Zazhi (Chinese J Ind Hyg Occupat Dis) 1:3-4,1984*

CP Wang, C., Gomer, R. H., and Lazarides, E. 1981. heat shock proteins are methylated in avian and mammalian cells. *Proceedings of the National Academy of Sciences of the United States of*

In Vit Wang, C., Lin, J. M., and Lazarides, E. 1992. methylations of 70,000-da heat shock proteins in 3t3 cells: alterations by arsenite treatment, by different stages of growth and by virus transformation. *Archives of Biochemistry and Biophysics* 297(1): 169-75.

Unrel Wang, T. C., Huang, J. S., Yang, V. C., Lan, H. J., Lin, C. J., and Jan, K. Y. delay of the excision of uv light-induced dna adducts is involved in the coclastogenicity of uv light plus arsenite. *International Journal of Radiation Biology; 66 (4). 1994. 367-372.*

In Vit Wang, T. S., Kuo, C. F., Jan, K. Y., and Huang, H. 1996. arsenite induces apoptosis in chinese hamster ovary cells by generation of reactive oxygen species. *Journal of Cellular Physiology; 169 (2). 1996. 256-268.*

In Vit Wang, T. S., Shu, Y. F., Liu, Y. C., Jan, K. Y., and Huang, H. 1997. glutathione peroxidase and catalase modulate the genotoxicity of arsenite. *Toxicology; 121 (3). 1997. 229-237.*

Unrel Warren, A. P. and Pasternak, C. A. 1988. common pathway for the induction of hexose transport by insulin and Stress. *J Cell Physiol; 138 (2). 1988. 323-328.*

In Vit Wasserman, R. H. 1979. *Molecular Mechanisms of the Epithelial Transport of Toxic Metal Ions, Particularly Mercury, Cadmium, Lead, Arsenic, Zinc, and Copper. Progress Report, January 1, 1979-December 31, 1979*

In Vit Wasserman, R. H. and Fullmer, C. S. 1986.*Molecular Mechanisms of the Epithelial Transport of Toxic Metal Ions. Final Report, September 1, 1975-December 31, 1985. DOE/EV/02792-12*

Diss Watanabe, T., Hirayama, T., Takahashi, T., Kokubo, T., and Ikeda, M. toxicological evaluation of arsenic in edible seaweed, hizikia.

CP Watanabe, T., Hirayama, T., Takahashi, T., Kokubo, T., and Ikeda, M. 1980. toxicological evaluation of arsenic in edible seaweed hizikia species. *2nd International Congress on Toxicology*

Aquatic Watanabe, Takao, Hirayama, Toshiko, Takahashi, Toru, Kokubo, Takeshi, and Ikeda, Masayuki. 1979. toxicological evaluation of arsenic in edible seaweed, hizikia species. *Toxicology (1979)* 14(1): 1-22.

Unrel Watson, A. P. and Griffin, G. D. 1992. toxicity of vesicant agents scheduled for destruction by the chemical stockpile disposal program. *Environmental Health Perspectives* 98: 259-80.

No Oral Webb, D. R., Wilson, S. E., and Carter, D. E. 1987. pulmonary clearance and toxicity of respirable gallium arsenide particulates intratracheally instilled into rats. *Am. Ind. Hyg. Assoc. J. (1987)* 48(7): 660-7.

Unrel Westing, T. W., Fontenot, J. P., McClure, W. H., Kelly, R. F., and Webb, K. E. Jr. 1985. characterization of mineral element profiles in animal waste andtissues from cattle fed animal waste. 1. heifers fed broiler litter. *Journal of Animal Science* 61(3): 670-681.

Nut Def Whanger, P. D., Weswig, P. H., Schmitz, J. A., and Oldfield, J. E. 1976. effects of selenium, cadmium, mercury, tellurium, arsenic, silver and arsenic on white muscle disease in lambs and effect of dietary forms of arsenic on its accumulation in tissues. *Nutr Rep Int.* 14(1): 63-72.

Unrel Wharton, R. H., Roulston, W. J., and <Editors> Wells, E. A. 1977. acaricide resistance in boophilus microplus in australia. 73-92.

Surv White, D. H., King, K. A., and Prouty, R. M. 1980. significance of organochlorine and heavy metal residues in wintering shorebirds at corpus christi, texas, 1976-77. *Pestic. Monit. J.* 14(2): 58-63.

In Vit Wiegant, F. A., van Bergen en Henegouwen, P. M., van Dongen, G., and Linnemans, W. A. 1987. stress-induced thermotolerance of the cytoskeleton of mouse neuroblastoma n2a cells and rat reuber h35 hepatoma cells. *Cancer Research* 47(6): 1674-80.

In Vit Wiegant, F. A. C., Souren, J. E. M., van Rijn, J., and van Wijk, R. stressor-specific induction of heat shock proteins in rat hepatoma cells. *Toxicology (1994)* 94(1-3): 143-59 .

Surv Wiemeyer, S. N., Jurek, R. M., and Moore, J. F. 1986. environmental contaminants in surrogates foods and feathers of california condors gymnogyps-californianus. *Environ Monit Assess.* 6(1): p91-111.

Surv Wiemeyer, Stanley N., Schmeling, Sheila K., and Anderson, Allen. 1987. environmental

pollutant and necropsy data for ospreys from the eastern united states, 1975-1982. *J. Wildl. Dis.* 23(2): 279-91 .

No Oral Wight, P. A. L., Dewar, W. A., Saunderson, C. L., Wiemeyer, S. N., Jurek, R. M., and Moore, J. F. 1986. zinc toxicity in the fowl ultrastructural pathology and relationship to selenium lead and copper: environmental contaminants in surrogates foods and feathers of california condors Gymnogyps-californianus. *Avian Pathol.* 15(1): 23-38.

Rev Wilber, C. G. 1980. toxicology of selenium: a review. *Clin. Toxicol.* 17(2): 171-230.

No Oral Wilkinson, F. C. 1979. dermatophilosis of sheep association with dipping and effects onproduction. *Australian Veterinary Journal* 55(2): 74-76.

Gene Willems, F., Vansanten-Urbain, G., De Wit, D., Slaoui, M., and Urbain, J. 1990. loss of a major idiotype (cria) after repopulation of irradiated mice. *Journal of Immunology* 144(4): 1396-403.

No Oral Willhite, C. C. arsenic-induced axial skeletal (dysraphic) Disorders. *Exp Mol Pathol 34:145-158,1981*

Rev Williams, S. N. and McDowell, L. R. 1985. newly discovered and toxic elements. *Animal Feeding and Nutrition: Nutrition of Grazing Ruminants in Warm Climates.* 317-338.

Sed Winger, P. V., Lasier, P. J., White, D. H., and Seginak, J. T. 2000. effects of contaminants in dredge material from the lower savannah river . *Arch. Environ. Contam. Toxicol.* 38(1): 128-136 .

Surv Winger, P. V(A), Lasier, P. J., White, D. H., and Seginak, J. T. 2000. effects of contaminants in dredge material from the lower savannah river. *Archives of Environmental Contamination and Toxicology* 38(1): 128-136.

Org met Wise, D. R., Hartley, W. J., and Fowler, N. G. 1974. pathology of 3-nitro-4-hydroxyphenylarsonic acid toxicity in turkeys. *Research in Veterinary Science* 16(No.3): 336-340.

Abstract Woods, J. S. and Fowler, B. A. 1978. perturbation of hepatic heme biosynthesis and urinary porphyrin levels as an early response to prolonged arsenic exposure. *Society of Toxicology Seventeenth Annual Meeting: Abstracts of Papers. In Toxicology and Applied Pharmacology* 45(1): 309.

Dup Woods, JS and Fowler, BA. 1977. effects of chronic arsenic exposure on hematopoietic function in adult mammalian liver. *Environ. Health. Perspect.* 19: 209-213.

Org met Worden, An and Wood, EC. 1973. the effect of carbarsone (33.6% w/v p-ureidobenzene arsonic acid) on bodyweight gain, food conversion and tissue arsenic levels of turkey poults. *J. Sci. Food Agric.* 24: 35-41 .

Unrel Xu, Xiuju, Xiao, Menglan, Li, Feng, Wang, Xiaoning, and Li, Meixian. nutritional and safety evaluation of delipidized castor bean proteins. *Shipin Kexue (Beijing) (1990)* : 122, 8-9

Mix Yanaga, Makoto, Enomoto, Shuichi, Hirunuma, Rieko, Endo, Kazutoyo, Ambe, Shizuko, Tozawa, Machiko, and Ambe, Fumitoshi. 1966. uptake and excretion of various elements in rats. *RIKEN Rev.* 13, 23-24 .

Mix Yanaga, Makoto, Enomoto, Shuichi, Hirunuma, Rieko, Furuta, Riko, Endo, Kazutoyo, Tanaka, Akira, Ambe, Shizuko, Tozawa, Machiko, and Ambe, Fumitoshi. multitracer study on uptake and excretion of trace elements in rats. *Appl. Radiat. Isot. (1996)* 47(2): 235-40 .

Acu Yanez, Leticia, Carrizales, Leticia, Zanatta, Maria Teresa, De Jesus Mejia, Jose, Batres, Lilia, and Diaz-Barriga, Fernando. arsenic-cadmium interaction in rats : toxic effects in the heart and tissue metal shifts. *Toxicology (1991)* 67(2): 227-34.

FL Yang, J. G., Zhou, L., and Liu, M. X. 1989. [antidotal effect of *Stenoloma chusanum*(l.) ching against arsenic and ammonium]. *Chung-Kuo Chung Yao Tsa Chih* 14(3): 46-8, 64.

In Vit Yang, J. L., Chen, M. F., Wu, C. W., and Lee, T. C. 1992. posttreatment with sodium arsenite alters the mutational spectrum induced by ultraviolet light irradiation in chinese hamster ovary cells. *Environmental and Molecular Mutagenesis* 20(3): 156-64.

No Oral Yang, Y. L., Lu, K. T., Tsay, H. J., Lin, C. H., and Lin, M. T. 1998. heat shock protein expression protects against death following exposure to heatstroke in rats. *Neuroscience Letters* 252(1): 9-12.

Aquatic Yannai, S., Mokady, S., Sachs, K., Kantorowitz, B., and Berk, Z. 1979. secondary toxicology and contaminants of algae grown on waste water. *Nutrition Reports International. 19 (3): 391-400.*

FL Yao, H. and Wang, G. Q. 1988. [experimental studies on the acute and chronic combined action of arsenic and fluoride]. *Chung-Hua Yu Fang i Hsueh Tsa Chih* 22(5): 284-6.

In Vit YIH, L. H. and Lee, T. C. 1994. a proteolytic activity enhanced by arsenite in chinese hamster ovary cells: possible involvement in arsenite-induced cell killing. *Biochemical and Biophysical Research Communications; 202 (2). 1994. 1015-1022.*

Acute Yoshida, K, Chen, H, Inoue, Y, Wanibuchi, H, Fukushima, S, Kuroda, K, and Endo, G. 1997. the urinary excretion of asenic metabolites after a single oral administration of dimethylarsinic acid to rats. *Arch Environ Contam Toxicol.* 32(4): 416-421.

Org met Yoshida, Kaoru, Inoue, Yoshinori, Kuroda, Koichi, Chen, Hua, Wanibuchi, Hideki, Fukushima, Shoji, and Endo, Ginji. 1998. urinary excretion of arsenic metabolites after long-term oral administration of various arsenic compounds to rats. *J. Toxicol. Environ. Health Part A* . 54(3): 179-192

Acu Yoshikawa, Hiroshi. preventive effect of pretreatment with low dose of metals on the acute toxicity of metals in mice. *Ind. Health (1970)* 8(4): 184-91.

Unrel Yotis William W(A), Gopalsami Chellam, Corrigan Kevin, Hoerman Kirk, and Keene Joseph J Jr. 1993. phosphorylated nutrient uptake by treponema denticola and other potential periodontopathogens. *Journal of Basic Microbiology* 33(5): 357-368.

Org met Young, R. A., Opresko, D. M., Watson, A. P., and King, J. preliminary data analysis and derivation of an estimated reference dose (rfde) for lewisite. *Toxicologist 1996 Mar;30(1 Pt 2):149*

Unrel Yu, Ping, Yan, Jinling, and Huang, Meng. extraction of the active constituents of fugus ovary and their properties. *Tianran Chanwu Yanjiu Yu Kaifa (1999)* 11(5): 51-54.

FL Yuan, Hongbing and Zhang, Gong. combined effects of lead, cadmium and arsenic on renal trace element levels in mice. *Gongye Weisheng Yu Zhiyebing (1991)* 17(2): 70-2 .

Prim Zakharyan, R. A., Wildfang, E., and Aposhian, H. V. 1996. enzymatic methylation of arsenic compounds. iii. the marmoset and tamarin, but not the rhesus, monkeys are deficient in methyltransferases that methylate inorganic arsenic. *Toxicology and Applied Pharmacology* 140(1): 77-84.

Prim Zakharyan, Robert A., Wildfang, Eric, and Aposhian, H. Vasken. enzymic methylation of arsenic compounds. iii. the marmoset and tamarin, but not the rhesus, monkeys are deficient in methyltransferases that methylate inorganic arsenic. *Toxicol. Appl. Pharmacol. (1996)* 140(1): 77-84.

Acute Zaman, K and Pardini, RS. 1995. an insect model for assessing toxicity: arsenic elevated glutathione content in the musca domestica and trichoplusia ni. *Bull Environ Contam Toxicol.* 55(6): 845-852.

No Org Zaman, Khalequz, MacGill, Randall S., Johnson, James E., Ahmad, Sami, and Pardini, Ronald S. an insect model for assessing oxidative stress related to arsenic toxicity. *Arch. Insect Biochem. Physiol. (1995)* 29(2): 199-209..

Unrel Zeledon, R. and De Monge, E. 1967. physiological studies on the culture form of four strains of leishmania braziliensis. i. nitrogen content, substrate utilization, and effect of metabolic inhibitors on respiration and its relation to infectivity. *Journal of Parasitology* 53(5): 937-45.

Mix Zhai, CK, Tang, WL, Jang, XL, and Lorenz, KJ. 1996. studies of the safety of chinese wild rice. *Food Chem Toxicol.* 34: 347-352.

FL Zhang, C., Yao, H., Ling, B., and Liu, J. 1997. [the effect of arsenic on reproduction and offspring development of rats]. *Wei Sheng Yen Chiu* 26(3): 179-82.

FL Zhang, Chen, Ling, Bing, Liu, Jiwen, Wang, Guoquan, and Xiao, Biyu. effect of fluoride-arsenic exposure on neurobehavioral development of offsprings in rats. *Weisheng Yanjiu (1999)* 28(6): 337-338, C4.

FL Zhang, Chen, Yao, Hua, Ling, Bing, and Liu, Jiwen. accumulative arsenic level in viscera in offsprings of exposed parent rats. *Zhonghua Yufang Yixue Zazhi (1998)* 32(2): 76-78.

FL Zhang, Cheng, Yao, Hua, Lin, Bin, Liu, Jiwen, and Jiang, Ping. arsenic exposed rat offspring mutagenicity study. *Weisheng Dulixue Zazhi (1998)* 12(1): 33-34.

Chem Meth Zinke-Allmang, M., Feldman, L. C., Patel, J. R., and Tully, J. C. The Morphology of Arsenic Terminated Silicon(111) from Desorption Kinetics. *Surf. Sci. (1988)* 197(1-2): 1-10.

FL Zmudzki, J. and Szkoda, J. Trace Elements Content of Hen Eggs in Poland. *Bromatologia I Chemia Toksykologiczna; 29 (1). 1996. 55-57.*

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

This Page Intentionally Left Blank

Appendix 5-1

Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Arsenic

March 2005

This page intentionally left blank

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic
Page 1 of 1

| Ref | | | Exposure | | |

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Arsenic

---

March 2005

This page intentionally left blank

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic

Ref			Exposure																								Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score										
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																																
1	14583	Neiger and Osweiler 1989	Sodium arsenite	57.69	Dog (*Canis familiaris*)	1	4	0.0/0.88/1.80/2.88	mg/kg bw/d	N	na	DLY	U	FD	8	w	8	mo	JV	F	M	Lab	BIO	ENZ	ASAT	SR	1.80	2.88	N	10.1	N	0.4597	1.04	1.66	10	10	5	10	10	1	10	10	10	4	80
2	15703	Neiger and Osweiler, 1992	Sodium arsenite	56.79	Dog (*Canis familiaris*)	1	4	0.0/0.88/1.80/2.88	mg/kg bw/d	N	na	DLY	M	FD	58	d	8	mo	JV	F	C	Lab	BIO	CHM	GBCM	UR		0.880	N	10.1	N	0.4597		0.500	10	10	10	10	10	1	4	10	10	4	79
3	15387	Wood and Fowler, 1978	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	4	0/1.2/2.2/3.5	mg/kg bw/d	N	na	NR	U	DR	6	w	NR	NR	JV	M	C	Lab	BIO	ENZ	GENZ	LI		1.20	Y	0.2000	N	0.02326		1.20	10	5	5	10	10	1	4	10	10	4	69
4	14580	Mahaffey et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/kg diet	N	na	ADL	UX	FD	10	w	NR	NR	AD	M	C	Lab	BIO	CHM	RBCE	BL		50.0	N	0.523	Y	0.01568		1.50	10	10	10	10	6	1	4	10	3	4	68
5	15011	Ghosh et al 1999	Sodium arsenite	57.69	Rat (*Rattus norvegicus*)	1	3	0/0.2/0.4	mg/org/d	N	na	DLY	U	GV	28	d	35	d	JV	F	C	Lab	BIO	ENZ	GENZ	AR		0.200	Y	0.056	N	0.006426		2.06	10	8	10	10	6	1	4	10	10	4	73
6	14577	Itoh et al., 1990	Arsenic trioxide	83.53	Mouse (*Mus musculus*)	1	3	0/3/10	mg/kg bw/d	N	na	DLY	U	OR	14	d	4	w	JV	M	C	Lab	BIO	CHM	TRYP	BR		3.0	N	0.022	N	0.002981		2.51	10	8	10	10	10	1	4	10	10	4	77
7	15506	Schroeder, 1968	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/3.776	mg/kg bw/d	N	na	ADL	U	DR	781	d	21-23	d	JV	B	C	Lab	BIO	CHM	CHOL	SR		3.78	N	0.2350	N	0.02689		3.78	10	5	5	10	10	1	4	10	10	4	69
8	15216	Nagaraja and Desiraju, 1994	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	20	d	2	d	JV	B	C	Lab	BIO	ENZ	ACHE	BR		5.0	Y	0.050	N	0.005855		5.00	10	8	10	10	10	1	4	10	10	4	77
9	14546	Nagaraja and Desiraju 1993	Arsenic	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	NR	C	Lab	BIO	HRM	DOPA	BR		5.0	Y	0.2152	N	0.01943		5.00	10	10	5	4	10	1	4	10	10	4	68
10	14546	Nagaraja and Desiraju 1993	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	18	d	2	d	JV	B	C	Lab	BIO	HRM	DOPA	BR		5.0	Y	0.0313	N	0.003984		5.00	10	8	10	10	10	1	4	10	10	4	77
11	15216	Nagaraja and Desiraju, 1994	Sodium arsenite	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	B	C	Lab	BIO	ENZ	ACHE	BR		5.0	Y	0.25	N	0.02198		5.00	10	10	5	10	10	1	4	10	10	4	74
12	11361	Glattre et. al., 1995	Sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/6.36	mg/kg bw/d	N	na	ADL	U	DR	4	w	NR	NR	JV	M	C	Lab	BIO	HRM	TRII	SR		6.36	Y	0.290	N	0.03249		6.36	10	5	5	10	10	1	4	10	10	4	69
13	15387	Wood and Fowler, 1978	Sodium arsenate	100	Mouse (*Mus musculus)*	2	4	0/6.6/11.4/25.1	mg/kg bw/d	N	na	NR	U	DR	6	w	NR	NR	JV	M	C	Lab	BIO	ENZ	GENZ	LI		6.60	Y	0.0300	N	0.004217		6.60	10	5	5	10	10	1	4	10	10	4	69
14	15709	Morrison and Chavez, 1983	Sodium arsenite	100	Pig (*Sus scrofa*)	1	2	0/100	mg/kg diet	N	na	ADL	U	FD	2	w	21	d	JV	B	C	Lab	BIO	ENZ	GLPX	PL		100	Y	5.40	Y	0.5100		9.44	10	10	5	10	7	1	4	10	10	4	71
15	25916	Biswas, et al, 2000	Sodium arsenite	57.69	Goat (*Ovis aries*)	1	2	0/25	mg/kg bw/d	N		DLY	U	OR	3	w	12	mo	AD	F	C	Lab	BIO	ENZ	ASAT	BL		25.0	Y	14.8	N	0.6294		14.4	10	8	10	10	10	1	4	10	3	4	70
16	15322	Biswas et al, 1998	Sodium arsenite	57.69	Goat (*Capra hircus*)	1	2	0/25.0	mg/kg bw/d	N	na	ADL	U	DR	6	w	1	yr	JV	F	C	Lab	BIO	CHM	HMGL	BL		25.0	Y	11.0	N	0.8568		14.4	10	5	5	10	10	1	4	10	10	4	69
17	15530	Garcia-Vargas et al, 1995	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/20	mg/L	Y		ADL	U	DR	2	w	NR	NR	JV	M	C	Lab	BIO	CHM	PORP	UR		20.0	Y	0.030	Y	0.0350		24.6	10	5	5	10	7	1	4	10	10	4	66
18	14590	Tripathi et al 1997	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/2.56	mg/org/d	Y	na	ADL	U	DR	16	w	NR	NR	AD	M	C	Lab	BIO	HRM	DOPA	BR		2.56	Y	0.080	N	0.01020		32.0	10	5	5	10	7	1	4	10	10	4	66
19	15530	Garcia-Vargas et al, 1995	Sodium arsenate	100	Mouse (*Mus musculus*)	2	2	0/50	mg/L	Y		ADL	U	DR	2	w	NR	NR	JV	M	C	Lab	BIO	CHM	PORP	UR		50.0	Y	0.0300	Y	0.0240		42.1	10	5	5	10	7	1	4	10	10	4	66
Behavior																																															
20	15007	Hunder et al, 1999	Sodium arsenite	100	Guinea pig (*Cavia porcellus*)	3	4	0/10/30/60	mg/kg diet	N	na	ADL	U	FD	3	w	NR	NR	JV	F	C	Lab	BEH	FDB	FCNS	WO	10.0	30.0	Y	0.315	N	0.02658	0.844	2.53	10	10	5	10	6	4	10	10	10	4	79
21	15471	Bencko 1972	Sodium arsenite	100	Mouse (*Mus musculus*)	1	3	0/0.88/6.0	mg/kg bw/d	N	na	NR	U	DR	64	d	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO	0.880	6.00	Y	0.03329	Y	0.005790	0.880	6.00	10	5	5	10	7	4	8	10	10	4	73
22	14583	Neiger and Osweiler 1989	Sodium arsenite	57.69	Dog (*Canis familiaris*)	1	4	0.0/0.88/1.80/2.88	mg/kg bw/d	N	na	DLY	U	FD	1	w	8	mo	JV	F	M	Lab	BEH	FDB	FCNS	WO	1.80	2.88	N	10.1	N	0.4597	1.04	1.66	10	10	5	10	10	4	10	10	10	4	83
23	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/1.88	mg/kg bw/d	N	na	DLY	U	FD	100	d	28	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	1.88		Y	0.2874	Y	0.01296	1.88		10	10	5	10	10	4	4	1	10	4	68
24	15358	Fowler and Woods 1979	Sodium arsenate	100	Mouse (*Mus musculus*)	1	4	0/20/40/85	mg/L	N	na	DLY	U	DR	6	w	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO	20.0	40.0	Y	0.0267	N	0.003801	2.84	5.69	10	5	5	10	6	4	10	10	10	4	74
25	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/3.22	mg/kg bw/d	N	na	DLY	U	FD	100	d	28	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	3.22		Y	0.2635	Y	0.01109	3.22		10	10	5	10	10	4	4	1	10	4	68
26	15709	Morrison and Chavez, 1983	Sodium arsenite	100	Pig (*Sus scrofa*)	1	2	0/100	mg/kg diet	N	na	ADL	U	FD	6	w	21	d	JV	B	C	Lab	BEH	FDB	FCNS	WO	100		Y	14.2	Y	0.5100	3.59		10	10	5	10	7	4	4	10	10	4	74
27	15007	Hunder et al, 1999	Sodium arsenite	100	Mouse (*Mus musculus*)	2	4	0/10/30/60	mg/kg diet	N	na	ADL	U	FD	3	w	NR	NR	JV	F	C	Lab	BEH	FDB	FCNS	WO	30.0	60.0	Y	0.0300	N	0.003847	3.85	7.69	10	10	5	10	6	4	10	10	10	4	79
28	15288	Benese and Bencko, 1981	Sodium arsenite	100	Mouse (*Mus musculus*)	1	4	0/4.945/49.45/249.4	mg/L	N	na	NR	U	DR	32	d	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO	49.5	249	Y	0.0325	Y	0.004225	6.43	32.4	10	5	5	10	7	4	8	10	10	4	73
29	14603	Coulson et al, 1935	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	2	2	0/0.21	mg/org/d	N	na	NR	M	FD	52	w	33-35	d	JV	B	C	Lab	BEH	FDB	FCNS	WO		0.21	Y	0.4450	Y	0.01208		0.472	10	10	10	10	7	4	4	10	10	4	79
30	14580	Mahaffey et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/kg diet	N	na	ADL	UX	FD	10	w	NR	NR	AD	M	C	Lab	BEH	FDB	FCNS	WO		50.0	N	0.523	Y	0.01568		1.50	10	10	10	10	6	4	4	10	3	4	71
31	14577	Itoh et al., 1990	Arsenic trioxide	83.53	Mouse (*Mus musculus*)	1	3	0/3/10	mg/kg bw/d	N	na	DLY	U	OR	14	d	4	w	JV	M	C	Lab	BEH	BEH	ACTV	WO		3.0	Y	0.022	N	0.002981		2.51	10	8	10	10	10	4	4	10	10	4	80
32	4	Brown et al., 1976	sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/4.7/9.4/10.9	mg/kg bw/d	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO		4.70	Y	0.444	Y	0.01785		4.70	10	5	5	10	10	4	4	10	6	4	68
33	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	21	d	2	d	JV	B	C	Lab	BEH	FDB	FCNS	WO		5.0	Y	0.050	N	0.005855		5.0	10	8	10	10	10	4	4	10	10	4	80
34	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	B	C	Lab	BEH	BEH	ACTP	WO		5.0	Y	0.250	N	0.02198		5.0	10	10	5	10	6	4	4	10	10	4	73
35	1244	Cabe, et al., 1979	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N	na	ADL	U	DR	18	w	50	d	JV	M	C	Lab	BEH	FDB	WCON	WO		50.0	Y	0.200	N	0.02326		5.81	10	5	5	10	6	4	4	10	10	4	68
36	15530	Garcia-Vargas et al, 1995	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/20	mg/L	Y	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO		20.0	Y	0.0300	Y	0.0350		24.6	10	5	5	10	7	4	4	10	10	4	69
37	15530	Garcia-Vargas et al, 1995	Sodium arsenate	100	Mouse (*Mus musculus*)	2	2	0/50	mg/L	Y	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO		50.0	Y	0.0300	Y	0.0240		42.1	10	5	5	10	7	4	4	10	10	4	69
Physiology																																															
38	15471	Bencko 1972	Sodium arsenite	100	Mouse (*Mus musculus*)	1	3	0/0.88/6.0	mg/kg bw/d	N	na	NR	U	DR	32	d	NR	NR	JV	M	C	Lab	PHY	PHY	GPHY	LI	0.880	6.00	Y	0.03329	Y	0.005790	0.880	6.00	10	5	5	10	7	4	8	10	10	4	73
39	15061	Kanisawa and Schroeder, 1969	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N	na	DLY	U	DR	18	mo	21	d	JV	B	C	Lab	PHY	PHY	BLPR	WO		5.0	N	0.248	N	0.02823		0.569	10	5	5	10	5	4	4	10	10	4	67
40	15174	Carmignani et al, 1985	Sodium arsenite	45.71	Rat (*Rattus norvegicus*)	2	2	0/50	mg/L	Y	na	NR	U	DR	18	mo	NR	NR	NR	M	C	Lab	PHY	PHY	GPHY	WO		50	N	0.50	N	0.05305		2.55	10	5	5	10	5	4	4	10	10	4	67
41	15174	Carmignani et al, 1985	Sodium arsenite	57.69	Rabbit (*Oryctolagus cuniculus*)	3	2	0/50	mg/L	Y	na	NR	U	DR	10	mo	NR	NR	NR	F	C	Lab	PHY	PHY	BLPR	WO		50	N	4.10	N	0.3525		2.61	10	5	5	10	5	4	4	10	10	4	67
42	15174	Carmignani et al, 1985	Sodium arsenite	57.69	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	Y	na	NR	U	DR	18	mo	NR	NR	NR	M	C	Lab	PHY	PHY	BLPR	WO		50	N	0.50	N	0.05305		3.22	10	5	5	10	5	4	4	10	10	4	67
43	15709	Morrison and Chavez, 1983	Sodium arsenite	100	Pig (*Sus scrofa*)	1	2	0/100	mg/kg diet	N	na	ADL	U	FD	6	w	21	d	JV	B	C	Lab	PHY	PHY	EXCR	WO		100	Y	14.2	Y	0.5100		3.59	10	10	5	10	7	4	4	10	10	4	74
44	4	Brown et al., 1976	sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/4.7/9.4/10.9	mg/kg bw/d	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	PHY	PHY	RPRT	KI		4.70	Y	0.444	Y	0.01785		4.70	10	5	5	10	10	4	4	10	6	4	68
45	14546	Nagaraja and Desiraju 1993	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	18	d	2	d	JV	B	C	Lab	PHY	PHY	GPHY	HA		5.0	Y	0.0313	N	0.003984		5.0	10	8	10	10	10	4	4	10	10	4	80
46	15249	Carmignani et al 1983	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N	na	DLY	U	DR	320	d	NR	NR	JV	M	C	Lab	PHY	PHY	GPHY	HA		50.0	N	0.2670	N	0.03016		5.65	10	5	5	10	5	4	4	10	10	4	67
47	15322	Biswas et al, 1998	Sodium arsenite	57.69	Goat (*Capra hircus*)	1	2	0/25.0	mg/kg bw/d	N	na	ADL	U	DR	6	w	1	yr	JV	F	C	Lab	PHY	PHY	GPHY	BL		25.0	Y	11.0	N	0.8568		14.4	10	5	5	10	10	4	4	10	10	4	72
48	25916	Biswas, et al, 2000	Sodium arsenite	57.69	Goat (*Ovis aries*)	1	2	0/25	mg/kg bw/d	N	na	DLY	U	OR	9	w	12	mo	AD	F	C	Lab	PHY	PHY	RPRT	WO		25.0	Y	21.3	N	0.8490		14.4	10	8	10	10	10	4	4	10	3	4	73
Pathology																																															
49	15160	Hughes and Thompson, 1996	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/0.014/1.4	mg/L	N	na	ADL	U	DR	28	d	96	d	SM	F	C	Lab	PTH	ORW	ORWT	LI	0.0140	1.40	Y	0.0799	Y	0.0049	0.000859	0.0859	10	5	5	10	7	4	6	10	6	4	67
50	14603	Coulson et al, 1935	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	2	2	0/0.21	mg/org/d	N	na	NR	M	FD	52	w	33-35	d	JV	B	C	Lab	PTH	HIS	GHIS	LI	0.210		Y	0.4700	Y	0.01168	0.447		10	10	10	10	7	4	4	1	10	4	69
51	15061	Kanisawa and Schroeder, 1969	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N	na	DLY	U	DR	42	mo	21	d	JV	B	C	Lab	PTH	HIS	GHIS	KI	5.0		N	0.248	N	0.02823	0.569		10	5	5	10	5	4	4	10	10	4	67
52	15057	Nemec et al, 1998	Arsenic acid	100	Rabbit (*Oryctolagus cuniculus*)	3	4	0/0.19/0.75/3.0	mg/kg bw/d	N	na	DLY	M	GV	7	d	NR	NR	GE	F	C	Lab	PTH	GRS	BDWT	WO	0.75	3.0	Y	4.36	N	0.2303	0.750	3.0	10	8	10	10	10	4	8	10	10	4	84
53	15471	Bencko 1972	Sodium arsenite	100	Mouse (*Mus musculus*)	1	3	0/0.88/6.0	mg/kg bw/d	N	na	NR	U	DR	64	d	NR	NR	JV	M	C	Lab	PTH	ORW	ORWT	SP	0.880	6.00	Y	0.03329	Y	0.005790	0.880	6.00	10	5	5	10	7	4	8	10	10	4	73
54	12934	Obermeyer et al, 1971	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/10	mg/kg diet	N	na	ADL	U	FD	4	w	NR	NR	JV	M	C	Lab	PTH	ORW	SMIX	LI	10.0		Y	0.202	N	0.01843	0.913		10	10	5	10	6	4	4	10	10	4	73

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic

Ref			Exposure																						Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
55	14589	Tice et al 1997	Sodium arsenite	57.69	Mouse (*Mus musculus*)	1	4	0/2.5/5.0/10.0	mg/kg bw/d	N	na	DLY	U	GV	4	d	12	w	JV	M	M	Lab	PTH	HIS	USTR	BL	2.5	5.0	N	0.0316	N	0.004015	1.44	2.88	10	8	10	10	10	4	10	10	10	4	86
56	14583	Neiger and Osweiler 1989	Sodium arsenite	57.69	Dog (*Canis familiaris*)	1	4	0.0/0.88/1.80/2.88	mg/kg bw/d	N	na	DLY	U	FD	8	w	8	mo	JV	F	M	Lab	PTH	ORW	SMIX	LI	2.88		N	10.1	N	0.4597	1.66		10	10	5	10	10	4	4	1	10	4	68
57	14569	Fowler et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	4	0/20/40/85	mg/L	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	PTH	HIS	USTR	LI	20.0	40.0	Y	0.325	N	0.03600	2.22	4.43	10	5	5	10	6	4	10	10	10	4	74
58	15358	Fowler and Woods 1979	Sodium arsenate	100	Mouse (*Mus musculus*)	1	4	0/20/40/85	mg/L	N	na	DLY	U	DR	6	w	NR	NR	JV	M	C	Lab	PTH	HIS	USTR	LI	20.0	40.0	Y	0.0267	N	0.003801	2.84	5.69	10	5	5	10	6	4	10	10	10	4	74
59	2	Byron et al, 1967	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	6	0/15.63/31.25/62.5/125/250	mg/kg diet	N	na	NR	U	FD	2	yr	NR	NR	JV	B	C	Lab	PTH	HIS	GHIS	LI	62.5	125	Y	0.4728	N	0.03711	4.91	9.81	10	10	5	10	6	4	10	10	10	4	79
60	2	Byron et al, 1967	Sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	2	6	0/31.25/62.5/125/250/400	mg/kg diet	N	na	NR	U	FD	2	yr	NR	NR	JV	B	C	Lab	PTH	HIS	GHIS	LI	125	250	Y	0.4652	N	0.03662	9.84	19.7	10	10	5	10	6	4	10	10	10	4	79
61	15057	Nemec et al, 1998	Arsenic acid	100	Mouse (*Mus musculus*)	1	4	0/7.5/24/48	mg/kg bw/d	N	na	DLY	M	GV	6	d	NR	NR	GE	F	C	Lab	PTH	GRS	BDWT	WO	24.0	48.0	Y	0.0527	N	0.006113	24.0	48.0	10	8	10	10	10	4	10	10	10	4	86
62	15530	Garcia-Vargas et al, 1995	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/20	mg/L	Y	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	PTH	ORW	SMIX	LI	20.0		Y	0.0300	Y	0.0350	24.6		10	5	5	10	7	4	4	10	10	4	69
63	15530	Garcia-Vargas et al, 1995	Sodium arsenate	100	Mouse (*Mus musculus*)	2	2	0/50	mg/L	Y		ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	PTH	ORW	SMIX	LI	50.0		Y	0.0300	Y	0.0240	42.1		10	5	5	10	7	4	4	10	10	4	69
64	113	Seidenberg et al 1986	Sodium arsenate	45.71	Mouse (*Mus musculus*)	1	2	0/95	mg/kg bw/d	N		DLY	U	GV	5	d	NR	NR	GE	F	C	Lab	PTH	GRS	BDWT	WO	95.0		Y	0.043	N	0.00517	43.4		10	8	10	10	10	4	4	8	10	4	78
65	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	2	3	0/6.5/750	ug/kg bw/d	N	na	ADL	U	DR	91	d	76	d	JV	M	C	Lab	PTH	ORW	ORWT	LI		6.50	N	0.0316	Y	na		0.00650	10	5	5	10	6	4	4	10	10	4	68
66	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	PTH	ORW	ORWT	KI		8.5	N	0.0316	Y	na		0.0085	10	5	5	10	6	4	4	10	10	4	68
67	7	Schroeder et al, 1968	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	1575	d	21-23	d	JV	M	C	Lab	PTH	ORW	SMIX	HE		5.0	Y	0.4790	N	0.05104		0.533	10	5	5	10	6	4	4	10	10	4	68
68	14580	Mahaffey et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/kg diet	N		ADL	UX	FD	10	w	NR	NR	AD	M	C	Lab	PTH	GRS	BDWT	WO		50.0	N	0.523	Y	0.01568		1.50	10	10	10	10	6	4	4	10	3	4	71
69	15011	Ghosh et al 1999	Sodium arsenite	57.69	Rat (*Rattus norvegicus*)	1	3	0/0.2/0.4	mg/org/d	N	na	DLY	U	GV	28	d	35	d	JV	F	C	Lab	PTH	ORW	SMIX	AR		0.200	Y	0.056	N	0.006426		2.06	10	8	10	10	6	4	4	10	10	4	76
70	4	Brown et al., 1976	sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/4.7/9.4/10.9	mg/kg bw/d	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	PTH	ORW	SMIX	KI		4.70	N	0.444	Y	0.01785		4.70	10	5	5	10	10	4	4	10	6	4	68
71	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	20	d	2	d	JV	B	C	Lab	PTH	ORW	ORWT	BR		5.0	Y	0.050	N	0.005855		5.0	10	8	10	10	10	4	4	10	10	4	80
72	14546	Nagaraja and Desiraju 1993	Arsenic	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	NR	C	Lab	PTH	ORW	ORWT	BR		5.0	Y	0.2152	N	0.01943		5.0	10	10	5	4	10	4	4	10	10	4	71
73	14546	Nagaraja and Desiraju 1993	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	18	d	2	d	JV	B	C	Lab	PTH	ORW	ORWT	BR		5.0	Y	0.0313	N	0.003984		5.0	10	8	10	10	10	4	4	10	10	4	80
74	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	B	C	Lab	PTH	ORW	ORWT	BR		5.0	Y	0.250	N	0.02198		5.0	10	10	5	10	6	4	4	10	10	4	73
75	15249	Carmignani et al 1983	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N		DLY	U	DR	320	d	NR	NR	JV	M	C	Lab	PTH	HIS	GHIS	KI		50.0	N	0.2670	N	0.03016		5.65	10	5	5	10	5	4	4	10	10	4	67
Reproduction																																															
76	14556	Savabieasfahani et al, 1998	Sodium arsenite	57.69	Cotton rat (*Sigmodon hispidus*)	1	3	0/0.088/0.15	mg/org/d	N		ADL	U	DR	6	w	NR	NR	AD	M	C	Lab	REP	REP	TEWT	TE	0.150		N	0.144	Y	0.01530	0.601		10	5	5	10	6	10	4	10	6	4	70
77	15057	Nemec et al, 1998	Arsenic acid	100	Rabbit (*Oryctolagus cuniculus*)	3	4	0/0.19/0.75/3.0	mg/kg bw/d	N	na	DLY	M	GV	12	d	NR	NR	GE	F	C	Lab	REP	REP	RSEM	WO	0.750	3.0	Y	4.355	N	0.2303	0.750	3.0	10	8	10	10	10	10	10	10	10	4	92
78	15125	Morris et al, 1938	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	3	0/450/4100	ug/org/d	N		ADL	U	FD	340	d	26-27	d	JV	M	C	Lab	REP	REP	PRWT	WO	4100		Y	0.549	N	0.01905	7.47		10	10	5	10	7	10	4	1	10	4	71
79	15057	Nemec et al, 1998	Arsenic acid	100	Mouse (*Mus musculus*)	1	4	0/7.5/24/48	mg/kg bw/d	N	na	DLY	M	GV	9	d	NR	NR	GE	F	C	Lab	REP	REP	PROG	WO	24.0	48.0	Y	0.0549	N	0.006322	24.0	48.0	10	8	10	10	10	10	8	10	10	4	92
80	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	2	3	0/6.5/750	ug/kg bw/d	N	na	ADL	U	DR	91	d	76	d	JV	M	C	Lab	REP	REP	TEWT	TE		6.50	N	0.0316	Y	na		0.00650	10	5	5	10	6	10	4	10	10	4	74
81	66	Schroeder and Mitchener, 1971	Arsenite	75.74	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		ADL	U	DR	6	mo	21	d	JV	F	C	Lab	REP	REP	PROG	WO		5.0	N	0.0225	N	0.003255		0.548	10	5	5	4	5	10	4	10	10	4	67
82	15167	Skalnaya et al, 1996	Sodium arsenite	56.6	Mouse (*Mus musculus*)	1	2	0/10	mg/kg bw/d	N		DLY	U	OR	30	d	NR	NR	GE	F	C	Lab	REP	REP	PRWT	WO		10.0	N	0.0288	N	0.003715		5.66	10	8	5	10	10	4	10	10	4	81
83	113	Seidenberg et al 1986	Sodium arsenate	45.71	Mouse (*Mus musculus*)	1	2	0/95	mg/kg bw/d	N		DLY	U	GV	5	d	NR	NR	GE	F	C	Lab	REP	REP	PROG	WO		95.0	Y	0.043	N	0.00517		43.4	10	8	10	10	10	10	4	10	10	4	86
Growth																																															
84	15160	Hughes and Thompson, 1996	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/0.014/1.4	mg/L	N		ADL	U	DR	28	d	96	d	SM	F	C	Lab	GRO	GRO	BDWT	WO	1.40		Y	0.0799	Y	0.0049	0.0859		10	5	5	10	7	8	4	10	6	4	69
85	14603	Coulson et al, 1935	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	2	2	0/0.21	mg/org/d	N		NR	M	FD	52	w	33-35	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	0.210		Y	0.4700	Y	0.01168	0.447		10	10	10	10	7	8	4	1	10	4	74
86	3701	Kanisawa and Schroeder, 1969	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	519	d	21	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	5.0		Y	0.479	N	0.05104	0.533		10	5	5	10	6	8	4	10	10	4	72
87	7	Schroeder et al, 1968	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	69	d	21-23	d	JV	B	C	Lab	GRO	GRO	BDWT	WO	5.0		Y	0.4790	N	0.0280	0.571		10	5	5	10	6	8	4	10	10	4	72
88	12934	Obermeyer et al, 1971	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/10	mg/kg diet	N		ADL	U	FD	4	w	NR	NR	JV	NR	C	Lab	GRO	GRO	BDWT	WO	10.0		Y	0.202	N	0.01843	0.913		10	10	5	10	6	8	4	10	10	4	77
89	14583	Neiger and Osweiler 1989	Sodium arsenite	57.69	Dog (*Canis familiaris*)	1	4	0.0/0.88/1.80/2.88	mg/kg bw/d	N	na	DLY	U	FD	8	w	8	mo	JV	F	M	Lab	GRO	GRO	BDWT	WO	1.80	2.88	N	10.1	N	0.4597	1.04	1.66	10	10	5	10	10	8	10	10	10	4	87
90	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/16	ug/g diet	N	na	ADL	U	FD	4	w	NR	NR	JV	M	V	Lab	GRO	GRO	BDWT	WO	16.0		Y	0.2652	N	0.02308	1.39		10	10	5	10	6	8	4	1	10	4	68
91	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	2	2	0/20	ug/g diet	N	na	ADL	U	FD	8	w	NR	NR	JV	M	V	Lab	GRO	GRO	BDWT	WO	20.0		Y	0.3624	N	0.02983	1.65		10	10	5	10	6	8	4	1	10	4	68
92	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/1.88	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	1.88		Y	0.2874	Y	0.01296	1.88		10	10	5	10	10	8	4	1	10	4	72
93	2	Byron et al, 1967	Sodium arsenite	100	Dog (*Canis familiaris*)	3	5	0/5/25/50/125	mg/kg diet	N	na	NR	U	FD	2	yr	6	mo	JV	B	C	Lab	GRO	GRO	BDWT	WO	50.0	125	N	10.8	N	0.4858	2.25	5.62	10	10	5	10	5	8	10	10	10	4	82
94	15264	Schmolke et al 1992	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	3	0/15/30	mg/kg diet	N		DLY	U	FD	15	w	7	w	JV	F	M	Lab	GRO	GRO	BDWT	WO	30.0		Y	0.3250	N	0.02727	2.52		10	10	5	10	6	8	4	1	10	4	68
95	15358	Fowler and Woods 1979	Sodium arsenate	100	Mouse (*Mus musculus*)	1	4	0/20/40/85	mg/L	N		DLY	U	DR	6	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	20.0	40.0	Y	0.0267	N	0.003801	2.84	5.69	10	5	5	10	6	8	10	10	10	4	78
96	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/3.22	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	3.22		Y	0.2635	Y	0.01109	3.22		10	10	5	10	10	8	4	1	10	4	72
97	15011	Ghosh et al 1999	Sodium arsenite	57.69	Rat (*Rattus norvegicus*)	1	3	0/0.2/0.4	mg/org/d	N	na	DLY	U	GV	28	d	35	d	JV	F	C	Lab	GRO	GRO	BDWT	WO	0.400		Y	0.061	N	0.006894	3.78		10	8	10	10	6	8	4	3	10	4	73
98	14569	Fowler et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	4	0/20/40/85	mg/L	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	40.0	85.0	Y	0.325	N	0.03600	4.43	9.42	10	5	5	10	6	8	10	10	10	4	78
99	15007	Hunder et al, 1999	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	4	0/10/30/60	mg/kg diet	N		ADL	U	FD	3	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO	60.0		Y	0.193	N	0.01777	5.52		10	10	5	10	6	8	4	1	10	4	68
100	15471	Bencko 1972	Sodium arsenite	100	Mouse (*Mus musculus*)	1	3	0/0.88/6.0	mg/kg bw/d	N	na	NR	U	DR	64	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	6.000		Y	0.03329	Y	0.005790	6.00		10	5	5	10	7	8	4	10	10	4	73
101	15288	Benese and Bencko, 1981	Sodium arsenite	100	Mouse (*Mus musculus*)	1	4	0/4.945/49.45/249.4	mg/L	N		NR	U	DR	32	d	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	49.5	249	Y	0.0325	Y	0.004225	6.43	32.4	10	5	5	10	7	8	8	10	10	4	77
102	15125	Morris et al, 1938	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	3	0/450/4100	ug/org/d	N		ADL	U	FD	340	d	26-27	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	4100		Y	0.549	N	0.01905	7.47		10	10	5	10	7	8	4	1	10	4	69
103	15007	Hunder et al, 1999	Sodium arsenite	100	Mouse (*Mus musculus*)	2	4	0/10/30/60	mg/kg diet	N		ADL	U	FD	3	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO	60.0		Y	0.030	N	0.003847	7.69		10	10	5	10	6	8	4	1	10	4	68
104	4	Brown et al., 1976	sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	4	0/4.7/9.4/10.9	mg/kg bw/d	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	9.40	10.7	Y	0.423	Y	0.01785	9.40	10.7	10	5	5	10	10	8	10	10	6	4	78
105	2	Byron et al, 1967	Sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	2	6	0/31.25/62.5/125/250/400	mg/kg diet	N	na	NR	U	FD	12	w	NR	NR	JV	B	C	Lab	GRO	GRO	BDWT	WO	125	250	Y	0.4652	N	0.03662	9.84	19.7	10	10	5	10	6	8	10	10	10	4	83
106	2	Byron et al, 1967	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	6	0/15.63/31.25/62.5/125/250	mg/kg diet	N	na	NR	U	FD	12	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO	125	250	Y	0.358	N	0.02952	10.3	20.6	10	10	5	10	6	8	10	10	10	4	83
107	20979	Kanisawa and Schroeder, 1967	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		NR	U	DR	338	d	20-22	d	JV	M	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.0536	N	0.007110		0.663	10	5	5	10	6	8	4	10	10	4	72
108	3084	Schroeder and Balassa, 1967	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		ADL	U	DR	339	d	21	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.052	N	0.069189		0.665	10	5	5	10	6	8	4	10	10	4	72
109	15007	Hunder et al, 1999	Sodium arsenite	100	Guinea pig (*Cavia porcellus*)	3	4	0/10/30/60	mg/kg diet	N		ADL	U	FD	3	w	NR	NR	JV	F	C	Lab	GRO	GRO	BDWT	WO		10.0	Y	0.305	N	0.02589		0.844	10	10	5	10	6	8	4	10	10	4	77
110	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	20	d	2	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.050	N	0.005855		5.0	10	8	10	10	10	8	4	10	10	4	84

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic
Page 3 of 4

Ref			Exposure																										Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score										
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
111	14546	Nagaraja and Desiraju 1993	Arsenic	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	NR	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.2152	N	0.01943		5.0	10	10	5	4	10	8	4	10	10	4	75
112	14546	Nagaraja and Desiraju 1993	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/kg bw/d	N	na	DLY	U	GV	18	d	2	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.0313	N	0.003984		5.0	10	8	10	10	10	8	4	10	10	4	84
113	15427	Kiyono et al, 1974	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	4	0/5.0/7.5/10.0	mg/kg bw/d	N		DLY	U	GV	10	d	1	d	JV	M	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.025	N	0.003312		5.0	10	8	10	10	10	8	4	10	10	4	84
114	15216	Nagaraja and Desiraju, 1994	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/5	mg/kg bw/d	N	na	DLY	U	FD	90	d	90	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		5.0	Y	0.250	N	0.02198		5.0	10	10	5	10	6	8	4	10	10	4	77
115	11361	Glattre et. al., 1995	Sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	1	2	0/6.36	mg/kg bw/d	N	na	ADL	U	DR	4	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO		6.36	Y	0.290	N	0.03249		6.36	10	5	5	10	10	8	4	10	10	4	76
116	15709	Morrison and Chavez, 1983	Sodium arsenite	100	Pig (*Sus scrofa*)	1	2	0/100	mg/kg diet	N	na	ADL	U	FD	2	w	21	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		100	Y	5.40	Y	0.5100		9.44	10	10	5	10	7	8	4	10	10	4	78
117	15322	Biswas et al, 1998	Sodium arsenite	57.69	Goat (*Capra hircus*)	1	2	0/25.0	mg/kg bw/d	N	na	ADL	U	DR	9	w	1	yr	JV	F	C	Lab	GRO	GRO	BDWT	WO		25.0	Y	19.6	N	1.441		14.4	10	5	5	10	10	8	4	10	10	4	76
118	25916	Biswas, et al, 2000	Sodium arsenite	57.69	Goat (*Ovis aries*)	1	2	0/25	mg/kg bw/d	N		DLY	U	OR	9	w	12	mo	AD	F	C	Lab	GRO	GRO	BDWT	WO		25.0	Y	21.3	N	0.8490		14.4	10	8	10	10	10	8	4	10	3	4	77
Survival																																																	
119	7	Schroeder et al, 1968	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	1575	d	21-23	d	JV	B	C	Lab	MOR	MOR	SURV	WO	5.0		Y	0.4790	N	0.05104	0.533		10	5	5	10	6	9	4	10	10	4	73
120	15057	Nemec et al, 1998	Arsenic acid	100	Rabbit (*Oryctolagus cuniculus*)	3	4	0/0.19/0.75/3.0	mg/kg bw/d	N	na	DLY	M	GV	12	d	NR	NR	GE	F	C	Lab	MOR	MOR	MORT	WO	0.750	3.0	Y	4.36	N	0.2303	0.750	3.00	10	8	10	10	10	9	8	10	10	4	89
121	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/16	ug/g diet	N	na	ADL	U	FD	4	w	NR	NR	JV	M	V	Lab	MOR	MOR	MORT	WO	16.0		Y	0.2652	N	0.02308	1.39		10	10	5	10	6	9	4	10	10	4	78
122	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	2	2	0/20	ug/g diet	N	na	ADL	U	FD	8	w	NR	NR	JV	M	V	Lab	MOR	MOR	SURV	WO	20.0		Y	0.3624	N	0.02983	1.65		10	10	5	10	6	9	4	1	10	4	69
123	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/1.88	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	MOR	MOR	MORT	WO	1.88		Y	0.2874	Y	0.01296	1.88		10	10	5	10	10	9	4	10	10	4	82
124	2	Byron et al, 1967	Sodium arsenate heptahydrate	100	Dog (*Canis familiaris*)	4	5	0/5/25/50/125	mg/kg diet	N	na	NR	U	FD	13.5	mo	6	mo	JV	B	C	Lab	MOR	MOR	MORT	WO	50.0	125	N	10.8	N	0.4858	2.25	5.62	10	10	5	10	5	9	10	10	10	4	83
125	2	Byron et al, 1967	Sodium arsenite	100	Dog (*Canis familiaris*)	3	5	0/5/25/50/125	mg/kg diet	N	na	NR	U	FD	2	yr	6	mo	JV	B	C	Lab	MOR	MOR	MORT	WO	50.0	125	N	10.8	N	0.4858	2.25	5.62	10	10	5	10	5	9	10	10	10	4	83
126	15057	Nemec et al, 1998	Arsenic acid	100	Rabbit (*Oryctolagus cuniculus*)	2	6	0/0.75/2.25/4.5/6.75/9.0	mg/kg bw/d	N	na	DLY	M	GV	12	d	NR	NR	GE	F	C	Lab	MOR	MOR	MORT	WO	2.25	4.50	N	4.10	N	0.2191	2.25	4.50	10	8	10	10	10	9	10	10	10	4	91
127	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/3.22	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	MOR	MOR	MORT	WO	3.22		Y	0.2635	Y	0.01109	3.22		10	10	5	10	10	9	4	1	10	4	73
128	15427	Kiyono et al, 1974	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	4	0/5.0/7.5/10.0	mg/kg bw/d	N		DLY	U	GV	10	d	1	d	JV	M	C	Lab	MOR	MOR	MORT	WO	5.0	7.5	Y	0.025	N	0.003312	5.00	7.5	10	8	10	10	10	9	10	10	10	4	91
129	1244	Cabe, et al., 1979	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N		ADL	U	DR	18	w	50	d	JV	M	C	Lab	MOR	MOR	MORT	WO	50.0		Y	0.200	N	0.02326	5.81		10	5	5	10	6	9	4	10	10	4	73
130	14569	Fowler et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	4	0/20/40/85	mg/L	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	85.0		Y	0.260	N	0.02945	9.63		10	5	5	10	6	9	4	10	10	4	73
131	2	Byron et al, 1967	Sodium arsenate heptahydrate	100	Rat (*Rattus norvegicus*)	2	6	0/31.25/62.5/125/250/400	mg/kg diet	N	na	NR	U	FD	78	w	NR	NR	JV	B	C	Lab	MOR	MOR	SURV	WO	125	250	Y	0.5206	N	0.04017	9.65	19.3	10	10	5	10	6	9	10	10	10	4	84
132	2	Byron et al, 1967	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	6	0/15.63/31.25/62.5/125/250	mg/kg diet	N	na	NR	U	FD	2	yr	NR	NR	JV	B	C	Lab	MOR	MOR	SURV	WO	125	250	Y	0.4279	N	0.03419	9.99	20.0	10	10	5	10	6	9	10	10	10	4	84
133	15057	Nemec et al, 1998	Arsenic acid	100	Mouse (*Mus musculus*)	1	4	0/7.5/24/48	mg/kg bw/d	N	na	DLY	M	GV	9	d	NR	NR	GE	F	C	Lab	MOR	MOR	MORT	WO	24.0	48.0	Y	0.0527	N	0.006113	24.0	48.0	10	8	10	10	10	9	10	10	10	4	91
134	14590	Tripathi et al 1997	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/2.56	mg/org/d	N		ADL	U	DR	16	w	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO	2.56		Y	0.080	Y	0.01020	32.0		10	5	5	10	7	9	4	10	10	4	74
135	3084	Schroeder and Balassa, 1967	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		ADL	U	DR	519	d	21	d	JV	M	C	Lab	MOR	MOR	SURV	WO		5.0	Y	0.045	N	0.006075		0.675	10	5	5	10	6	9	4	10	10	4	73
136	15322	Biswas et al, 1998	Sodium arsenite	57.69	Goat (*Capra hircus*)	1	2	0/25.0	mg/kg bw/d	N	na	ADL	U	DR	78	d	1	yr	JV	F	C	Lab	MOR	MOR	MORT	WO		25.0	Y	19.6	N	1.441		14.4	10	5	5	10	10	9	4	10	10	4	77
137	25916	Biswas, et al, 2000	Sodium arsenite	57.69	Goat (*Ovis aries*)	1	2	0/25	mg/kg bw/d	N		DLY	U	OR	12	w	12	mo	AD	F	C	Lab	MOR	MOR	MORT	WO		25.0	Y	20.1	N	0.8094		14.4	10	8	10	10	10	9	4	10	3	4	78
138	113	Seidenberg et al 1986	Sodium arsenate	45.71	Mouse (*Mus musculus*)	1	2	0/95	mg/kg bw/d	N		DLY	U	GV	5	d	NR	NR	GE	F	C	Lab	MOR	MOR	MORT	WO		95.0	Y	0.043	N	0.00517		43.4	10	8	10	10	10	9	4	10	10	4	85
Data Not Used to Derive TRV																																																
139	15160	Hughes and Thompson, 1996	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/0.014/1.4	mg/L	N		ADL	U	DR	28	d	96	d	SM	F	C	Lab	BEH	FDB	WCON	WO	1.40		Y	0.0799	Y	0.0049	0.0859		10	5	5	10	7	4	4	10	6	4	65
140	3701	Kanisawa and Schroeder, 1969	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	1175	d	21	d	JV	B	C	Lab	MOR	MOR	TDTH	WO	5.0		Y	0.479	N	0.05104	0.533		10	5	5	10	6	9	4	1	10	4	64
141	757	Mercado and Bibby 1973	Arsenic pentoxide	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	50	d	23	d	JV	M	C	Lab	PHY	PHY	GPHY	XX	5.0		N	0.2670	N	0.03016	0.565		10	5	5	10	5	4	4	1	10	4	58
142	757	Mercado and Bibby 1973	Arsenic pentoxide	100	Rat (*Rattus norvegicus*)	1	2	0/5	mg/L	N		ADL	U	DR	50	d	23	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	5.0		N	0.2670	N	0.03016	0.565		10	5	5	10	5	8	4	1	10	4	62
143	14556	Savabieasfahani et al, 1998	Sodium arsenite	57.69	Cotton rat (*Sigmodon hispidus*)	1	3	0/0.088/0.15	mg/org/d	N		ADL	U	DR	6	w	NR	NR	AD	M	C	Lab	BIO	CHM	HMGL	BL	0.150		Y	0.144	Y	0.01530	0.601		10	5	5	10	7	1	4	10	6	4	62
144	14556	Savabieasfahani et al, 1998	Sodium arsenite	57.69	Cotton rat (*Sigmodon hispidus*)	1	3	0/0.088/0.15	mg/org/d	N		ADL	U	DR	6	w	NR	NR	AD	M	C	Lab	GRO	GRO	BDWT	WO	0.150		Y	0.144	Y	0.01530	0.601		10	5	5	10	7	8	4	1	6	4	60
145	14556	Savabieasfahani et al, 1998	Sodium arsenite	57.69	Cotton rat (*Sigmodon hispidus*)	1	3	0/0.088/0.15	mg/org/d	N		ADL	U	DR	6	w	NR	NR	AD	M	C	Lab	PTH	ORW	ORWT	LI	0.150		Y	0.144	Y	0.01530	0.601		10	5	5	10	7	4	4	8	6	4	63
146	20979	Kanisawa and Schroeder, 1967	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		NR	U	DR	24	mo	20-22	d	JV	B	C	Lab	MOR	MOR	MORT	WO	5.0		Y	0.0536	N	0.007110	0.663		10	5	5	10	6	9	4	1	10	4	64
147	20979	Kanisawa and Schroeder, 1967	Sodium arsenite	100	Mouse (*Mus musculus*)	1	2	0/5	mg/L	N		NR	U	DR	518	d	20-22	d	JV	B	C	Lab	PTH	HIS	GHIS	MT	5.0		Y	0.0536	N	0.007110	0.672		10	5	5	10	6	4	4	1	10	4	59
148	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	2	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	750		N	0.0316	Y	na	0.750		10	5	5	10	6	8	4	1	10	4	63
149	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	BEH	FDB	WCON	WO	827		N	0.0316	Y	na	0.827		10	5	5	10	6	4	4	1	10	4	59
150	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	827		N	0.0316	Y	na	0.827		10	5	5	10	6	8	4	1	10	4	63
151	14598	Blakley et al., 1980	sodium arsenite	57.69	Mouse (*Mus musculus*)	1	4	0/0.5/2.0/10.0	mg/L	N	na	NR	U	DR	3	w	6	w	AD	M	C	Lab	BEH	FDB	WCON	WO	10.0		Y	0.02857	Y	0.00437	0.882		10	5	5	10	7	4	4	1	6	4	56
152	14598	Blakley et al., 1980	sodium arsenite	57.69	Mouse (*Mus musculus*)	1	4	0/0.5/2.0/10.0	mg/L	N		NR	U	DR	3	w	6	w	JV	M	C	Lab	GRO	GRO	BDWT	WO	10.0		Y	0.02857	Y	0.00437	0.882		10	5	5	10	7	8	4	6	6	4	65
153	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/16	ug/g diet	N	na	ADL	U	FD	4	w	NR	NR	JV	M	V	Lab	PTH	ORW	ORWT	KI	16.0		Y	0.2652	N	0.02308	1.39		10	10	5	10	6	4	4	1	10	4	64
154	15262	Palmer et al 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	2	2	0/20	ug/g diet	N	na	ADL	U	FD	8	w	NR	NR	JV	M	V	Lab	PTH	ORW	ORWT	KI	20.0		Y	0.3624	N	0.02983	1.65		10	10	5	10	6	4	4	1	10	4	64
155	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/1.88	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	BIO	CHM	HMGL	BL	1.88		Y	0.2874	Y	0.01296	1.88		10	10	5	10	10	1	4	1	10	4	65
156	14414	Morgareidge, 1963	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	2	2	0/16	mg/kg diet	N		DLY	U	FD	4	w	NR	NR	JV	B	C	Lab	BEH	FDB	FCNS	WO	16.0		Y	0.1810	Y	0.02310	2.04		10	10	5	10	7	4	4	1	3	4	58
157	14414	Morgareidge, 1963	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	2	2	0/16	mg/kg diet	N		DLY	U	FD	4	w	NR	NR	JV	B	C	Lab	GRO	GRO	BDWT	WO	16.0		Y	0.1810	Y	0.02310	2.04		10	10	5	10	7	8	4	1	3	4	62
158	15264	Schmolke et al 1992	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	3	0/15/30	mg/kg diet	N		DLY	U	FD	15	w	7	w	JV	F	M	Lab	BEH	FDB	FCNS	WO	30.0		Y	0.3250	N	0.02727	2.52		10	10	5	10	6	4	4	1	10	4	64
159	14508	Franke and Moxon 1937	Sodium arsenate	100	Rat (*Rattus norvegicus*)	2	2	0/3.22	mg/kg bw/d	N		DLY	U	FD	100	d	28	d	JV	M	C	Lab	BIO	CHM	HMGL	BL	3.22		Y	0.2635	Y	0.01109	3.22		10	10	5	10	10	1	4	1	10	4	65
160	1244	Cabe, et al., 1979	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N		ADL	U	DR	18	w	50	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	50.0		Y	0.200	N	0.02326	5.81		10	5	5	10	6	8	4	1	10	4	63
161	1244	Cabe, et al., 1979	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/50	mg/L	N		ADL	U	DR	18	w	50	d	JV	M	C	Lab	PTH	ITX	INCO	WO	50.0		Y	0.200	N	0.02326	5.81		10	5	5	10	6	4	4	1	10	4	59
162	15125	Morris et al, 1938	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	3	0/450/4100	ug/org/d	N		ADL	U	FD	340	d	26-27	d	JV	M	C	Lab	BEH	FDB	FCNS	WO	4100		Y	0.549	N	0.01905	7.47		10	10	5	10	7	4	4	1	10	4	65
163	15125	Morris et al, 1938	Arsenic trioxide	100	Rat (*Rattus norvegicus*)	1	3	0/450/4100	ug/org/d	N		ADL	U	FD	340	d	26-27	d	JV	M	C	Lab	PTH	ORW	ORWT	KI	4100		Y	0.549	N	0.01905	7.47		10	10	5	10	7	4	4	1	10	4	65
164	14590	Tripathi et al 1997	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/2.56	mg/org/d	N		ADL	U	DR	16	w	NR	NR	JV	M	C	Lab	BEH	FDB	WCON	WO	2.56		Y	0.080	Y	0.01020	32.0		10	5	5	10	7	4	4	3	10	4	62
165	15288	Benese and Bencko, 1981	Sodium arsenite	100	Mouse (*Mus musculus*)	1	4	0/4.945/49.45/249.4	mg/L	N		NR	U	DR	32	d	NR	NR	JV	M	C	Lab	BIO	CHM	LIPD	LI	249		Y	0.0200	Y	0.004225	32.4		10	5	5	10	7	1	4	1	10	4	57
166	15198	Cobo et al 1995	As_2O_3	37.9	Rat (*Rattus norvegicus*)	1	2	0/0.295	mg/g bw	N		ADL	U	DR	8	w	NR	NR	AD	M	C	Lab	BEH	FDB	WCON	WO	0.295		Y	0.338	N	0.03730	112		10	5	5	10	10	4	4	1	3	4	56

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Arsenic
Page 4 of 4

Ref			Exposure																								Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score											
Result #	Ref N.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
167	15160	Hughes and Thompson, 1996	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/0.014/1.4	mg/L	N		ADL	U	DR	28	d	96	d	SM	F	C	Lab	BIO	CHM	TRIG	PL		0.0140	Y	0.0793	Y	0.0049		0.00086	10	5	5	10	7	1	4	10	6	4	62
168	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	1	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	BIO	ENZ	GENZ	TE		8.50	N	0.0316	Y	na		0.00850	10	5	5	10	6	1	4	10	10	4	65
169	14570	Fuentes et al., 1981	Arsenic trioxide	61.01	Rat (*Rattus norvegicus*)	1	3	0/4/12	mg/L	N		ADL	U	DR	3	mo	45	d	JV	F	C	Lab	BIO	ENZ	CCOX	LI		4.0	N	0.204	N	0.02368		0.283	10	5	5	10	5	1	4	10	10	4	64
170	14556	Savabieasfahani et al, 1998	Sodium arsenite	57.69	Cotton rat (*Sigmodon hispidus*)	1	3	0/0.088/0.15	mg/org/d	N	na	ADL	U	DR	4	w	NR	NR	AD	M	C	Lab	BEH	FDB	FCNS	WO		0.0880	Y	0.144	Y	0.01530		0.353	10	5	5	10	7	4	4	10	6	4	65
171	14569	Fowler et al., 1977	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	4	0/20/40/85	mg/L	N	na	ADL	U	DR	6	w	NR	NR	JV	M	C	Lab	BIO	ENZ	MAOA	LI		20.0	Y	0.340	N	0.03749		2.22	10	5	5	10	6	1	4	10	10	4	65
172	15397	Schiller et al, 1977	Sodium arsonate	100	Rat (*Rattus norvegicus*)	1	4	0/20/40/85	mg/L	N		NR	U	DR	3	w	NR	NR	AD	M	C	Lab	BIO	ENZ	GENZ	LI		20.0	Y	0.2650	N	0.02996		2.26	10	5	5	10	6	1	4	10	6	4	61
173	15358	Fowler and Woods 1979	Sodium arsenate	100	Mouse (*Mus musculus*)	1	4	0/20/40/85	mg/L	N		DLY	U	DR	6	w	NR	NR	JV	M	C	Lab	BIO	ENZ	MAOA	LI		20.0	Y	0.0267	N	0.003801		2.84	10	5	5	10	6	1	4	10	10	4	65
174	15324	Schiller et al 1981	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/40	mg/L	N		ADL	U	DR	3	w	NR	NR	AD	M	C	Lab	BIO	ENZ	ALPH	UR		40.0	N	0.510	N	0.05401		4.24	10	5	5	10	5	1	4	10	3	4	57
175	15033	Chaudhuri et al, 1999	Sodium arsenate	100	Rat (*Rattus norvegicus*)	1	2	0/0.05/0.10/0.30/3.0	g/L	Y		DLY	U	DR	40	d	4	w	JV	M	C	Lab	BIO	ENZ	GLRE	BR		0.0500	Y	0.1100	N	0.01358		6.50	10	5	5	10	6	1	4	10	10	4	65
176	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	2	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	BIO	ENZ	GENZ	TE		6.5	N	0.0316	Y	na		6.5	10	5	5	10	6	1	4	10	10	4	65
177	14543	Healy et al., 1998	Sodium arsenate heptahydrate	100	Mouse (*Mus musculus*)	2	3	0/8.5/827	ug/kg bw/d	N	na	ADL	U	DR	32	d	76	d	JV	M	C	Lab	BEH	FDB	WCON	WO		6.5	N	0.0316	Y	na		6.5	10	5	5	10	6	4	4	1	10	4	59
178	14593	Valdonen et al., 1983	Sodium arsenite	100	Rat (*Rattus norvegicus*)	1	2	0/0.1	g/L	N		ADL	U	DR	11	d	3	mo	JV	M	C	Lab	BIO	ENZ	ACHE	NE		0.100	Y	0.313	N	0.03480		11.1	10	5	5	10	6	1	4	10	10	4	65
179	15198	Cobo et al 1995	As_2O_3	37.9	Rat (*Rattus norvegicus*)	1	2	0/0.295	mg/g bw	N		ADL	U	DR	8	w	NR	NR	AD	M	C	Lab	BIO	CHM	GLUC	BL		0.295	Y	0.338	N	0.03730		112	10	5	5	10	10	1	4	10	3	4	62

vailable from Attachment 4-3 of the Eco-SSL *guidance* (U.S. EPA 2003).

Ecological Soil Screening Levels for Beryllium

Interim Final

OSWER Directive 9285.7- 64

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

February 2005

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR BERYLLIUM 1

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 3

4.0 ECO-SSL FOR SOIL INVERTEBRATES 3

5.0 ECO-SSL FOR AVIAN WILDLIFE 3

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 6
- 6.1 Mammalian TRV 6
- 6.2 Estimation of Dose and Calculation of the Eco-SSL 6

7.0 REFERENCES 10
- 7.1 General Beryllium References 10
- 7.2 References for Plants and Soil Invertebrates 10
- 7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs . 11
- 7.4 References Used to Derive the Wildlife TRV 13
- 7.5 References Rejected for Use in Derivation of Wildlife TRV 13

LIST OF TABLES

Table 2.1 Beryllium Eco-SSLs (mg/kg dry weight in soil) 2

Table 3.1 Plant Toxicity Data - Beryllium 4

Table 4.1 Soil Invertebrate Toxicity Data - Beryllium 5

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Beryllium 7

Table 6.2 Calculation of the Mammalian Eco-SSL for Beryllium 9

LIST OF FIGURES

Figure 2.1 Typical Background Concentrations of Beryllium in U.S. Soils 3

Figure 6.1 Mammalian TRV Derivation for Beryllium 8

LIST OF APPENDICES

Appendix 6-1 Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Beryllium

1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs are derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify the intended use of these Eco-SSLs as national cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (US EPA, 2003). The derivation procedures represent the collaborative effort of a multi-stakeholder group consisting of federal, state, consulting, industry, and academic participants led by the U.S. EPA, Office of Solid Waste and Emergency Response.

This document provides the Eco-SSL values for beryllium and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying beryllium concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR BERYLLIUM

Beryllium occurs naturally in the earth's crust, in coal, and in minerals, such as beryl, bertrandite, bromellite, chrysoberyl, and beryllonite. Plagiocase feldspar contains most of the world's beryllium. The greatest known concentrations of beryllium are found in certain pegmatite bodies, where crystals of beryl account for a few percent of the total pegmatite volume, and may be found in several of the strata of zoned dykes. The element is sometimes concentrated in hydrothermal veins, and some granitic rocks contain sufficient amounts to permit the crystallization of small

amounts of beryl (http://toxnet.nlm.nih.gov). Beryllium's production and use in alloys, microelectronics, aerospace technology, aircraft brakes, X-ray windows, neutron reflectors, and as a solid-propellant in rocket fuels may result in its release to the environment through various waste streams. Beryllium enters the environment principally from coal combustion. (http://toxnet.nlm.nih.gov).

Data concerning the fate of beryllium in the environment are limited. Since the major source of atmospheric beryllium is coal combustion, the most prevalent chemical form is probably beryllium oxide, mainly bound to particles smaller than 1 µm. The residence time of these particles in the atmosphere is about 10 days (US EPA, 1987). Beryllium returns to earth by wet and dry deposition in a similar manner to other metals and on particles of comparable size distribution (Kwapulinski & Pastuszka, 1983 as cited in IPCS, 1990).

Reactions of beryllium in solution and soil depend on the pH. At environmental pH ranges of 4 to 8, beryllium oxide is highly insoluble, thus preventing mobilization in soil. Beryllium is strongly adsorbed by finely dispersed sedimentary materials including clays, iron hydroxides, and organic substances (Izmerov, 1985). Thus, very little is released into ground water during weathering. If beryllium oxide is converted to the ionized salts (chloride, sulfate, nitrate) during atmospheric transport, solubility upon deposition and, hence, mobility in soils would be greatly enhanced, but this has not been reported in the literature as cited in IPCS, 1990.

If beryllium is bioavailable in the soil matrices, it can be assimilated by plants. Beryllium is classified as a fast-exchange metal, and can potentially interfere with the transport of nutritive metals, such as calcium, into eukaryotic cells (Wood & Wang,1983). Although there is a lack of data on beryllium levels in environmental organisms representing high trophic levels and on the fate of beryllium in ecosystems, it is not believed to biomagnify within food chains. Some plant species, however, including hickory trees (*Carya* spp.), act as accumulators of beryllium (Griffitts, 1977; Nikonova,1967, Sainsbury et al., 1968), and plant ash may contain greater amounts of beryllium in comparison to soil as cited in IPCS, 1990.

Eco-SSL values for beryllium were derived for soil invertebrates and mammalian wildlife (Table 2.1). Eco-SSL values for beryllium could not be derived for plants or avian wildlife. For these receptor groups, data were insufficient to derive soil screening values. The Eco-SSLs for beryllium are 21 mg/kg dry weight (dw) for mammalian wildlife and 40 mg/kg dw for soil invertebrates. The Eco-SSLs are higher than the reported range of background soil concentrations in eastern and western U.S. soils (Figure 2.1). The reported background concentrations of many metals in U.S. soils are described in Attachment 1-4 of the Eco-SSL guidance (U.S. EPA, 2003).

Table 2.1 Beryllium Eco-SSLs (mg/kg dry weight in soil)

Plants	Soil Invertebrates	Avian Wildlife	Mammalian Wildlife
NA	40	NA	21

NA = Not Available. Data were insufficient to derive an Eco-SSL.

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

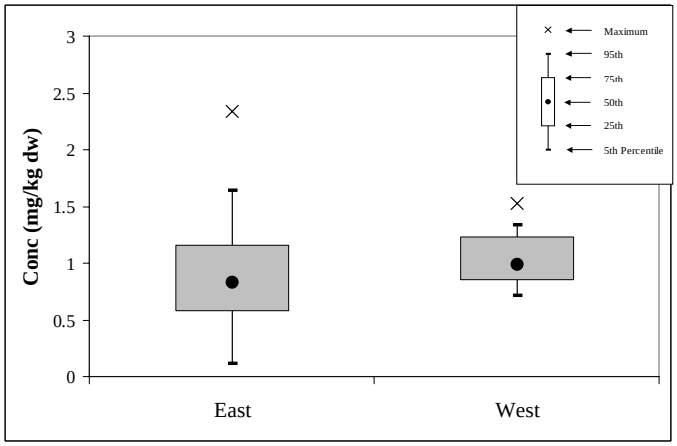


Figure 2.1 Typical Background Concentrations of Beryllium in U.S. Soils

Of the papers identified from the literature search process, 32 were selected for acquisition for further review. Of those papers acquired, three met all 11 Study Acceptance Criteria. Each of these papers was reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Five studies received an Evaluation Score greater than ten. These studies are listed in Table 3.1. There was only one study result with an acceptable endpoint; the other four results are unbounded lowest observed adverse effect concentrations (LOAECs) which cannot be used to derive an Eco-SSL. Therefore, an Eco-SSL could not be derived for beryllium for plants according to the Eco-SSL guidance (US EPA, 2003; Attachment 3-2).

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, six were selected for acquisition for further review. Of those papers acquired, three met all 11 Study Acceptance Criteria. Each of these papers was reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Three studies received an Evaluation Score greater than ten. These studies are listed in Table 4.1.

The studies in Table 4.1 are sorted by bioavailability score and all three studies are used to derive the soil invertebrate Eco-SSL according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the EC_{20} values reported for each of three test species and is equal to 40 mg/kg dw.

5.0 ECO-SSL FOR AVIAN WILDLIFE

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 167 studies with possible toxicity data for beryllium for mammalian species. There were no studies identified for the toxicity of beryllium to avian species; therefore an Eco-SSL could not be derived for beryllium.

Table 3.1 Plant Toxicity Data - Beryllium

Reference	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value Soil Conc. (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Kaplan, D.I., 1990	a	Kale	*Brassica oleracea v.acephalia L.*	6.5	1.9	2	GRO	MATC	56.8	16	Y	N
Sajwan, K.S., 1996	a	Soybean	*Glycine max*	4.9	1.9	2	GRO	LOAEC	25	12	N	N
Sajwan, K.S., 1996	b	Soybean	*Glycine max*	6.5	1.9	2	GRO	LOAEC	25	12	N	N
Sajwan, K.S., 1996	c	Soybean	*Glycine max*	5.5	3.2	2	GRO	LOAEC	25	12	N	N
Sajwan, K.S., 1996	d	Soybean	*Glycine max*	6.0	3.2	1	GRO	LOAEC	25	12	N	N

ERE = Ecologically relevant endpoint
GRO = growth
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration. Geometric mean of NOAEC and LOAEC.
N = No
NOAEC = No observed adverse effect concentration
OM = Organic matter content
Y = yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

Table 4.1 Invertebrate Toxicity Data - Beryllium

Reference	IP Number	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value Soil Conc. (mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Kuperman et al., 2002	62344	Pot worm	*Enchytraeus crypticus*	4.29 - 5.29	1.2	2	REP	EC_{20}	45	17	Y	Y
Phillips et al., 2002	62345	Springtail	*Folsomia candida*	4.29 - 5.29	1.2	2	REP	EC_{20}	28	18	Y	Y
Simini et al., 2002	62343	Earthworm	*Eisenia fetida*	3.83 - 5.29	1.2	2	REP	EC_{20}	52	16	Y	Y
								Geometric Mean	40			

EC_{20} = Effect concentration for 20% of test population
ERE = Ecologically relevant endpoint
OM = Organic matter content
REP = Reproduction
Y = yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

6.1 Mammalian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 167 studies with possible toxicity data for mammalian species. Of these studies, 163 were rejected for use as described in Section 7.5. The remaining papers four papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3). The results of the data extraction and review are summarized in Table 6.1. The complete results are included as Appendix 6-1.

There are six results for biochemical (BIO), pathology (PTH), growth (GRO), and survival (MOR) endpoints with a total Data Evaluation Score of > 65 that are used to derive the TRV (U.S. EPA, 2003; Attachment 4-4). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The no-observed adverse effect level (NOAEL) results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

A geometric mean of the NOAEL values for growth and reproduction could not be calculated as only one NOAEL is available for growth or reproductive effects. There are no bounded LOAELs for comparison. Therefore, the TRV is equal to the lowest NOAEL for effects on growth, reproduction, or survival which is equal to 0.532 mg beryllium/kg bw/day.

6.2 Estimation of Dose and Calculation of the Eco-SSL

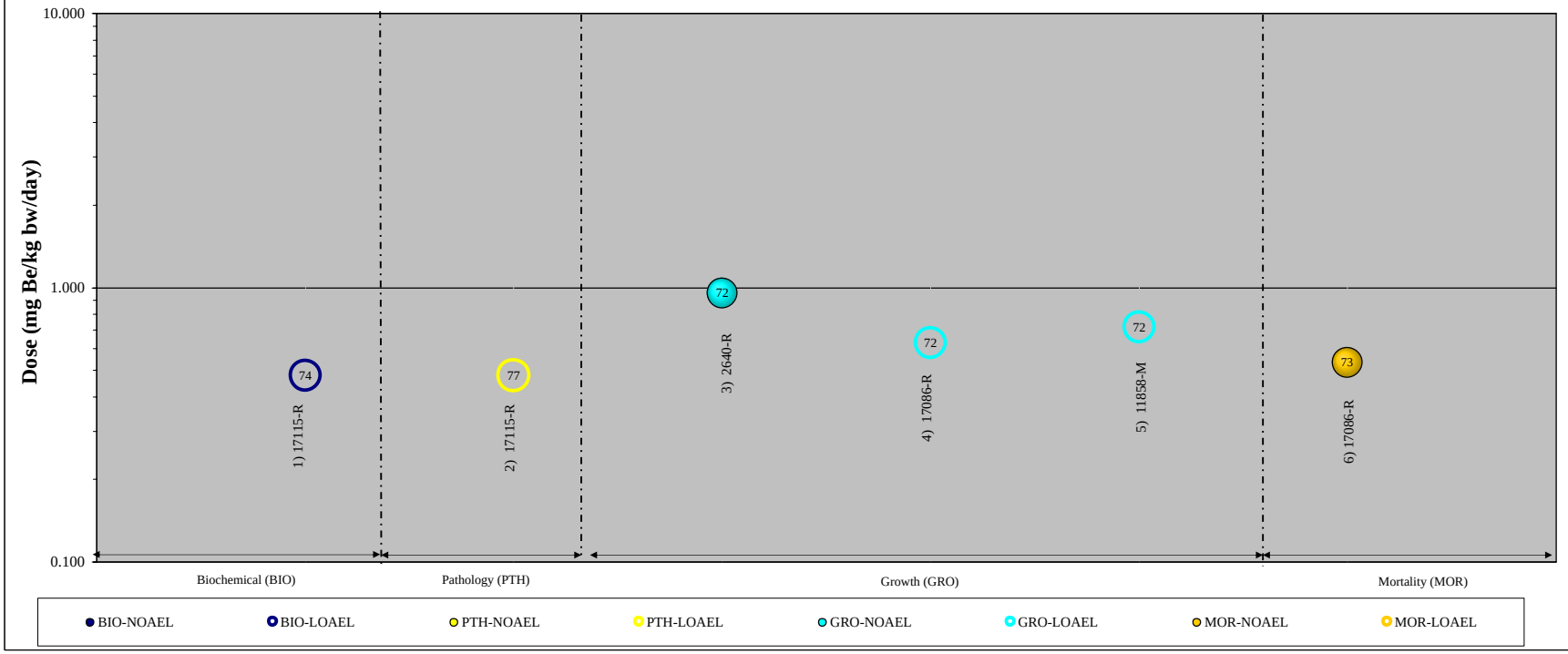
Three separate Eco-SSL values were calculated for mammalian wildlife, one for each of three surrogate receptor species representing different trophic groups. The mammalian Eco-SSLs derived for beryllium were calculated according to Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5) and are summarized in Table 6.2.

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Beryllium

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Biochemical Effects																		
1	Goel et al, 1980	17115	Rat *(Rattus norvegicus)*	2	U	OR	75	d	NR	NR	JV	M	ENZ	ALPH	LU		0.478	74
Pathology Effects																		
2	Goel et al, 1980	17115	Rat *(Rattus norvegicus)*	2	U	OR	75	d	NR	NR	JV	M	HIS	GHIS	LU		0.478	77
Growth Effects																		
3	Freundt and Ibrahim, 1990	2640	Rat *(Rattus norvegicus)*	2	U	DR	91	d	NR	NR	SM	F	GRO	BDWT	WO	0.953		72
4	Schroeder and Mitchener, 1975	17086	Rat *(Rattus norvegicus)*	2	U	DR	39	d	21	d	JV	M	GRO	BDWT	WO		0.630	72
5	Schroeder and Mitchener, 1975	1858	Mouse (*Mus musculus*)	2	U	DR	70	d	19-20	d	JV	F	GRO	BDWT	WO		0.718	72
Effects on Survival																		
6	Schroeder and Mitchener, 1975	17086	Rat *(Rattus norvegicus)*	2	U	DR	1464	d	21	d	JV	B	MOR	LFSP	WO	0.532		73

ALPH = alkaline phosphatase; B = both; BDWT = body weight changes; bw = body weight; d = days; DR = drinking water; ENZ = enzyme; F = female; GHIS = general histological changes; GRO = Growth; HIS = histology; JV = juvenile; kg = kilogram; LFSP = lifespan; LOAEL = lowest observed adverse effect level; LU = lung; M = male; mg = milligram; mo = months; MOR = effects on survival; NOAEL = no observed adverse effect level; NR = not reported; OR =other oral (e.g. capsule); Score = Total Data Evaluation Score as described in US EPA (2003; Attachment 4-3); SM = sexually mature; U = unmeasured; WO = whole organism.

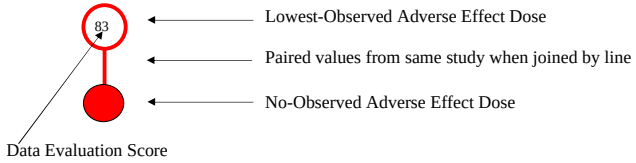
Figure 6.1 Mammalian TRV Derivation for Beryllium



Result number → 1) 10 - C ← Test Species
Reference Number

Test Species Key

M = Mouse
R = Rat



Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

2) There are not three NOAEL results available for calculation of a geometric mean.

4) There is one NOAEL value for reproduction or growth effects

5) There are no bounded LOAELs for comparison. The TRV is equal to the lowest NOAEL for effects on growth, reproduction, or survival.

6) The mammalian wildlife TRV for beryllium is equal to 0.532 mg beryllium/kg bw/day which is the lowest NOAEL for effects on growth, reproduction, and survival.

Table 6.2 Calculation of the Mammalian Eco-SSL for Beryllium						
Surrogate Receptor Group	**TRV for Beryllium (mg dw/kg bw/d) [1]**	**Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)[2]**	**Concentration of Beryllium in Biota Type (i)[2,3] (B_i) (mg/kg dw)**	**Beryllium in Diet of Prey [4] (C_{diet})**	**Eco-SSL (mg/kg dw)[5]**
Mammalian herbivore (vole)	0.532	0.0875	0.032	$\ln(B_i) = 0.7345 * \ln(Soil_j) - 0.5361$ where i = plants	NA	21
Mammalian ground insectivore (shrew)	0.532	0.209	0.030	$B_i = 0.045 * Soil_j$ where i = earthworms	NA	34
Mammalian carnivore (weasel)	0.532	0.130	0.043	$B_i = C_{diet} * 0.05$ where i = mammals	$C_{diet} = 0.045 * Soil_j$	90

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] C_{diet} = Concentration in the diet of small mammals consumed by predatory species (weasel).
[5] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV) solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

This Page Intentionally Left Blank

7.0 REFERENCES

7.1 General Beryllium References

Griffitts, W.R., Allaway, W.H., & Groth, D.H. (1977) Beryllium. In*: Geochemistry and the Environment*. Vol. II. The relation of other selected trace elements to health and disease. Washington, DC, National Academy of Sciences, US National Committee for Geochemistry, pp. 7-10.

International Programme on Chemical Safety (IPCS). 1990. *Environmental Health Criteria 106 Beryllium.* Published jointly by the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. http://www.inchem.org/documents/ehc/ehc/ehc106.htm

Izmerov, N.F. (ed.) (1985) Beryllium. Series "Scientific Reviews of Soviet Literature on Toxicity and Hazards of Chemicals", International Register of Potentially Toxic Chemicals and Centre of International Projects, Moscow, GKNT, 49 pp.

Kwapulinski, J. and Pastuszka, J. 1983. Application of the mass balance equation in the estimation of beryllium and radium concentrations in the lower atmosphere. *Sci. Total Environ*. 26: 203-207.

http://toxnet.nlm.nih.gov. National Library of Medicine. Hazardous Substances Database (HSDB).

Nikonova, N.N. (1967) [On the accumulation of beryllium, molybdenum, zirconium, yttrium, and other rare elements in plants of South Ural.] Izv. Sib. Akad. Nauk. SSSR Ser. Biol. Med., 3: 25-29 (in Russian).

Sainsbury, C.l., Hamilton, J.C., & Huffmann, C. (1968) *Geochemical Cycle of Selected Trace Elements in the Tin-tungsten-beryllium District, Western Seward Peninsula, Alaska - a Reconnaissance Study.* Washington, DC, US Government Printing Office, 71 pp (US Geological Survey Bulletin 1242-F).

United States Environmental Protection Agency (US EPA). 2003. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs).* November. Office of Solid Waste and Emergency Response. OSWER Directive 92857-55.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment.* Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

US EPA (1987) Health assessment document for beryllium. Research Triangle Park, North Carolina, US Environmental Protection Agency, Office of Research and Development (EPA Report No. 600/8-84-026F).

Wood, J. M. and H.K. Wang. 1983. Microbial resistance to heavy metals. *Environ. Sci. Technol*., 17: 582A-590A.

7.2 References for Plants and Soil Invertebrates

Kaplan, D. I., Sajwan, K. S., Adriano, D. C., and Gettier, S. 1990. Phytoavailability and Toxicity of Beryllium and Vanadium. *Water Air Soil Pollut.* 53[3/4], 203-212

Kuperman, R.G., Checkai, R.T., Phillips, C.T., Simini, M., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Enchytraeid Reproduction Benchmark Values*. Technical Report No. ECBC-TR-324. U.S. Army Edgewood

Phillips, C.T., Checkai, R.T., Kuperman, R.G., Simini, M., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Folsomia Reproduction Benchmark Values.* Technical Report No. ECBC-TR-326. U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

Sajwan, K. S., Ornes, W. H., and Youngblood, T. V. 1996. Beryllium Phytotoxicity in Soybeans. *Water Air Soil Pollut*. 86[1-4], 117-124

Simini, M., Checkai, R.T., Kuperman, R.G., Phillips, C.T., Speicher, J.A., Barclift, D.J. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Earthworm (Eisenia fetida) Benchmark Values.* Technical Report No. ECBC-TR-325. U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD.

7.3 References Rejected for Use in Deriving Plant and Soil Invertebrate Eco-SSLs

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Not Avail Bingham, J. D. and Steucek, G. L. 1972. Phloem Mobility of Beryllium in the Bean, *Phaseolus vulgaris* 5512. *Proc Acad Sci* 46, 16

OM Bohn, H. 1979. Beryllium Effects on Potatoes and Oats in Acid Soil. *Water Air Soil Pollut* 11[3], 319-322

OM Bohn, H. L. and Seekamp, G. 1979. Beryllium effects on potatoes solanum-tuberosum and oats avena-sativa in acid soil. *Water Air Soil Pollut* 11[3], 319-322

Media Carlson, C. L., Adriano, D. C., Sajwan, K. S., Abels, S. L., and Thoma, D. P. 1991. Effects of Selected Trace Metals on Germinating Seeds of Six Plant Species. *Water Air Soil Pollut* 59[3/4], 231-240

Species Curtis, G. H. 1951. Cutaneous Hypersensitivitiy due to Beryllium. *Arch.Dermatol.Syphilol.* 64, 470-482

Mix Davis, R. D., Beckett, P. H. T., and Wollan, E. 1978. Critical Levels of Twenty Potentially Toxic Elements in Young Spring Barley. *Plant Soil* 49, 395-408

Media Degreave, N. 1971. Modification des Effects du Methane Sulfonated d'Ethyl au Niveau Chromosomique. I. Les Ions Metalligues. *Rev Cytol Biol Veg* 34, 233-244

No Dur Ebinger, M. H. and Hansen, W. R. 1994. Environmental Radiation Monitoring Plan For Depleted Uranium And Beryllium Areas, Yuma Proving Ground. Govt-Reports-Announcements-&-Index-(GRA&I),-Issue-23,-1994 [23]

No Dur Florence TM, Farrar YJ, Dale LS, Batley GE. Beryllium Content of NBS Standard Reference Orchard Leaves. *Anal Chem* 1974; 46: 1874-1876.

FL Gerola, F. M. and Gilardi, E. 1955. Action of Beryllium on Absorption of Phosphorus and Increaes of Apical Roots (Fisiologia Vegetale - L'Azione del Beriollio Sull'Assorbimento del Fosforo e Sull'Aumento in peso di Apici radicali). Atti Adad.Naz.Lincei Rend Classe Sci.Fis.Mat.Nat. 18, 533-538 (ITA)

Media Gormley, C. J. and London, S. A. 1973. Effect of Beryllium on Soil Microorganisms. In: *Proc.Annu.Conf.Environ.Toxicol.,* Pap.No.29, AMRL-TR-73-125 , 401-416

Media Hara, T., Furuta, T., Sonoda, Y., and Iwai, I. 1977. Growth Response of Cabbage Plants to Beryllium and Strontium Under Water Culture Conditions. *Soil Sci.Plant Nutr*. 23[3], 373-380

Media Hoagland, M. B. 1952. Beryllium and Growth: II. The Effect of Beryllium on Plant Growth. *Arch.Biochem.Biophys*. 35, 249-258

Media Hoagland, M. B. 1952. Beryllium and Growth: III. The Effect of Beryllium on Plant Phosphatase. Arch.Biochem.Biophys. 35, 259-267

Media Holst, R. W., Schmid, W. E., and Yopp, J. H. 1975. Beryllium Absorption by Excised Barley Roots. *Plant Physiol*. 56[Suppl.], 43

Media Holst, R. W., Schmid, W. E., and Yopp, J. H. 1980. Beryllium Uptake by Excised Barley Roots. *Plant Cell Physiol*. 21[5], 737-743

FL Horovitz, C. T. and Petrescu, O. 1964. The Roles of Beryllium and of Magnesium in Plant Metabolism (Die Rolle des Berylliums und des Magnesiums fur den Stoffwechsel der Pflanzen). *Trans 8th Int.Cong.Soil Sci* 4, 1205-1213

Species Ireland, M. P. 1986. Studies on the Effects of Dietary Beryllium at Two Different Calcium Concentrations in Achatina fulica (Pulmonata). *Comp Biochem Physiol Part C* 83[2], 435-438

Media Kosak-Channing, L. 1986. Beryllium Distribution in Hydroponically-Grown Tobacco Plants. *Plant Sci*. 46[3], 175-180

Media Lamersdorf, N. P., Godbold, D. L., and Knoche, D. 1991. Risk Assessment of Some Heavy Metals for the Growth of Norway Spruce44006. *Water Air Soil Pollut* 57/58, 535-543

FL Langhans, D. 1984. The Influence of Beryllium on the Germination of Garden Cress (Lepidium sativum L.) (Der Einflub von Beryllium auf die Keimung der Gartenkresse (*Lepidium sativum L.)*). *Angew.Bot.* 58[3/4], 295-300

FL Nikonova, N. N. 1971. Plants as Indicators of Beryllium (Biosfere Primen). V.R.Fillipov (Ed.), Ikh.Sel.Khoz.Med.Sib., Dalinego Vostoka; Chem.Abstr.79 (ABS No.135810) (1973) , 163-166

FL Oustrin, M. L., Magna, H., Payet, S., and Oustrin, J. 1967. Study of the Toxicity and Localization of Beryllium in a Culture of Zea mays (Etude de la Toxicite et de la Localisation du Beryllium dans la Culture de Zea mays). *Bull.Soc.Hist.Nat.Toulouse* 103, 344-351 (FRE)

Media Romney, E. M., Childress, J. D., and Alexander, G. V. 1962. Beryllium and the Growth of Bush Beans. *Science* 185, 786-787

Score Romney, E. M. and Childress, J. D. 1965. Effects of Beryllium in Plants and Soil. *Soil Sci.* 100[3], 210-217

Media Romney, E. M., Wallace, A., Alexander, G. V., and Lunt, O. R. 1980. Effect of beryllium on mineral element composition of bush beans (and toxicity). *Journal Of Plant Nutrition*. 2[1/2], 103-106

Media Silverman, L. 1959. Control of Neighborhood Contamination near Beryllium-Using Plants. *Arch.Ind.Health* 19, 254-262

Media Tso, T. C., Sorokin, T. P., and Engelhaupt, M. E. 1973. Effects of Some Rare Elements on Nicotine Content of the Tobacco. *Plant. Plant Physiol* 51, 805-806

Media Wallace, A. and Romney, E. M. 1966. Effect of Beryllium on In Vitro Carboxylation Reactions. *Curr.Topics Plant Nutr*. 185-188

No Dur Williams, R. J. B. 1965. Effect of Beryllium in Kale19978. Reprint from Rothamsted Exp.Station (1964) , 66-67

No Om Williams, R. J. B. and Le Riche, H. H. 1968. The Effects of Traces of Beryllium on the Growth of Kale, Grass, and Mustard. *Plant Soil (Netherlands*) 29[2], 317-326

No Om Williams, R. J. B. and LeRiche, H. H. 1968. The Effect of Traces of Beryllium on the Growth of Kale, Grass, and Mustard. *Plant Soil* 29, 317-326

7.4 References Used to Derive the Wildlife TRV

Freundt, K. J. and Ibrahim, H. A. 1990. Growth of rats during a subchronic intake of the heavy metals Pb, Cd, Zn, Mn, Cu, Hg, and Be. *Pol. J. Occup. Med.* 3(2): 227-232. Ref ID: 2640

Goel, K. A., Agrawal, V. P., and Garg, V. 1980. Pulmonary toxicity of beryllium in albino rat. *Bulletin of Environmental Contamination and Toxicology*. 24(1): 59-64. Ref ID: 17115

Schroeder, H. A. and Mitchener, M. 1975. Life-term effects of mercury, methyl mercury, and nine other tracemetals on mice. *Journal of Nutrition* 105(4): 452-458. Ref ID: 1858

Schroeder, Henry A. and Mitchener, Marian. Life-term studies in rats. Effects of aluminum, barium, beryllium, and tungsten *J. Nutr*. 105(4): 421-7. Ref ID: 17086

7.5 References Rejected for Use in Derivation of Wildlife TRV

These references were reviewed and rejected for use in derivation of the Eco-SSL. The definition of the codes describing the basis for rejection is provided at the end of the reference sections.

Diss Some changes produced in growth reproduction, blood and urine of rats by salts of zinc with certain observations on the effects of cadmium and beryllium salts

Diss A study of the chemistry and mutagenicity of welding fume 910380 .

FL 1978. Toxicity of beryllium salts Lan-chou Ta Hsueh Hsueh Pao Tzu Jan K'o Hsueh Pao (3):116-21 .

FL Abd El-Fadil Ibrahim Hassan, H. 1988. Influence of the heavy metals lead, cadmium, zinc, manganese, copper, mercury and beryllium on the glutathione S-transferases in the rat liver. <Original> Einfluss der Schwermetalle Pb, Cd, Zn, Mn, Cu, Hg und Be Blei, Cadmium, Zink, Mangan, Kupfer, Quecksilber und Beryllium auf die Glutathion-S-Transferasen der Rattenleber

No Oral Amano, Ryohei, Oishi, Shigeo, Enomoto, Shuichi, and Ambe, Fumitoshi. 1996. Comparative uptake behavior of trace elements in normal, Al-overloaded and Cd-overloaded Mice *Riken Rev*. 13, 29-30.

FL Anon. 1988. Monthly results of measurements, october 1986.Govt Reports Announcements & Index (GRA&I)

CP Arkhipova, O. G., Demokidova, N. K., Medved, T. Ya., and Rudomino, M. V. 1972. Biological action of organophosphorus complexons Khim. Primen. Fosfororg. Soedin. Tr. Vses. Konf., 3rd :Meeting Date 1965, 497-502. Editor(s): Kabachnik, M. I. Publisher: "Nauka", Moscow, USSR.

FL Arkhipova, O. G., Dvizhkov, P. P., Kochetkova, T. A., and Ivanova, A. S. 1968. Protective action of organophosphorus complexes during intoxication with soluble beryllium compounds. *Gig. Sanit.* 33(5):26-31 .

CP Baarli, J., Bianchi, M., Sullivan, A. H., and Di Paola M. Biological effects of hadrons at very low doses LEWIS, MIRIAM (ED.). Biological and Environmental Effects of Low-level Radiation, Vols. 1 and 2. Proceedings of a Symposium on Biological Effects of Low-level Radiation Pertinent to Protection of Man and His Environment. Chicago, Ill., Usa, Nov. 3-7, 1975. Vii+372p(vol. 1.); Viii+451p(vol. 2.) Illus. International Atomic Energy Agency: Vienna, ISBN 92-0-010076-7(VOL. 1.); ISBN 92-0-010176-3(VOL. 2.). 1976 195-204

No Oral Barna, B. P., Deodhar, S. D., Gautam, S., Edinger, M., Chiang, T., and Mcmahon, J. T. 1984. Experimental beryllium-induced lung-disease .2. Analyses of bronchial lavage cells in strains-2 and strains-13 guinea-pigs. *International Archives Of Allergy And Applied Immunology* 73(1):49-55.

Abstract Barna, B. P., Edinger, M., Chiang, T., Gautam, S., and Deodhar, S. D. 1981. Strain dependent variability in development of experimental beryllium lung-disease in guinea-pigs. *Federation Proceedings* 40:992.

Meth Basketter, D. A., Lea, L. J., Cooper, K., Stocks, J., Dickens, A., Pate, I., Dearman, R. J., and Kimber, I. 2000. Threshold for classification as a skin sensitizer in the local lymph node assay: a statistical evaluation. *Food Chem. Toxicol*. 37(12): 1167-1174 .

No Oral Bencko, V., Brezina, M., Benes, B., and Cikrt, M. 1979. Penetration of beryllium through the placenta and its distribution in the mouse J. Hyg. Epidemiol., Microbiol., Immunol. 24(4):361-7.

FL Berencsi, G. and Nagymajtenyi, L. 1977. [Pulmonary injury of mice produced by chronically peroral treatment with different substances (author's transl)] Zentralblatt fur Bakteriologie, Parasitenkunde, Infektionskrankheiten

FL Berencsi, G. and Nagymajtenyi, L. 1977. Ueber Lungenschaedigung Bei Der Maus Durch Per OS Chronischaufgenommene Substanzen. [Pulmonary injury of mice produced by chronically peroral treatment with different substances (author's transl)] *Zentralbl Bakteriol* [Orig B] 164(3):282-7.

Phys Bohm, L., Blekkenhorst, G., Slabbert, J. P., Verheye, F., Jones, D. T., and Yudelev, M. 1992. RBE and OER measurements on the p(66) + Be neutron beam at Faure, South Africa. *Strahlentherapie und Onkologie* 168(1):42-7.

BioAcc Bortolotti, G. R. and Barlow, J. C. 1988. Some sources of variation in the elemental composition of bald eagle Feathers. *Can J Zool* 66(9):1948-1951.

Chem Meth Brokeshoulder, S. F., Robinson, F. R., Thomas, A. A., and Cholak, J. 1966. Limits of Detection of Beryllium in Tissues By Microemission Spectrography :6p.

Gene Brooks, A. L., Griffith, W. C., Johnson, N. F., Finch, G. L., and Cuddihy, R. G. 1989. The induction of chromosome damage in cho cells by beryllium and radiation given alone and in Combination. *Radiat Res* 120(3):494-507.

Unrel Brooks, Antone L., Griffith, William C. , Johnson, Neil F., Finch, Gregory L., and Cuddihy, Richard G. 1989. The induction of chromosome damage in CHO cells by beryllium and radiation given alone and in combination. *Radiat. Res*. 120(3):494-507 .

HHE Budach, V., Olthoff-Muenter, K., Frank, H. U., and Tessler, H. 1988. Dosimetry of a new holding device for fast d-14 plus beryllium neutron irradiation of human xenografts in nude mice. *Applied Radiation and Isotopes*. 39(4):297-302.

FL Bugryshev, P. F., Zaikina, T. I., and Moskalev, Yu. I. 1984. Absorption of beryllium from the rat gastrointestinal tract. *Gig. Tr. Prof. Zabol*. (6):52-3

Unrel Bukanov, V. N., Kataevskii, I. u. F., Indyk, V. M., Chebotarev, E. E., and Tkachenko, N. A. 1983. [Determination of the contribution of gamma radiation to absorbed dose and the radiobiological effects in the radiation field resulting from the reaction p(50MeV)--Be]. <Original> Opredelenie vklada gamma-izlucheniia v pogloshchennuiu dozu i nekotorye radiobiologicheskie effekty v radiatsionnom pole, poluchennom iz reaktsii p(50MeV)--Be. *Radiobiologiia* 23(4):565-8.

Unrel Bukanov, V. N., Kataevskii Yu F, Indyk, V. M., Chebotarev, E. E., and Tkachenko, N. A. 1983. Some dosimetric and radiobiological characteristics of the radiation field produced by the reaction 50 mev deuterons with a beryllium target *Radiobiologiya*. 23(5):709-711.

No Oral Caujolle, Fernand, Pham-Huu-Chanh, Maciotta-Lapoujade, M., and Silve-Mamy, Gaby. 1968. Cardiovascular effects of beryllium sulfate poisoning *Agressologie* 9(4):531-6 .

No Oral Chiappino, Gerolamo, Cirla, Angelo, and Vigliani, Enrico C. 1989. Delayed-type hypersensitivity reactions to beryllium compounds. An experimental study. *Arch. Pathol*. (1969) 87(2):131-40 .

No Oral Clary, J. J., Bland, L. S., and Stokinger, H. E. 1975. Effect of reproduction and lactation on the onset of latent chronic beryllium disease. *Toxicol. Appl. Pharmacol.* 33(2):214-21 .

No Oral Clary, J. J., Hopper, C. R., and Stokinger, H. E. 1972. Altered adrenal function as an inducer of latent chronic beryllium disease. *Toxicol. Appl. Pharmacol*. (1972) 23(3):365-75 .

Rev Cohen, MD, Bowser, DH, and Costa, M. 1996. Chapter 16: Carcinogenicity and genotoxicity of Lead, Beryllium, and Other Metals. In: Chang, Louis W., Ed. *Toxicology of Metals*. 253-284.

Prim Conradi, C. R., Kapanci, Y., Weibel, E. R., and Sopher, R. L. 1969. Electron Microscopic and Morphometric Study of Monkey and Dog Lungs Exposed to Beryllium-Containing Dust. <NOTE> Final rept. Nov 67-Dec 68. AMRL-TR-69-45

No Dose Cumming, D. V., Ord, M. G., and Stocken, L. A. 1986. Protein kinase activities in rat liver nuclei: effects of age and partial hepatectomy. *Bioscience Reports* 6(6):565-71.

No Oral Denham, S. and Hall, J. G. 1988. Studies on the adjuvant action of beryllium. III. The activity in the plasma of lymph efferent from nodes stimulated with beryllium. *Immunology* 64(2):341-4.

Unrel Deodhar, S. D. and Barna, B. P. 1991. Immune mechanisms in beryllium lung disease. *Cleveland Clinic Journal of Medicine* 58(2):157-60.

FL Dubrovina, Z. V. and Sokov, L. A. 1970. [Dependence of the behavior of radioactive isotopes in the organism on their physico-chemical characteristics]. <Original> Zavisimost' povedeniia radioaktivnykh izotopov v organizme ot ikh fiziko-khimicheskikh kharakteristik. *Meditsinskaia radiologiia* 15(10):41-7.

Species Dusenbery, D. B. 1989. Screening test for neurotoxins using Caenorhabditis elegans. Report (1987) Order No. PB89-130025, Avail.: NTIS From: Gov. Rep. Announce. Index U. S.) 1989,. 89(6. Abstr. No. 914,213. 6 pp.

Species Dusenbery, D. B. 1987. Screening Test for Neurotoxins Using 'Caenorhabditis elegans'. <NOTE> Final rept.

FL Dymin, V. V., Loshchilina, T. E., and Liaginskaia, A. M. 1983. [Methodological approaches to evaluating specific body reactions in the hygienic standardization of chemical compounds]. <Original> Metodicheskie podkhody k otsenke spetsificheskikh reaktsii organizma pri gigienicheskom normirovanii khimicheskikh soedinenii. *Gigiena i sanitariia* (10):56-9.

No Oral Enomoto, S., Yanaga, M., Hirunuma, R., Endo, K., Ambe, S., and Ambe, F. 1995. Behavior and metabolism of various rare-earth elements studied in rats by the multitracer technique. *Kidorui* (1995) :26, 406-7 .

No Oral Eskenasy, A. 1976. Experimental data asserting the immune morpho-pathogenic component of chronic inflammatory processes. *Morphologie et embryologie* 22(3):195-204.

No Oral Eskenasy, A. 1979. Experimental pulmonary berylliosis in rabbits sensitized to beryllium sulfate: contact hypersensitivity. *Rev Roum Morphol Embryol Physiol Morphol Embryol* 25(3):257-262.

Mix Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. Element content in tissues of four rodent species sampled in the Geysers geothermal steamfield. *Environ. Pollut.* (1989) 58(2-3):155-78 .

FL Fischer, P. and Krampitz, G. 1983. [Biochemical action mechanism of beryllium. 2. Beryllium binding in magnum of the laying hen]. <Original> Uber den biochemischen Wirkungsmechanismus des Berylliums. 2. Mitteilung, Beryllium-Bindung im Magnum des Huhns. Zeitschrift fur Tierphysiologie, Tierernahrung und Futtermittelkunde;

Unrel Floersheim, G. L. 1995. Modification of radiation sensitivity by salts of the metals beryllium and indium and the rare earths cerium, lanthanum and scandium *Radiat. Res.* (1995) 141(3):318-23 .

In Vit Garin, Jerome and Vignais, Pierre V. 1993. Characterization of the inhibition of rabbit muscle adenylate kinase by fluoride and beryllium ions. *Biochemistry* (1993) 32(27):6821-7.

Unrel Goble, J. H. 1982. Investigations of the Potential Functions of Weakly Bound Diatomic Molecules and Laser-Assisted Excitive Penning Ionization. LBL-14278

Unrel Gregoire, V., Beauduin, M., Gueulette, J., De Coster, B. M., Octave-Prignot, M., Vynckier, S., and Wambersie, A. 1993. Radiobiological intercomparison of p(45)+Be and p(65)+Be neutron beams for lung tolerance in mice after single and fractionated irradiation. *Radiation research* 133(1):27-32.

FL Gueulette, J., Breteau, N., Sabattier, R., and Wambersie, A. 1982. [Relative biological effectiveness (RBE) of d(50)-Be neutrons (Louvain-la-Neuve) and p(34)-Be neutrons (Orleans) for early intestinal tolerance in mice]. <Original> Efficacite biologique relative (EBR) des neutrons d(50)-Be (Louvain-la-Neuve) et des neutrons p(34)-Be (Orleans) pour la tolerance intestinale precoce chez la souris. *Comptes rendus des seances de la Societe de biologie et de ses filiales*

FL Gusek, W. 1965. [Histology and electron microscopy comparative cytology of tuberculosis and epithelium cell granulomas]. <Original> Histologie und elektronenmikroskopische komparative Zytologie tuberkuloser und epitheloidzelliger *Granulome. Bibliotheca tuberculosea* 21:97-156.

In Vit Haley, P. J., Finch, G. L., Hoover, M. D., Mewhinney, J. A., Bice, D. E., and Muggenburg, B. A. 1992. Beryllium-induced lung disease in the dog following two exposures to BeO. *Environmental Research* 59(2):400-15.

No Oral Hall, J. G. 1988. Studies on the adjuvant action of beryllium iv. The preparation of beryllium containing macromolecules that induce immunoblast responses in-vivo *Immunology*. 64(2):345-352.

No Oral Hall, J. G. and Spencer, J. 1984. The adjuvant action of beryllium 2. Systemic effects with particular reference to secretory immunity *Contraception*. 30(1):115-120.

No Oral Hall, J. G. and Spencer, J. 1984. Studies on the adjuvant action of beryllium. II. Systemic effects with particular reference to secretory immunity. *Immunology* 53(1):115-20.

No Oral Hart, B. A., Harmsen, A. G., Low, R. B., and Emerson, R. 1984. Biochemical, cytological, and histological alterations in rat lung following acute beryllium aerosol exposure. *Toxicology and Applied Pharmacology* 75(3):454-65.

FL Hatjipanagiotou, A., Hardebeck, H., Lesur, Eva, Krampitz, G., and Greuel, E. 1979. Effects of beryllium compounds on the hen. 3. Long-term effects of beryllium sulfate on feed intake, and number and weight of eggs. *Arch. Gefluegelkd*. (1979) 43(3):93-6 .

Unrel Hendry J.H., Potten C.S., Chadwick, C., and Bianchi, M. 1982. Cell death (apoptosis) in the mouse small intestine after low doses: Effects of dose-rate, 14 multiplied by 7 MeV neutrons, and 600 MeV (maximum energy) neutrons. *Int. J. Radiat. Biol* 42, (6):pp. 611-620.

Unrel Hill, C. K. and Zhu, L. 1991. Energy and dose-rate dependence of neoplastic transformation and mutations induced in mammalian cells by fast neutrons *Radiation Research*. 128 (I Suppl):S53-S59.

CP Hoshishima, K., Tujii, H., and Kano, K. 1978. Effects of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their offspring *Proc Int Congr Toxicol* 1ST 1977 :569-570.

FL Hu, Zinan, Long, Shengxi, Xiao, Gonghua, Tang, Limin, Zhu, Aijun, Yang, Mingyan, Xiao, Cequn, and Luo, Bifang. 1988. A potable water quality standard for beryllium. *Zhonghua Yufang Yixue Zazhi* (1988) 22(6):335-7.

FL Hulliger, L., Pohler, O., and Straumann, F. 1967. [Influence of some pure metals and alloys on the growth of rabbit fibrocytes in tissue culture]. <Original> Einfluss einiger reiner Metalle und Legierungen auf das Wachstum von Kaninchenfibrocyten in Gewebekulturen. Zeitschrift fur die gesamte experimentelle Medizin einschliesslich

No Oral Ireland, M. P. 1986. Studies on the effects of dietary beryllium at 2 different calcium concentrations in *Achatina-fulica* (pulmonata). *Comparative Biochemistry And Physiology C-Comparative Pharmacology And Toxicology* 83(2):435-438.

CP Itano, W. M., Monroe, C., Meekhof, D. M., Leibfried, D., and King, B. E. 1997. Quantum Harmonic Oscillator State Synthesis and Analysis. <NOTE> Final rept :11p.

No Oral Joshi, J. G., Goodman, S., Deshpande, V. V., and Price, D. J. 1985. Ferritin, a multifunctional molecule Proteins Iron Storage Transp. Proc. Int. Conf. Proteins Iron Metab., 7th :93-6. Editor(s): Spik, Genevieve. Publisher: Elsevier, Amsterdam, Neth.

No Oral Kang, K. Y., Bice, D., and Salvaggio, J. 1976. Delayed hypersensitivity study on zirconium compounds and beryllium sulfate. *Med. J. Osaka Univ*. (1976) 26(3-4):131-45 .

FL Karamzina, N. M. and Pavlova, I. V. 1966. Oxidation processes in the lungs of rats following their intoxication with certain beryllium compounds. *Gig. Tr. Prof. Zabol*. (1966) 10(9):32-6 .

FL Knyazhev, V. A., Umnikova, N. M., and Shtym, N. N. 1980. Some data on beryllium in Shmakovka mineral water and its effect on animals. *Vopr. Kurortol. Fizioter. Lech. Fiz. Kul't.* (4):64-5 .

No Oral Kochetkova, T. A., Arkhipova, O. G., Ivanova, A. S., and Panyukova, T. V. 1969. Morphological changes of experimental berylliosis of the lungs on treatment with aminoalkyl polyphosphinic acids (organophosphorus complexons) *Arkh. Patol*. (1969) 31(2):52-7.

In Vit Kurz, Erhard and Goslar, Hans G. 1974. Histochemical behavior of the unspecific esterases in the liver and kidney opposite some inorganic and organic compounds. *Enzyme toxicology Acta Histochem*. (1974) 48(1):82-101 .

Surv LaDelfe, C. M. 1981. Detailed Geochemical Survey Data Release for the San Andres-Oscura Mountains Special Study Area, New Mexico. GJBX-215-81; LA-8016-MS

No Oral Levi-Setti, R., Berry, J. P., Chabala, J. M., and Galle, P. 1988. Selective intracellular beryllium localization in rat tissue by mass-resolved ion microprobe imaging. *Biology of the Cell* 63(1):77-82.

FL Litvinov, N. N. and Kazenashev, V. F. 1982. Features of morphological response of animal lungs to exposure to various beryllium compounds. *Gig. Tr. Prof. Zabol*. (1982) (10):34-8

FL Litvinov, N. N., Popov, V. A., Vorozheikina, T. V., Kazenashev, V. F., and Bugryshev, P. F. 1984. Data to determine maximum permissible concentrations of beryllium in the work environment. *Gig. Tr. Prof. Zabol*. (1984) (1):34-7 .

HHE Lutaj, A. V., Lutaj, G. F., Kazanceva, S. V., Fed'kina, L. G., Solomina, S. N., Mal'ceva, M. E., and Kas'janova, T. I. Silicoberylliosis - a clinical, hygienic and experimental study *Gigiena truda i professional'nye zabolevanija* Jan. 1982 No. 1:23-26.

No Oral Mason, K. A. and Withers, H. R. 1977. Relative biological effectiveness of neutrons generated by 50 mev deuterons on beryllium for control of artificial pulmonary metastases of a mouse *Fibro sarcoma*. *British Journal of Radiology*. 50(597):652-657.

FL Masse, R., Fritsch, P., and Chretien, J. 1981. [Renewal of bronchial and pulmonary cells: a comprehensive review of recent information (author's transl)]. <Original> Renouvellement des cellules des bronches et du poumon. Analyse des donnees recentes. *Revue francaise des maladies respiratoires* 9(2):85-112.

No Oral Mathur, R., Asthana, Kamini, Sharma, Shashi, and Prakash, Anand O. 1985. Measurement of lethal dose of some beryllium compounds *IRCS Med. Sci.* 13(2):163

No Oral Mathur, R., Mathur, S., and Prakash, A. O. 1989. Liv-52 protection against beryllium toxicity in female albino rats. *Reproductive toxicology* 3(4):249-60.

No Oral Mathur, R., Mathur, Seema, and Prakash, Anand O. 1987. Mobilization of glycogen content in the reproductive organs of adult rats exposed to beryllium nitrate. *Med. Sci. Res.* 15(2):77-8 .

No Oral Mathur, R., Sharma, S., Mathur, S., and Prakash A.O. 1987. Effect of beryllium nitrate on early and late pregnancy in rats. *Bull. Environ. Contam. Toxicol* 38(1):pp. 73-77.

Unrel Mathur, R. Jiwaji Univ Gwalior India, Mathur, Seema, and Prakash, A. O. Effect of Intramuscular Administration of Beryllium Nitrate. *J Environ Biol*. 12(1):63.

No Oral Mathur, S., Prakash, A. O., and Mathur, R. 1986. Protective effect of liv-52 against beryllium toxicity in rats. *Current Science* 55(18):899-901.

No Oral Mathur, S., Prakash A.O., Mathur, R., and Sumino, K. (ed.). 1988. Therapeutic use of Liv-52 in beryllium induced reproductive toxicity in rats *Environmental and Occupational Chemical Hazards* :pp. 285-292.

No Oral Mathur, Seema. 1998. Effect of beryllium nitrate on the survival of rat blastocysts and fetuses exposed at different times of gestation. *Proc. Acad. Environ. Biol.* 7(2):179-182 .

No Oral Mathur, Seema, Flora, S. J. S., Mathur, R., and Das Gupta, S. 1993. Mobilization and distribution of beryllium over the course of chelation therapy with some polyaminocarboxylic acids in the rat. *Hum. Exp. Toxicol*. (1993) 12(1):19-24 .

No Oral Mathur, Seema, Prakash, Anand O., and Mathur, R. 1990. Toxic effects of beryllium nitrate on tissue cholesterol content in female rats *J. Adv. Zool*. (1990) 11(2):72-7.

Not Avail Matsumoto, Akira, Hisada, Yoh, and Yoshimura, Yoshitaka. 1991. Calcium and phosphate concentrations, and alkaline and acid phosphatase activities in serum of the rat fed with low calcium and beryllium diets *Shika Yakubutsu Ryoho* 10(3):253-9 .

HHE McLean, A. EM. 1977. Testing of industrial Chemicals. *Lancet* 2(8047):1070-1071.

Unrel Mellenberg, D. E., Tilbury, R. S., and Hogstrom, K. R. 1988. Radionuclide production and partial radiochemical characterization following fast neutron irradiation of mouse spleens. International journal of radiation applications and instrumentation.

Rev Montero Prieto, M. and Vidania Muoz, R. 1994. Modelizacion de la retencion sistemica del Berilio en la rata. Extrapolacion al hombre. (Modeling the systemic retention of beryllium in rat. Extrapolation to human). CIEMAT-747

Unrel Moschcovich, L., Peyser, Y. M., Salomon, C., Burghardt, T. P., and Muhlrad, A. 1998. Interaction of myosin subfragment 1 with two non-nucleotide ATP analogues. *Biochemistry* 37(43):15137-43.

FL Nikiforova, V. Ya. and Voronin, S. A. 1989. Mutagenic effect of beryllium on animal. *Tsitol. Genet.* 23(4):27-30 .

FL Nomiyama, Kazuo, Matsui, Kanji, and Nomiyama, Hiroko. 1978. Acute toxicity of beryllium in mice at different environmental temperatures. *Sangyo Igaku* 20(6):384-5

Unrel Persky, M. J. 1999. Review of black surfaces for space-borne infrared systems *Rev. Sci. Instrum.* 70(5):2193-2217 .

No Oral Pham-Huu-Chanh and Maciotta-Lapoujade, M. 1966. Immediate toxicity of beryllium sulfate in pigeons and chickens. *Agressologie* 7(6):597-601 .

FL Ponomareva, T. V. and Merkushev, G. N. 1978. Effects of some nonradioactive and radioactive chemical compounds on spleen structure. *Arkhiv Anatomii Gistologii i Embriologii*. 74(4):47-52.

FL Potapova, I. N. 1970. (Iron metabolism in experimental berylliosis.) *Gig Tr Prof Zabol;* 14 (10). 1970 57-59 14(10):57-59.

No Oral Prakash, A. O., Mathur, S., and Mathur, R. 1986. Effect of feeding Gymnema sylvestre leaves on blood glucose in beryllium nitrate treated rats. *Journal of Ethnopharmacology* 18(2):143-6.

No Oral Prine, J. R., Brokeshoulder, S. F., McVean, D. E., and Robinson, F. R. 1996. Demonstration of the Presence of Beryllium in Pulmonary Granulomas American *Journal of Clinical Pathology* 45(4):448-454.

No Oral Puzanova, L. 1983. Effect of lithium on the developing chicken embryo Spurenelem.-Symp. 4th (Issue Lithium,): 295-9. Editor(s): Anke, Manfred. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

No Oral Puzanova, L. 1980. Teratogenic effect of different toxic elements on young chick embryos. *Folia Morphol* 28:354-356.

No COC Puzanova, L. and Doskocil, M. 1979. Teratogenic effect of lithium salts on young chick embryos *Folia Morphol(prague)* 27:26-30.

FL Puzanova, L., Doskocil, M., and Doubkova, A. 1978. Disorders in the development of chicken embryos following beryllium chloride administration in the early developmental stages. *Sb. Lek.* 80(4):105-11 .

FL Puzanova, L., Doskocil, M., and Doubkova, A. 1978. [Disturbances in the development of chicken embryos following BeCl2 administration in early development stages (author's transl)]. <Original> Poruchy ve vyvoji kurecich zarodk.ANG.u po podani chloridu berylnateho na ranych vyvojovych stadiich. *Sbornik lekarsky* 80(4):105-11.

No Oral Puzanova, L., Doskocil, M., and Doubkova, A. 1978. Disturbances of the development of chick embryos after the administration of beryllium chloride at early stages of embryogenesis. *Folia Morphol*. (Prague) 26(3):228-31

Chem Meth Rao, D. Muralidhar, Ramaiah, E. Kondanda , and Ram, Kashi. 1995. Chemical equilibrium studies on some bivalent metal chelates of substituted 2-(phenylhydrazono) propanoic acids *Proc. Natl. Acad. Sci. India, Sect. A* 65(4):403-407.

Chem Meth Rao, D. Muralidhar, Reddy, G. Nivedita, Ramaiah, E. Kodanda, and Ram, Kashi. 1995. Complex formation of some bivalent metal ions with p- tolylhydrazonopropanoic acid in ethanol-water medium. *Acta Cienc. Indica Chem.* 21(3):111-114 .

Prim Raulston, G. L., Gray, K. N., Gleiser, C. A., Jardine, J. H., Flow, B. L., Huchton, J. I., Bennett, K. R., and Hussey, D. H. 1978. A comparison of the effects of 50 mev deuterium to beryllium neutron and cobalt-60 irradiation of the kidneys of rhesus monkeys. *Radiology*. 128 (1). 1978 245-249. 128(1):245-249.

No Oral Reeves, A. L. and Krivanek, N. D. 1974. The influence of cutaneous hypersensitivity to beryllium on the development of experimental pulmonary berylliosis. *Transactions of the New York Academy of Sciences* 36(1):78-93.

No Oral Resch, N. and Krampitz, G. 1979. Effect of cadmium in combination with other environmentally toxic agents on embryogenesis in hens Kadmium-Symp. Meeting Date 1977, 175-80. Editor:Meeting Date 1977, 175-80. Editor(s): Bolck, Franz. Publisher: Friedrich-Schiller-Univ., Jena, Ger. Dem. Rep.

FL Reuling, N., Fuhrmann, R., and Keil, M. 1992. [Experimental studies on the systemic toxicity of dental alloys free of precious metals]. <Original> Experimentelle Untersuchungen zur systemischen Toxizitat edelmetallfreier *Dentallegierungen. Schweizer Monatsschrift fur Zahnmedizin* 102(7):818-27.

No Tox Reynolds, J. J. and Dew, G. W. 1977. Comparison of the inhibition of avian and mammalian bone alkalinephosphatases by levamisole and compound R8231. *Experientia* 33(2):154-155.

Acute Rhoads, K. and Sanders, C. L. 1985. Lung clearance, translocation, and acute toxicity of arsenic, beryllium, cadmium, cobalt, lead, selenium, vanadium, and ytterbium oxides following deposition in rat lung. *Environmental Research* 36(2):359-378.

No Oral Ridgway, L. P. and Karnofsky, D. A. 1952. The effects of metals on the chick embryo: toxicity and production of abnormalities in development. *Ann N Y Acad Sci* 55:203-215.

No Oral Robinson, F. R. 1967. Pathological Response of the Lung to Certain Inhaled Irritants :10p.

No Oral Robinson, F. R., Schaffner, F., and Trachtenberg, E. 1968. Ultrastructure of the Lungs of Dogs Exposed to Beryllium-Containing Dust :10p.

No Oral Sakaguchi, S., Sakaguchi, T., Nakamura, I., Aminaka, M., Tanaka, T., and Kudo, Y. Effect of beryllium on delta-aminolevulinic acid dehydratase and porphobilinogen deaminase in pregnant mice. *Pharmacology & Toxicology* 79(4):214-216.

No Org Sandberg, G. W. Jr, Lee, R. C., Pegg, C. A. S., Huffman, F. N., and Norman, J. C. 1969. Simulated radiation fields from plutonium-238 fueled artificial hearts long-term effects of intra corporeal strontium-90 americium-241 beryllium sources. *Surgical Forum*. 20. 1969 194-196 20:194-196.

In Vit Schellander, F. and Marks, R. 1973. Thymidine uptake by high-level epidermal cells. A potential error in studies of keratinocyte Proliferation. *Acta Dermato-venereologica* 53(1):31-4.

Rev Schubert, J. 1973. Heavy metals--toxicity and environmental pollution. *Adv Exp Med Biol* 40:239-97.

Phys Schulert, A. R., Glasser, S. R., Stant, E. G. Jr, Brill, A. B., Koshakji, R. P., and Mansour, M. M. 1969. Development of placental discrimination among homologous elements. *Aec Symp Ser* 17:145-152.

FL Selivanova, L. N. and Savinova, T. B. 1986. Effect of beryllium chloride and beryllium oxide on the sexual function of female rats and the development of progeny *Gig Sanit* 8:44-46.

FL Selivanova, L. N. and Savinova, T. B. 1986. The impact of beryllium chloride and oxide on sexual function and offspring development in female rats. *Gig. Sanit.* (1986) (8):44-6 .

Surv Shahin, Usama, Yi, Seung-Muk, Paode, Rajendra D., and Holsen, Thomas M. 2000. Long-Term Elemental Dry Deposition Fluxes Measured around Lake Michigan with an Automated Dry Deposition Sampler. *Environ. Sci. Technol.* (2000) 34(10):1887-1892 .

No Oral Shukla, Sangeeta, Sharma, Pragya, Johri, Sonia, and Mathur, R. 1998. Influence of chelating agents on the toxicity and distribution of beryllium in rats. *J. Appl. Toxicol.* (1998) 18(5):331-335.

In Vit Skilleter, D. N. and Legg, R. F. 1989. Inhibition of epidermal growth factor-stimulated hepatocyte proliferation by the metallocarcinogen beryllium *Biochemical Society Transactions* 17:1040-1041.

In Vit Skilleter, D. N. and Price, R. J. 1981. Effects of beryllium compounds on rat liver Kupffer cells in culture. *Toxicology and Applied Pharmacology* 59(2):279-86.

In Vit Skilleter, D. N. and Price, R. J. 1984. Lymphocyte beryllium binding: relationship to development of delayed beryllium hypersensitivity. *International Archives of Allergy and Applied Immunology* 73(2):181-3.

In Vit Skilleter, David N. and Legg, Robert F. 1989. Inhibition of epidermal growth factor-stimulated hepatocyte proliferation by the metallocarcinogen beryllium *Biochem. Soc. Trans.* 17(6):1040-1 .

No Oral Skilleter, David N. and Price, Roger J. 1978. The uptake and subsequent loss of beryllium by rat liver parenchymal and non-parenchymal cells after the intravenous administration of particulate and soluble forms. *Chem.-Biol. Interact.* 20(3):383-96 .

No Oral Spencer, H. C., Hook, R. H., Blumenshine, J. A., McCollister, S. B., and Sadek, S. E. 1968. Toxicological Studies on Beryllium and Oxides and Beryllium-Containing Exhaust Products. <NOTE> Technical rept. 1 Jan 66-31 May 68. AMRL-TR-68-148

No Oral Spencer, H. C., McCollister, S. B., Kociba, R. J., Humiston, C. G., and Sparschu, G. L. 1972. Toxicological Evaluation of a Beryllium Motor Exhaust Product. <NOTE> Final rept. 1 Jul 70-10 Jul 72. AMRL-TR-72-118

No Oral Stemmer, K. L. 1976. Investigation on the Pulmonary Effects of Intermetallic Beryllium Compounds. Progress Report, January 1--December 31, 1976

Diss Sutton, W. R. 1939. Some changes produced in growth reproduction, blood and urine of rats by salts of zinc with certain observations on the effects of cadmium and beryllium salts

Unrel Szeinfeld, D. and de Villiers, N. 1992. Response of normal BALB/c mouse tissue to p(66 MeV)/Be fast neutron radiation: protection by exogenous ATP. *Strahlentherapie und Onkologie* 168(3):174-8.

No Oral Tsujii, H. and Hoshishima, K. 1979. Effect of the administration of trace amounts of metals to pregnant mice upon the behavior and learning of their Offspring. *Shinshu Daigaku Nogakubu Kiyo(j Fac Agric Shinshu Univ)* 16:13-28.

CP Turner, J. E., Williams, M. W., Jacobson, K. B., and Hingerty, B. E. 1984. Correlations of Acute Toxicity of Metal Ions and the Covalent/Ionic Character of Their Bonds. CONF-8409263-1

No Oral Vacher, J., Delevallee, F., and Deraedt, R. 1977. Mechanism of the hypersusceptibility to the lethal effect of endotoxin (ET) induced in mice by injection of beryllium phosphate. *Toxicol. Appl. Pharmacol.* 40(1):99-108 .

No Oral Vacher, J., Deraedt, R., and Benzoni, J. 1973. Compared effects of two beryllium salts (soluble and insoluble): toxicity and blockade of the reticuloendothelial system. *Toxicology and Applied Pharmacology* 24(3):497-506.

Drug Vacher, J., Deraedt, R., and Benzoni, J. Influence of a change in the activity of the res on the development of adjuvant induced poly arthritis in the rat. Res *Journal of the Reticuloendothelial Society*. 13(6):579-588.

Unrel Van Dam, J., Billiet, G., Wambersie, A., Bridier, A., Dutreix, A., and Bouhnik, C. 1980. RBE of d(50)-Be neutrons and of 650-MeV helium ions at different depths for growth reduction in Vicia faba. *Radiation research* 81(1):31-47.

FL Vasil'eva, E. V. 1971. [Development of an autoimmune process against myocardial tissue in experimental berylliosis]. <Original> Vyiavlenie autoimmunnogo protsessa, napravlennogo protiv serdechnoi tkani pri eksperimental'nom berillioze. *Gigiena truda i professional'nye zabolevaniia* 15(3):54-5.

In Vit Vorbrodt, A. and Maul, G. G. 1980. Cytochemical studies on the relation of nucleoside tri phosphatase activity to ribo nucleo proteins in isolated rat liver nuclei. *Journal of Histochemistry and Cytochemistry*. 28(1):27-35.

FL Voronin, S. A., Nikiforova, V. I. a., Ko'nshina, L. G., and Seliankina, K. P. 1989. [Data for revising the MPEL of beryllium in drinking water]. <Original> Materialy k peresmotru PDK berilliia v pi'tevoi vode. *Gigiena i sanitariia* (8):73-4.

FL Voronin, S. A., Nikiforova, V. Ya, Kon'shina, L. G., and Selyankina, K. P. 1989. Preliminary data for a review of the maximum permissible concentration of beryllium in drinking water. *Gigiena i Sanitariya.* 0(8):73-74.

No Oral Votto, J. J., Barton, R. W., Gionfriddo, M. A., Cole, S. R., McCormick, J. R., and Thrall, R. S. 1987. A model of pulmonary granulomata induced by beryllium sulfate in the rat. *Sarcoidosis* 4(1):71-6.

Drug Waldman, R. H., Grunspan, R., and Ganguly, R. 1972. Oral immunization of mice with killed Salmonella typhimurium vaccine. *Infection and Immunity* 6(No.1):58-61.

No Org Wang, Chonglu and Liu, Shiguo. 1991. Growth of alexandrite cat 's eye *Rengong Jingti Xuebao*. 20(1):39-41 .

No Oral Wang, Wenxue and Wang, Youlan. 1989. Antidotal effect of quinamidic acid in lethal -dose beryllium intoxication. *Zhonghua Laodong Weisheng Zhiyebing Zazhi* 7(5):304-5 .

Bact Watanabe, K., Takesue, S., Jin-Nai, K., and Yoshikawa, T. 1970. Bacteriophage active against the lactic acid beverage-producing bacterium Lactobacillus casei. *Applied Microbiology* 20(3):409-15.

Phys Wedrychowicz, H. and Bezubik, B. 1990. Influence of adjuvants on immunity in rabbits vaccinated with infective larval somatic proteins of Trichostrongylus Colubriformis. *Veterinary Parasitology* 37(3-4):273-84.

No Oral Wedrychowicz, H., Bezubik, B., and Trojanczuk, I. 1989. Local and systemic humoral protective immunity in rabbits vaccinatedwith adult Trichostrongylus colubriformis somatic proteins. *Acta Parasitologica Polonica* 34(4):365-374.

BioX Wedrychowicz, H., Doligalska, M., Bezubik, B., and Graczyk, E. 1990. Investigations on the role of antigen and its route of administrationin induction of protective response against infection with *Trichostrongylus colubriformis* in the rabbit. *Acta Parasitologica Polonica* 35(1):77-84.

BioX Wedrychowicz, H., Holmes, P. H., and Tait, A. 1994. Surface antigens of exsheathed infective larvae of Ostertagiacircumcincta. *Acta Parasitologica* 39(3):162-169.

No Oral Wedrychowicz, H., Romanik, I., Szczygielska, E., and Bezubik, B. 1992. The effect of adjuvant and specific or non-specific vacciation on development of protective immunity of rabbits against trichostrongylus colubriformis infection *International Journal For Parasitology*. 22(7):991-996.

No Org Wile, George J., Barker, James Francis , and Ross, Earl W. 1964. Beryllium impact behavior -implications for the jet engine compressor blade application *Metall. Soc. Conf. [Proc.]* (1966) 33:

929-62 .

Species Williams, Phillip L. and Dusenbery, David B. 1988. Using the nematode Caenorhabditis elegans to predict mammalian acute lethality to metallic salts *Toxicol. Ind. Health* 4(4):469-78 .

No Oral Witschi, H. P. and Marchand, P. 1971. Interference of Beryllium with enzyme induction in rat liver. *Toxicology and Applied Pharmacology* 20(4):565-72.

Chem Meth Wyatt, J. H. 1972. The demonstration of beryllium oxide in paraffin sections with chromoxane stains. *Stain Technology* 47(1):33-6.

Mix Yanaga, Makoto, Enomoto, Shuichi, Hirunuma, Rieko, Endo, Kazutoyo, Ambe, Shizuko, Tozawa, Machiko, and Ambe, Fumitoshi. 1966. Uptake and excretion of various elements in rats *Riken* **Rev**. 13, 23-24 .

Mix Yanaga, Makoto, Enomoto, Shuichi, Hirunuma, Rieko, Furuta, Riko, Endo, Kazutoyo, Tanaka, Akira, Ambe, Shizuko, Tozawa, Machiko, and Ambe, Fumitoshi. Multitracer study on uptake and excretion of trace elements in rats *Appl. Radiat. Isot*. (1996) 47(2):235-40 .

FL Zaugol'nikov, S. D., Kuznetsov, A. V., Matveev, O. G., and Suntsov, G. D. 1974. Effectiveness of organophosphorus complexons during intratracheal poisoning with beryllium chloride *Farmakol. Toksikol.* (Moscow) 37(2): 239-42 .

No Oral Zaugolnikov, S. D., Kuznetsov, A. V., Matveev, O. G., and Suntsov, G. D. 1974. Effectiveness of Organophosphorus Complexons in Intratracheal Poisoning with Beryllium Chloride (Effektivnost Fosforoganicheskikh Kompleksonov pri Intratrakhealnom Otravlenii Khloristym Berilliem). EPA-TR-27-75

Unrel Zelickson, B. D., Mehregan, D. A., Zarrin, A. A., Coles, C., Hartwig, P., Olson, S., and Leaf-Davis, J. 1994. Clinical, histologic, and ultrastructural evaluation of tattoos treated with three laser systems. *Lasers in Surgery and Medicine* 15(4):364-72.

Unrel Zhu, L. X. and Hill, C. K. 1994. Neutron-energy-dependent mutagenesis in V79 Chinese hamster cells. *Radiation research* 139(3):300-6.

This Page Intentionally Left Blank

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

This page intentionally left blank

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Beryllium

---

February 2005

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Beryllium

Ref		Exposure																			Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score											
Result #	Ref No.	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units for Study NOAEL/LOAEL	Wet Weight Reported?	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	Sor t Order	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight (kg)	Ingestion Rate Reported?	Ingestion Rate (kg or L/day)	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total Data Evaluation Score
Biochemical																																											
1	17115	Beryllium nitrate	6.77	Rat *(Rattus norvegicus)*		2	0/1.06	mg/org/d		40	U	OR	75	d	NR	NR	JV	M			2	BIO	ENZ	ALPH	LU		1.06	Y	0.150	N	0.014		0.478	10	8	10	10	7	1	4	10	10	4	74
Pathology																																											
2	17115	Beryllium nitrate	6.77	Rat *(Rattus norvegicus)*		2	0/1.06	mg/org/d		40	U	OR	75	d	NR	NR	JV	M			1	PTH	HIS	GHIS	LU		1.06	Y	0.150	N	0.014		0.478	10	8	10	10	7	4	4	10	10	4	77
Growth																																											
3	2640	Beryllium sulfate	8.58	Rat *(Rattus norvegicus)*		2	0/100	mg/L		ADL	U	DR	91	d	NR	NR	SM	F			2	GRO	GRO	BDWT	WO	100		N	0.315	N	0.035	0.953		10	5	5	10	6	8	4	10	10	4	72
4	17086	Beryllium sulfate	100	Rat *(Rattus norvegicus)*		2	0/5	mg/L		DLY	U	DR	39	d	21	d	JV	M			1	GRO	GRO	BDWT	WO		5.00	Y	0.090	N	0.011		0.630	10	5	5	10	6	8	4	10	10	4	72
5	1858	Beryllium sulfate	100	Mouse (*Mus musculus*)		2	0/5	mg/L		NR	U	DR	70	d	19-20	d	JV	F			1	GRO	GRO	BDWT	WO		5.00	Y	0.024	N	0.0035		0.718	10	5	5	10	6	8	4	10	10	4	72
Survival																																											
6	17086	Beryllium sulfate	100	Rat *(Rattus norvegicus)*		2	0/5	mg/L		DLY	U	DR	1464	d	21	d	JV	B			3	MOR	MOR	LFSP	WO	5.00		Y	0.486	N	0.052	0.532		10	5	5	10	6	9	4	10	10	4	73
Data Not Used to Derive Wildlife Toxicity Reference Value																																											
7	17086	Beryllium sulfate	100	Rat *(Rattus norvegicus)*		2	0/5	mg/L		DLY	U	DR	475	d	21	d	JV	B			4	BIO	CHM	CHOL	SR		5.00	Y	0.497	N	0.053		0.531	10	5	5	10	6	1	4	10	10	4	65
8	2640	Beryllium sulfate	8.58	Rat *(Rattus norvegicus)*		2	0/100	mg/L		ADL	U	DR	91	d	NR	NR	SM	F			1	BEH	FDB	WCON	WO	100		Y	0.315	N	0.035	1.00		10	5	5	10	6	4	4	1	10	4	59
9	1858	Beryllium sulfate	100	Mouse (*Mus musculus*)		2	0/5	mg/L		NR	U	DR	520	d	19-20	d	JV	F			3	PTH	HIS	EDMA	WO	5.00		Y	0.030	N	0.0042	0.703		10	5	5	10	6	4	4	1	10	4	59
10	1858	Beryllium sulfate	100	Mouse (*Mus musculus*)		2	0/5	mg/L		NR	U	DR	520	d	19-20	d	JV	B			3	MOR	MOR	LFSP	WO	5.00		Y	0.030	N	0.0042	0.703		10	5	5	10	6	9	4	1	10	4	64
11	17086	Beryllium sulfate	100	Rat *(Rattus norvegicus)*		2	0/5	mg/L		DLY	U	DR	540	d	21	d	JV	B			2	PTH	ORW	ORWT	HE	5.00		Y	0.497	N	0.053	0.531		10	5	5	10	6	4	4	1	10	4	59

All abbreviations and definitions are used in coding stuides are available from Attachment 4-3 of the Eco-SSL guidance (U.S. EPA 2003).

Ecological Soil Screening Levels for Silver

Interim Final

OSWER Directive 9285.7-77

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

September 2006

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SUMMARY OF ECO-SSLs FOR SILVER 1

3.0 ECO-SSL FOR TERRESTRIAL PLANTS 3

4.0 ECO-SSL FOR SOIL INVERTEBRATES 5

5.0 ECO-SSL FOR AVIAN WILDLIFE 5
5.1 Avian TRV 5
5.2 Estimation of Dose and Calculation of the Eco-SSL 8

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE 8
6.1 Mammalian TRV 8
6.2 Estimation of Dose and Calculation of the Eco-SSL 9

7.0 REFERENCES 12
7.1 General Silver References 12
7.2 References Used for Derivation of Plant and Soil Invertebrate Eco-SSLs 13
7.3 References Rejected for Use in the Derivation of Plant and Soil Invertebrate Eco-SSLs 13
7.4 References Used in Derivation of Wildlife TRVs 17
7.5 References Rejected for Use in Derivation of Wildlife TRVs 19

LIST OF TABLES

Table 2.1 Silver Eco-SSLs (mg/kg dry weight in soil) 2

Table 3.1 Plant Toxicity Data - Silver 4

Table 5.1 Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Silver 6

Table 5.2 Calculation of the Avian Eco-SSLs for Silver 8

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV) - Silver 10

Table 6.2 Calculation of the Mammalian Eco-SSL for Silver 12

LIST OF FIGURES

Figure 2.1 Typical Concentrations of Silver in U.S. Soils 2

Figure 5.1 Avian TRV Derivation for Silver 6

Figure 6.1 Mammalian TRV Derivation for Silver 10

LIST OF APPENDICES

Appendix 5-1 Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Silver

Appendix 6-1 Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Silver

1.0 INTRODUCTION

Ecological Soil Screening Levels (Eco-SSLs) are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs for wildlife are derived to be protective of the representative of the conservative end of the distribution in order to make estimates for local populations. The Eco-SSLs are conservative and are intended to be applied at the screening stage of an ecological risk assessment. These screening levels should be used to identify the contaminants of potential concern (COPCs) that require further evaluation in the site-specific baseline ecological risk assessment that is completed according to specific guidance (U.S. EPA, 1997, 1998, and 1999). The Eco-SSLs are not designed to be used as cleanup levels and the United States (U.S.) Environmental Protection Agency (EPA) emphasizes that it would be inappropriate to adopt or modify these Eco-SSLs as cleanup standards.

The detailed procedures used to derive Eco-SSL values are described in separate documentation (U.S. EPA, 2003, 2005). The derivation procedures represent the group effort of a multi-stakeholder group consisting of federal, state, consulting, industry, and academic participants led by the U.S. EPA Office of Solid Waste and Emergency Response.

This document provides the Eco-SSL values for silver and the documentation for their derivation. This document provides guidance and is designed to communicate national policy on identifying silver concentrations in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA may change this guidance in the future, as appropriate. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this document and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this document at any time and may consider such comments in future revisions of this document.

2.0 SUMMARY OF ECO-SSLs FOR SILVER

Silver is a rare, naturally occurring metal, often found deposited as a mineral ore in association with other elements (ATSDR, 1990). In nature, silver compounds occur as halides, cyanide, thiocyanate, oxides, hydroxides, carbonates, nitrate, sulfate, sulfides, ferrocyanide complexes, and thiosulfate complexes (Bodek et al., 1988 HSDB). The oxides, sulfates, carbonates, and phosphates of silver are moderately soluble. Other silver compounds are insoluble, with the exception of nitrate which is miscible (Bodek et al., 1988 HSDB). Silver is found in minerals

such as cerargyrite (AgCl), pyrargyrite ($2Ag_2S$-Sb_2S_3), proustite ($3Ag_2S$-Ag_2S_3), and stephanite ($5Ag_2S$-Sb_2S_2) (Bodek et al. 1988 HSDB). From these natural sources, silver is released to air and water through the weathering of rocks and the erosion of soils.

Silver may also enter the environment from the production and use of silver compounds in batteries, catalysts, medical preparations, electroplating and photography (Cappel, 1997 HSDB). The primary use of silver (about 40% of the total U.S. supply) is in photographic film and chemicals. Another 20% is used in electrical contacts and conductors. Other uses of the metal, its alloys and compounds include sterling ware, solder, jewelry, coins, medallions, dental and medical applications (Bodek et al., 1988). Other anthropogenic sources include smelting operations, cloud seeding operations, coal combustion, steel and iron production, cement manufacturing, urban refuse incineration, and cigarette tobacco (HSDB).

When released to soils, silver exists as Ag^+ ions or as insoluble silver complexes. the behavior of silver is strongly influenced by pH, redox conditions, and interactions with soil organic matter. Silver is highly immobile in soils relative to other metals. This immobility is due to precipitation of silver to form insoluble salts and adsorb to organic matter, clays, and manganese and iron oxides (Smith and Carson, 1977). The mobility of silver is increased by humus decomposition or by lowering pH (Alloway, 1990). The speciation of Ag^+ ions are affected by the concentration of chloride and under reducing environments the concentration of sulfide ions. Silver compounds have a range of mobilities with partitioning controlled by silver speciation both in solution and on soil surfaces. Manganese oxide has a strong affinity to adsorb silver ions followed by $Fe(OH)_3$, clays, Fe_2O_3 and organic colloids. Relatively large amounts of organic colloids will substantially lower the partitioning of silver and remobilize adsorbed silver. Silver compounds are not expected to volatilize from moist or dry soil surfaces based upon their ionic character and low vapor pressures (HSDB).

Accumulation of silver from soil to plants is low and studies have shown the roots to be the main site of silver accumulation (Ratte, 1999). Silver accumulation in leaves results from deposition from airborne sources such as a smelter (Ward et al., 1979). Data on the accumulation of silver from soils by soil invertebrates is limited (Ratte, 1999). Silver is toxic in laboratory studies to avian and mammalian species with effects including reduced growth and reproduction and increased mortality.

Table 2.1 Silver Eco-SSLs (mg/kg dry weight in soil)

Plants	Soil Invertebrates	Wildlife	
		Avian	Mammalian
560	NA	4.2	14

NA = Not Available. Data were insufficient to derive an Eco-SSL.

Eco-SSL values were derived for silver for plants, and avian and mammalian wildlife. Eco-SSL values for silver could not be derived for soil invertebrates. For this receptor group, data were insufficient to derive soil screening values. Eco-SSL values calculated for Silver range from 4.2 mg/kg dry weight (dw) for avian wildlife to 560 mg/kg dw for plants. These concentrations are higher than the reported background soil concentrations of silver in eastern and western U.S. soils (Figure 2.1). Background concentrations reported for many metals in U.S. soils are described in Attachment 1-4 of the Eco-SSL guidance (U.S. EPA, 2003).

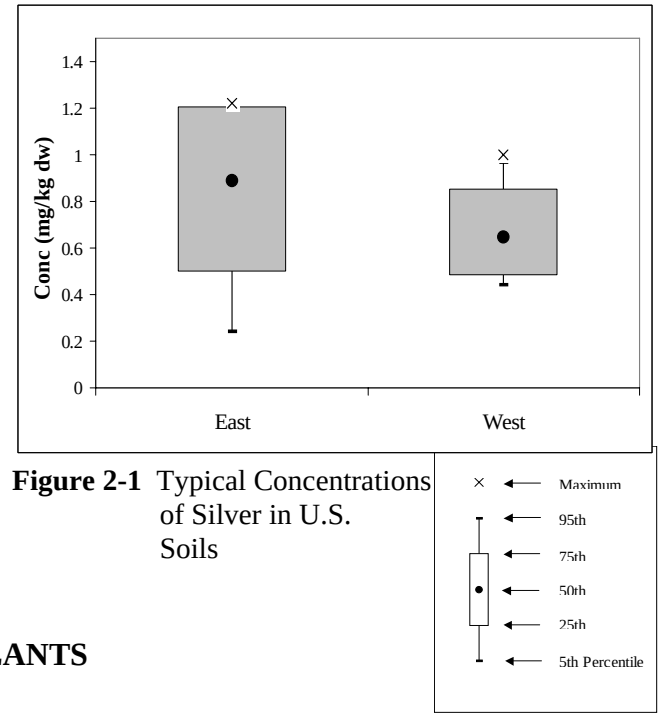


Figure 2-1 Typical Concentrations of Silver in U.S. Soils

3.0 ECO-SSL FOR TERRESTRIAL PLANTS

Of the papers identified from the literature search process, 61 were selected for acquisition for further review. Of those papers acquired, two met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). Each of these papers were reviewed and the studies were scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2). Three studies received an Evaluation Score greater than ten. These studies are listed in Table 3.1.

There are four studies eligible for Eco-SSL derivation that were used to derive the plant Eco-SSL for Silver (U.S. EPA, 2003; Attachment 3-2). The Eco-SSL is the geometric mean of the MATC values for 4 test species under different test conditions (pH and OM%) and is equal 560 mg/kg dw.

Table 3.1 Plant Toxicity Data - Silver

Reference	IP Number	Study ID	Test Organism		Soil pH	OM%	Bio-availability Score	ERE	Tox Parameter	Tox Value (Soil Conc at mg/kg dw)	Total Evaluation Score	Eligible for Eco-SSL Derivation?	Used for Eco-SSL?
Weaver and Klarich, 1973	20195	c	soybeans	*Glycine max*	7.4	0.17 - 2.8	0	GRO	MATC	3162	11	Y	Y
Weaver and Klarich, 1973	20195	e	wheat	*Triticum aestivum*	7.4	0.17 - 2.8	0	GRO	MATC	316	11	Y	Y
Weaver and Klarich, 1973	20195	f	corn	*Zea mays*	7.4	0.17 - 2.8	0	GRO	MATC	316	11	Y	Y
Weaver and Klarich, 1973	20195	g	sunflower	*Helianthus annus*	7.4	0.17 - 2.8	0	GRO	MATC	316	11	Y	Y
									Geometric Mean	560			

EC_{10} = Effect concentration for 10% of test population
EC_{20} = Effect concentration for 10% of test population
EC_{50} = Effect concentration for 50% of test population
ERE = Ecologically relevant endpoint
GRO = Growth
LOAEC = Lowest observed adverse effect concentration
MATC = Maximum acceptable toxicant concentration. Geometric mean of NOAEC and LOAEC.
N = No
NOAEC = No observed adverse effect concentration
ns = Not specified
OM = Organic matter content
REP = Reproduction
Y = Yes
Bioavailability Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)
Total Evaluation Score described in *Guidance for Developing Eco-SSLs* (U.S. EPA, 2003)

4.0 ECO-SSL FOR SOIL INVERTEBRATES

Of the papers identified from the literature search process, 61 papers were acquired for further review. Of those papers acquired, two met all 11 Study Acceptance Criteria (U.S. EPA, 2003; Attachment 3-1). Each of these papers were reviewed and there were no studies scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 3-2) that received an Evaluation Score greater than ten. An Eco-SSL could not be derived for soil invertebrates for Silver.

5.0 ECO-SSL FOR AVIAN WILDLIFE

The derivation of the Eco-SSL for avian wildlife was completed as two parts. First, the toxicity reference value (TRV) was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

5.1 Avian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 4,009 papers with possible toxicity data for either avian or mammalian species. Of these papers, 2,526 were unrelated to toxicity testing and contained information on the use of silver nitrate staining of cells. These papers are not listed in Section 7.5. Of the remaining 1,483 papers, 1,463 were rejected for use as described in Section 7.5. Of the 20 remaining papers, seven contained data for avian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 5.1. The complete results are included as Appendix 5-1.

Within the three papers there are 22 results for biochemical (BIO), behavior (BEH), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints that meet the Data Evaluation Score of > 65 for use to derive the TRV. These data are plotted in Figure 5.1 and correspond directly with the data presented in Table 5.1. The no-observed adverse effect level (NOAEL) results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded lowest-observed adverse effect level (LOAEL) for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

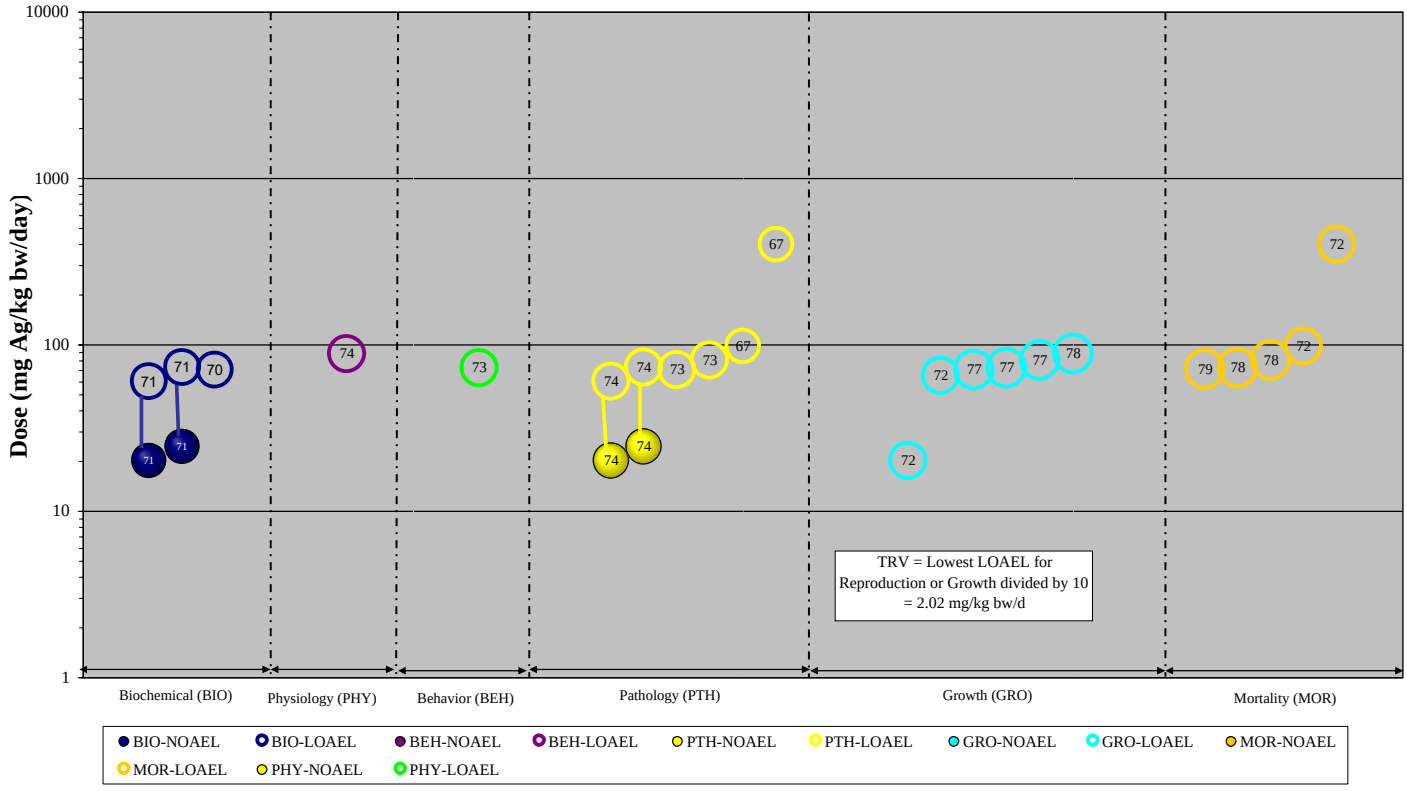
There are not three NOAEL values within the growth and reproduction effect groups. A geometric mean could not be calculated. There is not at least one NOAEL for reproduction or growth. There are at least three LOAEL values within the growth and reproduction effect groups. The avian TRV for Silver is equal to the lowest LOAEL for reproduction or growth divided by 10 and is equal to 2.02 mg/kg bw/d.

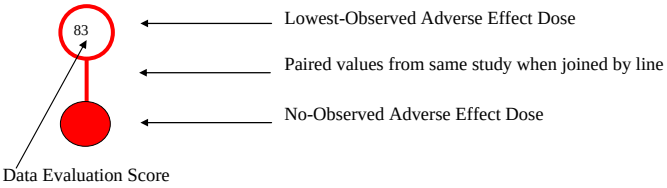
Table 5.1
Avian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Silver

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Biochemical (BIO)																		
1	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	3	U	FD	5	w	1	d	JV	B	CHM	PCLV	BL	20.2	60.5	71
2	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	4	U	FD	4	w	1	d	JV	B	CHM	PCLV	BL	24.5	73.4	71
3	Peterson et al, 1973	9232	Turkey (*Meleagris gallopavo*)	2	U	FD	4	w	1	d	JV	B	CHM	HMGL	BL		70.8	70
Behavior (BEH)																		
4	Jensen , 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	FDB	FCNS	WO		88.4	74
Physiology (PHY)																		
5	Petersen and Jensen, 1975	6899	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	NR	PHY	GPHY	WO		72.8	73
Pathology (PTH)																		
6	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	3	U	FD	5	w	1	d	JV	B	HIS	GHIS	HE	20.2	60.5	74
7	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	4	U	FD	4	w	1	d	JV	B	HIS	GHIS	HE	24.5	73.4	74
8	Peterson et al, 1973	9232	Turkey (*Meleagris gallopavo*)	2	U	FD	4	w	1	d	JV	B	ORW	SMIX	HE		70.8	73
9	Peterson and Jensen, 1975	6901	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	B	ORW	ORWT	HE		81.1	73
10	Van Vleet, 1977	6778	Duck (*Anas platyrhynchos*)	2	U	FD	3	w	1	d	JV	M	HIS	GHIS	MU		98.6	67
11	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	HIS	NCRO	GZ		401	67
Growth (GRO)																		
12	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	3	U	FD	5	w	1	d	JV	B	GRO	BDWT	WO		20.2	72
13	Jensen et al, 1974	9892	Turkey (*Meleagris gallopavo*)	2	U	FD	5	w	1	d	JV	B	GRO	BDWT	WO		65.5	72
14	Peterson et al, 1973	9232	Turkey (*Meleagris gallopavo*)	2	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		70.8	77
15	Petersen and Jensen, 1975	6899	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	NR	GRO	BDWT	WO		72.8	77
16	Peterson and Jensen, 1975	6901	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	B	GRO	BDWT	WO		81.1	77
17	Jensen , 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	GRO	BDWT	WO		88.4	78
Survival (MOR)																		
18	Jensen , 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	MOR	MORT	WO		71.4	79
19	Petersen and Jensen, 1975	6899	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	NR	MOR	MORT	WO		72.8	78
20	Peterson and Jensen, 1975	6901	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	B	MOR	MORT	WO		81.1	78
21	Van Vleet, 1977	6778	Duck (*Anas platyrhynchos*)	2	U	FD	3	w	1	d	JV	F	MOR	MORT	WO		98.6	72
22	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO		401	72

JV = juvenile; w = week; FD = food; U = unmeasured; M = Male; B = both; GRO = growth; F = female; d = day; MORT = mortality; NR = not reported; MU = multiple; HE = heart; NCRO = necrosis; WO = whole organism; GZ = gizzard; SMIX = relative to body weight; GHIS = general histological changes; ORWT = organ weight; FCNS = food consumption; FDB = feeding behavior; PHY = physiology; GPHY = general physiological changes; HMGL = hemoglobin; BL = blood; PCLV = packed cell volume; CHM = chemical changes.

Figure 5.1 Avian TRV Derivation for Silver





Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are not three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.
3) There is not a NOAEL for reproduction or growth.
4) There are at least three LOAEL values for reproduction or growth.
5) The avian TRV for Silver is equal to the lowest LOAEL for reproduction or growth divided by 10 and is equal to 2.02 mg/kg bw/d.

5.2 Estimation of Dose and Calculation of the Eco-SSL

Three separate Eco-SSL values were calculated for avian wildlife, one for each of three surrogate species representing different trophic groups. The avian Eco-SSLs were calculated according to the Eco-SSL guidance (U.S. EPA, 2003) and are summarized in Table 5.2.

Table 5.2 Calculation of the Avian Eco-SSLs for Silver

Surrogate Receptor Group	TRV for Silver (mg dw/kg bw/d) [1]	Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)	Soil Ingestion as Proportion of Diet (P_s)[2]	Concentration of Silver in Biota Type (i)[2,3] (B_i) (mg/kg dw)	Silver in Diet of Prey (C_{diet})	Eco-SSL (mg/kg dw)[4]
Avian herbivore (dove)	2.02	0.190	0.139	$B_i = 0.014 * Soil_j$ where i = plants	NA	69
Avian ground insectivore (woodcock)	2.02	0.214	0.164	$B_i = 2.045 * Soil_j$ where i = earthworms	NA	4.2
Avian carnivore (hawk)	2.02	0.0353	0.057	$B_i = 0.004 * Soil_j$ where i = mammals	NA	930

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV) solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

6.0 ECO-SSL FOR MAMMALIAN WILDLIFE

The derivation of the Eco-SSL for mammalian wildlife was completed as two parts. First, the TRV was derived according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5). Second, the Eco-SSL (soil concentration) was back-calculated for each of three surrogate species based on the wildlife exposure model and the TRV (U.S. EPA, 2003).

6.1 Mammalian TRV

The literature search completed according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-2) identified 4,009 papers with possible toxicity data for either avian or mammalian species. Of these papers, 2,526 were unrelated to toxicity testing and contained information on the use of silver nitrate staining of cells. These papers are not listed in Section 7.5. Of the remaining 1,483 papers, 1,463 were rejected for use as described in Section 7.5. Of the 20 remaining papers, 13 contained data for mammalian test species. These papers were reviewed and the data were extracted and scored according to the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-3 and 4-4). The results of the data extraction and review are summarized in Table 6.1. The complete results are provided in Appendix 6-1.

Within the 13 papers there are 15 results for biochemical (BIO), behavior (BEH), pathology (PTH), reproduction (REP), growth (GRO), and survival (MOR) endpoints with a total Data Evaluation Score >65 that were used to derive the TRV (U.S. EPA, 2003; Attachment 4-4). These data are plotted in Figure 6.1 and correspond directly with the data presented in Table 6.1. The NOAEL results for growth and reproduction are used to calculate a geometric mean NOAEL. This mean NOAEL is examined in relationship to the lowest bounded LOAEL for reproduction, growth, and survival to derive the TRV according to procedures in the Eco-SSL guidance (U.S. EPA, 2003; Attachment 4-5).

There are not three NOAEL values within the growth and reproduction effect groups. A geometric mean could not be calculated. There is not at least one NOAEL for reproduction or growth. There are at least three LOAEL values within the growth and reproduction effect groups. The mammalian TRV for Silver is equal to the lowest LOAEL for reproduction or growth divided by 10 and is equal to 6.02 mg/kg bw/d.

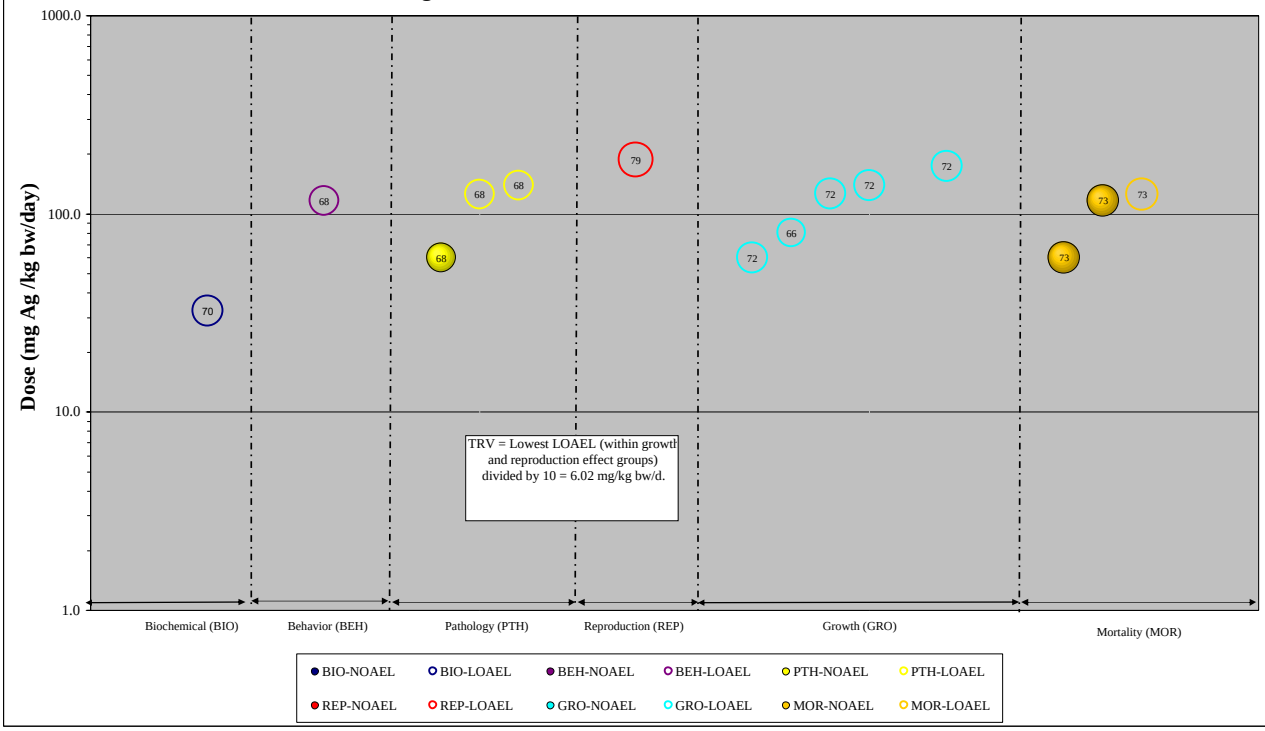
6.2 Estimation of Dose and Calculation of the Eco-SSL

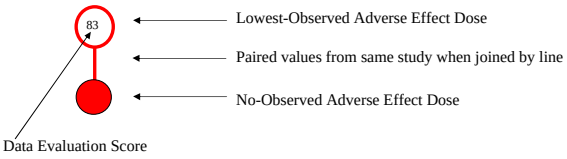
Three separate Eco-SSL values were calculated for mammalian wildlife, one for each of three surrogate species representing different trophic groups. The mammalian Eco-SSLs derived for Silver were calculated according to the Eco-SSL guidance (U.S. EPA, 2003) and are summarized in Table 6.2.

Table 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Silver

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Biochemical (BIO)																		
1	Pribyl et al, 1980	23825	Rat (*Rattus norvegicus*)	2	U	FD	4	d	NR	NR	JV	M	ENZ	GENZ	SR		32.3	70
Behavior (BEH)																		
2	Cabe, et al., 1979	1244	Rat (*Rattus norvegicus*)	2	U	DR	13	w	50	d	JV	M	FDB	WCON	WO		116	68
Pathology (PTH)																		
3	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	40	d	NR	NR	JV	NR	HIS	NCRO	LI	60.2		68
4	Van Vleet et al, 1981	149	Pig (*Sus scrofa*)	2	U	FD	25	d	NR	NR	JV	M	HIS	GLSN	HE		125	68
5	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	28	d	NR	NR	JV	NR	HIS	NCRO	LI		140	68
Reproduction (REP)																		
6	Shavlovski et al, 1995	21093	Rat (*Rattus norvegicus*)	2	U	FD	20	d	NR	NR	GE	F	REP	PROG	WO		188	79
Growth (GRO)																		
7	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	40	d	NR	NR	JV	NR	GRO	BDWT	WO		60.2	72
8	Wagner et al, 1975	14503	Rat (*Rattus norvegicus*)	2	U	DR	15	w	21	d	JV	B	GRO	BDWT	WO		80.2	66
9	Van Vleet et al, 1981	149	Pig (*Sus scrofa*)	2	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		126	72
10	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	28	d	NR	NR	JV	NR	GRO	BDWT	WO		140	72
11	Matuk et al, 1981	22823	Rat (*Rattus norvegicus*)	2	U	DR	16	w	NR	NR	JV	M	GRO	BDWT	WO		174	72
Survival (MOR)																		
12	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	40	d	NR	NR	JV	NR	MOR	MORT	WO	60.2		73
13	Cabe, et al., 1979	1244	Rat (*Rattus norvegicus*)	2	U	DR	13	w	50	d	JV	M	MOR	MORT	WO	116		73
14	Van Vleet et al, 1981	149	Pig (*Sus scrofa*)	2	U	FD	25	d	NR	NR	JV	M	MOR	MORT	WO		125	73
15	Van Vleet, 1976	22589	Pig (*Sus scrofa*)	2	U	FD	28	d	NR	NR	JV	NR	MOR	MORT	WO		140	73

Figure 6.1 Mammalian TRV Derivation for Silver





Wildlife TRV Derivation Process

Step 1: There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.

Step 2: There are not three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.

Step 3: There is not at least on NOAEL results within the growth and reproduction effect groups.

Step 5: There are at least 3 LOAEL results within growth and reproduction effect groups.

TRV = Lowest LOAEL (within growth and reproduction effect groups) divided by 10 = 6.02 mg/kg bw/d.

Table 6.2 Calculation of the Mammalian Eco-SSL for Silver						
Surrogate Receptor Group	**TRV for Silver (mg dw/kg bw/d) [1]**	**Food Ingestion Rate (FIR)[2] (kg dw/kg bw/d)**	**Soil Ingestion as Proportion of Diet (P_s)[2]**	**Concentration of Silver in Biota Type (i)[2,3] (B_i) (mg/kg dw)**	**Silver in Diet of Prey [4] (C_{diet})**	**Eco-SSL (mg/kg dw)[5]**
Mammalian herbivore (vole)	6.02	0.0875	0.032	$B_i = 0.014 * Soil_j$ where i = plants	NA	1500
Mammalian ground insectivore (shrew)	6.02	0.209	0.030	$B_i = 2.045 * Soil_j$ where i = earthworms	NA	14
Mammalian carnivore (weasel)	6.02	0.130	0.043	$B_i = 0.004 * Soil_j$ where i = mammals	NA	990

[1] The process for derivation of wildlife TRVs is described in Attachment 4-5 of U.S. EPA (2003).
[2] Parameters (FIR, P_s, B_i values, regressions) are provided in U.S. EPA (2003) Attachment 4-1 (revised February 2005).
[3] B_i = Concentration in biota type (i) which represents 100% of the diet for the respective receptor.
[4] C_{diet} = Concentration in the diet of small mammals consumed by predatory species (weasel).
[5] HQ = FIR * ($Soil_j$ * P_s + B_i) / TRV) solved for HQ=1 where $Soil_j$ = Eco-SSL (Equation 4-2; U.S. EPA, 2003).
NA = Not Applicable

7.0 REFERENCES

7.1 General Silver References

Alloway, B. J. (ed.). 1990. *Heavy Metals in Soils.* New York, NY: John Wiley & Sons, 14.4: 298-304.

ATSDR. 1990. *Toxicological Profile for Silver*. Atlanta, GA, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (TP-90-24).

Bodek, I. et al. (eds.) 1988. *Environmental Inorganic Chemistry. Properties, Processes, and Estimation Methods*. New York, NY. Pergamon Press.

Cappel, C. R. 1997. *Kirk-Othmer Encyclopedia of Chemical Technologies*. 4th Edition. New York, NY: John Wiley & Sons, 22: 163-195.

Hazardous Substances Database (HSBD). http://toxnet.nlm.nih.gov. National Library of Medicine.

Ratte, H. T. 1999. Bioaccumulation and toxicity of silver compounds. *Environmental Toxicology and Chemistry*. 18(1): 89-108.

Smith, I. and Carson, B. 1977. *Trace metals in the environment*. Volume 2. Silver. Ann Arbor, MI, Ann Arbor Science Publishers, 469 pp.

United States Environmental Protection Agency (U.S. EPA). 2003. *Guidance for Developing Ecological Soil Screening Levels*. OSWER Directive 92857-55. Office of Solid Waste and Emergency and Remedial Response. Revised February 2006.

United States Environmental Protection Agency (U.S. EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites*. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-28.P.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment.* Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

Ward, N. I., Roberts, E., and Brooks, R. R. 1979. Silver uptake by seedlings of *Lolium perenne L.* and *Trifolium repens L.* New Zealand Journal of Science, 22: 129-132.

7.2 References Used for Derivation of Plant and Soil Invertebrate Eco-SSLs

Weaver, T. W. III. and Klarich, D. 1973. Ecological Effects of Silver Iodide in Terrestrial Ecosystems: A Preliminary Study, Section 3. In: Final Res Rep No.42, Impacts of Induced Rainfall on the Great Plains of Montana, Mont.Agric.Exp Stn., Montana State Univ., MT: 18

7.3 References Rejected for Use in the Derivation of Plant and Soil Invertebrate Eco-SSLs

Mix Hirsch, M. P. 1998. Availability of Sludge-Borne Silver to Agricultural Crops. *Environ.Toxicol.Chem.* 17[4], 610-616

Media Allus, M. A., Brereton, R. G., and Nickless, G. 1988. Chemometric studies of the effect of toxic metals on plants: the use of response surface methodology to investigate the influence of tl, cd and ag on the growth of cabbage seedlings. Environ.Pollut.Ser.A 52[3], 169-181

No Tox Data Andren, A. W. and Bober, T. W. 1995. Transport, Fate, and Effects of Silver in the Environment. In: Abstr.of 3rd Int.Conf., 6-9 Aug., 1995, Washington, D.C., Univ.of Wisconsin Sea Grant Inst., Madison , 35

OM, pH Atsmon, D. and Tabbak, C. 1979. Comparative Effects of Gibberellin, Silver Nitrate and Aminoethoxyvinyl Glycine on Sexual Tendency and Ethylene Evolution in the Cucumber Plant (Cucumis sativus L.). Plant Cell Physiol. 20[8], 1547-1556

Abstract Beglinger, J. M. and Ruffing, C. J. 1998. Effects of Silver Sulfide on the Terrestrial Earthworm. Proc.5th Argentum Intl.conf.on the Transport, Fate, and Effects of Silver in the Environment, Sept.28-Oct.1, 1997, Hamilton, Ont., Canada

OM, pH Belles, J. M., Carbonell, J., and Conejero, V. 1991. Polyamines in plants infected by citrus exocortis viroid or treated with silver ions and ethephon. Plant Physiol.(Bethesda) 96[4], 1053-1059

OM, pH Beyer, E. Jr. 1976. Silver Ion: A Potent Antiethylene Agent in Cucumber and Tomato 50038. Hortscience 11[3], 195-196

Media Brown, W. V., Mollenhauer, H., and Johnson, C. 1962. An Electron Microscope Study of Silver Nitrate Reduction in Leaf Cells. Am.J.Bot. 49[1], 57-63

No Dose Cataldo, D. A. and Wildung, R. E. 1978. Soil and Plant Factors Influencing the Accumulation of Heavy Metals by Plants. Environ.Health Perspect. 27, 149-159

Media Cheung, Y. H., Wong, M. H., and Tam, N. F. Y. 1989. Root and Shoot Elongation as an Assessment of Heavy Metal Toxicity and `Zn Equivalent Value' of Edible Crops. Hydrobiologia 188/189, 377-383

Rev Cooper, C. F. and Jolly, W. C. 1970. Ecological Effects of Silver Iodide and Other Weather Modification Agents: A Review. Water Resour.Res. 6[1], 88-98

Mix Cufar, K., Robic, D., Torelli, N., and Kermavnar, A. 1995. Phenology, Occurrence of Epicormic Branches and Reproductive Growth in Air-Polluted Silver Firs 38287. Acta Pharm. 45[2, Suppl 1], 379-381

OM, pH Cushman, K. E. and Tibbitts, T. W. 1998. The role of ethylene in the development of constant-light injury in potato and tomato. Journal Of The American Society For Horticultural Science. 123[2], 239-245

OM, pH Cushman, L. C., Pemberton, H. B., and Kelly, J. W. 1994. Cultivar, Flower Stage, Silver Thiosulfate and BA Interactions Affect Performance of Potted Miniature Roses. Hortscience 29[7], 805-808

Mix Davis, R. D., Beckett, P. H. T., and Wollan, E. 1978. Critical Levels of Twenty Potentially Toxic Elements in Young Spring Barley. Plant Soil 49, 395-408

OM, pH Earhart, D. R., Paterson, D. R., Walker, D., and Fuqua, M. C. 1978. Further Studies on Silver Ion (Ag+) Translocation, Ethylene (C2H4) Production, and Growth of Iponoea batates Treated with Silver Nitrate 51356. Hortscience 13[3], 268

Rev Eisler, R. 1996. Silver Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Biol.Rep.32, Contaminant Hazard Reviews, U.S.Dep.Interior, Natl.Biol.Serv., Patuxent Wildl.Res.Cent., Laurel, MD , 44 p.

Abstract Ewell, W. S., Gorsuch, J. W., Ritter, M., and Ruffing, C. J. 1993. Ecotoxicological Effects of Silver Compounds. In: A.W.Andren and T.W.Bober (Eds.), 1st International Conference Proceedings on Transport, Fate and Effects of Silver in the Environment, Aug.8-10, University of Wisconsin-Madison, Madison, WI , 113 (ABS)

No Dur Falandysz, J. and Danisiewicz, D. 1995. Bioconcentration Factors (BCF) of Silver in Wild Agaricus campestris. Bull.Environ.Contam.Toxicol 55, 122-129

OM, pH Falandysz, J., Bona, H., and Danisiewicz, D. 1994. Silver Uptake by Agaricus bisporus from an Artificially Enriched Substrate. Z Lebensm-Unters-Forsch 199, 225-228

OM, pH Feng, J. and Barker, A. V. 1992. Ethylene evolution and ammonium accumulation by nutrient-stressed tomatoes grown with inhibitors of ethylene synthesis or action. Journal Of Plant Nutrition. 15[2], 155-167

Media Feng, J. and Barker, A. V. 1993. Polyamine Concentration and Ethylene Evolution in Tomato Plants under Nutritional Stress. Hortscience : A Publication Of The American Society For Horticultural Science. 28[2], 109-110

OM, pH Fjeld, T. 1991. Effects of Silver Thiosulfate Ethephon Temperature and Irradiance Level on Keeping Quality of Christmas Begonia begonia-cheimantha Everett. Gartenbauwissenschaft. 56[2], 66-70

OM, pH Girling, C. A., Peterson, P. J., and Minski, M. J. 1978. Gold and Arsenic Concentrations in Plants as an Indication of Gold Mineralization. Sci Total Environ 10[1], 79-86

Media Goransson, A. and Eldhuset, T. D. 1991. Effects of Al(3+) on Seedling Growth of Silver Birch, Scots Pine and Norway Spruce at Steady State Nutrition 52132. Developments In Agricultural And Managed-Forest Ecology 24, 58-65

Rev Gorsuch, J. W. and Klaine, S. J. 1998. Toxicity and Fate of Silver in the Environment 52145. Environ.Toxicol.Chem. 17, 537-538

Media Guven, K., Duce, J. A., and De Pomerai, D. I. 1994. Evaluation of a Stress-Inducible Transgenic Nematode Strain for Rapid Aquatic Toxicity Testing. Aquat.Toxicol. 29, 119-137

No Dur Hiltbrunner, E. and Fluckiger, W. 1996. Manganese Deficiency of Silver Fir Trees (Abies alba) at a Reforested Site in the Jura Mountains, Switzerland: Aspects of Cause and Effect 38494. Tree Physiol. 16[11/12], 963-975

Mix Hirsch, M., Ritter, M., Roser, K., Garrisi, P., and Forsythe, S. 1997. The Effect of Silver on Plants Grown in Sludge-Amended Soils. In: A.W.Andren and T.W.Bober (Eds.), 1st International Conference Proceedings on Transport, Fate and Effect of Silver in the Environment, Aug.8-10, 1993, University of Wisconsin-Madison, Madison, WI , 69-73

OM, pH Hoyer, L. 1998. Silver Thiosulphate can Considerably Reduce Leaf and Fruit Abscission Caused by Ethylene in Capsicum annuum 'janne'. J.Hortic.Sci.Biotechnol. 73[1], 29-34

Media Ireland, M. P. 1988. A Comparative Study of the Uptake and Distribution of Silver in a Slug Arion ater and a Snail Achatina fulica. Comp.Biochem.Physiol.C 90, 189-194

Media Ke, Hueli Yang David, Anderson, Wendy L., Moncrief, Robyn M., Rayson, Gary D., and Jackson, Paul J. 1994. Luminescence studies of metal ion-binding sites on Datura inoxia biomaterial. Environ.Sci.Technol. 28[4], 586-591

No Dose Kong, L. S., Gao, P., Ren, T. X., and Hong, H. J. 1991. Characteristics of Plant Communities and Element Contents in Plants at Mengentaoligai Silver Lead Zinc Mine Area in Inner Mongolia. Acta Bot.Sin. 33[7], 529-541

No Dose Kormutak, A., Salaj, J., and Vookova, B. 1994. Pollen Viability and Seed Set of Silver Fir (Abies alba Mill.) in Polluted Areas of Slovakia 53603. Silvae Genet. 43[2/3], 68-73

OM, pH Kramer, James R., Adams, Nicholas W. H., Manolopoulos, Helen, and Collins, Pamela V. 1999. Silver at an old mining camp, Cobalt, Ontario, Canada. 53652. Environ.Toxicol.Chem. 18[1], 23-29

In Vit Lamoreaux, R. J. and Chaney, W. R. 1978. Photosynthesis and Transpiration of Excised Silver Maple Leaves Exposed to Cadmium and sulphur Dioxide. Environ.Pollut. 17[4], 259-268

Media Lamoreaux, R. J. and Chaney, R. J. 1978. The Effect of Cadmium on Net Photosynthesis, Transpiration and Dark Respiration of Excised Silver Maple Leaves. 38601. Physiol.Plant 43, 231-236

Media Lane, I. and Puckett, K. J. 1979. Responses of the Phosphatase Activity of the Lichen Cladina rangiferina to Various Environmental Factors Including Metals. Can.J.Bot. 57, 1534-1540

Media Marre, M. T. and Albergoni, F. 1998. Fusicoccin Counteracts the n-Ethylmaleimide and Silver-Induced Stimulation of Oxygen Uptake in Egeria densa Leaves. Plant Physiology. 116[2], 681-686

OM, pH Mason, M. R. and Miller, W. B. 1991. Flower Bud Blast in Easter Lily is Induced by Ethephon

and Inhibited by Silver Thiosulfate. Hortscience 26[9], 1165-1167 (ABS)

OM, pH Mnzava, N. A. and Mpina, G. A. 1987. Effects of Silver Nitrate on Flower Growth, Senescence, and Pyrethrin Content of Pyrethrum (Chrysanthemum cinerariaefolium Vis.). Pyrethrum Post 16[4], 128-131

Species Molise, E. M. and Klein, D. A. 1974. Effects of Silver on Radiorespiration of Glucose by Soil Microorganisms. Ann.Meeting Am.Soc.Microbiol. 2

Media Mollers, C., Zhang, S., and Wenzel, G. 1992. The influence of silver thiosulfate on potato protoplast cultures. Plant Breeding = Zeitschrift Fur Pflanzenzuchtung. 108[1], 12-18

Media Nielsen, L. W. and Massay, L. M. 1940. Silver as a Fungicide. In: L.Addicts (Ed.), Silver in Industry, Reinhold, London , 597

Media Pestana, M. C., Lacorte, C., de Freitas, V. G., de Oliveira, D. E., and Mansur, E. 1999. In Vitro Regeneration of Peanut (Arachis hypogaea L.) Through Organogenesis: Effect of Culture Temperature and Silver Nitrate. 58465. In Vitro Cell.Dev.Biol.- Plant 35[3], 214-216

FL Petering, H. G. 1984. Silver. Merian, E.(Ed.).Metalle in der Umwelt: Verteilung, Analytik und Biologische Relevanz (Metals in the Environment: Distribution, Analysis and Biological Relevance).Xvii+722P.Vch Verlagsgesellschaft/Physik-Verlag: Weinheim, West Germany; Deerfield Beach, 0[0], 555-560

OM, pH Pitcher, R. S. and McNamara, D. G. 1972. The Toxicity of Low Concentrations of Silver and Cupric Ions to the Three Species of Plant-Parasitic Nematodes. Nematologica 18, 385-390

Media Popham, J. D. and Webster, J. M. 1976. Comparative toxicity of heavy metals with special reference to cadmium on caenorhabditis-elegans. Proc Int Colloq Invertebr Pathol , 372-373

Media Puckett, K. J. 1976. The Effect of Heavy Metals on Some Aspects of Lichen Physiology. Can J Bot 54, 2695-2703

OM, pH Rajput, J. C., Parulekar, Y. R., Sawant, S. S., and Jamadagni, B. M. 1994. Sex Modification in Kartoli (Momordica dioica Roxb.) by Foliar Sprays of Silver Nitrate (AgNO3). Curr.Sci. 66[10], 779

Rev Ratte, H. T. 1999. Bioaccumulation and Toxicity of Silver Compounds: A Review. Environ.Toxicol.Chem. 18[1], 89-108

No COC Richardson, R. G. 1979. Absorption, Translocation and Toxicity of Picloram in Silver Leaf Nightshade (Solanum elaeagnifolium Cav.). J Aust Int Agric Sci 45[4], 263-266

Media Serek, Margrethe and Andersen, Arne Skytt. 1994. Polyamine Uptake Does not Affect Floral Longevity in Miniature Potted Roses. Hortscience 29[3], 196-198

In Vit Siegel, S. M. 1977. The Cytotoxic Response of Nicotiana Protoplast to Metal Ions: A Survey of the Chemical Elements. Water Air Soil Pollut. 8[1-4], 293-304

OM, pH Singleton, P. and White, R. 1975. Silver Iodide: Its Movement in an Alpine Ecosystem and Its Effect on Two Plant Species. In: D.H.Knight (Ed.), The Medicine Bow Ecology Proj., Univ.Wyoming, Laramie, WY , 329-351

Media Slade, S. J. 1993. The Effect of Silver and Other Metal Ions on the In Vivo Growth of Root-Rotting Phytophthora and Other Fungal Species. Ann.Appl.Biol. 122[2], 233-251

Media Smith, G. C. and Brennan, E. 1984. Responses of Silver Maple Seedlings to an Acute Dose of Root Applied Cadmium. For.Sci. 30, 582-586

Media Tso, T. C., Sorokin, T. P., and Engelhaupt, M. E. 1973. Effects of Some Rare Elements on Nicotine Content of the Tobacco Plant. Plant Physiol. 51, 805-806

Rev Vanselow, A. P. 1966. Silver 57542. In: H.D.Chapman (Ed.), Diagnostic Criteria for Plants and Soils, University of California, Berkeley, CA , 405, 407-405, 408

Media Wallace, A., Alexander, G. V., and Chaudry, F. M. 1977. Phytotoxicity of Cobalt, Vanadium, Titanium, Silver, and Chromium. Commun.Soil Sci.Plant Anal. 8[9], 751-756

Media Wallace, A. 1980. Recovery from Acute Silver Toxicity by Bush Beans Grown in Solution Culture. J.Plant Nutr. 2[1/2], 93-95

Media Wang, W. 1993. Comparative Rice Seed Toxicity Tests using Filter Paper, Growth Pouch, and Seed Tray Methods. Environ.Monit.Assess. 24[3], 257-265

Media Wang, W. 1994. Rice Seed Toxicity Tests for Organic and Inorganic Substances. Environ.Monit.Assess. 29, 101-107

Media Ward, N. I., Roberts, E., and Brooks, R. R. 1979. Silver Uptake by Seedlings of Lolium perenne L. and Trifolium repens L. N.Z.J.Sci. 22, 129-132

Media Weaver, T. and Brock, D. 1972. Ecological Effects of Weather Modification: Effect of Silver Nitrate on Plant Growth. Proc Mont Acad Sci 32, 27-30

Media Weier, E. 1938. Factors Affecting the Reduction of Silver Nitrate by Chloroplasts. Am.J.Bot. 25, 501-507

Media Werner, C. and Hohl, H. R. 1990. The Effects of Calcium and Magnesium on Accumulation and Secretion of Isoflavonoids by Soybean Roots. Plant Sci 72[2], 181-192

Media Wettlaufer, S. H., Osmeloski, J., and Weinstein, L. H. 1991. Response of polyamines to heavy metal stress in oat seedlings. Environ.Toxicol.Chem. 10[8], 1083-1088

7.4 References Used in Derivation of Wildlife TRVs

Bencko, V. 1972. oxygen consumption by ***mouse*** liver homogenate during ***drinking*** ***water*** arsenic exposure. ii. *J. Hyg. Epidemiol., Microbiol., Immunol.* 16(1): 42-6. Ref ID: 15471

Cabe, P. A., Carmichael, N. G., and Tilson, H. A. 1979. Effects of Selenium, Alone and in Combination with Silver or Arsenic, in Rats. *Neurobehav Toxicol.* 1(4): 275-8. Ref Id: 1244.

Healy, Sm, Casarez, Ea, Ayala-Fierro, F, and Aposhian, HV. 1998. enzymatic methylation of arsenic compounds. *Toxicol. Appl. Pharmacol.* 148: 65-70. Ref ID: 14543

Jensen, L. S. 1975. Modification of a Selenium Toxicity in Chicks by Dietary Silver and Copper. *J Nutr.* 105(6): 769-775. Ref Id: 1403

Jensen, L. S., Peterson, R. P., and Falen, L. Inducement of Enlarged Hearts and Muscular Dystrophy in Turkey Poults with Dietary Silver. *Poultry Science. 53(1): 57-64.* Ref Id: 9892

Kanisawa, M. and H. A. Schroeder. 1967. life term studies on the effects of arsenic, germanium, tin, and vanadium on spontaneous tumors in mice. *Cancer Research*. 27: 1192-1195. Ref ID: 20979

Kiyono, S., Hasui, K., Takasu, K., and Seo, M. toxic effect of arsenic trioxide in infant rats. *J. Physiol. Soc. Jpn.* 36(7): 253-254; 1974.(5 References) Ref ID: 15427

Matuk. Y., Ghosh, M., and Mcculloch, C. 1981. Distribution of Silver in the Eyes and Plasma Proteins of the Albino Rat. *Can. J. Ophthalmol.* 16(3): 145-50. Ref Id: 22823

Peterson, R. P. and Jensen, L. S. 1975. Induced Exudative Diathesis in Chicks by Dietary Silver. *Poult. Sci.* 54(3): 795-8. Ref Id: 6899

Peterson, R. P. and Jensen, L. S. 1975. Interrelation of Dietary Silver with Copper in the Chick. *Poult. Sci.* 54(3): 771-5. Ref Id: 6901

Peterson, R. P., Jensen, L. S., and Harrison, P. C. 1973. Effect of Silver-induced Enlarged Hearts During the First Four Weeks Oflife on Subsequent Performance of Turkeys. *Avian Diseases.* 17(4): 802-806. Ref Id: 9232

Pribyl, T., Schreiber, V., and Jahodova, J. 1980. inhibition of rat serum polyphenoloxidase activity by silver ions abolished by administration of copper ions. Folia Biologica 26(1): 47-52. Ref ID: 23825

Shavlovski, Mikhail M., Chebotar, Nicolai A., Konopistseva, Liudmila A., Zakharova, Elena T., Kachourin, Anatoliy M., Vassiliev, Vadim B., and Gaitskhoki, Vladimir S. 1995. Embryotoxicity of Silver Ions Is Diminished by Ceruloplasmin-further Evidence for its Role in the Transport of Copper. *Biometals.* 8(2): 122-8. Ref Id: 21093

Tripathi, N, Kannan, GM, Pant, BP, Jaiswal, DK, Malhotra, PR, and Flora, SJS. 1997. arsenic-induced changes in certain neurotransmitter levels and their recoveries following chelation in rat whole brain. Toxicol. Letters. 92: 201-208. Ref ID: 14590

Van Vleet, J. F. Induction of Lesions of Selenium Vitamin E Deficiency in Pigs Fed Silver. *American Journal of Veterinary Research.* 37(12): 1415-1420. Ref Id: 22589

Van Vleet, J. F., Boon, G. D., and Ferrans, V. J. 1981. Induction of Lesions of Selenium-vitamin E Deficiency in Ducklings Fed Silver, Copper, Cobalt, Tellurium, Cadmium, or Zinc: Protection by Selenium or Vitamin E Supplements. *Am J Vet Res.* 42(7): 1206-1217. Ref Id: 80

Van Vleet, J. F., Boon, G. D., and Ferrans, V. J. 1981. Induction of Lesions of Selenium-vitamin E Deficiency in Weanling Swine Fed Silver, Cobalt, Tellurium, Zinc, Cadmium, and Vanadium. *Am J Vet Res.* 42(5): 789-799. Ref Id: 149

Van Vleet, John F. 1977. Protection by Various Nutritional Supplements Against Lesions of Selenium-vitamin E Deficiency Induced in Ducklings Fed Tellurium or Silver. *Am. J. Vet. Res.* 38(9): 1393-8. Ref Id: 6778

Wagner, Pa, Hoekstra, Wg, and Ganther, He. 1975. Alleviation of Silver Toxicity by Slenite in the Rat in Relation to Tissue Glutathione Peroxidase. *Proc. Soc. Exp. Biol. Med.* 148: 1106. Ref Id: 14503

Whanger, P. D. and Weswig, P. H. 1970. Effect of Some Copper Antagonists on Induction of Ceruloplasmin in the Rat. *Journal of Nutrition.* 100(3): 341-8. Ref Id: 22300

7.5 References Rejected for Use in Derivation of Wildlife TRVs

Unrel 1988 annual report on alaska's mineral resources. *USGS Circular 1023. (65)*

Diss an aberrant recurrent excitatory circuit in the fascia dentata of rats following kainic acid lesions. *841660 ORDER NO: AAD84-08583*

Abstract 1966.*Abstracts of Research Reports*

Diss acetylcholine receptor clustering and formation of neuromuscular junctions in regenerating rat skeletal muscle. *833761 ORDER NO: AAD84-02406*

An Prod 1974? activity report, 1973. *Belgium, Government Agricultural Research Centre, Ghent* : 205 pp.

Diss analysis of avirulent strains of histoplasma capsulatum. *01111238 ORDER NO: AAD90-17376*

Diss analysis of the anatomical structure subserving enkephalin function in the hippocampal formation (neuropeptides). *01628714 ORDER NO: AAD98-21026*

HHE anatomical and morphological aspects of the human corpus callosum. *777819 ORDER NO: AAD82-11094*

Diss angiotensin converting enzyme in the brain, testis, epididymis, pituitary gland and adrenal gland (captopril, eukephalin convertase, peptidase, corpus striatum, guanidinoethyl mercaptosuccinic acid). *922033 ORDER NO: AAD86-16003*

Abstract 1973. annual report of the secretary for agricultural technical services forthe period 1 july 1971 to 30 june 1972. *Department of Agricultural Technical Services, South Africa* : 270pp.

Diss appearances suggesting reconstruction in the rat brain after well-defined lesions. *1052950 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss artisans in the carolina backcountry: rowan county, 1753-1770 (north carolina). *01203621 ORDER NO: AAD92-07757*

Diss assimilation of metals by sediment-ingesting invertebrates: effects of natural sediment qualities and intrinsic metal characteristics (metal uptake, leptocheirus plumulosus, exopolymers, assimilation efficiency). *01658736 ORDER NO: AAD98-41765*

HHE autoradiographic and immunofluorescent detection of low concentrations of actinomycin d bound to human metaphase chromosomes. *791581 ORDER NO: AAD82-23004*

Diss behavioural ecology of the silver leaf monkey, trachypithecus auratus sondaicus, in the pangandaran nature reserve, west java, indonesia (monkey). *01146037 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss biochemical and genetic characterization of the n-acetyltransferase polymorphism in c57bl/6j and a/j mice. *954931 ORDER NO: AAD87-12169*

Diss biological activity and biochemistry of a chemotaxin produced by blastomyces dermatitidis (fungus, neutrophils). *887291 ORDER NO: AAD85-13980*

FL 1984. breeding results in denmark in 1978-83. *Va Ra Palsdjur* 55(1): 18.

Diss the byzantine lead seals with family names from the collection of the numismatic museum of athens (numismatic museum) original title: die byzantinischen bleisiegel mit sammlung des numismatischen museums athen. *01285432 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss canine chemonucleolysis. *0978932 ORDER NO: AAD87-29924*

Diss the cardiac heparan sulfate storage site for basic fibroblast growth factor. *01138012 ORDER NO: AAD91-00229*

Diss characterisation of nuclear proteins interacting with the trout protamine genes (salmo gardnerii)|. *01208366 ORDER NO: AADNN-61681*

Diss characterization of lymphocyte-produced macrophage growth factor and its action on the proliferation of macrophages (colony stimulating factor, csf type 1). *933649 ORDER NO: AAD86-24554*

Diss characterization of membrane-associated molecules of the retinal pigmented epithelium in rat retina. *01183980 ORDER NO: AAD91-33217*

Diss the characterization of the biological and mechanical properties of porous calcium phosphate ceramics used as bone implants|. *01213302 ORDER NO: AAD92-11183*

Imm chemical sensors employing catalytic antibodies and methods using them. *PCT Int. Appl.* 102 pp.

Diss chicken chromosome analysis: location of cloned genes. *01204610 ORDER NO: AAD92-05467*

Diss the chromatin patterns of seven vertebrate species (banding, birds. cat). *0996732 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

No Oral comparative toxicity of trimethyltin in four "normal" inbred strains of mice (neurodegeneration). *01440993 ORDER NO: AADAA-I9536479*

Diss corelease of acetylcholine and gaba by an amacrine cell: evidence for independent mechanisms. *1083525 ORDER NO: AAD89-26150*

Diss cytogenetic analysis of chromosomal heterozygosity in the peromyscus maniculatus species group . *1040764 ORDER NO: AAD89-03346*

Diss dental primary afferent connectivity in the brain stem trigeminal nuclear complex (degeneration, transganglionic). *894164 ORDER NO: AAD85-21606*

Diss development and distribution of neuroepithelial bodies in the fetal hamster lung. *833519 ORDER NO: AAD84-01837*

Diss development and evaluation of monoclonal antibodies to acanthamoeba spp. (dot-immunobinding assay. *880026 ORDER NO: AAD85-08639*

Diss development of a cryosection em autoradiography technique and its application for the subcellular localization of receptors (methyl cellulose). *01618626 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss the development of order in the rat trigeminal system. *1052958 ORDER NO: AAD82-07023*

An Prod drinking water containing rare earth metals and silver-plated metals for acceleration of egg production in hens. *Jpn. Kokai Tokkyo Koho* : 4 pp.

Diss early events in the mechanism of action of nerve growth factor (neural development, map2 kinase, phosphorylation, tyrosine kinase). *01174076 ORDER NO: AAD91-25949*

Diss ecological and population genetic studies of forest-dwelling bats (louisiana, phylogenetic, corynorhinus rafinesquii, lasionycteris noctivagans, nycticeius humeralis, lasiurus seminolus, nyssa sylvatica). *01698859 ORDER NO: AAD99-25307*

Diss an ecology of the bahamian hutia (geocapromys ingrahami) (hutia).

Diss the effect of dietary fiber on canine colonic motility. *693085 ORDER NO: AAD80-18529*

Diss effect of irradiation on proliferation of endothelial cells during neovascularization of the cornea: an autoradiographic study. *826684 ORDER NO: AAD83-25722*

Diss the effect of surface charge on arterial thrombosis. *696335 ORDER NO: AAD80-21695*

Diss effects of dietary fat on production performance, body fat composition and skin storage in farm-raised mink and foxes. *01215369 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss Effects of dietary glycine and copper on metabolic symptoms INDUCED BY A METHIONINE TOXICITY IN THE CHICK :

Diss the effects of lesions of sensory and motor cortex on ingestive behavior in rats. *762801 ORDER NO: AAD81-20898*

Diss an enzyme histochemical and histopathological study of the degenerative and regenerative changes in the transected or hemisected spinal cord of the rat. *793806 ORDER NO: AAD82-12771*

Diss the evaluation of marine by-products for use as feedstuffs in mink diets. *01573034 ORDER NO: AADMM-15783*

Diss the evoked response and the modulation of cortical arousal in the visual neglect phenomenon. *794018 ORDER NO: AAD82-23730*

Diss an examination of the development and maintenance of the deafferented olfactory cortex. *1053096 ORDER NO: AAD82-12323*

Diss experimental infection of the white-footed mouse (peromyscus leucopus) with the lyme disease spirochete (borrelia burgdorferi). *0975757 ORDER NO: AAD87-28911*

Diss foraging ecology and behavior of atlantic bottlenose dolphins (tursiops truncatus) in the indian river lagoon, florida (activity budgets, habitat utilization, passive listening)|. *1593265 ORDER NO: AAD97-30127*

Diss gaze movements and the thalamic internal medullary lamina in the cat. *794459 ORDER NO: AAD82-25597*

Diss genetic and cytogenetic studies of the aprt locus of mouse friend cells. *01154302 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss geologic models of sediment-buffered hydrothermal vents: a case study of the red dog zn-pb-ag orebody, western brooks range, alaska (red dog orebody, zinc-lead-silver). *01629666 ORDER NO: AAD98-22586*

Diss geschlechtsdifferenzierung des vogelhirns: auswirkung original title: sexual dimorphism in the avian brain: effects of prenatal hormone treatment on sexual dimorphic organization and japanese quail (coturnix coturnix japonica) original title: sexual dimorphism in the avian brain: effects of prenatal hormone treatment on sexual dimorphic organization and behaviour in the japanese quail (coturnix coturnix japonica). *01464445 ORDER NO: AADAA-IC467461*

Diss glutathione transport in epithelial cells: biochemical, toxicological, and nutritional aspects . *01108242 ORDER NO: AAD90-15647*

Diss habitat use and mortality of mule deer fawns in western south dakota. *760816 ORDER NO: AAD81-24765*

Diss hereditary striatonigral and cerebello-olivary degeneration of the kerry blue terrier. *765972 ORDER NO: AAD81-28912*

Diss immunochemical studies of lipopolysaccharides isolated from strains of campylobacter jejuni and campylobacter coli (bacteria, antigen). *1019408 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss immunological studies of stage specificity of erythrocytic and exoerythrocytic merozoites of plasmodium fallax|. *879287 ORDER NO: AAD85-07138*

Diss the influence of dietary trace metals upon the enzymatic, neurochemical, and neuropathological expression of aluminum neurotoxicity. *750288 ORDER NO: AAD81-15393*

Diss insulin receptor function and regulation in erythroblastic leukemic cells. *757984 ORDER NO: AAD81-22218*

Diss intermediate filament proteins in the developing rat optic nerve. *830836 ORDER NO: AAD83-24841*

Diss intrahemispheric and commissural connections between and within commissurally and noncommissurally interconnected regions in the primary and secondary somatic sensory cerebral cortex: their possible role in interhemispheric transfer of learning in the raccoon. *694114 ORDER NO: AAD80-20707*

Diss an investigation into the efferent projections from areas 17, 18 and 18a in the albino rat cortex. *757450 ORDER NO: AAD81-20593*

Diss iron hands: the internal sources of international cooperation (cartels). *01133901 ORDER NO: AAD90-35561*

Diss local communication in an introduced colony of feral rhesus monkeys (macaca mulatta) (florida) . *825360 ORDER NO: AAD83-24996*

Diss mechanisms of axonal guidance: the problem of intersecting fiber systems (corpus callosum, glial sling, perforating fibers).

Diss morphological and neurochemical identification of enteric neuron populations in the small intestine of vertebrates|. *01431395 ORDER NO: AADAA-I9529088*

Diss morphometric study of the neuromuscular synapses in the adult rat original title: remodelacion de conexiones nerviosas en el adulto. analisis morfometrico. *1042928 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss myosin light chain kinase and selected metabolic profiles within human and rabbit skeletal muscle fibres. *01227741 ORDER NO: AADMM-61129*

Diss nerve axon outgrowth as a model for studying cell movement . *776064 ORDER NO: AAD82-07748*

Diss neural mechanisms for behavioral response specificity in the siphon-withdrawal response of aplysia. *01419071 ORDER NO: AADAA-I9519105*

Diss neuroanatomical and chemical changes within the nucleus accumbens paralleling patterns of behavioral activation in the developing rat. *1070842 ORDER NO: AAD89-14752*

Diss neurotransmitters and pathways mediating the central dipsogenic and pressor actions of angiotensin ii given intraventricularly. *749964 ORDER NO: AAD81-14238*

Diss nuclear magnetic resonance studies of avian ovomucoids and their isolated structural domains (nmr)|. *UMI - Dissertation*

FL 1975. number of kits produced at the experimental fur farm in finland. *Vara Palsdjur* 46(11): 259.

Diss or phase catalytic oxidation of propylene (oxide). *839043 ORDER NO: AAD84-06237*

Diss organophosphorus-induced delayed neuropathology in the rat . *930156 ORDER NO: AAD86-21271*

Bact 1990. performance recording of fur bearers in 1989. *Norsk Pelsdyrblad* 64(5): 10-12.

Bact 1990. performance recording of fur bearers in 1990. *Norsk Pelsdyrblad* 64(10-11): 25-26.

Diss pharmacological and biochemical properties of the benzodiazepine-gaba receptor in codfish brain in comparison with mammalian brain. *01090748 ORDER NO: AAD90-06087*

Diss plasticity of the developing neuromuscular system of infant rats exposed to non-steroidogenic fragments of acth. *0979616 ORDER NO: AAD88-01534*

Diss primary sex determination and gonadal morphogenesis in the mouse. *788840 ORDER NO: AAD82-20827*

CP 1987. proceedings. papers presented at the summer meeting of the society forveterinary ethology, wageningen, the netherlands, 16-19 july 1986. *Applied Animal Behaviour Science* 17(3/4): 365-383.

FL 1986. production recording in finland. *Va Ra Palsdjur* 57(7): 235-236.

Diss pulmonary neuroendocrine cell dynamics and regulation of circulation. *742184 ORDER NO: AAD81-02207*

Diss purification and characterization of rat fibroblast derived interferon. *921914 ORDER NO: AAD86-15733*

Diss purification, characterization, and comparison of the mammalian uterine estrogen receptors. *841650 ORDER NO: AAD84-08566*

Diss recovery and recoverability in the central nervous system following long-term ethanol consumption. *898850 ORDER NO: AAD85-23848*

Not Avail 1974. report 1973. *UK, Long Ashton Research Station* : 213 pp.

Bact 1990. results of the recording of fur bearers in 1990. *Norsk Pelsdyrblad* 64(9): 11.

Diss the role of gap-43 and growth factors on axon elongation of rat retinal ganglion cells through peripheral nervous system tissue grafts (igf-1, bfgf). *01541659 ORDER NO: AAD97-14430*

Prim silver stains for protein in gels. *U.S.* 21 pp. Cont.-in-part of U.S. Ser. No. 240,577, abandoned.

Diss spatial overlap and dietary preference of the native silver rice rat (oryzomys argentatus) and the exotic black rat (rattus rattus) in the florida keys (rat). *01123690 ORDER NO: AAD90-23238*

Diss steroid hormone regulation of substance p in the anterior pituitary and hypothalamus. *01169952 ORDER NO: AAD91-22379*

Diss studies of neurons and regeneration. *746388 ORDER NO: NOT AVAILABLE FROM UNIVERSITY MICROFILMS INT'L.*

Diss studies within the t-complex of the mouse utilizing a new embryonic lethal (tcl(0)), and the genetical markers rb7 and tcp-1. *849092 ORDER NO: AAD84-12239*

Diss a study of liver and brain 6-phosphofructo-2-kinase (pfk2) from product to enzyme (phosphofructokinase, fructose bisphosphate, aging). *01431289 ORDER NO: AADAA-I9528895*

Diss a study of the uptake and turnover of 1,5,6, tritium labeled fucose in the dental tissue of aging mice. *746751 ORDER NO: AAD81-10728*

Plant 1975. sub-tropical crops. <document title>israel, institute of horticulture: scientificactivities 1971-1974. *Israel, Institute of Horticulture* : 135 pp.

Diss supernumeraries at bushtit (psaltriparus minimus) nests: incidence, origins, and proximate causes|. *01279662 ORDER NO: AAD93-03822*

Diss the surface of pseudomonas aeruginosa in cystic fibrosis lung infection. *1030206 ORDER NO: AADDX-83315*

Diss sympathetic cardiac connections of the left sympathetic ganglia of the dog. *826569 ORDER NO: AAD83-25365*

Diss synthesis of potential prostacyclin receptor antagonist. *01679353 ORDER NO: AAD99-13188*

Diss three essays on the philippine external sector. *829966 ORDER NO: AAD83-29240*

Fungus tracking-resistant electrically insulating polymer compositions for outdoors with good resistance to moss and fungi and high-voltage outdoor electric machineries therefrom. *Jpn. Kokai Tokkyo Koho* : 6 pp.

Diss treasure of the land of darkness: a study of the fur trade and its significance for medieval russia (x-xvi centuries). *733257 ORDER NO:*

Drug treatment of septic shock with transition metal complexes. *PCT Int. Appl.* 13 pp.

Diss turnover of stratum corneum of mouse oral mucosa and skin (cell proliferation, renewal rate, mitotic index, epithelium, surface clearance). *918000 ORDER NO: AAD86-11105*

Diss vitamin-a metabolism by the vertebrate retina: an autoradiographic and radiobiochemical study . *749783 ORDER NO: AAD81-13838*

Gene Abad, F. X., Pinto, R. M., Diez, J. M., and Bosch A(A). 1994. disinfection of human enteric viruses in water by copper and silver in combination with low levels of chlorine. *Applied and Environmental Microbiology* 60(7): 2377-2383.

Chem Meth Abadia-Fenoll, F. 1968. staining pericellular boutons of glutaraldehyde-fixed nervous tissue; a chromation-silvering sequence for frozen sections. *Stain Technology* 43(4): 191-5.

Method Abadia-Fenoll, F., Ostos Garrido, M. V., Lopez-Lendinez, J. L., and Carmona Martos, R. 1985. a modification of the chronic tartrate silver impregnation technique for block impregnation of the central nervous system and paraffin wax embedding. *Journal of Microscopy* 137(Pt 3): 225-32.

Not Avail Abdel Rahim, A. G. 1985. the effects of dietary l-ascorbic acid on the absorption and utilization of na75seo3 of silver-treated rats. *Comparative Biochemistry and Physiology. C, Comparative Pharmacology.*

In Vit Aberer, E. and Duray, P. H. 1991. morphology of borrelia burgdorferi: structural patterns of cultured borreliae in relation to staining methods. *Journal of Clinical Microbiology* 29(4): 764-72.

FL Abok, K., Brunk, U., Jung, B., and Ericsson, J. 1984. morphologic and histochemical studies on the differing radiosensitivity of ductular and acinar cells of the rat submandibular gland. *Virchows Archiv* 45(4): 443-60.

FL Abok, K., Hirth, T., Ericsson, J. L., and Brunk, U. 1983. effect of iron on the stability of macrophage lysosomes. *Virchows Archiv* 43(2): 85-101.

FL Abraham, A. 1966. [silver procedures for the impregnation of elements of the nervous system]. <original> silververfahren zur impragnation der elemente des nervensystems. *Zeitschrift Fur Wissenschaftliche Mikroskopie Und Mikroskopische*

Phys Abramczyk P(A), Ziecina, R., Lisiecka, A., Papierski, K., and Przybylski, J. 2000. the adrenal renal vascular connection plays an essential role in the pathogenesis of renovascular hypertension in the rat. *Journal of Physiology and Pharmacology* 51(1): 35-40.

Prim Adachi, E., Hayashi, T., and Hashimoto, P. H. 1991. a comparison of the immunofluorescent localization of collagen types i, iii, and v with the distribution of reticular fibers on the same liver sections of the snow monkey (macaca fuscata). *Cell and Tissue Research* 264(1): 1-8.

Prim Adachi, E., Hayashi, T., and Hashimoto, P. H. 1987. type v collagen in splenic reticular fibers of the macaque monkey. *Acta Anatomica* 129(3): 169-75.

FL ADACHI, S., KAWAI, H., HOSOGAI, Y., TAKAHASHI, T., YOSHIMURA, H., KATAYAMA, H., and TAKEMOTO, K. toxicity of hijiki (hizikia fusiforme) extract containing unidentified arsenic compound. *J FOOD HYG SOC JPN; 21 (6). 1980 (RECD. 1981). 425-434.*

Chem Meth Adams, J. C. 1979. a fast, reliable silver-chromate golgi method for perfusion-fixed tissue. *Stain Technology* 54(4): 225-6.

Method Adamski Jerzy, Husen Bettina, Marks Frank, and Jungblut Peter W. 1992. purification and properties of oestradiol-17-beta dehydrogenase extracted from cytoplasmic vesicles of porcine endometrial cells. *Biochemical Journal* 288(2): 375-381.

Plant Abbott, D. L., Hislop, E. C., and Clifford, D. R. 1977. temperate tree fruits. <*Document Title>UK, Long Ashton Research Station: Report 1976.* 208 pp.

CP Al-Wahab, R. M. H., Bailie, J. H., Bastiman, B., Bateman, N., Croston, D., El-Tarabolsy, M. N., English, P. R., Galbraith, H., Hanrahan, J. P., Hocking, P. M., Jones, R., Kay, R. M., Kempster, A. J., Macfarlane, J. S., McGloughlin, P., Maund, B. A., Mulvany, P. M., O'Ferrall, G. J. M., Bryant, M. J., Dury, N. S., Norman, J. A., Scott, B. M., Morgan, J. B., Jones, D. W., Chamberlain, A. G., Hammond, D., Davidson, F. M., Smith, W. J., Silver, C. L., Dias, M. F. M., MacPherson, R. M., Miller, T. B., Quirke, J. F., Bowman, J. C., Duncan, J. G. S., Boaz, T. G., Mallinson, C. B., Little, W., Cuthbertson, A., Owen, M. G., Somerville, S. H., Lowman, B. G., Deas, D. W., and Duffell, S. J. 1977. titles and abstracts of papers for presentation at the 66th meeting ofthe british society of animal production, harrogate, 21-24 march1977. *Animal Production* 24(1): 125-162.

Not Avail Alston, F. H., Watkins, R., Sewell, G. W. F., Wilson, J. F., Howard, B. H., Burchill, R. T., Butt, D. J., North, C. J., and Cockburn, J. T. 1975. idem (continued). *UK, East Malling Research Station* : 196 pp.

CP Amoroso, E. C., Baranov, O. K., Bogdan, A. T., Boitor, I., Capaul, E. G., Deletang, F., Dell'Orto, V., Orto, V. dell', Fabre-Nys, C., First, N. L., Freund, M., Galloway, D. B., Glatzel, P., Hafez, E. S. E., Marie, M., Otel, V., Schwartmann, B., Sciaraffia, F., Sturman, H., Ting, H., Trut, L. N., King, G. J., Atkinson. B. A., Coltau, G., Angi, E., Salantiu, D., Bohm, B., Kadar, L., Mates, N., Muntean, M., Luca, L. J. de, De Luca, L. J., Petit, M., Carenzi, C., Pagnacco, G., Gerrity, M., Falvo, R., Stelmasiak, T., Lahlou-Kassi, A., Enbergs, H., Perotti, L., Kao, T. C., Chiang, K. T., and Tseng, K. C. 1980. symposium 2. ovarian activity and sexual cycle control. 61-130.

Abstract Andrews, L. D., Ansah, G. A., Buckland, R. B., Kennedy, B. W., Bartov, I., Jensen, L. S., Becker, W. A., Spencer, J. V., Mirosh, L. W., Verstrate, J. A., Bell, D. D., Swanson, M. H., Kuney, D. R., Adams, C. J., Bennett, G. I., Benoff, F. H., Berg, R. W., El Halawani, M. E., Bitgood, J. J., Shoffner, R. N., Bradley, F. A., Ogasawara, F. X., Fuqua, C. L., Buss, E. G., Campos, E. J., Baiao, N. C., Cantor, A. H., Bacon, W. L., Coleman, M. A., Carter, T. A., Martin, G. A., Ward, J. B., West, J. R., Cecil, H. C., Sexton, T. J., Cheng, S. E., Edgar, S. A., Cramerland, J., Harper, J. A., Croze, F., Etches, R. J., DeMeritt, R. J., Waibel, P. E., Ferrier, W. T., Borrelli, J., Fitzsimmons, R. C., Emsile, D. R., Garlich, J. D., Garwood, V. A., Lowe, P. C., Gebriel, G. M., Pevzner, I. Y., Nordskog, A. W. , Giesen, A. F. III., Pierson, E. E. M., McDaniel, G. R., Brake, J., Gildersleeve, R. P., Satterlee, D. G., Johnson, W. A., Harris, C. E., Kinner, J. A., Hill, L., Renden, J. A., Ingram, D. R., Wilson, H. R., Johnston, N. P., and Warner, D. H. 1979. abstracts of papers to be presented at the 68th annual meeting of thepoultry science association, inc. *Poultry Science* 58(4): 1029-1124.

Not Avail Butt, D. J., Burchill, R. T., Atkinson, D., White, G. C., Perring, M. A., Parry, M. S., and Quinlan, J. D. 1976. report for 1975. <document title>uk, east malling research station: report for 1975. *UK, East Malling Research Station* : 202 pp.

Abstract Chacon, R. S., Talbot, P., Chakraborty, J., Choong, S., Shuster, T., Rosenberg, M. D., Cole, A., Chen, R., Todd, M., Langley, R., Eastman, E. M., Wray, V. P., Wray, W., Heffner, L. J., Storey, B. T., Kaiserman, M. Z., Burkholder, G. D., Kooda-Cisco, M. J., Langmore, J. P., Schutt, C., Luckett, D. C., Mukherjee, A. B., Mrsny, R. J., Meizel, S., Myles, D. G., Primakoff, P., Yu, L., Szabo, P., Hardy, W. D. Jr., and Prensky, W. 1980. abstracts of papers presented at the twentieth annual meeting,cincinnati, ohio, 14-18 november 1980. *Journal of Cell Biology* 87(2, 2): 1a-345a.

Abstract Cooper, J. E., Ray, M., Fairfull, R. W., Haley, L. E., Castell, J. D., Glebe, B. D., Saunders, R. L., Sreedharan, A., Golding, G. B., Strobeck, C., MacKay, T. F. C., Mallet, A., Mrakovcic, M., Nagai, J., Newkirk, G. F., Roberts, F. L., Pasquine, P. C., Schom, C., Halfon, E., Scott, T., Kennedy, B. W., Buckland, R. B., Singh, R. S., Singh, S. M., Zouros, E., Stiles, S. S., and Strobeck, C. 1978. abstracts of papers presented at the twenty-third annual meeting of thegenetics society of canada, dalhousie university, halifax, nova scotiajune 13-16, 1978. *Canadian Journal of Genetics and Cytology* 20(3): 439-456.

CP Cooper, J. E., Ray, M., Fairfull, R. W., Haley, L. E., Castell, J. D., Glebe, B. D., Saunders, R. L., Sreedharan, A., Golding, G. B., Strobeck, C., MacKay, T. F. C., Mallet, A., Mrakovcic, M., Nagai, J., Newkirk, G. F., Roberts, F. L., Pasquine, P. C., Schom, C., Halfon, E., Scott, T., Kennedy, B. W., Buckland, R. B., Singh, R. S., Singh, S. M., Zouros, E., Stiles, S. S., and Strobeck, C. 1978. abstracts of papers presented at the twenty-third annual meeting ofgenetics society of canada, dalhousie university, halifax, nova scotiajune 13-16, 1978. *Canadian Journal of Genetics and Cytology* 20(3): 439-456.

CP Haas, W. P., Koteles, R. M., Stephens, J. F., Jaap, R. G., Halawani, M. E. El., Burke, W. H., Harrison, P. C., Cogburn, L. A., Brown, D. E., Hughes, B. L., Holleman, K. A., Hutt, R. B., Jones, D. G., McClung, M. R., Wang, A., Jones, W. T. McDaniel G. R., Coleman, M. A., McGibbon, W. H., Malone, G. W., Smyth, J. R. Jr., Marks, H. L., Marquez, B. J., Miller, D. H., Ferguson, T. M., Bradley, J. W., Mitchell, R. L., Buckland, R. B., Forgrave, L., Baker, R. D., Monsi, A., Enos, H. L., Nordskog, A. W., Silva, M. A., Ogasawara, F. X., Woodard A. E., Fuqua, L., Stinnett, V., Parker, J. E., Potter, L. M., Shelton, J. R., Meyer, G. B., Raffel, L. J., Buss, E. G., Rahn, A. P., Sexton, T. J., Shoffner, R. N., Shrestha, J. N. B., Otis, J., Telloni, R. V., Fechheimer, N. S., Washburn, K. W., Wilson, W. O., and Siopes, T. D. 1975. 64th annual meeting of the poultry science association (continuation). *Poultry Science* 54: 1724-1831.

Unrel Silver, R., <Editors> Wada, M., Ishii, S., and Scanes, C. G. 1990. endocrinology of birds. molecular to behavioral. *(Book)* : x + 320 pp.

Drug Ager, A. 1982.*Screening and Evaluation of Experimental Antiparasitic Drugs. <NOTE> Annual Rept. No. 14, 1 Oct 81-5 May 82*

HHE Agerholm, C., Bastholm, L., Johansen, P. B., Nielsen, M. H., and Elling, F. 1994. epithelial transport and bioavailability of intranasally administered human growth hormone formulated with the absorption enhancers didecanoyl-l-alpha-phosphatidylcholine and alpha-cyclodextrin in rabbits. *Journal of Pharmaceutical Sciences* 83(12): 1706-11.

Unrel Ahmad, K N, Ahmad, M D, Chaudhry, M R, and Sial, M B. comparative study of hatchability, fertility and embryonic mortality in the first and second laying years of white leghorn and layllpur silver black breeds. [chicken]. *J Agric Res.* Mar 1972 10 (1): 54-58. Ref.

Alt Ahmad, M. and Reams, W. M. Jr. the behavior of the donor melano blasts in the nonpigmented host embryos. *Z MIKROSK-ANAT FORSCH (LEIPZ). Zeitschrift Fuer Mikroskopisch-Anatomische Forschung (Leipzig). 90 (3). 1976 (Recd 1977) 484-488.*

FL Ahmad, M. and Reams, W. M. Jr. 1977. the behaviour of pigment cells in the leg muscle compartments of silver campine fowl. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 91(3): 573-80.

No Tox Ahmad, Z., Khan, M. Z., and Majid, M. A. 1981. effect of breed and age on parenterally induced newcastle disease. *Pakistan Veterinary Journal* 1(2): 67-69.

Phys Aibara, R. 1991. [motor innervation of the canine arytenoid muscle]. *Nippon Jibiinkoka Gakkai Kaiho* 94(6): 805-16.

No Oral Akeret, O., Haas, J. N., Leuzinger, U., and Jacomet, S. 1999. plant macrofossils and pollen in goat/sheep faeces from the neolithiclake-shore settlement arbon bleiche 3, switzerland. *Holocene* 9(2): 175-182.

Alt Al-Radawy, M. A. the differentiation of the golgi apparatus in the developing oocytes in chicken. *BULL NAT HIST RES CENT UNIV BAGHDAD. Bulletin of the Natural History Research Centre University of Baghdad. 7 (1). 1976 (Recd 1977) 1-15.*

FL Aleksandrov, P. N. and Speranskaia, T. V. 1987. [indices of acute inflammation against a background of lithium oxybutyrate action]. <original> pokazateli ostrogo vospaleniia na fone deistviia oksibutirata litiia. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 103(2): 188-90.

FL Aleksandrov, P. N., Speranskaia, T. V., Bobkov, I. u. G., Zagorevskii, V. A., and Zykov, D. A. 1986. [effect of rutin and esculamine on models of aseptic inflammation]. <original> vliianie rutina i eskulamina na nekotorye modeli aspeticheskogo vospaleniia. *Farmakologiia i Toksikologiia* 49(1): 84-6.

CP ALHEID, G. F. 1985. neurons in dorsal and ventral pallidum of rat concentrate heavy metals and project to frontal and entorhinal cortex and to mediodorsal thalamus. *AMERICAN ASSOCIATION OF ANATOMISTS 98TH ANNUAL MEETING AND THE ASSOCIATION CANADIENNE DES ANATOMISTES (CANADIAN ASSOCIATION OF ANATOMISTS) 29TH ANNUAL MEETING*

Abstract ALHEID, G. F. and HASELTON, C. L. 1988. enhanced uptake of a heavy metal silver after surgical disruption of the blood-brain barrier in rats and monkeys. *18TH ANNUAL MEETING OF THE SOCIETY FOR NEUROSCIENCE*

Aquatic Ali, M. A., Hossain, M. A., and Islam, M. A. 1992. polyculture of carps in integrated duck-cum-fish farming ponds [in bangladesh]. *Bangladesh Journal of Training and Development. V. 5(2) P. 25-32*

HHE Altar, C. A. and Bakhit, C. receptor-mediated transport of human recombinant nerve growth factor from olfactory bulb to forebrain cholinergic nuclei. *BRAIN RES. Brain Research. 541 (1). 1991. 82-88.*

Prim Amaral, D. G., Insausti, R., and Cowan, W. M. 1987. the entorhinal cortex of the monkey: i. cytoarchitectonic organization. *Journal of Comparative Neurology* 264(3): 326-55.

Prim Amaral, D. G. and Price, J. L. 1984. amygdalo-cortical projections in the monkey (macaca fascicularis). *Journal of Comparative Neurology* 230(4): 465-96.

Phys Amenta, F., Bongrani, S., Cadel, S., Ricci, A., Valsecchi, B., and Zeng, Y. C. 1994. neuroanatomy of aging brain. influence of treatment with l-deprenyl. *Annals of the New York Academy of Sciences* 717: 33-44 .

Phys Amenta, F., Del Valle, M., Vega, J. A., and Zaccheo, D. 1991. age-related structural changes in the rat cerebellar cortex: effect of choline alfoscerate treatment. *Mechanisms of Ageing and Development* 61(2): 173-86.

Phys Amenta, F., Liu, A., and Sabbatini, M. 1995. pharmacological characterization and autoradiographic localization of dihydropyridine-type calcium channels in the kidney of spontaneously hypertensive rats. *Clinical and Experimental Pharmacology & Physiology* 22 Suppl 1: S232-3.

No COC Amenta, F. and Ricci, A. autoradiographic localization of dopamine da-1 receptors in the rat renal vasculature using tritiated sch-23390 as a ligand. *J AUTON PHARMACOL. Journal of Autonomic Pharmacology. 10 (6). 1990. 373-383.*

No Oral Andreasen, A., Danscher, G., Juhl, S., Stoltenberg, M., Revsbech, N. P., Jensen, H., and Jensen, K. B. 1997. distinct differences in partial oxygen pressure at micrometer ranges in the rat hippocampal region. *Journal of Neuroscience Methods* 72(1): 15-21.

Alt Anjo, A. and Couturier, E. 1976. long-term alloxan diabetes in the rat. study of mesangial cell morphology by serial biopsies. *Pathologia Europaea.* 11(4): 239-50.

Plant Antipov, V. G. 1970.*Effect of SO Sub 2 on Generative Organs of Woody Plants. CEGB-TRANS-5924*

FL Antonenko, L. A. 1987. structure of the lymph vessels of skeletal muscle. *Vestnik Zoologii* (No.5): 54-58.

No Oral Appel, N. M., Rapoport, S. I., and O'Callaghan, J. P. 1997. sequelae of parenteral domoic acid administration in rats: comparison of effects on different anatomical markers in brain. *Vol. 25, No. 4, Pp. 350-358* Synapse

Bact Arlet, G. and Perol, Y. 1990. cat-scratch disease bacteria. *Nouvelle Revue Francaise D'Hematologie* 32(6): 461-3.

In Vit Arnolds, W. J. A. silver staining methods for the demarcation of superficial cell boundaries in whole mounts of embryos. *Mikroskopie. 35 (7-8). 1979. 202-206.*

Phys Arrighi S(A) and Domeneghini, C. 1997. peculiar granules of principal cells of equine epididymis are immunoreactive to (met)-enkephalin. *Biomedical Research (Aligarh)* 8(1): 29-36.

No Oral Arvidson, B. 1990. accumulation of mercury in brainstem nuclei of mice after retrograde axonal transport. *Acta Neurologica Scandinavica* 82(4): 234-7.

In Vit Ashwell, K. W., Hollander, H., Streit, W., and Stone, J. 1989. the appearance and distribution of microglia in the developing retina of the rat. *Visual Neuroscience* 2(5): 437-48.

No Dose Atsumi, S. the histogenesis of motor neurons with special reference to the correlation of their end plate formation part 3 the development of motor neurons innervating the inter costal muscle in the chick embryo. *ACTA ANAT. Acta Anatomica. 80 (4). 1971 (Recd 1972) 504-515.*

BioX Attridge, S. R., Daniels, D., Morona, J. K., and Morona, R. 1990. surface co-expression of vibrio cholerae and salmonella typhi o-antigens on ty21a clone ex210. *Microbial Pathogenesis* 8(3): 177-88.

Drug Aulick, L. H., McManus, A. T., Mason, A. D. Jr, and Pruitt, B. A. Jr. 1986. effects of infection on oxygen consumption and core temperature in experimental thermal injury. *Annals of Surgery* 204(1): 48-52.

FL Avrushchenko, M. S. h., Bul'chuk, O. V., Grigor'eva, A. V., and Iarygin, V. N. 1990. [changes in the structural and functional states of chromatin of the neurons of the cerebral hemisphere cortex in the early post-resuscitation period in rats]. <original> izmenenie strukturno-funktsional'nogo sostoianiia khromatina neironov kory bol'shikh polusharii krys v rannem post- reanimatsionnom periode. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 109(4): 402-5.

Phys Avrushchenko, M. Sh, Bul'chuk, O. V., Grigor'eva, A. V., and Yarygin, V. N. change in the structural and functional state of chromatin of the cerebral cortex neurons in the early postresuscitation period in rats. *BYULL EKSP BIOL MED. Byulleten' Eksperimental'Noi Biologii i Meditsiny. 109 (4). 1990. 402-405.*

FL Babenko, G. A., Mazepa, I. V., Mosulishvili, L. M., Belokoby'skii, A. I., and Shavliashili, N. S. h. 1980. [metal content of nucleic acids in experimental leukosis]. <original> soderzhanie metallov v nukleinovykh kislotakh pri eksperimental'nom leikoze. *Ukrainskii Biokhimicheskii Zhurnal* 52(5): 551-5.

FL Babenko, G. A., Mazepa, I. V., Mosulishvili, L. M., Belokoby'skii, A. I., and Shavliashvili, N. Sh. metal content in nucleic-acids during experimental leukemia. *UKR BIOKHIM ZH. Ukrainskii Biokhimicheskii Zhurnal. 52 (5). 1980 (Recd. 1981). 551-555.*

Anat Backenkohler, U., Strasmann, T. J., and Halata, Z. 1997. topography of mechanoreceptors in the shoulder joint region--a computer-aided 3d reconstruction in the laboratory mouse. *Anatomical Record* 248(3): 433-41.

FL Bajmocy, E., Bacsadi, A., Glavits, R., and Kiss, I. 1999. occurrence of porcine proliferative enteropathy in a hungarian pigherd. *Magyar Allatorvosok Lapja* 121(6): 330-336.

FL Bakken, M. 1988. effect of social status on mothering characters in silver foxes. *Va Ra Palsdjur* 59(5): 178-179.

FL Bakken, M. 1989. is it possible to predict the future maternal behaviour in silver foxcubs? *Va Ra Palsdjur* 60(9): 286-288.

CP Bakken, M. Norges Landbrukshoegskole Aas Norway Inst. for Husdyrfag and Skrede, A. ed. 1992. the relationship between open field activity, competition capacity and first year reproductive success among farmed silver fox cubs (vulpes vulpes). progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 520-528. No. 9(Suppl.)*

CP Bakken Morten. 1995. does fear of humans by silver fox affect reproductive performance and cub behaviour? *Applied Animal Behaviour Science* 44(2-4): 257.

BioX Balaban, C. D. and Severs, W. B. toxic effects of somatostatin in the cerebellum and vestibular nuclei multiple sites of action. *NEUROSCI RES. Neuroscience Research. 12 (1). 1991. 140-150.*

Drug Balakirev, N. A., Drozdova, E. I., Loenko, N. N., Bevz, N. I., Efimova, O. G., Kuzikov, A. N., Abramov, N. A., and Bondarenko, V. M. 1994. application of bifidumbakterin in fur animal husbandry. *Zootekhniya* (7): 17-19.

In Vit Baldi, C., Minoia, C., Di Nucci A, Capodaglio, E., and Manzo, L. effects of silver in isolated rat hepatocytes. *TOXICOL LETT (AMST). Toxicology Letters (Amsterdam). 41 (3). 1988. 261-268.*

Phys Banks, R. W. 1991. the distribution of static gamma-axons in the tenuissimus muscle of the cat. *Journal of Physiology* 442: 489-512.

Anat Banks, R. W. 1994. intrafusal motor innervation: a quantitative histological analysis of tenuissimus muscle spindles in the cat. *Journal of Anatomy* 185(Pt 1): 151-72.

FL Barkov, G. D., Dvoskin, Ya. G., and El'piner, L. I. effect of small concentrations of silver on some live organisms of the evolutionary series. *Vodopodgot. Ochistka Prom. Stokov (1973)* : 10, 83-91

FL Barkov, G. D. and El Piner L I. necessity of limiting silver content in drinking water mouse rat rabbit. *GIG SANIT. Gigiena i Sanitariya. 33 (6). 16-21. 1968.*

FL Barkov, G. D. and El'piner, L. I. the necessity of limiting silver levels in drinking water. *Gig. Sanit. (1968)* 33(6): 16-21

FL Barkov, G. D. and El'piner, L. I. 1968. [on the necessity of limiting the amount of silver in drinking water]. <original> o neobkhodimosti ogranicheniia kolichestva serebra v pit'evoi vode. *Gigiena i Sanitariia* 33(6): 16-21.

No Dose Barroso, C. P., Afonso, F., Caldas, M. Castro, Pinho, M., Mata, L., and Gulbenkian, S. A. 1999. suppression of 125i-vasoactive intestinal polypeptide binding sites in arteries of the hamster seminal vesicle following castration. *Histochemical Journal* 31(5): 271-276.

CP Barta, M. and Mertin, D. Slovenska Polnohospodarska Univerzita Nitra Slovak Republic. 1997. creation of the red fox type suitable for farm conditions. <original> tvorba vhodneho typu lisky cervenej pre farmove chovy. topical and prospective tasks in rearing and breeding of farm animals. part 2. [proceedings from the international conference held on the occasion of the 50th aniversary of the research institute of animal production]. <original> aktualne a perspektivne ulohy v chove a slachteni hospodarskych zvierat. 2 cast. zbornik referatov z konferencie s medzinarodnou ucastou poriadanej pri prilezitosti 50. vyrocia zalozenia ustavu. *(Pt.2) P. 269-271*

CP Bartel H(A) and Orkisz, S. 1994. ultrastructural evaluation of transcriptional activity with gold-rnase and silver staining methods. *Cell Biology International* 18(5): 409.

Drug Barua, A. B. and Olson, J. A. 1992. chemical synthesis, growth-promoting activity, and metabolism of all-trans retinyl beta-glucose in the rat. *International Journal For Vitamin And Nutrition Research.* 62(4): 298-302.

BioX Baskerville, A., Dowsett, A. B., Cook, R. W., Dennis, M. J., Cranage, M. P., and Greenaway, P. J. 1991. pneumocystis carinii pneumonia in simian immunodeficiency virus infection: immunohistological and scanning and transmission electron microscopical studies. *Journal of Pathology* 164(2): 175-84.

Prim Baskin, G. B., Chandler, F. W., and Watson, E. A. 1984. cutaneous zygomycosis in rhesus monkeys (macaca mulatta). *Veterinary Pathology* 21(1): 125-128.

Phys Basso, N., Kurnjek, M. L., Ruiz, P., and Taquini, A. C. 1993. effect of central norepinephrine depletion on renovascular hypertension and on the renin system. *Clinical and Experimental Hypertension* 15(4): 641-62.

FL Bat'kaev, A. I. 1972. some helminthiases with a natural focal occurrence in the pavlodarregion. *Voprosy Prirodnoi Ochagovosti Boleznei Alma-Ata, USSR: Akademiya Nauk Kazakhskoi SSR* (5): 158-161.

Phys Batra, S. and Konig, M. F. 1996. a novel method to demonstrate capillary geometry and perfusion patterns in rat brain from the same histological section. *Advances in Experimental Medicine and Biology* 388: 77-83.

Fate Bayer, V. E. and Pickel, V. M. 1991. gaba-labeled terminals form proportionally more synapses with dopaminergic neurons containing low densities of tyrosine hydroxylase-immunoreactivity in rat ventral tegmental area. *Brain Research* 559(1): 44-55.

No Dose Bazhan, N. M., Krass, P. M., and Trut, L. N. genetic and pheno genetic hormonal characteristics of animals 2. changes in functional interaction between gonads and the pituitary adrenal system during the process of silver fox domestication. *SOV GENET (ENGL TRANSL GENETIKA). Soviet Genetics (English Translation of Genetika). 14 (7). 1978 (1979). 891-895.*

HHE Bein, G., Bitsch, A., Hoyer, J., and Kirchner, H. 1991. the detection of human cytomegalovirus immediate early antigen in peripheral blood leucocytes. *Journal of Immunological Methods* 137(2): 175-80.

FL Beletskaia, L. V., Katasonova, L. P., and Aliev, T. S. 1981. [collector system of the thymus]. <original> kollektornaia sistema timusa. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 92(9): 371-3.

Phys Belisle, C. and Sainte-Marie, G. a modified silver impregnation technique for the observation of thick sections of lymph nodes perfused with colloidal carbon. *BIOTECH HISTOCHEM. 66 (3). 1991. 145-152.*

Phys Bell, D. R., Sabbah, H. N., and Stein, P. D. 1990. fatty streak development in the vicinity of aortic coarctations in hypercholesterolemic rabbits. *Biorheology* 27(5): 645-57.

Unrel Bell, J. A. and Manning, D. D. 1991. evaluation of campylobacter jejuni colonization of the domestic ferret intestine as a model of proliferative colitis. *American Journal Of Veterinary Research.* 52(6): 826-832.

FL Belyaev, D. K., Isakova, G. K., and Trut, L. N. early embryonal development of domesticated silver foxes. *Zhurnal Obshchei Biologii. 47 (4). 1986. 450-452.*

FL Belyaev, D. K., Isakova, G. K., and Trut, L. N. effect of selection for behavior on the early embryonic development of silver foxes. *DOKL AKAD NAUK SSSR. Doklady Akademii Nauk Sssr. 290 (6). 1986 (Recd. 1987). 1496-1498.*

FL Belyaev D K, Isakova G K, and Trut L N . 1986. the effect of selection for behaviour on the early embryonic development of silver foxes. *DOKLADY AKADEMII NAUK SSSR* 290. 124(6): 1496-1498, illustr.

FL Belyaev D K, Plyusnina I Z, and Trut L N. 1986. physiological boundaries of the sensitive period of primary socialization in silver foxes, their changes during domestication. *ZHURNAL EVOLYUTSIONNOI BIOKHIMII I FIZIOLOGII* 22. 123(6): 555-562, illustr.

FL Belyaev, D. K., Plyusnina, I. Z., and Trut, L. N. physiological boundaries of the sensitive period of primary socialization in silver foxes and changes in the boundaries during domestication. *ZH EVOL BIOKHIM FIZIOL. Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 22 (6). 1986 (Recd. 1987). 555-562.*

FL Belyaev, D. K. and Trut, L. N. reorganization of the seasonal rhythm of reproduction in silver black foxes vulpes-fulva during their selection for domestication. *ZH OBSHCH BIOL. Zhurnal Obshchei Biologii. 44 (6). 1983 (Recd. 1984). 739-752.*

FL Belyaev D K and Trut L N. 1983. reorganization of the seasonal rhythm of reproduction in the silver-black foxes during their selection for the capacity to domestication. *ZHURNAL OBSHCHEI BIOLOGII* 44. 120(6): 739-752, illustr.

No Dose Belyaev, D. K., Volobuev, V. T., Radzhabli, S. I., and Trut, L. N. investigation of the nature and role of supplementary chromosomes of silver foxes part 2 supplementary chromosomes in the selection of animals according to behavior. *SOV GENET (ENGL TRANSL GENETIKA). Soviet Genetics (English Translation of Genetika). 10 (8). 1974 (1976) 997-1003*

In Vit Benelli Umberto, Bocci Guido, Danesi Romano, Lepri Antonio, Bernardni Nunzia, Bianchi Francesco, Lupetti Mario, Dolfi Amelio, Campagni Antonio, Agen Cristiana, Nardi Marco, and Del Tacca Mario(A). 1998. the heparan sulfate suleparoide inhibits rat corneal angiogenesis and in vitro neovascularization. *Experimental Eye Research* 67(2): 133-142.

In Vit Benelli Umberto, Lepri Antonio, Nardi Marco, Danesi Romano, and Del Tacca= Mario(A). 1995. trapidil inhibits endothelial cell proliferation and angiogenesis in the chick chorioallantoic membrane and in the rat cornea. *Journal of Ocular Pharmacology and Therapeutics* 11(2): 157-166.

Method Benga Gheorghe, Banner Malcolm, and Wrigglesworth John M. 1996. quantitation of the water channel protein aquaporin (chip28) from red blood cell membranes by densitometry of silver stained polyacrylamide gels. *Electrophoresis* 17(4): 715-719.

No Dose Bennion, R. S., Williams, R. A., and Wilson, S. E. 1984. comparison of infectibility of vascular prosthetic materials by quantitation of median infective dose. *Surgery* 95(1): 22-6.

Method Benveniste, H., Cofer, G. P., Piantadosi, C. A., Davis, J. N., and Johnson, G. A. quantitative pmr imaging in focal cerebral ischemia in rat brain. *STROKE. Stroke. 22 (2). 1991. 259-268.*

Method Benveniste, H., Cofer, G. P., Piantadosi, C. A., Davis, J. N., and Johnson, G. A. 1991. quantitative proton magnetic resonance imaging in focal cerebral ischemia in rat brain. *Stroke* 22(2): 259-68.

Abstract Benvenisty, A., White, J. V., Fox, P., Modak, S., Fox, C., Voorhees, A. B., Reemtsma, K., Todd, G. J., and Nowygrod, R. development of an infection resistant vascular prosthesis using silver impregnated dacron. *16TH WORLD CONGRESS OF THE INTERNATIONAL SOCIETY FOR CARDIOVASCULAR SURGERY, RIO DE JANEIRO, BRAZIL, SEPT. 18-23, 1983. J CARDIOVASC SURG. 24 (4). 1983. 441-442.*

HHE Benyon, R. Christopher, Enciso, J. Antonio, and Befus, A. Dean(A). 1993. analysis of human skin mast cell proteins by two-dimensional gel electrophoresis: identification of tryptase as a sialylated glycoprotein. *Journal of Immunology* 151(5): 2699-2706.

No Oral Berdjis, C. C., Byers, N. T., and Bice, J. 1971.*Comparative Studies of the Effects of I125 and I131 in Rat Thyroid* : 13p.

Fate Beresford, N. A., Mayes, R. W., Crout, N. M. J., Howard, B. J., and Kanyar, B. 1994. dynamic behaviour of 110mag in sheep tissues. *Health Physics.* 66(4): 420-426.

No Dose Berestova, V. I. 1981. cobalt content in the bodies of mink, arctic foxes (alopex lagopus) and silver foxes at various stages of growth. <original> soderzhanije kobal'ta v organizme norok, nestsov i lisits raznogo vozrasta. *Scientifur. V. 5(1) P. 34-37*

FL Berestova, V. I. 1981. cobalt content in the bodies on mink, arctic foxes (alopex lagopus) and silver foxes at various stages of growth: <original> soderzhanije kobal'ta v organizme norok, nestsov i lisits ranogo vozrasta. *Scientifur.* 5(1): 34-37.

No COC Bergamaschi, M., Pierucci, L., and Branzoli, U. 1984. inhibitory activity of indobufen (*) on platelet aggregation in vivo. *Pharmacological Research Communications* 16(10): 979-85.

HHE Bergeron, J. J. M., Posner, B. I., Josefsberg, Z., and Sikstrom, R. intra cellular poly peptide hormone receptors the demonstration of specific binding sites for insulin and human growth hormone in golgi fractions isolated from the liver of female rats. *J BIOL CHEM. Journal of Biological Chemistry. 253 (11). 1978 4058-4066.*

CP Berglund, O., Hallmans, G., Nygren, C., and Taljedal I-B. effects of a diet poor in fiber on the frequency of intestinal cells stained with silver or lead-hematoxylin in mice. *XII CONGRESS OF THE INTERNATIONAL DIABETES FEDERATION, MADRID, SPAIN, SEPT. 23-28, 1985. DIABETES RES CLIN PRACT. 0 (Suppl. 1). 1985. S44.*

No Dose Berk, M. L. and Butler, A. B. efferent projections of the medial preoptic nucleus and medial hypothalamus in the pigeon columba-livia. *J COMP NEUROL. Journal of Comparative Neurology. 203 (3). 1981. 379-400.*

FL Bernatskii, V. G. 1983. the duration of pregnancy in mink in relation to the date of mating,age and colour. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Pushnogo Zverovodstva i Krolikovodstva* (29): 93-100.

FL Bernatskii, V. G. and Mashtak, Z. A. 1983. the relationship of reproductive performance of mink with the time andorganisation of mating. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Pushnogo Zverovodstva i Krolikovodstva* (29): 101-109.

No Dose Berry, J. P., Zhang, L., and Galle, P. 1995. interaction of selenium with copper, silver, and gold salts. electron microprobe study. *Journal of Submicroscopic Cytology and Pathology* 27(1): 21-8.

Gene Bidwell Christopher A(A) and Carlson Don M. 1995. characterization of vitellogenin from white sturgeon, acipenser transmontanus. *Journal of Molecular Evolution* 41(1): 104-112.

Abstract Bihlmeyer, J., Goldman, M., and Scott, L. silver nitrate ingestion 1. the effect of chronic ingestion of silver nitrate on growth thyroid function and reproduction. *66TH ANNUAL MEETING OF THE SOUTH DAKOTA ACADEMY OF SCIENCE, VERMILLION, S.D., USA, APRIL, 1981. PROC S D ACAD SCI. 60 (0). 1981 (Recd. 1982). 177-178.*

Abstract Bihlmeyer, J., Goldman, M., and Scott, L. silver nitrate ingestion 2. effects of chronic intake of silver nitrate on behavior. *66TH ANNUAL MEETING OF THE SOUTH DAKOTA ACADEMY OF SCIENCE, VERMILLION, S.D., USA, APRIL, 1981. PROC S D ACAD SCI. 60 (0). 1981 (Recd. 1982). 178.*

Imm Bilinska Barbara(A), Koziel Edyta, and Kmicikiewicz Iwona. 1998. interactions between voles/mice leydig cells and macrophages. cyto- and immunocytochemical approach. *Central-European Journal of Immunology* 23(2): 106-115.

Method Bilinski Szczepan M(A) and Bilinska Barbara. 1996. a new version of the ag-nor technique: a combination with dapi staining. *Histochemical Journal* 28(9): 651-656.

FL Bilsing, V. A. and Schuetz, M. influence of black-white-colored floor plates on heart rate and behavior of guinea-pigs cavia-porcellus. *Z VERSUCHSTIERKD. Zeitschrift Fuer Versuchstierkunde. 31 (2). 1988. 77-83.*

In Vit Birch, N. P., Christie, D. L., and Renwick, A. G. 1984. immunoreactive insulin from mouse brain cells in culture and whole rat brain. *Biochemical Journal* 218(1): 19-27.

Diss Bishara, R. H. a radiotracer distribution study of p,p'-ddt in rats and the effect of some physical and chemical factors on its excretion. *Diss. Abstr. Int.; 33(2): 675B-676B; 1972*

No Dose Bitman, J. and Wood, D. L. 1980. cholesterol and cholesteryl esters of eggs from various avian species. *Poultry Science.* 59(9): 2014-2023.

HHE Blake, J., Westphal, M., and Li, C. H. 1984. synthesis of human pancreatic growth hormone-releasing factor and two omission analogs by segment-coupling method in aqueous solution. *International Journal of Peptide and Protein Research* 24(5): 498-504.

Gene Bloom, S. E. and Bacon, L. D. 1985. linkage of the major histocompatibility (b) complex and the nucleolar organizer in the chicken. assignment to a microchromosome. *Journal of Heredity* 76(3): 146-54.

FL Blumen, G. and Merzel, J. 1972. the decrease in the concentration of organic marterial in the course of formation of the enamel matrix. *Experientia* 28(5): 545-8.

FL Boccignone, M., Damasio, L., and Sarra, C. high content of some metals in the diet and fatty acid composition of different tissues of growing chicks. *Riv. Zootec. Vet. (1982)* 10(3): 164-70

Method Boermans, H. J. 1990. diagnosis of nitrate toxicosis in cattle, using biological fluids and arapid ion chromatographic method. *American Journal of Veterinary Research* 51(3): 491-495.

Phys Bofill, Roger, Palacios, Oscar, Capdevila, Merce, Cols, Neus, Gonzalez-Duarte, Roser, Atrian, Silvia, and Gonzalez-Duarte, Pilar. a new insight into the ag+ and cu+ binding sites in the metallothionein .beta. domain. *J. Inorg. Biochem. (1999)* 73(1,2): 57-64 .

FL Bogdan, S. D. 1971. the effect of inbreeding on growth and development of rabbits. *Trudy Chuvashskogo Sel'Skokhozyaistvennogo Instituta* 8(2): 87-91.

FL Bogolepov, N. N. and Verbitskaya, L. B. electron microscopic study of the rat cerebral cortex impregnated by the golgi method. *ARKH ANAT GISTOL EMBRIOL. Arkhiv Anatomii Gistologii i Embriologii. 73 (8). 1977 81-84.*

In Vit Bonke, B. A., Bonke, D., and Scheich, H. 1979. connectivity of the auditory forebrain nuclei in the guinea fowl (numida meleagris). *Cell and Tissue Research* 200(1): 101-21.

Herp Bonnet, X., Bradshaw, D., Shine, R., and Pearson, D. 1999. why do snakes have eyes? the (non-)effect of blindness in island tiger snakes (notechis scutatus). *Vol. 46, No. 4, Pp. 267-272* Behavioral Ecology And Sociobiology

In Vit Booyse, F. M., Sedlak, B. J., and Rafelson, M. E. Jr. culture of arterial endothelial cells characterization and growth of bovine aortic cells. *THROMB DIATH HAEMORRH. Thrombosis Et Diathesis Haemorrhagica. 34 (3). 1975 (Recd 1976) 825-839.*

FL Bornstein, M. B., Iwanami, H., Lehrer, G. M., and Breitbart, L. 1968. observations on the appearance of neuromuscular relationships in cultured mouse tissues. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 92(2)

FL Borodin, P. M. a stable polymorphism in fur color among the red fox populations of kamchatka russian-sfsr ussr. *ZH OBSHCH BIOL. Zhurnal Obshchei Biologii. 43 (4). 1982. 541-546.*

Method Borodin, P. M., Oda, S., Takagishi, Y., Inoue, M., and Yamamura, H. 1993 *.Sunkusu Osu Ni Okeru Senshokutai Taigo No Denshi Kenbikyo Ni Yoru Kaiseki (Electron Microscopic Analysis of Meiotic Chromosome Pairing in Male House Musk Shrew, Suncus Murinus)*

In Vit Bosma, P. T., Kolk, S. M., Rebers, F. E. M., Lescroart, O., Roelants, I., Willems, P. H. G M, and Schulz, R. W(A). 1997. gonadotrophs but not somatotrophs carry gonadotrophin-releasing hormone receptors: receptor localisation, intracellular calcium, and gonadotrophin and gh release. *Journal of Endocrinology* 152(3): 437-446.

Phys Bottino, N. R., Anderson, R. E., and Friser, R. 1970. animal endogenous triglycerides. ii. rat and chicken adipose tissue. *Lipids* 5(2): 165-70.

BioX Boulos Laila M(A), El-Mansoury Salwa T(A), Hegazy Iman H(A), El-Gohari Samira H, and Ebrahim Eman R(A). 1996. detection of trichinella pseudospiralis antigen in the parenteral phase in experimentally infected mice. *Journal of the Egyptian Society of Parasitology* 26(1): 9-17.

FL Bozhilova-Pastirova, A. 1990. [a structural and ultrastructural study of the inferior olivary complex in ground squirrels (citellus citellus l.)]. <original> strukturno i ultrasturno izsledvane na dolniia olivaren kompleks u laluger (citellus citellus l.). *Eksperimentalna Meditsina i Morfologiia* 29(4): 1-7.

FL Braastad, B. 1988. relationship between behaviour and reproductive performance in foxes. *Va Ra Palsdjur* 59(5): 180-184.

FL Braastad, B. O. 1999. ethological research related to animal welfare at the department ofanimal science, the agricultural university of norway. *Nordisk Jordbrugsforskning* 81(3): 286-292.

CP Brannan, L. R., Turner, C. M. R(A), and Phillips, R. S. 1994. malaria parasites undergo antigenic variation at high rates in vivo. *Proceedings of the Royal Society of London Series B Biological Sciences* 256(1345): 71-75.

Abstract Brauer, M. M., Casanova, G., Kanovich, S., and Sotelo, J. R. development of the innervation of the uro genital system in the fetal mouse. *23RD ANNUAL MEETING OF THE AMERICAN SOCIETY FOR CELL BIOLOGY, SAN ANTONIO, TEX., USA, NOV. 29-DEC. 3, 1983. J CELL BIOL. 97 (5 Part 2). 1983. 479a.*

FL Brauer, M. M., Kanovich, S., Casanova, G., and Sotelo, J. R. 1985. development of the innervation of the urogenital complex in the fetal mouse. *Experientia* 41(12): 1605-7.

Bact Braun U(A), Anliker, H., Corboz, L., and Ossent, P. 1997. spiral-shaped bacteria in the abomasum of cows. *Schweizer Archiv Fuer Tierheilkunde* 139(11): 507-516.

FL Braun, U. Zurich Univ. Switzerland Klinik fuer Wiederkaeuer und Pferdemedizin, Anliker, H., Corboz, L., and Ossent, P. 1997. [investigations into the prevalence of spiral-shaped bacteria in the abomasum of cattle]. <original> untersuchungen ueber das vorkommen von spiralfoermigen bakterien im labmagen des rindes. *Schweizer Archiv Fuer Tierheilkunde. <Subtitle>Archives Suisses De Medecine Veterinaire. Archivio Svizzero Di Medicina Veterinaria. Swiss Archive for Veterinary Medicine. V. 139(11) P. 507-516*

Phys Brautigam, R. T., Porter, R. S., Frasch, F., and Kutalek, S. P. 1991. chronic stability of bipolar epicardial plunge electrodes in dogs. *Journal of Investigative Surgery* 4(2): 153-9.

Drug Brenneman, D. E., Nicol, T., Warren, D., and Bowers, L. M. 1990. vasoactive intestinal peptide: a neurotrophic releasing agent and an astroglial mitogen. *Journal of Neuroscience Research* 25(3): 386-94.

Aquatic Breteler, R. J., Williams, J. W., and Buhl, R. L. measurement of chronic toxicity using the opossum shrimp mysidopsis bahia. *Hydrobiologia (1982)* 93(1-2): 189-94.

Abstract Brigham, D., Hu, M. L., Lamberts, D., and Spallholz, J. E. 1983. effect of dietary selenium and silver on tissue glutathione-peroxidase activity and incidence of cataracts in mice. *Federation Proceedings* 42: 927.

Method Brigstock, D. R., Heap, R. B., Barker, P. J., and Brown, K. D. purification and characterization of heparin-binding growth factors from porcine uterus. *Biochemical Journal. 266 (1). 1990. 273-282.*

Anat Brinkman, R. and Martin, A. H. 1973. a cytoarchitectonic study of the spinal cord of the domestic fowl gallus gallus domesticus. i. brachial region. *Brain Research* 56: 43-62.

In Vit Brooker, B. E. and Fuller, R. 1975. adhesion of lactobacilli to the chicken crop epithelium. *Journal of Ultrastructure Research* 52(No.1): 21-31.

CP Brown, E. R., Roth, K. A., and Krause, J. E. 1991. sexually dimorphic distribution of substance p in specific anterior pituitary cell populations. *Proceedings of the National Academy of Sciences of the United States of*

Phys Brum-Zorrilla, N., De Catalfo G H, Degiovanangelo, C., Wainberg, R. L., and De Fronza T G. calomys-laucha chromosome rodentia cricetidae from uruguay and argentina. Caryologia. 43 (1). 1990. 65-78.

FL Brzozowski, M. 1995. study on fox reproduction in poland. <original> studia nad rozplodem lisow w polsce. *60 P. No. 204*

FL Brzozowski, M. Szkola Glowna Gospodarstwa Wiejskiego Akademia Rolnicza Warszawa Poland Inst. Hodowli i Technologii Produkcji Zwierzecej. 1984. collection, evaluation and conservation of semen of silver fox (vulpes vulpes l.) and an attempt to test males as sperm donors. <original> pobieranie, ocena i przechowywanie nasienia lisow srebrzystych (vulpes vulpes l.) oraz proba oceny samcow jako dawcow nasienia. *Roczniki Naukowe Zootechniki. <Subtitle>Polish Journal of Animal Science and Technology. V. 11(2) P. 31-39*

Phys Buijs, R. M., Van der Beek, E. M., Renaud, L. P., Day, T. A., and Jhamandas, J. H. 1990. oxytocin localization and function in the a1 noradrenergic cell group: ultrastructural and electrophysiological studies. *Neuroscience* 39(3): 717-25.

FL Bulau, P. 1980. [orientation of nerve fiber systems in the tangential plane of layer i of the rat neocortex]. <original> vorzugsrichtungen von fasersystemen in der tangentialebene von lamina i des neocortex der ratte. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 94(5): 913-29.

No Oral Buntin, J. D. and Walsh, R. J. 1988. in vivo autoradiographic analysis of prolactin binding in brain and choroid plexus of the domestic ring dove. *Cell and Tissue Research* 251(1): 105-9.

Nut def Bunyan, J., Diplock, A. T., Cawthorne, M. A., and Green, J. 1968. vitamin e and stress. 8. nutritional effects of dietary stress with silver in vitamin e-deficient chicks and rats. *British Journal of Nutrition* 22(2): 165-82.

CP Burgess Andrew W O, Paradise Lois J(A), Hilbelink Don, and Friedman Herman. 1994. adherence of treponema pallidum subsp. pallidum in the rabbit placenta. *Proceedings of the Society for Experimental Biology and Medicine* 207(2): 180-185.

Phys Burton, K. A., Kabigting, E. B., Steiner, R. A., and Clifton, D. K. 1995. identification of target cells for growth hormone's action in the arcuate nucleus. *American Journal of Physiology* 269(4 Pt 1): E716-22.

Phys Buscher, H. P., Schramm, U., MacNelly, S., Kurz, G., and Gerok, W. 1991. the acinar location of the sodium-independent and the sodium-dependent component of taurocholate uptake. a histoautoradiographic study of rat liver. *Journal of Hepatology* 13(2): 169-78.

No Org Butler, J. and Cosmos, E. differentiation of the avian latissimus dorsi primordium analysis of fiber type expression using the myosin atpase histochemical reaction. *Journal of Experimental Zoology. 218 (2). 1981. 219-232.*

Prim Buttner-Ennever, J. A., Cohen, B., Pause, M., and Fries, W. 1988. raphe nucleus of the pons containing omnipause neurons of the oculomotor system in the monkey, and its homologue in man. *Journal of Comparative Neurology* 267(3): 307-21.

BioX Calera, J. A., Lopez-Medrano, R., Ovejero, M. C., Puente, P., and Leal, F. 1994. variability of aspergillus nidulans antigens with media and time and temperature of growth. *Infection and Immunity* 62(6): 2322-33.

Prim Cano, J., Pasik, P., and Pasik, T. 1989. early postnatal development of the monkey globus pallidus: a golgi and electron microscopic study. *Journal of Comparative Neurology* 279(3): 353-67.

CP Cao J(A) and Cheng M-F(A). 1999. temporal changes in apoptosis after brain lesions in young and adult ring doves. *Society for Neuroscience Abstracts* 25(1-2): 1777.

FL Capella, C., Vassallo, G., and Solcia, E. 1971. light and electron microscopic identification of the histamine-storing argyrophil (ecl) cell in murine stomach and of its equivalent in other mammals. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 118(1)

Prim Carpenter, M. B. and Batton, R. R. 3d. 1980. abducens internuclear neurons and their role in conjugate horizontal gaze. *Journal of Comparative Neurology* 189(1): 191-209.

Prim Carpenter, M. B. and Pierson, R. J. 1973. pretectal region and the pupillary light reflex. an anatomical analysis in the monkey. *Journal of Comparative Neurology* 149(3): 271-300.

Phys Carstens, E., Leah, J., Lechner, J., and Zimmermann, M. 1990. demonstration of extensive brainstem projections to medial and lateral thalamus and hypothalamus in the rat. *Neuroscience* 35(3): 609-26.

Chem Meth Caruolo, E. V. and Minchew, P. 1985. a method for silver impregnation of mammary myoepithelia. *Stain Technology* 60(5): 255-60.

Phys Caselli, C., Carlier, H., and Bezard, J. 1990. erucic acid metabolism in rat heart. a combined biochemical and radioautographical study. *Archives Internationales De Physiologie Et De Biochimie* 98(6): 377-95.

Prim Cass, S. P., Davidson, P., and Goshgarian, H. 1989. survival of the vestibular nerve after labyrinthectomy in the cat. *Otolaryngology--Head and Neck Surgery* 101(4): 459-65.

Method Cathieni, M. M. and Taban, C. H. 1992. microwave-aided binding of gold-protein-ligand (gpl) complexes. light microscopic observations in the rat brain. *Journal of Histochemistry and Cytochemistry* 40(3): 387-401.

In Vit Centrella, M. and Canalis, E. 1987. isolation of egf-dependent transforming growth factor (tgf beta-like) activity from culture medium conditioned by fetal rat calvariae. *Journal of Bone and Mineral Research* 2(1): 29-36.

No Tox Chae G-T and Choe, J. transformation of subcutaneous reticular cells by injection of allogenic thymocytes in chickens. *Journal of Catholic Medical College. 38 (2). 1985. 417-430.*

FL Chan, A. W. K., Schanley, D. L., and Leong, F. W. 1980. the adequacy of thiamine in liquid diets used in animal models ofalcoholism. *Experientia* 36(7): 859-860.

Imm Chan, H. M., Pringle, G. A., and Cherian, M. G. 1992. heterogeneity of antibodies to metallothionein isomers and development of a simple enzyme-linked immunosorbent assay. *Journal of Biochemical Toxicology* 7(4): 219-27.

Phys Chan, J., Aoki, C., and Pickel, V. M. 1990. optimization of differential immunogold-silver and peroxidase labeling with maintenance of ultrastructure in brain sections before plastic embedding. *Journal of Neuroscience Methods* 33(2-3): 113-27.

Method Chancellor, M. B., Blaivas, J. G., Levin, R. M., Kaplan, S. A., Otter, M. W., and Schussler, G. new method of measuring uroflow in the rat bladder. *Neurourology and Urodynamics. 11 (2). 1992. 123-129.*

No Oral CHANG, C. C., TATUM, H. J., and KINCL, F. A. effect of intrauterine copper and other metals on implantation in rats and hamsters. *FERTIL STERIL 21:274-278,1970*

HHE Charlton, H. M., Parry, D., Halpin, D. M., and Webb, R. 1982. distribution of 125i-labelled follicle-stimulating hormone and human chorionic gonadotrophin in the gonads of hypogonadal (hpg) mice. *Journal of Endocrinology* 93(2): 247-52.

HHE Charlton, H. M., Parry, D., Halpin, D. M. G., and Webb, R. distribution of iodine-125 labeled fsh and human chorionic gonadotropin in the gonads of hypo gonadal hpg mice. *Journal of Endocrinology. 93 (2). 1982. 247-252.*

Phys Chaudhry, M. R. and Sial, M. B. 1973. studies on the effect of lowered temperature during summer nights onthe physiological behaviour of white leghorn and lyallpur silver blacklayers. *Pakistan Journal of Science* 25(4/6): 179-182.

FL Chelidze, P. V., Mdivani, T. V., Dzidziguri, D. V., Cherkeziia, E. O., Tumanishvili, T. G., and Tumanishvili, G. D. 1992. [the 3-dimensional organization of the nucleolus and the nucleolus organizer regions in differentiated cells. iii. changes in the nature of the distribution of argentophilic proteins in the nucleoli of mouse hepatocytes with stimulation of the hepatocytes to proliferation]. <original> trekhmernaia organizatsiia iadryshka i iadryshko-obrazuiushchikh raionov differentsirovannykh kletok. iii. izmenenie kharaktera raspredeleniia argentofil'nykh belkov iadryshek gepatotsitov myshi pri stimuliatsii gepatotsitov k proliferatsii. *Tsitologiia* 34(9): 26-31.

No Org Chen, M, Ma, LQ, and Harris, WG. 1999. baseline concentrations of 15 trace elements in florida surface soils. *J. Environ. Quality*. 28: 1173-1181.

Abstract Chen, R. W., Whanger, P. D., and Weswig, P. H. rat liver metallo thionein relationship to metal metabolism. *FED PROC. Federation Proceedings. 34 (3). 1975 927*

Bio Acc Chen, S. Y. 1977. cytochemical and autoradiographic study of nuclei in zinc-deficientbuccal epithelium. *Journal of Dental Research* 56(12): 1546-1551.

FL Chernov, A. I. 1976. experiences with feeding replacement females. *Krolikovodstvo i Zverovodstvo* (4): 14-15.

No Dose Chignier, E. and Eloy, R. 1986. adventitial resection of small artery provokes endothelial loss and intimal hyperplasia. *Surgery, Gynecology & Obstetrics* 163(4): 327-34.

Phys Chilingaryan, L. I., Bogdanov, N. N., and Mats, V. N. 1996. similarity and difference between the dogs by the indices of electrical activity of the frontal cortex, hippocampus, amygdala, and hypothalamus. *Zhurnal Vysshei Nervnoi Deyatel'Nosti Imeni I. P. Pavlova* 46(6): 1018-1031.

Prim Christensen, J., Stiles, M. J., Rick, G. A., and Sutherland, J. 1984. comparative anatomy of the myenteric plexus of the distal colon in eight mammals. *Gastroenterology* 86(4): 706-13.

FL Christiansen, I. J. and Lohi, O. 1985. reproduction in foxes, 5: optimal time for artificial insemination [silver fox, blue fox, reinsemination, electrical resistance]. <original> reproduktion hos raev, 5: det optimale tidspunkt for inseminering, foreloebig meddelelse. *Aarsberetning. Kongelige Veterinaer- Og Landbohoejskole. Institut for Sterilitetsforskning. (No.28) P. 73-77*

Chem Meth Christie, K. N. 1977. the demonstration of canaliculi in sections of decalcified bone by a silver impregnation method. *Stain Technology* 52(5): 301-2.

Phys Chu, C. S., McManus, A. T., Okerberg, C. V., Mason, A. D. Jr, and Pruitt, B. A. Jr. 1991. weak direct current accelerates split-thickness graft healing on tangentially excised second-degree burns. *Journal of Burn Care & Rehabilitation* 12(4): 285-93 .

Drug Chu, C. S., McManus, A. T., Pruitt, B. A. Jr, and Mason, A. D. Jr. 1988. therapeutic effects of silver nylon dressings with weak direct current on pseudomonas aeruginosa-infected burn wounds. *Journal of Trauma* 28(10): 1488-92.

FL Chung, Keun H., Kang, Myun H., Han, In K., and Kim, Chun S. 1984. the toxicity of chromium and its interaction with silver, copper and zinc in the chicks. *Hanguk Ch'Uksan Hakhoe Chi* 26(2): 172-6 .

Gene Civitelli, M. V., Consentino, P., and Capanna, E. inter and intra-individual chromosome variability in thamnomys-gazellae rodentia muridae b-chromosomes and structural heteromorphisms. *GENETICA (The Hague). 79 (2). 1989. 93-106.*

Gene Civitelli, M. V., Consentino, P., and Capanna, E. 1989. inter- and intra-individual chromosome variability in thamnomys (grammomys) gazellae (rodentia, muridae) b-chromosomes and structural heteromorphisms. *Genetica* 79(2): 93-105.

Phys Clarke, S. and Miklossy, J. 1990. occipital cortex in man: organization of callosal connections, related myelo- and cytoarchitecture, and putative boundaries of functional visual areas. *Journal of Comparative Neurology* 298(2): 188-214.

In Vit Claude, P., Hawrot, E., Dunis, D. A., and Campenot, R. B. 1982. binding, internalization, and retrograde transport of 125i-nerve growth factor in cultured rat sympathetic neurons. *Journal of Neuroscience* 2(4): 431-42.

Drug Cockerell, C. J., Tierno, P. M., Friedman-Kien, A. E., and Kim, K. S. 1991. clinical, histologic, microbiologic, and biochemical characterization of the causative agent of bacillary (epithelioid) angiomatosis: a rickettsial illness with features of bartonellosis. *Journal of Investigative Dermatology* 97(5): 812-7.

No COC Coetzee, C. B., Casey, N. H., and Meyer, J. A. 1997. fluoride tolerance of laying hens. *British Poultry Science* 38(5): 597-602.

No COC Coetzee Christel B(A), Casey, N. H., and Meyer, J. A. 2000. the effect of water-borne fluoride on the egg production of laying hens. *Water S A (Pretoria)* 26(1): 115-118.

Mineral Coldwell, J. R. and Gensler, E. C. 1994.*Minerals Yearbook, 1992: Alaska. <NOTE> Annual Rept*

Phys Coli, A. and Marroni, P. 1996. dog retinal ganglion cells: a morphological and morphometrical study in aging. *Anatomia, Histologia, Embryologia* 25(2): 127-30.

CP Connor, M. L. influence of regulating photoperiod on furring and onset of reproductive season in silver fox. *Meeting of Eastern Branch of the Canadian Society of Animal Science, Truro, Nova Scotia, Canada, June 14-15, 1988. Can J Anim Sci. 68 (4). 1988. 1321-1322.*

Phys Cooke, P. S., Young, P., Hess, R. A., and Cunha, G. R. 1991. estrogen receptor expression in developing epididymis, efferent ductules, and other male reproductive organs. *Endocrinology* 128(6): 2874-9.

Method Coronel, C. E., Maldonado, C., Aoki, A., and Lardy, H. A(A). 1995. electron microscopic immunolocalization of caltrin proteins in guinea pig seminal vesicles. *Archives of Andrology* 35(3): 233-246.

No COC Corso, T. D., Sesma, M. A., Tenkova, T. I., Der, T. C., Wozniak, D. F., Farber, N. B., and Olney, J. W. 1997. multifocal brain damage induced by phencyclidine is augmented by pilocarpine. *Brain Research* 752(1-2): 1-14.

No Oral Cottell, D. C. and Bannigan, J. immunohistochemical detection of bromodeoxyuridine (budr) incorporated into mouse embryo cells. *Teratology 1990 Aug;42(2):22A*

Phys Courty, J., Dauchel, M. C., Caruelle, D., Perderiset, M., and Barritault, D. mitogenic properties of a new endothelial cell growth factor related to pleiotrophin. *Biochemical and Biophysical Research Communications. 180 (1). 1991. 145-151.*

HHE Cover, T. L., Dooley, C. P., and Blaser, M. J. 1990. characterization of and human serologic response to proteins in helicobacter pylori broth culture supernatants with vacuolizing cytotoxin activity. *Infection and Immunity* 58(3): 603-10.

FL Creasey, M. and Moffat, D. B. deposition of ingested silver in the rat kidney at different ages. *Experientia (1973)* 29(3): 326-7.

Unrel Crosby, E. C. and Lauer, E. W. 1968. neuroanatomy. *Progress in Neurology and Psychiatry* 23: 1-20.

Prim Crossland, W. J., Hu, X. J., and Rafols, J. A. 1994. morphological study of the rostral interstitial nucleus of the medial longitudinal fasciculus in the monkey, macaca mulatta, by nissl, golgi, and computer reconstruction and rotation methods. *Journal of Comparative Neurology* 347(1): 47-63 .

Phys Cunnane, S. C. 1990. differential utilization of long chain fatty acids during fasting-induced triacylglycerol depletion. iii. comparison of n-3 and n-6 fatty acids in rat plasma and liver. *Biochimica Et Biophysica Acta : International Journal Of Biochemistry And Biophysics.* 1036(1): 64-70.

Surv Custer, Thomas W. and Hohman, William L. trace elements in canvasbacks (aythya valisineria) wintering in louisiana, usa, 1987-1988. *Environ. Pollut. (1994)* 84(3): 253-9 .

FL Czaker, R. 1984. observations on the dynamics of argyrophilic nucleolar material in the nuclei of mice spermatids. *Experientia* 40(9): 960-3.

FL Czaker, R. and Mayr, B. 1982. comparative studies on the polymorphism of nucleolus organizer regionsin 4 breeds of domestic pigs (sus scrofa domestica) with specialemphasis on the development of breeds. *Zeitschrift Fur Die Zoologische Systematik Und Evolutionsforschung* 20(3): 233-241.

FL Dammrich, J. and Pfeifer, U. 1983. cardiac hypertrophy in rats after supravalvular aortic constriction. i. size and number of cardiomyocytes, endothelial and interstitial cells. *Virchows Archiv* 43(3): 265-86.

Aquatic Danesh, A. 1997. fish culture experiments with abramis brama orientalis in earthen pond to diversify aquaculture fish composition in iran. *Vol. 5, No. 4, Pp. 5-6* Iran. Fish. Sci. J.

FL Danilov, E. P., Metelkin, O. A., Geller, V. I., and Dorofeev, V. M. 1976. use on fur farms of distemper vaccine prepared from the "epm" strainvirus (in mink, silver foxes and arctic foxes). *Krolikovodstvo i Zverovodstvo* (5): 36-37.

Method Danscher, G. 1996. the autometallographic zinc-sulphide method: a new approach involving in vivo creation of nanometer-sized zinc sulphide crystal lattices in zinc-enriched synaptic and secretory vesicles. *Histochemical Journal* 28(5): 361-373.

Chem Meth Danscher, G. 1983. a silver method for counterstaining plastic embedded tissue. *Stain Technology* 58(6): 365-72.

HHE Danscher, G., Juhl, S., Stoltenberg, M., Krunderup, B., Schroder, H. D., and Andreasen, A. 1997. autometallographic silver enhancement of zinc sulfide crystals created in cryostat sections from human brain biopsies: a new technique that makes it feasible to demonstrate zinc ions in tissue sections from biopsies and early autopsy material. *Journal of Histochemistry and Cytochemistry* 45(11): 1503-10.

No Oral Danscher, G. and Rungby, J. differentiation of histochemically visualized mercury and silver. *Histochem. J. (1986)* 18(2-3): 109-14.

Phys Danscher, Gorm, Mosekilde, Lis, and Rungby, Jorgen. histochemical detection of zinc in mineralizing rat bone: autometallographic tracing of zinc ions in the mineralization front, osteocytes, and osteoblasts. *J. Histotechnol. (1999)* 22(2): 85-90.

Phys Dart, C., Leyland, M. L., Barrett-Jolley, R., Shelton, P. A., Spencer, P. J., Conley, E. C., Sutcliffe, M. J., and Stanfield, P. R. 1998. the dependence of ag+ block of a potassium channel, murine kir2.1, on a cysteine residue in the selectivity filter. *Journal of Physiology* 511(Pt 1): 15-24.

No Tox Das, P., Kumar, D., and Guha Roy M K. national demonstration on composite fish culture in west bengal india. *Journal of the Inland Fisheries Society of India. 7 1975 (1976) 112-115.*

Phys Dawirs, R. R., Teuchert-Noodt, G., and Kacza, J. 1992. naturally occurring degrading events in axon terminals of the dentate gyrus and stratum lucidum in the spiny mouse (acomys cahirinus) during maturation, adulthood and aging. *Developmental Neuroscience* 14(3): 210-20.

FL de Bruijn, W. C. and van Mourik, W. 1975. scanning electron microscopic observations of endothelial changes in experimentally induced atheromatosis of rabbit aortas. *Virchows Archiv. A, Pathological Anatomy and Histology* 365(1): 23-40.

HHE De Grandi, P. 1970. the routine demonstration of c cells in human and animal thyroid glands. value of a simple silver stain. *Virchows Archiv. B: Cell Pathology* 6(2): 137-50.

Phys De Nicola, L., Blantz, R. C., and Gabbai, F. B. 1991. renal functional reserve in treated and untreated hypertensive rats. *Kidney International* 40(3): 406-12.

FL De S. Costa, C. A., Benatti Neto, C., Vicentini, L. E. M., De S. Gonzaga, H. F., and Hebling, J. 1996. biological compatibility of fluoride varnish duraphat when used as cavity liner on dentin in molars rat's teeth. <original title> compatibilidade biologica do verniz fluoretado duraphat, quando aplicado sobre dentina em molares de ratos. *Vol. 25, No. 1, Pp. 61-68* Rev. Odontol. Unesp

Imm De Sa Carlos, Souriau Armel, Bernard Francoise, Salinas Jesus, and Rodolakis Annie(A). 1995. an oligomer of the major outer membrane protein of chlamydia psittaci is recognized by monoclonal antibodies which protect mice from abortion. *Infection and Immunity* 63(12): 4912-4916.

BioX Deerberg, F., Pohlmeyer, G., Wullenweber, M., and Hedrich, H. J. 1993. history and pathology of an enzootic pneumocystis carinii pneumonia in athymic han:rnu and han:nznu rats. *Journal of Experimental Animal Science* 36(1): 1-11.

Dead Degange, A. R. and Newby, T. C. mortality of sea birds and fish in a lost salmon drift net. Marine Pollution Bulletin. 11 (11). 1980. 322-323.

Phys DEGRANDCHAMP, R. L. and LOWNDES, H. E. early degeneration and sprouting at the rat neuromuscular junction following acrylamide administration. *NEUROPATHOL APPL NEUROBIOL; 16 (3). 1990. 239-254.*

Phys Delverdier, M., Cabanie, P., Roome, N., Enjalbert, F., and Van Haverbeke, G. 1991. critical analysis of the histomorphometry of rat thyroid after treatment with thyroxin and propylthiouracil. *Annales De Recherches Veterinaires* 22(4): 373-8.

Phys Delverdier, M., Cabanie, P., Roome, N., Enjalbert, F., and van Haverbeke, G. 1991. quantitative histology of the rat thyroid. influence of histologic techniques on the morphometric data. *Analytical and Quantitative Cytology and Histology* 13(2): 110-4.

FL Demenko, V. I(A), Kkorzinnikov Yu S, Petrova, E. L., and Konon, S. A. 1992. regulation of the fall of ripe sea buckthorn and dog rose fruits. *Agrokhimiya* 0(8): 99-104.

In Vit Denizeau, F. and Marion, M. 1989. genotoxic effects of heavy metals in rat hepatocytes. *Cell Biology and Toxicology* 5(1): 15-25.

FL Deryagina, M. A. manipulation activity of primates. *ZAKHAROV, A. A. (ED.). Materialy Tret'ei Vsesoyuznoi Konferentsii Po Povedeniyu Zhivotnykh, Tom 2. Povedenie Zhivotnykh V Soobshchestvakh; (Proceedings of the 3rd All-union Conference on Animal Behavior, Vol. 2. Behavior of Animals in Communities); 1983. 304p. Izdatel'stvo Nauka: Moscow, Ussr. Paper. 0 (0). 1983 (Recd. 1984). 200-202.*

Chem Meth Desclin, J. C. 1973. a simplified silver impregnation of neural end-feet in paraffin sections. *Stain Technology* 48(6): 327-31.

No Dose Dichiara, J. F., Rowley, P. P., and Ogilvie, R. W. 1980. backscatter electron imaging (bei) of paraffin sections stained with heavy metal histopathologic stains, with observations on some variables encountered in bei. *Scanning Electron Microscopy* (3): 181-8.

Abstract DINH, T. T. and RITTER, S. 1986. monosodium glutamate toxicity in neonatal rats analysis with silver stain degeneration techniques. *16TH ANNUAL MEETING OF THE SOCIETY FOR NEUROSCIENCE*

Nut def Diplock, AT, Green, J, Bunyan, J, McHale, D, and Muthy, IR. 1967. vitamin e and stress. 3. the metabolism of d-alpha-tocopherol in the rat under dietary stress with silver. *Br. J. Nutr.* 21: 115.

FL Doedens, K., Nagel, I., and Schierhorn, H. 1974. [further studies of the nude (spine-free) initial zone of the apical dendrite of cortical pyramidal cells in the albino rat]. <original> weitere untersuchungen uber die nackte (spine-freie) initialzone der apikaldendriten corticaler pyramidenzellen der albinoratte. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 88(6): 1093-109.

FL Dokukin, Yu. M. and Shorokhov, V. M. 1974. relationship between the reproductive capacity of vixens and theirphysical condition. *Krolikovodstvo i Zverovodstvo* (5): 4-5.

Phys Dong L-J and Chung, A. E. the expression of the genes for entactin laminin a laminin b1 and laminin b2 in murine lens morphogenesis and eye development. *Differentiation. 48 (3). 1991. 157-172.*

No Dose Dopfer, D., Koopmans, A., Meijer, F. A., Szakall, I., Schukken, Y. H., Klee, W., Bosma, R. B., Cornelisse, J. L., Asten, A. J. A. M. van, and Huurne, A. A. H. M. ter. 1997. histological and bacteriological evaluation of digital dermatitis incattle, with special reference to spirochaetes and campylobacterfaecalis. *Veterinary Record* 140(24): 620-623.

Phys Doucet, G., Brundin, P., Descarries, L., and Bjorklund, A. effect of prior dopamine denervation on survival and fiber outgrowth from intrastriatal fetal mesencephalic grafts. *EUR J NEUROSCI. 2 (4). 1990. 279-290.*

CP Douglas, D. A., Harri, M., Gonzalez Reyna A, Onderka, D. K., Murphy, B. D(A), <Book> Concannon P W, England, G. C. W., Verstegen, J. P., and Russell, H. A: Eds. 1994. induction of follicular development in silver foxes (vulpes vulpes) with equine chorionic gonadotrophin (ecg) and antibodies against ecg. <book> journal of reproduction and fertility; fertility and infertility in dogs, cats and other carnivores. *Journal of Reproduction and Fertility* (SUPPL. 47): 379-385.

Alt Dressler, D. P. and Skornik, W. A. 1970. silver sulfadiazine and sulfamylon cream in the burned rat model: a comparative evaluation. *Surgery* 67(4): 644-9.

No Dose Drozd, U. V., Bondarenko, S. V., Yasnetsov, V. V., Batrakov, S. G., Sakandelidze, O. G., and Shashkov, V. S. composition from laminaria saccharina increases the survival time of mice at low temperatures. *Byull. Eksp. Biol. Med. (1991)* (4): 383-4.

Method Duan, H. J., Gao, F., Oguchi, K., and Nagata, T. 1994. light and electron microscopic radioautographic study on the incorporation of 3h-thymidine into the lung by means of a new nebulizer. *Arzneimittel-Forschung* 44(7): 880-3.

Unrel Dube, Benoit, Dunning, Greg, and Lauziere, Kathleen. geology of the hope brook mine, newfoundland, canada: a preserved late proterozoic high-sulfidation epithermal gold deposit and its implications for exploration. *Econ. Geol. (1998)* 93(4): 405-436 .

Abstract Dubiel, A., Stanczyk, J. F., Krolinski, J., and Michalewska, M. concentration of ions of selected trace elements in ejaculates of boars after interruption of the flow of secretion from the testicles epididymides and accessory sex glands. *Polskie Archiwum Weterynaryjne. 21 (4). 1980. 485.*

Prim DUBIN, N. H., PARMLEY, T. H., COX, R. T., and KING, T. M. effect of silver nitrate on pregnancy termination in cynomolgus monkeys. *FERTIL STERIL 36:106-109,1981*

In Vit Dudnik, O. A. and Zatsepina, O. V. 1995. behaviour of some nucleolar proteins under the action of hypotonic medium causing 3d separation of individual nucleolar compartments. *Tsitologiya* 37(1-2): 126-132.

Phys Dupont, E., Rheaume, E., Simard, J., Luu-The, V., Labrie, F., and Pelletier, G. 1991. ontogenesis of 3 beta-hydroxysteroid dehydrogenase/delta 5-delta 4 isomerase in the rat adrenal as revealed by immunocytochemistry and in situ hybridization. *Endocrinology* 129(5): 2687-92.

Chem Meth Dutrizac, J. E. and Jambor, J. L. 1987. behavior of silver during jarosite precipitation. *Trans. - Inst. Min. Metall. Sect. C* : 96(Dec.), C206-C218.

Drug Dutton Robert C, Rampil Ira J(A), and Eger Edmond I Ii. 2000. inhaled nonimmobilizers do not alter the middle latency auditory-evoked response of rats. *Anesthesia & Analgesia* 90(1): 213-217.

No Oral Dux, M. and Jancso G(A). 1994. a new technique for the direct demonstration of overlapping cutaneous innervation territories of peptidergic c-fibre afferents of rat hindlimb nerves. *Journal of Neuroscience Methods* 55(1): 47-52.

Abstract DYCK, R. F., HALLORAN, P. F., and URMSON, J. 1989. the effect of a chemically induced acute phase stimulus on mhc expression in mice. *Annual Meeting of the Societe Canadienne De Recherches Cliniques (Canadian Society for Clinical Investigation)*

FL Dygalo N N, Bykova T S, and Naumenko E V. 1988. tyrosine hydroxylase activity in the brain of silver foxes selected for the type of behaviour. *Zhurnal Evolyutsionnoi Biokhimii i FIZIOLOGII* 24. 125(4): 503-508, illustr.

FL Dygalo, N. N., Bykova, T. S., and Naumenko, E. V. tyrosine hydroxylase activity in the brain of silver foxes selected for the type of behavior. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 24 (4). 1988. 503-508.*

Anat Ebendal, T. and Jacobson C-O. tissue explants affecting extension and orientation of axons in cultured chick embryo ganglia. *Experimental Cell Research. 105 (2). 1977 379-387.*

In Vit Ebstein, R. P., Bennett, E. R., Sokoloff, M., and Shoham, S. 1993. the effect of nerve growth factor on cholinergic cells in primary fetal striatal cultures: characterization by in situ hybridization. *Brain Research. Developmental Brain Research* 73(2): 165-72.

CP <Editors> Concannon, P. W., England, G. C. W., Verstegen, J. P., and Russell, H. A. 1993. fertility and infertility in dogs, cats and other carnivores:proceedings of the second international symposium on canine and felinereproduction, university of liege, liege, belgium, august 1992. *(Book)* : xv + 569 pp.

Method Effmann, E. L., Whitman, S., and Pexieder, T. 1986. stereomicroangiography in embryologic and teratologic investigation. *Teratology* 34(1): 103-12.

FL Egri, B., Szeness, A., and Gordos, A. 1993. observations on the composition of microflora in the respiratory andreproductive organs of furbearing animals using a new sampling device. *Magyar Allatorvosok Lapja* 48(5): 289-292.

Anat Ehrlich, D. and Mark, R. 1984. the course of axons of retinal ganglion cells within the optic nerve and tract of the chick (gallus gallus). *Journal of Comparative Neurology* 223(4): 583-91.

FL Eiberle, K. and Bucher, H. 1989. interdependence between the browsing of different tree species in aselection forest region. *Zeitschrift Fur Jagdwissenschaft* 35(4): 235-244.

Unrel Eiberle, K. and Nigg, H. 1987. basis for assessing game browsing in montane forest. *Schweizerische Zeitschrift Fur Forstwesen* 138(9): 747-785.

No Dose Eiberle, K. and Nigg, H. 1983. consequences of browsing damage to norway spruce and silver fir atmontane sites. *Schweizerische Zeitschrift Fur Forstwesen* 134(5): 361-372.

FL Eikhgorn, A. V., Ermolova, Z. S., and Kutsenko, I. N. the cardiac lymphatic bed during the postresuscitation period. *Arkhiv Anatomii Gistologii i Embriologii. 89 (10). 1985 (Recd. 1986). 64-67.*

Rev Eisler, R. 1996.*Silver Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. BIOLOGICAL-32; CONTAMINANT HAZARD REVIEWS-32*

Rev Eisler, R., Andren A.W., and Bober, T. W. (eds.). 1996. a review of silver hazards to plants and animals. pp. 143-144.

Anat Ekataksin, W. and Wake, K. liver units in three dimensions i. organization of argyrophilic connective tissue skeleton in porcine liver with particular reference to the compound hepatic lobule. *AM J ANAT. American Journal of Anatomy. 191 (2). 1991. 113-153.*

Nutrition El-Dakroury, A. A., Mahmoud, T. H. Ministry of Agriculture Cairo Egypt Animal Production Research Inst., and Kosba, M. A. 1983. effect of dietary protein level on productive performance and egg quality for silver montazah and gimmizah pullets egypt. *Agricultural Research Review. V. 61(6) P. 53-69*

Aquatic El-Sayed, A. F. M. Qatar Univ. Doha Qatar Dept. of Marine Sciences. 1994. evaluation of soybean meal, spirulina meal and chicken offal meal as protein sources for silver seabream (rhabdosargus sarba) fingerlings. *Aquaculture. V. 127(2-3) P. 169-176*

FL Elbertzhagen, H. detection of bovine casein in sheep and goat milk cheese by means of immunoelectrophoresis. *Zeitschrift Fuer Lebensmittel-Untersuchung Und -Forschung. 185 (5). 1987. 357-361.*

FL Elbertzhagen, H. 1987. [determination of cow milk-casein in sheep and goat cheese by immunoelectrophoresis]. <original> bestimmung von kuhmilch-casein in schaf- und ziegenkase mittels immunelektrophorese. *Zeitschrift Fur Lebensmittel-Untersuchung Und -Forschung* 185(5)

Anat Ellenberger, H. H. and Feldman, J. L. 1994. origins of excitatory drive within the respiratory network: anatomical localization. *Neuroreport* 5(15): 1933-6.

Unrel Elliot, H. behavior of silver gulls larus-novae-hollandiae on seeing a fairy penguin eudyptula-minor walk out of the sea at manly new-south-wales australia. *EMU. Emu. 67 (Part 3/4). 298-300. 1968.*

No Dose Elvingsson, P. 1988. reproduction and oestrous diagnosis in farmed foxes. *Scientifur* 12(3): 206.

FL Elvingsson, P. and Lagerkvist, G. 1987. reproduction of farmed foxes and methods of detection of oestrus. *Va Ra Palsdjur* 58(2): 44-51.

Chem Meth Enestrom, S. 1983. immunohistology on formol-sublimate fixed and paraplast embedded kidney tissue with comparison to formalin fixation and to pre-embedding immunofluorescent staining. *Stain Technology* 58(5): 259-71.

Imm Enestrom, S. and Hultman, P. 1995. does amalgam affect the immune system? a controversial issue. *International Archives of Allergy and Immunology* 106(3): 180-203.

FL Engbaek, K. and Frederiksen, W. 1994. [cat-scratch disease and bacillary angiomatosis. an old and a new infectious disease with common etiology?]. <original> kattekradssygdom og bacillaer angiomatosis. en gammel kending og en ny infektionssygdom med faelles aetiologi? *Ugeskrift for Laeger* 156(42): 6175-80.

No COC Ernst, E., Moller-Madsen, B., and Danscher, G. 1991. ultrastructural demonstration of mercury in sertoli and leydig cells of the rat following methyl mercuric chloride or mercuric chloride treatment. *Reproductive Toxicology*. 5(3): 205-9.

In Vit Ethell Douglas W and Steeves John D(A). 1993. changes in protein expression associated with developmental transition from permissive to restrictive states of spinal cord repair in embryonic chick. *Developmental Brain Research* 76(2): 163-169.

Phys Ettaiche Mohamed, Fillacier Kathleen, Widmann Catherine, Heurteaux Catherine, and Lazdunski Michel(A). 1999. riluzole improves functional recovery after ischemia in the rat retina. *IOVS* 40(3): 729-736.

FL Eustachiewicz, R. and Luszczewska, I. 1999. the morphology and topography of formatio hippocampi in the polar fox(alopex lagopus). *Annales Universitatis Mariae Curie-Sklodowska. Sectio DD, Medicina Veterinaria* 54: 33-45.

FL Evsikov, V. I., Vagin Yu V, Osetrova, T. D., and Matysko, E. K. fecundity of colored female american minks that are heterozygous for some fur color genes. *Tsitologiya i Genetika. 19 (5). 1985. 377-383.*

Anat FABER, H., BRAUN, K., ZUSCHRATTER, W., and SCHEICH, H. system-specific distribution of zinc in the chick brain: a light and electron-microscopic study using the timm method. *CELL TISSUE RES; 258 (2). 1989. 247-258.*

FL Fahrenkrug, P. 1987. small animal dentistry: introduction to equipment, methodology and endodontic principles. *Tijdschrift Voor Diergeneeskunde* 112 Suppl 1: 25S-33S.

Surv Falkenberg, I. D., Dennis, T. E., and Williams, B. D. 1994. organochloride pesticide contamination in three species of raptor and their prey in south australia. *WILDLIFE RESEARCH.* 21(2): 163-173.

Nutrition Faulkner, W. L. and Anderson, D. M. 1991. the effects of fiber supplementation on diet digestibility by silverfoxes. *Canadian Journal of Animal Science* 71(3): 943-947.

Phys Fayein, N. A., Courtois, Y., and Jeanny, J. C. 1990. ontogeny of basic fibroblast growth factor binding sites in mouse ocular tissues. *Experimental Cell Research* 188(1): 75-88.

FL Fehn, P. A. and McCuskey, R. S. 1971. development of the innervation of fetal mesenteric microvasculature. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 118(1)

Prim Felleman, D. J., Burkhalter, A., and Van Essen, D. C. 1997. cortical connections of areas v3 and vp of macaque monkey extrastriate visual cortex. *Journal of Comparative Neurology* 379(1): 21-47.

Bio Acc Fendick, E. A., Stevens, G. L., Brown, R. J., and Jordan, W. P. 1989. element content in tissues of four rodent species sampled in the geysers geothermal steamfield california usa. *ENVIRON POLLUT.* 58(2-3): 155-178.

In Vit Ferrara, N. and Henzel, W. J. pituitary follicular cells secrete a novel heparin-binding growth factor specific for vascular endothelial cells. *Biochemical and Biophysical Research Communications. 161 (2). 1989. 851-858.*

Prim Fiandaca, M. S., Kordower, J. H., Hansen, J. T., Jiao, S. S., and Gash, D. M. 1988. adrenal medullary autografts into the basal ganglia of cebus monkeys: injury-induced regeneration. *Experimental Neurology* 102(1): 76-91.

Unrel Filistowicz Andrzej(A), Wierzbicki Heliodor(A), and Zajaczkowska Anna(A). 1999. welfare of carnivorous furbearing animals and the future of their farm breeding and production - a review. *Prace i Materialy Zootechniczne* 0(55): 7-15.

FL Find'o, S. 1992. tolerance of tree species to browsing damage. *Lesnictvi* 38(5): 379-390.

FL Findo, S. reasons for the failure of artificial regeneration of silver fir abies-alba mill. *LESNICTVI (Prague). 34 (11). 1988. 973-990.*

FL Finger, F. L., Campanha, M. M., Barbosa, J. G., and Fontes, P. C. R. 1999. influence of ethephon, silver thiosulfate and sucrose pulsing onbird-of-paradise vase life. *Revista Brasileira De Fisiologia Vegetal* 11(2): 119-122.

Anat Finkelstein, D. I., Lang, J. G., and Luff, A. R. 1991. functional and structural changes of rat plantaris motoneurons following compensatory hypertrophy of the muscle. *Anatomical Record* 229(1): 129-37.

Chem Meth FitzGerald, M. J. and Pohlmann, M. 1966. use of the silver-hydroquinone sequence for the display of reticular fibers. *Stain Technology* 41(5): 267-72.

Prim Fitzgerald, M. J. and Sachithanandan, S. R. 1979. the structure and source of lingual proprioceptors in the monkey. *Journal of Anatomy* 128(3): 523-52.

FL Fjeldsa, J. some behavior patterns of 4 closely related grebes podiceps-nigricollis podiceps-gallardoi podiceps-occipitalis and podiceps-taczanowskii with reflections on phylogeny and adaptive aspects of the evolution of displays. *Dansk Ornithologisk Forenings Tidsskrift. 76 (1-2). 1982 (Recd. 1983). 37-68.*

FL Florez-Cossio, T. J. 1971. [modification of the gomori silver impregnation method for the visualisation of reticular fibre in paraffin embedded material]. <original> eine modifikation der silberimpragnationsmethode nach gomori zur darstellung der gitterfasern an paraffineingebettetem material. *Zeitschrift Fur Wissenschaftliche Mikroskopie Und Mikroskopische*

Prim Fonoff, R. de N, Watanabe, I. S., and Kao, T. H. 1989. [sensory nerve endings of the medium and posterior parts of cebus apella monkey's tongue mucosa]. <original> terminacoes nervosas sensitivas das partes media e posterior da mucosa lingual dorsal do macaco cebus apella. *Revista De Odontologia Da Universidade De Sao Paulo* 3(3): 377-82.

HHE Ford, L. hereditary aspects of human and canine cyclic neutropenia. *Journal of Heredity. 60 (5). 1969 293-299.*

FL Forsberg, M. 1985. insemination of foxes in 1985. *Va Ra Palsdjur* 56(11): 332.

Diss Forsberg, M. 1990. the male silver fox. effects on reproduction of sperm numbers, photoperiod and melatonin. *56 P. No. 8*

FL Forsberg, M. 1987. results of insemination of foxes in 1987. *Va Ra Palsdjur* 58(11): 394.

CP Forys Elizabeth A. 1996. why is the silver rice rat (oryzomys argentatus) so rare? *Bulletin of the Ecological Society of America* 77(3 SUPPL. PART 2): 145.

No Oral Foschi D(A), Castoldi, L., Corsi, F., Radaelli, E., and Trabucchi, E. 1994. inhibition of inflammatory angiogenesis in rats by loco-regional administration of hydrocortisone and protamine. *Agents and Actions* 42(1-2): 40-43.

No Oral Foschi D(A), Corsi, F., Cellerino, P., Fiume, M., and Trabucchi, E. 1997 . paradoxical effects of intra-arterial administration of basic fibroblast growth factor on inflammatory angiogenesis in rats. *Drugs Under Experimental and Clinical Research* 23(3-4): 123-129.

Nutrition Fowden, A. L., Rossdale, P. D., and Silver, A. eds. Physiological Laboratory University of Cambridge Downing Street Cambridge CB2 3EG United Kingdom. 1997. comparative fetal and neonatal physiology: reviews in memory of marian silver. *Equine Veterinary Journal. (Supplement,24) P. 0-117*

Drug Fox, C. L., Stanford, J. W., and Modak, S. M. topical zinc sulfadiazine therapy of pseudomonas-aeruginosa infection in burned mice and rats. *FED PROC. Federation Proceedings. 34 (3). 1975 907*

Drug Fox, C. L. Jr. 1983. topical therapy and the development of silver sulfadiazine. *Surgery, Gynecology & Obstetrics* 157(1): 82-8.

Drug Fox, C. L. Jr, Sampath, A. C., and Stanford, J. W. 1970. virulence of pseudomonas infection in burned rats and mice. comparative efficacy of silver sulfadiazine and mafenide. *Archives of Surgery* 101(4): 508-12.

No Dose Fox, J. G., Zeman, D. H., and Mortimer, J. D. 1994. copper toxicosis in sibling ferrets. *Journal of the American Veterinary Medical Association.* 205(8): 1154-6.

Gene Fox, T. W. and Smyth, J. R. Jr. 1984. the columbian restriction gene, co, and early growth rate in the domestic fowl. *Poultry Science* 63(3): 586-8.

Anat Franzoni, M. F., Viglietti-Panzica, C., Ramieri, G., and Panzica, G. C. 1984. a golgi study on the neuronal morphology in the hypothalamus of the japanese quail (coturnix coturnix japonica). i. tuberal and mammillary regions. *Cell and Tissue Research* 236(2): 357-64.

Phys Freund, T. F., Buzsaki, G., Leon, A., and Somogyi, P. 1990. hippocampal cell death following ischemia: effects of brain temperature and anesthesia. *Experimental Neurology* 108(3): 251-60.

No Dose Frindt, A. 1980. evaluation of the reproductive performance of male silver foxes (vulpesvulpes l.). *Scientifur* 4(1): 16-17.

FL Frohlich, J. and Rummelfanger, H. 1982. [a simple light and dark field set-up for documentation purposes in brain research]. <original> eine einfache auflicht-dunkelfeldeinrichtung zu dokumentationszwecken in der hirnforschung. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 96(4): 633-42.

Method Fry Michael J, Panayotou George, Dhand Ritu, Gout Fernanda Vv= Ruiz-Larreaan, Nguyen Oanh, Courtneidge Sara A, and Waterfield Michael D(A). 1992. purification and characterization of a

phosphatidylinositol 3-kinase complex from bovine brain by using phosphopeptide affinity columns. *Biochemical Journal* 288(2): 383-393.

HHE Fu, A. Z., Morris, J. C., Ford, G. C., and Nair, K. S. 1997. sequential purification of human apolipoprotein b-100, albumin, and fibrinogen by immunoaffinity chromatography for measurement of protein synthesis. *Analytical Biochemistry* 247(2): 228-36 .

Gene Fuji Jun-Ichiro(A) and Wakasugi Noboru. 1993. transdifferentiation from retinal pigment epithelium (rpe) into neural retina due to silver plumage mutant gene in japanese quail. *Development Growth & Differentiation* 35(5): 487-493.

BioX Fujikura Y(A), Kuniki, H., Sawada, T., Hamano, K., Akino, T., Shigetomi, M., Hiroazane, A., and Fukumoto, T. 1994. membrane antigen expression of syngeneically but heterotopically transplanted hepatocytes in rats. *Cell Transplantation* 3(1): 23-31.

Method Fujimori, O., Ueda, H., and Yamada, K. 1991. a histochemical method for the demonstration of unsaturated lipids. *Histochemical Journal* 23(2): 91-9.

Prim Fujioka, M. projection to the striatum and the claustrum from the somatic sensory cortex in monkey macaca-irus. *BRAIN NERVE (TOKYO). Brain and NERVE (Tokyo). 32 (3). 1980. 269-279.*

In Vit Furber, S., Oppenheim, R. W., and Prevette, D. 1987. naturally-occurring neuron death in the ciliary ganglion of the chick embryo following removal of preganglionic input: evidence for the role of afferents in ganglion cell survival. *Journal of Neuroscience* 7(6): 1816-32.

Imm Furrie, E., Turner, M. W., and Strobel S(A). 1995. partial characterization of a circulating tolerogenic moiety which, after a feed of ovalbumin, suppresses delayed-type hypersensitivity in recipient mice. *Immunology* 86(3): 480-486.

Method Furukawa Kenichi(A), Yamoto Mareo, Kokawa Nobuyoshi, and Nakano Ryosuke. 1994. purification of high-molecular-weight follicle-stimulating hormone binding inhibitor in porcine follicular fluids. *European Journal of Endocrinology* 130(6): 625-633.

Method Gallyas, F., Guldner, F. H., Zoltay, G., and Wolff, J. R. 1990. golgi-like demonstration of "dark" neurons with an argyrophil iii method for experimental neuropathology. *Acta Neuropathologica* 79(6): 620-8.

Method Gallyas, F., Lohner, H., and Wolff, J. R. 1990. an argyrophil-iii method for the selective demonstration of mitochondria in aldehyde-fixed rat brain. *Journal of Neuroscience Methods* 35(3): 223-8.

Chem Meth Gallyas, F., Wolff, J. R., Bottcher, H., and Zaborszky, L. 1980. a reliable and sensitive method to localize terminal degeneration and lysosomes in the central nervous system. *Stain Technology* 55(5): 299-306.

Chem Meth Gallyas, F., Wolff, J. R., Bottcher, H., and Zaborszky, L. 1980. a reliable method for demonstrating axonal degeneration shortly after axotomy. *Stain Technology* 55(5): 291-7.

Chem Meth Gallyas, F., Zaborszky, L., and Wolff, J. R. 1980. experimental studies of mechanisms involved in methods demonstrating axonal and terminal degeneration. *Stain Technology* 55(5): 281-90.

No Tox Ganchrow Donald(A), Ganchrow Judith R, Gross-Isseroff Ruth, and Kinnamon John C. 1995. taste bud cell generation in the perihatching chick. *Chemical Senses* 20(1): 19-28.

Nutrition Ganegoda, G. A. P., Siriwardene, J. A. De S., Ekanayake, E. M. C., Jayawardena, K. M., and Poulter, R. G. 1979. dried fish silage as a protein source for poultry. 2. effect of fishquality on broiler performance. *Ceylon Veterinary Journal* 28(1/4): 12-18.

Nutrition Ganegoda, G. A. P, Siriwardene, J. A. De S., Gunaratne, S. P., Jayawardena, K. M., and Poulter, R. G. 1982. dried fish silage as a protein source for poultry. 3. comparison withfish meal using parboiled or raw rice bran as filler. *Sri Lanka Veterinary Journal* 30(1): 18-22.

Rev Ganther, H. E. 1980. interactions of vitamin e and selenium with mercury and silver. *Annals of the New York Academy of Sciences.* 355: 212-26.

Phys Gao, F., Chen, S., Sun, L., Kang, W., Wang, Z., and Nagata, T. 1995. radioautographic study of the macromolecular synthesis of leydig cells in aging mice testis. *Cellular and Molecular Biology* 41(1): 145-50.

Method Gao, K. X. and Godkin, J. D. 1991. a new method for transfer of polyethylene glycol-embedded tissue sections to silanated slides for immunocytochemistry. *Journal of Histochemistry and Cytochemistry* 39(4): 537-40.

Phys Gao, K. X., Liu, K. H., and Godkin, J. D. 1991. immunohistochemical localization of bovine placental retinol-binding protein. *International Journal of Developmental Biology* 35(4): 485-9.

Abstract Garrido, A. development of the innervation of the lungs in the fetal Mouse. *24th Annual Meeting of the American Society for Cell Biology, Kansas City, MO., USA, NOV. 12-16, 1984. J CELL BIOL. 99 (4 Part 2). 1984. 422a.*

FL Gauly M(A) and Dzapo, V. 1992. research on the oxygen utilization of pheasant embryos during incubation applying a new method. *Archiv Fuer Gefluegelkunde* 56(5): 210-212.

In Vit Gavrish, A. S. 1984. [spatial organization of the microcirculatory bed and organ-tissue functional elements of the myocardium]. <original> prostranstvennaia organizatsiia mikrotsirkuliatornogo rusla i organno-tkanevykh funktsional'nykh elementov miokarda. *Arkhiv Anatomii, Gistologii i Embriologii* 87(7): 36-42.

Phys Gearing, M., Tigges, J., Mori, H., and Mirra, S. S. 1997. beta-amyloid (a beta) deposition in the brains of aged orangutans. *Neurobiology of Aging* 18(2): 139-46.

Phys Gee, B., Warhol, M. J., and Roth, J. use of an anti-horseradish peroxidase antibody gold complex in the abc technique. *Journal of Histochemistry and Cytochemistry. 39 (6). 1991. 863-870.*

Method Gee, J. M., Amselgruber, W. M., Jasani, B., and Nicholson, R. I. 1991. use of the dinitrophenyl hapten sandwich staining procedure (dhss) to localize estrogen receptors in paraffin-embedded tissues. *Journal of Histochemistry and Cytochemistry* 39(12): 1659-70.

Chem Meth Geisert, E. E. Jr and Updyke, B. V. 1977. chemical stabilization of golgi silver chromate impregnations. *Stain Technology* 52(3): 137-41.

FL Geneser-Jensen, F. A., Haug, F. M., and Danscher, G. 1974. distribution of heavy metals in the hippocampal region of the guinea pig. a light microscope study with timm's sulfide silver method. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 147(4)

In Vit George, S. T. and Malbon, C. C. large-scale purification of beta-adrenergic receptors from mammalian cells in culture. *Preparative Biochemistry. 15 (5). 1985 (Recd. 1986). 349-366.*

Prim Gerard, A., Egloff, M., Gerard, H., El Harate A, Domingo, M., Gueant, J. L., Dang, C. D., and Degrelle, H. internalization of human sex steroid-binding protein in the monkey epididymis*Journal of Molecular Endocrinology. 5 (3). 1990. 239-252.*

Gene 1989. Non-isotopic RNA probes. Comparison between different labels and detection systems. 93 (2) : 191-6

Gene Gibson-Brown Jeremy J, Agulnik Sergei I, Silver Lee M, and Papaioannou Virginia E(A). 1998. expression of t-box genes tbx2-tbx5 during chick organogenesis. *Mechanisms of Development* 74(1-2): 165-169.

BioX Gilbert Jerome A(A), Cooper Robert C, Puryear Harry A, Glantz Jerald, Jack Sherman W, Cox Nancy M, Crawford Douglas A, Butler, R. Allen, and Buddington Karyl K. 1998. a swine model for the evaluation of efficacy of anti-microbial catheter coatings. *Journal of Biomaterials Science Polymer Edition* 9(9): 931-942.

In Vit Gilmore, R. S. C. and Bridges, J. B. histological and ultrastructural studies on the myoid cells of the thymus of the domestic fowl gallus-domesticus. *J ANAT. Journal of Anatomy. 118 (3). 1974 (Recd 1975) 409-416.*

Chem Meth Giusti, G. V. and Fiori, A. 1969; (REF:6). the histochemical detection of thallium in paraffin-embedded tissues by the sulfide-selenium-silver method. *Stain Technology; 44(6): 263-7*

Chem Meth Gladden, M. H. 1970. a modified pyridine-silver stain for teased preparations of motor and sensory nerve endings in skeletal muscle. *Stain Technology* 45(4): 161-4.

Surv Glooschenko, V., Blancher, P., Herskowitz, J., Fulthorpe, R., and Rang, S. 1986. association of wetland acidity with reproductive parameters and insect prey of the eastern kingbird tyrannus-tyrannus near sudbury, ontario. *Water Air Soil Pollut.* 30(3-4): 553-568.

FL Godovich, P. L., Nikitina, M. M., Vinogradov, V. K., and Rozen, V. B. comparative characteristics of sex steroid content in the blood plasma of a bigmouth buffalo silver carp and canal sheatfish during reproduction. *Problemy Endokrinologii. 31 (2). 1985. 70-75.*

FL Goertzen, M., Gruber, J., Dellmann, A., Clahsen, H., and Schulitz, K. P. 1993. [neurohistological studies in allogeneic cruciate ligament transplants as intra-articular ligament replacement]. <original> neurohistologische untersuchungen bei allogenen kreuzbandtransplantaten als intraartikularer bandersatz. *Zeitschrift Fur Orthopadie Und Ihre Grenzgebiete* 131(5): 420-4.

Nut def Goldberg, M., LeColle, S., Bissila-Mapahou, P., Septier, D., and Carreau, J. P. 1996. radioautographic study of the incorporation of (3h)-choline into the phospholipids of secretory ameloblasts and enamel of normal and essential-fatty-acid-deficient rats. *Advances in Dental Research* 10(2): 126-34.

Chem Meth Goldberg, S. 1972. silver staining, featuring rapid reduction, for whole mounts of retina and optic pathways in chick embryos. *Stain Technology* 47(2): 65-9.

Alt Goldberg, S. and Coulombre, A. J. 1972. topographical development of the ganglion cell fiber layer in the chick retina. a whole mount study. *Journal of Comparative Neurology* 146(4): 507-18.

Anat Goldberg, S. and Frank, B. do young axons regenerate better than old axons. *Experimental Neurology. 74 (1). 1981. 245-259.*

No Dose Goldberg, S. and Frank, B. the guidance of optic axons in the developing and adult mouse retina. *ANAT REC. Anatomical Record. 193 (4). 1979. 763-774.*

Method Gomathi, K. G. and Sharma Shail K(A). 1993. purification and reconstitution of the delta opioid receptor. *FEBS (Federation of European Biochemical Societies) Letters* 330(2): 146-150.

Phys Gonzalez-Parra, S., Argente, J., Garcia-Segura, L. M., and Chowen, J. A(A). 2000. effect of neonatal and adult testosterone treatment on the cellular composition of the adult female rat anterior pituitary. *Journal of Endocrinology.* 164(3): 265-276.

HHE Gonzalez Tania, Berlanga Jorge, and Perez Luis C. 1995. progress in preclinical studies of recombinant human epidermal growth factor in cuba. *Biotecnologia Aplicada* 12(3): 179-180.

Unrel Goodman, B. L. and Shealey, S. 1974. the response of egg quality traits to divergent growth selection. *Poultry Science. 53 (5). 1929*

Phys Goodman, J. H. and Sloviter, R. S. 1993. cocaine neurotoxicity and altered neuropeptide y immunoreactivity in the rat hippocampus; a silver degeneration and immunocytochemical study. *Brain Research* 616(1-2): 263-72.

Abstract Gorcs, T. J., Liposits, Z., Lengvari, I., Vigh, S., Schally, A. V., and Chan-Palay, V. the use of the di amino benzidine silver chromogen reaction for immuno histological detection of brain peptides and transmitters. *7th European Neuroscience Congress, Hamburg, West Germany, Sept. 12-16, 1983. Neurosci Lett. 0 (Suppl. 14). 1983. S143.*

Anat Goshgarian, H. G. 1977. a rapid silver impregnation for central and peripheral nerve fibers in paraffin and frozen sections. *Experimental Neurology* 57(1): 296-301.

CP Gottlob, R. endothelial regeneration the role of smooth muscle cells blood cells and histiocytes. *Sinzinger, H. et Al. (Ed.). Progress in Biochemical Pharmacology, Vol. 13. Atherogenesis. Morphology, Metabolism and Function of the Arterial Wall. International Atherosclerosis Conference, Vienna, Austria, April 12-16, 1977. Viii+352p. Illus. S. Karger: Basel, Switzerland; New York, N.Y., USA. ISBN 3-8055-2761-6. 1977 (Recd 1978) 276-282*

Chem Meth Goyal, R. K. and Sengupta, A. 1986. a rapid silver-free method for staining the myenteric plexus. *Stain Technology* 61(3): 127-34.

FL Gracheva, N. D. 1982. [autoradiographic study of the dna synthesis rate in subependymal cells of the rat brain]. <original> avtoradiograficheskoe izuchenie skorosti sinteza dnk v subependimnykh kletkakh golovnogo mozga krys. *Tsitologiia* 24(10): 1185-98.

Rev Graham-Bryce, I. J. insecticides and fungicides department. *Rothamsted Report for 1978 1: 125-155 1978 (38 References)*

Nut def Grasso, P., Abraham, R., Hendy, R., Diplock, A. T., Golberg, L., and Green, J. 1970. hepatocellular necrosis from dietary silver in vitamin e-deficient rats. *Journal of Pathology* 100(2): Pix.

Nut def Grasso, P., Abraham, R., Hendy, R., Diplock, A. T., Golberg, L., and Green, J. 1969. the role of dietary silver in the production of liver necrosis in vitamin e-deficient rats. *Experimental and Molecular Pathology* 11(2): 186-99.

No COC GRAUWILER, J. and SCHOEN, H. teratological experiments with ergotamine in mice,rats and rabbits. *TERATOLOGY 7:227-236,1973*

Rev Green, J. and Bunyan, J. 1969. vitamin e and the biological antioxidant theory. *Nutrition Abstracts and Reviews.* 39(2): 321-45.

Bact Greenfeld Jonathan I, Sampath Lester, Popilskis Sulli J, Brunnert Steven R, Slylianos Steven, and Modak Shanta(A). 1995. decreased bacterial adherence and biofilm formation on chlorhexidine and silver sulfadiazine-impregnanted central venous catheters implanted in swine. *Critical Care Medicine* 23(5): 894-900.

BioX Griem, P., Panthel, K., Kalbacher, H., and Gleichmann, E. 1996. alteration of a model antigen by au(iii) leads to t cell sensitization to cryptic peptides. *Vol. 26, No. 2, Pp. 279-287* Eur. J. Immunol.

FL Grigor'eva, A. V., Bul'chuk, O. V., Iushchenko, O. M., and Iarygin, V. N. 1990. [the structure and transcription activity of the neuronal chromatin in the sensorimotor cortex during postnatal differentiation]. <original> issledovanie struktury i transkriptsionnoi aktivnosti khromatina neironov sensomotornoi kory v period postnatal'noi differentsirovki. *Ontogenez* 21(5): 517-23.

Chem Meth Grinyo, A. 1968. staining of oligodendroglia with silver ammino tungstate in unembedded and embedded material. *Stain Technology* 43(1): 19-25.

Phys Grossmann, A., Erley, W., Hannon, J. B., and Ibach, H. giant surface stress in heteroepitaxial films: invalidation of a classical rule in epitaxy. *Phys. Rev. Lett. (1996)* 77(1): 127-130

FL Groth, H. P. 1972. [light and fluorescence microscopy studies on the innervation of the air sac system in birds]. <original> licht- und fluoreszenzmikroskopische untersuchungen zur innervation des luftsacksystems der vogel. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 127(1)

Method Grzybek, H., Sliwa-Tomczok, W., and Tomczok, J. 1990. application on timm sulphide silver method for electron microscope localization of lead ions in blood cells. *Folia Haematologica; Internationales Magazin Fur Klinische Und*

CP Gu, J. and D'andrea, M. a novel combined light and electron microscopic immunocytochemical procedure to study antigen distribution in the same cells at both histologic and ultrastructural levels. *Third Joint Meeting of the Japanese Society of Histochemistry and Cytochemistry and the Histochemical Society, Seattle, Washington, Usa, August 8-11, 1990. Acta Histochem Cytochem. 23 (5). 1990. 699.*

In Vit Gu, Xin Xing, Tsai, Chao Ming, Apicella, M. A., and Lim, D. J. 1995. quantitation and biological properties of released and cell-bound lipooligosaccharides from nontypeable haemophilus influenzae. *Vol. 63, No. 10, Pp. 4115-4120* Infect. Immun.

No Oral Guedes, R. M. C., Zica, K. G. B., and Nogueira, R. H. G. 1998. phycomycosis and cutaneous habronemiasis: retrospective study of diagnosed cases from 1979 to 1996. *Arquivo Brasileiro De Medicina Veterinaria e Zootecnia* 50(4): 465-468.

Alt Gugliucci, A. and Allard, M. F. 1996. glycation of hepatocyte cytosolic proteins in streptozotocin-induced diabetic rats. *Biochemical And Biophysical Research Communications.* 229(3): 952-958.

Prim Guridi, J., Herrero, M. T., Luquin, M. R., Guillen, J., Ruberg, M., Laguna, J., Vila, M., Javoy-Agid, F., Agid, Y., Hirsch, E., and Obeso, J. A. 1996. subthalamotomy in parkinsonian monkeys. behavioural and biochemical analysis. *Brain* a journal of neurology; 119(Pt 5): 1717-27.

FL Gurina, O. I. u., Mamontov, S. G., and Banin, V. V. 1987. [proliferative activity of endotheliocytes of growing corneal capillaries in the rabbit]. <original> proliferativnaia aktivnost' endoteliotsitov rastushchikh kapilliarov rogovitsy glaza krolika. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 103(5): 613-7.

FL Guschlbauer, B. 1980. nor (nucleolus organisator region) behaviour in peripheral blood cellsof pig as shown by silver dye technique of thesis. *Wiener Tierarztliche Monatsschrift* 67(11): 342.

Method Gutterer Jan Mirko, Dringen Ralf(A), Hirrlinger Johannes, and Hamprecht Bernd. 1999. purification of glutathione reductase from bovine brain, generation of an antiserum, and immunocytochemical localization of the enzyme in neural cells. *Journal of Neurochemistry* 73(4): 1422-1430.

Prim Haber, S. N., Wolfe, D. P., and Groenewegen, H. J. 1990. the relationship between ventral striatal efferent fibers and the distribution of peptide-positive woolly fibers in the forebrain of the rhesus monkey. *Neuroscience* 39(2): 323-38.

FL Hacker, G. W., Springall, D. R., Van Noorden, S., Bishop, A. E., Grimelius, L., and Polak, J. M. 1985. the immunogold-silver staining method. a powerful tool in histopathology. *Virchows Archiv* 406(4): 449-61.

FL Hackman, C. R. and Vapaatalo, H. 1972. reproducible chemography in autoradiographs of rat brain. *Experientia* 28(4): 492-3.

Prim Hahn, L. J., Kloiber, R., Leininger, R. W., Vimy, M. J., and Lorscheider, F. L. 1990. whole-body imaging of the distribution of mercury released from dental fillings into monkey tissues [see comments]. *FASEB Journal* 4(14): 3256-60.

FL Hahn von Dorsche, H., Scheibner, R., Fehrmann, P., and Sulzmann, R. 1973. [histotopochemistry of the islet organ (langerhans) of the pancreas in wister rats. iv. studies on heavy metal content]. <original> beitrage zur histotopochemie des inselorgans (langerhans) des pankreas von wistar-ratten. iv. untersuchungen uber den schwermetallgehalt. *Acta Histochemica* 46(1): 60-7.

Imm Hainfeld, J. F. and Furuya, F. R. 1992. a 1.4-nm gold cluster covalently attached to antibodies improves immunolabeling. *Journal of Histochemistry and Cytochemistry* 40(2): 177-84.

In Vit Hajos, F., Balazs, R., Baker, R. E., Gerics, B., and Nuijtinck, R. 1994. structural maturation, cell proliferation and bioelectric activity in long-term slice-cultures of immature rat hippocampus. *Vol. 12, No. 2, Pp. 87-97* Int. J. Dev. Neurosci.

FL Hakanson, R. and Owman, C. 1969. argyrophilic reaction of histamine-containing epithelial cells in murine gastric mucosa. *Experientia* 25(6): 625-6.

Prim Halata, Z. and Munger, B. L. 1980. sensory nerve endings in rhesus monkey sinus hairs. *Journal of Comparative Neurology* 192(4): 645-63.

Method 1991. Cerium as amplifying agent--an improved cerium-perhydroxide-DAB-nickel (Ce/Ce-H2O2-DAB-Ni) method for the visualization of cerium phosphate in resin sections. 37 (3) : 295-307

Phys Hale, D. W., Hedin, M. C., Smith, S. A., Sudman, P. D., and Greenbaum, I. F. 1991. the effect of heterochromatin on synapsis of the sex chromosomes of peromyscus (rodentia, cricetidae). *Cytogenetics and Cell Genetics* 56(1): 48-56.

In Vit Halfter, W. and Deiss, S. 1984. axon growth in embryonic chick and quail retinal whole mounts in vitro. *Developmental Biology* 102(2): 344-55.

Anat Halfter, W., Deiss, S., and Schwarz, U. 1985. the formation of the axonal pattern in the embryonic avian retina. *Journal of Comparative Neurology* 232(4): 466-80.

In Vit Halfter, W., Newgreen, D. F., Sauter, J., and Schwarz, U. 1983. oriented axon outgrowth from avian embryonic retinae in culture. *Developmental Biology* 95(1): 56-64.

HHE Halleen, J., Hentunen, T. A., Hellman, J., and Vaeaenaenen, H. K. 1996. tartrate-resistant acid phosphatase from human bone: purification and development of an immunoassay. *Vol. 11, No. 10, Pp. 1444-1452* J. Bone Miner. Res.

No Oral Halonen, T., Miettinen, R., Toppinen, A., Tuunanen, J., Kotti, T., and Riekkinen, P. J. Sr. 1995. vigabatrin protects against kainic acid-induced neuronal damage in the rat hippocampus. *Neuroscience Letters* 195(1): 13-6.

Fate Ham, Kathryn N. and Tange, J. D. 1972. silver deposition in rat glomerular basement membrane. *Aust. J. Exp. Biol. Med. Sci.* 50(4): 423-34 .

Phys Hamburger, D. A., Yinnon, A. T., and Gerber, R. B. fractal dimension of disordered submonolayers: determination from he scattering data. *Chem. Phys. Lett. (1996)* 253(3,4): 223-229.

Not Avail Hamdy, S. M., Kosba, M. A., Mahmoud, T. H., and El-Turky, A. I. 1982. comparative study on the performance of four local breeds of chickens.2. feed utilization and livability in the laying house. 573-581.

Phys Hanawa, M., Takano, Y., and Wakita, M. 1990. an autoradiographic study of calcium movement in the enamel organ of rat molar tooth germs. *Archives of Oral Biology* 35(11): 899-906.

Herp Hancock, S. N., Agulnik, S. I., Silver, L. M., and Papaioannou, V. E. 1999. mapping and expression analysis of the mouse ortholog of xenopus eomesodermin. *Mechanisms of Development* 81(1-2): 205-8.

No Oral Handl, J., Kallweit, E., Henning, M., and Szwec, L. 2000. on the long-term behaviour of 110 mag in the soil-plant system and itstransfer from feed to pig. *Journal of Environmental Radioactivity* 48(2): 159-170.

Abstract HANNA, L., PETERS, J. M., WILEY, L. M., CLEGG, M. S., and KEEN, C. L. 1996. comparative effects of essential and nonessential metals on preimplantation mouse embryo development. *EXPERIMENTAL BIOLOGY 96*

FL Hanusova-Oravcova, E., Hanus, A., and Lohi, O. 1994. reproduction ability in different colour types of nutria. *Scientifur* 18(4): 267-270.

Plant Haq Raza-Ul. 1992. effect of seed production, distribution, viability, losses and germination on the natural regeneration of silver fir (abies pindrow) in moist temperate forests of pakistan. *Pakistan Journal of Forestry* 42(2): 102-111.

CP Harri, M., Mononen, J., Kasanen, S., Ahola, L., <Editors> Rutter, S. M., Rushen, J., Randle, H. D., and Eddison, J. C. 1995. choice between floor type and floor level in farmed silver foxes. <document title>proceedings of the 29th international congress of theinternational society for applied ethology: exeter, uk, 3-5 august,1995. 171-172.

CP Harri, M., Mononen, M., Rekila, T., and Korhonen, H. use of resting platforms and whole year nest boxes by farmbred foxes. *Meeting of the American Society of Animal Science and International*

Society of Applied Ethology, Pittsburgh, Pennsylvania, Usa, August 8-11, 1992. J Anim Sci. 70 (Suppl. 1). 1992. 175.

Unrel Harri Mikko(A), Mononen Jaakko(A), Rekila Teppo(A), and Rouvinen Kirsti. 1999. comparison of two breeding systems for timing of whelpings in farmed silver foxes. *Agricultural and Food Science in Finland* 8(1): 3-8.

HHE Harrison, H. N. pharmacology of sulfadiazine silver its attachment to burned human and rat skin and studies of gastro intestinal absorption and extension. *Archives of Surgery. 114 (3). 1979 281-285*

Phys Hatier, R., Malaprade, D., Roux, M., Nguyen B-L, Grignon, G., and Pasqualini, J. R. autoradiographic localization of tritiated estradiol in epididymis seminal vesicles and prostate of the fetal guinea-pig. *International Journal of Andrology. 13 (2). 1990. 147-154.*

Phys Hatzidimitriou, A. G., Kessissoglou, D. P., Manoussakis, G. E., Kourounakis, P. N., and Economidis, G. 1990. solid and solution behavior of sulphonylurea complexes with ions of iia group metals. molecular modeling of k[zn(clch4so2nconhc3h7)3] and action of zinc-sulphonylurea complexes as hypoglycemic agents. *Journal of Inorganic Biochemistry* 39(3): 263-76.

FL Haug, F. M. 1974. light microscopical mapping of the hippocampal region, the pyriform cortex and the corticomedial amygdaloid nuclei of the rat with timm's sulphide silver method. i. area dentata, hippocampus and subiculum. *Zeitschrift Fur Anatomie Und Entwicklungsgeschichte* 145(1): 1-27.

In Vit Hauw, J. J., Boutry, J. M., Crosnier-Suttin, N., and Robineaux, R. 1974. morphology of cultured guinea-pig cerebellum. i. pattern of development. comparison of phase contrast cinematography and silver impregnations of various cell types. *Cell and Tissue Research* 152(2): 141-64.

Chem Meth Hayashi, I., Tome, Y., and Shimosato, Y. 1989. thiosemicarbazide used after periodic acid makes methenamine silver staining of renal glomerular basement membranes faster and cleaner. *Stain Technology* 64(4): 185-90.

In Vit He, C., Muller, U., Oberthur, W., and Werdan, K. 1992. application of high resolution two-dimensional polyacrylamide gel electrophoresis of polypeptides from cultured neonatal rat cardiomyocytes: regulation of protein synthesis by catecholamines. *Electrophoresis* 13(9-10): 748-54.

FL Heckmann, F. W., Mehner, A., and Niehaus, H. 1971. fattening ability and dressing percentage of several rabbit breeds invarious weight classes. *Archiv Fur Geflugelkunde* 35(5): 197-204.

Drug Heggers, J. P., McHugh, T., Zoellner, S., Boertman, J. A., Niu, X. T., Robson, M. C., and Velanovich, V. 1989. therapeutic efficacy of timentin and augmentin versus silvadene in burn wound infections. *Journal of Burn Care & Rehabilitation* 10(5): 421-4.

Prim Heilbroner, P. L. and Kemper, T. L. 1990. the cytoarchitectonic distribution of senile plaques in three aged monkeys. *Acta Neuropathologica* 81(1): 60-5.

FL Heimer, L. and Ekholm, R. 1967. neuronal argyrophilia in early degenerative states: a light and electron-microscopic study of the glees and nauta techniques. *Experientia* 23(3): 237-9.

Nutrition Heinen, J. M. and Mensi, M. J. Jr. 1991. feeds and feeding schedules for indoor nursery culture of postlarvalfreshwater prawns macrobrachium rosenbergii. *Journal of the World Aquaculture Society* 22(2): 118-127.

Method Heinke, M. Y., Wheeler, C. H., Yan, J. X., Amin, V., Chang, D., Einstein, R., Dunn, M. J., and dos Remedios, C. G. 1999. changes in myocardial protein expression in pacing-induced canine heart failure. *Electrophoresis* 20(10): 2086-93.

FL Helgebostad, A. and Nordstoga, K. 1978. hypervitaminosis d in fur-bearing animals. *Nordisk Veterinaermedicin* 30(10): 451-455.

Chem Meth Herdman, P. R. and Taylor, J. J. 1975. suppression of connective tissue impregnation in a silver technique for demonstrating nerve fibers. *Stain Technology* 50(1): 37-42.

Mix Hermann, J. C. Goad A. Arquitt B. Stoecker R. Porter and P. L. Claypool. effects of dietary chromium, copper and zinc on plasma lipid concentrations in male japanese quail. *Nutr. Res. (N. Y.) (1998)* 18(6): 1017-1027 .

Phys Herrero, M. T., Hirsch, E. C., Kastner, A., Luquin, M. R., Javoy-Agid, F., Gonzalo, L. M., Obeso, J. A., and Agid, Y. 1993. neuromelanin accumulation with age in catecholaminergic neurons from macaca fascicularis brainstem. *Developmental Neuroscience* 15(1): 37-48.

FL Herrmann, V. 1986. [formation and repression of neuromuscular endplates in neurogenic and muscular lesions]. <original> formation und repression neuromuskularer endplatten bei neurogenen und muskularen lasionen. *Zentralblatt Fur Allgemeine Pathologie Und Pathologische Anatomie; 131*

FL Herrmann, V. the influence of lesions of nerve and muscle on the formation and repression of the neuromuscular end plates. *Zentralblatt Fuer Allgemeine Pathologie Und Pathologische Anatomie. 131 (4). 1986. 323-336.*

Prim Herzog, A. G. and Van Hoesen, G. W. 1976. temporal neocortical afferent connections to the amygdala in the rhesus monkey. *Brain Research* 115(1): 57-69.

FL Hilbig, H., Stubbe, A., and Winkelmann, E. 1989. [volumetric and golgi studies of the corpus geniculatum laterale pars dorsalis of alticola stoliczkanus barakshin and alticola argentatus semicanus]. <original> volumetrische und golgi-studien am corpus geniculatum laterale pars doralis alticola stoliczkanus barakshin und alticola argentatus semicanus. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 103(1): 14-20.

Not Prim Hill, C. H. 1979. chromium - interactions with other elements. *Dev. Nutr. Metab.* 2(Chromium Nutr. Metab.): 229-240.

Rev Hill, C. H. and Matrone, G. 1970. chemical parameters in the study of in vivo and in vitro interactions of transition elements. *Federation Proceedings.* 29(4): 1474-81.

Mix Hill, Ch, Starcher, B, and Matrone, G. 1964. mercury and silver interrelationships with copper. *J. Nutr.* 83: 107.

Method Hirabayashi, Yoshifumi. light-microscopic detection of acidic glycoconjugates with sensitized diamine procedures. *Histochem. J. (1992)* 24(7): 409-18.

In Vit Hirose, S., Yamamoto, M., Kim, S. J., Tsuchiya, M., and Murakami, K. 1983. localization of renin mrna in the mouse submandibular gland by in situ hybridization histochemistry. *Vol. 4, No. 6, Pp. 591-596* Biomed. Res.

Phys Hisano, S., Tsuruo, Y., Kagotani, Y., Daikoku, S., and Chihara, K. 1990. immunohistochemical evidence for synaptic connections between neuropeptide y-containing axons and periventricular somatostatin neurons in the anterior hypothalamus in rats. *Brain Research* 520(1-2): 170-7.

HHE Hitchcock, P. F. and Hickey, T. L. pre natal development of the human lateral geniculate nucleus. *J COMP NEUROL. Journal of Comparative Neurology. 194 (2). 1980. 395-412.*

FL Hlindkii, A. N. and Bogomolova, A. P. 1969. [formation and outflow of cerebrospinal fluid]. <original> ob obrazovanii i ottoke spinnomozgovoi zhidkosti. *Zhurnal Nevropatologii i Psikhiatrii Imeni S.S. Korsakova* 69(7)

Nut def Hoeger, H., Labudova, O., Mosgoeller, W., Herrera-Marschitz, M., Fuerst, G., Kitzmuller, E., and Lubec, B. 1998. deficient transcription of subunit rpa 40 of rna polymerase i and iii in heart of rats with neonatal asphyxia. *Life Sciences* 62(4): 275-82.

Phys Hoehn, G. T. and Clark, V. L. 1990. distribution of a protein antigenically related to the major anaerobically induced gonococcal outer membrane protein among other neisseria species. *Infection and Immunity* 58(12): 3929-33.

No Oral Hoey, M. J. 1966. the effects of metallic salts on the histology and functioning of the rat testis. *J Reprod Fertil.* 12(3): 461-472.

No Oral Hoffman, D. J., Melancon, M. J., Klein, P. N., Eisemann, J. D., and Spann, J. W. 1998. comparative developmental toxicity of planar polychlorinated biphenyl congeners in chickens, american kestrels, and common terns. *Vol. 17, No. 4, Pp. 747-757* Environ. Toxicol. Chem.

Diss Hofmo, P. O. 1988. studies on cryopreservation of fox spermatozoa and evaluation of the fertilizing capacity of frozen/thawed silver fox spermatozoa. *Vp.*

FL Hogl, O. 1975. molybdenum as a toxic factor in a swiss alpine valley. *Mitteilungen Aus Dem Gebiete Der Lebensmitteluntersuchung Und Hygiene* 66(4): 485-495.

Phys Holm, I. E. and Geneser, F. A. 1991. histochemical demonstration of zinc in the hippocampal region of the domestic pig: ii. subiculum and hippocampus. *Journal of Comparative Neurology* 305(1): 71-82.

In Vit Holm, I. E. and Geneser, F. A. 1991. histochemical demonstration of zinc in the hippocampal region of the domestic pig: iii. the dentate area. *Journal of Comparative Neurology* 308(3): 409-17.

No Dose Homma, K., Oki, H., and Watanabe, G. 1985. a plumage color mutation in japanese quails associated with female specific sterility due to oviducal dysfunction. *Japanese Journal of Animal Reproduction* 31(2): 84-89.

Phys Honea, E. C., Ogura, A., Peale, D. R., Felix, C., Murray, C. A., Raghavachari, K., Sprenger, W. O., Jarrold, M. F., and Brown, W. L. structures and coalescence behavior of size-selected silicon nanoclusters studied by surface-plasmon-polariton enhanced raman spectroscopy. *J. Chem. Phys. (1999)* 110(24): 12161-12172.

Prim Honrubia, F. M. and Elliott, J. H. 1970. efferent innervation of the retina. ii. morphologic study of the monkey retina. *Investigative Ophthalmology* 9(12): 971-6.

Alt Hoog, A., Hu, W., Abdel-Halim, S. M., Falkmer, S., Qing, L., and Grimelius, L. 1997. ultrastructural localization of insulin-like growth factor-2 (igf-2) to the secretory granules of insulin cells: a study in normal and diabetic (gk) rats. *Ultrastructural Pathology* 21(5): 457-66.

CP Horder, T. J. and Mashkas, A. silver stained whole mounts and horseradish peroxidase preparations demonstrating some of the rules of development of optic fibers in normal and experimentally manipulated embryonic chick Retinae. *Proceedings of the Physiological Society, March 27-28, 1981. J Physiol. 317 (0). 1981. 15p.*

Org met Horner, H. C., Roebuck, B. D., Smith, R. P., and English, J. P. 1983. acute toxicity of some silver salts of sulfonamides in mice and the efficacy of penicillamine in silver.*Drug and Chemical Toxicology*. 6(3): 267-77.

Chem Meth Howard, M. J. and Barnes, P. R. 1979. a silver carbonate method for cell counts of neurons and glial elements on paraffin embedded brain tissue. *Stain Technology* 54(6): 299-303.

Phys Hoyt, R. F. Jr, McNelly, N. A., McDowell, E. M., and Sorokin, S. P. 1991. neuroepithelial bodies stimulate proliferation of airway epithelium in fetal hamster lung. *American Journal of Physiology* 260(4 Pt 1): L234-40.

Anat Hoyt, R. F. Jr, McNelly, N. A., and Sorokin, S. P. 1990. dynamics of neuroepithelial body (neb) formation in developing hamster lung: light microscopic autoradiography after 3h-thymidine labeling in vivo. *Anatomical Record* 227(3): 340-50.

In Vit Hsu, H. H., Munoz, P. A., Barr, J., Oppliger, I., Morris, D. C., Vaananen, H. K., Tarkenton, N., and Anderson, H. C. 1985. purification and partial characterization of alkaline phosphatase of matrix vesicles from fetal bovine epiphyseal cartilage. purification by monoclonal antibody affinity chromatography. *Journal of Biological Chemistry* 260(3): 1826-31.

FL Huang, Y., Gan, M. H., and Liu, S. G. 1995. studies on a silver-enhanced colloidal gold assay for the detection ofporcine parvovirus antigen. *Acta Veterinaria Et Zootechnica Sinica* 26(3): 239-244.

FL Hulliger, L., Pohler, O., and Straumann, F. 1967. [influence of some pure metals and alloys on the growth of rabbit fibrocytes in tissue culture]. <original> einfluss einiger reiner metalle und legierungen auf das wachstum von kaninchenfibrocyten in gewebekulturen. *Zeitschrift Fur Die Gesamte Experimentelle Medizin Einschliesslich*

Phys Hume, W. J. 1990. a reproducible technique combining tritiated thymidine autoradiography with immunodetection of bromodeoxyuridine for double labelling studies of cell proliferation in paraffin sections of tissues. *Cell and Tissue Kinetics* 23(3): 161-8.

FL Ibata, Y. and Otsuka, N. 1968. fine structure of synapses in the hippocampus of the rabbit with special reference to dark presynaptic endings. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 91(4)

Nutrition Ibrahim, K. A. 1997. effect of feeding some local animal protein sources on the performanceof r.i.r and silver montazah. *Egyptian Poultry Science Journal* 17(2): 127-152.

Abstract Ichinohe, K., Unakami, S., Hirata, M., and Tanimoto, y. 1985. electrophoretic studies on urinary proteins using silver stain in rats. *21st Annual Meeting of the Japanese Society of Toxicological Sciences*

Method Ikezu, T., Ueda, H., Trapp, B. D., Nishiyama, K., Sha, J. F., Volonte, D., Galbiati, F., Byrd, A. L., Bassell, G., Serizawa, H., Lane, W. S., Lisanti, M. P., and Okamoto, T. 1998. affinity-purification and characterization of caveolins from the brain: differential expression of caveolin-1, -2, and -3 in brain endothelial and astroglial cell types. *Brain Research* 804(2): 177-92.

FL Insausti, R. and Gonzalo, L. M. 1980. new data on the precise location of the lacrimo-muconasal nucleus of the rat. *Experientia* 36(8): 977-8.

No Oral Intengan, H. D. and Smyth, D. D. 1997. renal alpha 2a/d-adrenoceptor subtype function: wistar as compared to spontaneously hypertensive rats. *British Journal of Pharmacology* 121(5): 861-6.

Gene Isakova, G. K. and Zhogoleva, N. N. 1997. activity of mink embryonic genome during diapause (cytogenic analysis):number of cells and size of cell nuclei in blastocysts of various sizeand age. *Genetika (Moskva)* 33(6): 822-830.

FL Isakova, G. K. and Zhogoleva, N. N. 1997. [activity of the embryonal genome of mink during diapause (cytogenetic analysis): number of cells and cell nucleus size in blastocysts or various size and age]. <original> aktivnost' embrional'nogo genoma norki vo vremia diapauzy (tsitogeneticheski analiz): chislo kletok i razmer kletochnykh iader v blastotsistakh raznogo razmera i vozrasta. *Genetika* 33(6): 822-30.

Method Ishimura, R., Noda, K., Hattori, N., Shiota, K., and Ogawa, T. 1995. analysis of rat placental plasma membrane proteins by two-dimensional gel electrophoresis. *Molecular and Cellular Endocrinology* 115(2): 149-59.

Prim Itoh, K., Wakita, M., and Kobayashi, S. 1981. innervation of the periodontium in the monkey. *Archivum Histologicum Japonicum* 44(5): 453-66.

HHE Itoh, Y., Yagishita, S., and Nakano, T. ultrastructural study on the effect of thio semi carbazide for the detection of poly saccharide on rat and human tissues including poly glucosan bodies in the human brain. *Journal of Clinical Electron Microscopy. 16 (3-4). 1983 (Recd. 1984). 343-352.*

FL Iudica, C. E. and Alberio, R. H. 1995. preliminary study of the sexual cycle of the south american nutria(myocastor coypus) by the method of exfoliative colpocytology. *Scientifur* 19(1): 33-42.

FL Ivanics, E., Glavits, R., and Hadhazy, A. 1982. occurrence of tyzzer's disease in brown hares (lepus europaeus). *Magyar Allatorvosok Lapja* 37(8): 525-527.

FL Iwasaki Taizo(A), Kojima Toshiyuki, Zeniya Yumie, and Totsukawa Kiyoshi(A). 1995. viability of porcine embryos after thawing at various temperatures with freezing slowly. *Animal Science and Technology* 66(8): 705-712.

CP Jackson-Lewis, V., Jakowec, M. W., Burke, R. E., and Przedborski, S. 1995. time course and morphology of mptp-induced neuronal death. *Society for Neuroscience Abstracts* 21(1-3): 2002.

Phys Jacquin, M. F., McCasland, J. S., Henderson, T. A., Rhoades, R. W., and Woolsey, T. A. 1993. 2-dg uptake patterns related to single vibrissae during exploratory behaviors in the hamster trigeminal system. *Journal of Comparative Neurology* 332(1): 38-58.

CP Jalkanen, L., <Book> Concannon P W, England, G. C. W., Verstegen, J. P., and Russell, H. A: Eds. 1994. sperm abnormalities in silver fox (vulpes vulpes) semen selected for artificial insemination. <book> journal of reproduction and fertility; fertility and infertility in dogs, cats and other carnivores. *Journal of Reproduction and Fertility* (SUPPL. 47): 287-290.

CP Jalkanen, L. Kuopio Univ. Finland Veterinary Research Station and Skrede, A. ed. 1992. embryonal development and embryo losses during the preimplantation period in the silver fox. progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 108-114. No. 9(Suppl.)*

In Vit James, W. M. and Klein, W. L. 1988. localization of acetylcholine receptors on isolated cns neurons: cellular and subcellular differentiation. *Journal of Neuroscience* 8(11): 4225-38.

Drug Jelenko, C., Wheeler, M. L., Anderson, A. P., Callaway, B. D., and McKinley, J. C. 1975. studies in burns: xiv, heling in burn wounds treated with ethyl linoleate alone or in combination with selected topical antibacterial agents. *Annals of Surgery* 182(5): 562-6.

In Vit Jeno, P., Jaggi, N., Luther, H., Siegmann, M., and Thomas, G. 1989. purification and characterization of a 40 s ribosomal protein s6 kinase from vanadate-stimulated swiss 3t3 cells. *Journal of Biological Chemistry* 264(2): 1293-7.

Abstract Jensen, L. S. interactions of silver and copper with selenium in chicks. *Federation Proceedings. 33 (3 Part 1). 1974 694*

Abstract Jensen, L. S., Werho, D. B., and Leyden, D. E. hepatic selenium content of chicks fed toxic levels of selenium as affected by copper silver and linseed meal. *Federation Proceedings. 35 (3). 1976 577*

In Vit Jensen, S., Sorensen, T., Moller, A. G., and Zimmer, J. 1984. intraocular grafts of fresh and freeze-stored rat hippocampal tissue: a comparison of survivability and histological and connective organization. *Journal of Comparative Neurology* 227(4): 559-68.

No Dose Jeppesen, L. L. and Pedersen, V. 1988. effect of visual isolation during pregnancy and lactation on reproductive success in silver fox vixens. *Scientifur. V. 12(4) P. 257-259*

CP Jeppesen, L. L., Pedersen, V. Copenhagen Univ. Denmark Inst. of Population Biology, and Skrede, A. ed. 1992. correlation between levels of cortisol, behaviour and nest box use in silver fox vixens. progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 505-511. No. 9(Suppl.)*

FL Jesewska, G., Leznicki, A., Geisler, W., and Maciejowski, J. 1994. the polish white neck fox. *Scientifur* 18(2): 101-103.

Phys Jhaveri, S., Edwards, M. A., and Schneider, G. E. 1991. initial stages of retinofugal axon development in the hamster: evidence for two distinct modes of growth. *Experimental Brain Research. Experimentelle Hirnforschung.*

Phys Jin, C. 1996. study on dna synthesis of aging mouse colon by light and electron microscopic radioautography. *Cellular and Molecular Biology* 42(2): 255-68.

Phys Johkura Kohei. 1996. the aging change of glycoconjugate synthesis in mouse kidney studied by 3h-glucosamine radioautography. *Acta Histochemica Et Cytochemica* 29(1): 57-63.

Anat Johnson, M. C. and Beebe, D. C. 1984. growth, synthesis and regional specialization of the embryonic chicken lens capsule. *Experimental Eye Research* 38(6): 579-92.

Drug Johnson, T. L., Kenney, R. M., McGee, W. R., and Polk, H. C. Jr. 1980. pseudomonas infection in a stallion: a case report. *Proceedings of the American Association of Equine Practitioners* 26: 111-116.

Bio Acc Jones, Allen M. and Bailey, James A. 1974. effect of silver from cloud seeding on cecal flora of rabbits. *Water Air, Soil Pollut.* 3(3): 353-63 .

Phys Jones, B. E., Holmes, C. J., Rodriguez-Veiga, E., and Mainville, L. 1991. gaba-synthesizing neurons in the medulla: their relationship to serotonin-containing and spinally projecting neurons in the rat. *Journal of Comparative Neurology* 313(2): 349-67 .

Acu Jones, M. M., Schoenheit, J. E., and Weaver, A. D. 1979. pretreatment and heavy metal ld50 values. *Toxicology and Applied Pharmacology* 49(1): 41-4.

Alt Jones, T. E. and Munger, B. L. 1985. early differentiation of the afferent nervous system in glabrous snout skin of the opossum (monodelphis domesticus). *Somatosensory Research* 3(2): 169-84.

Phys Jordan, C. L., Breedlove, S. M., and Arnold, A. P. 1991. ontogeny of steroid accumulation in spinal lumbar motoneurons of the rat: implications for androgen's site of action during synapse elimination. *Journal of Comparative Neurology* 313(3): 441-8.

Method Jorritsma-Byham, B., Witter, M. P., and Wouterlood, F. G. 1994. combined anterograde tracing with biotinylated dextran-amine, retrograde tracing with fast blue and intracellular filling of neurons with lucifer yellow: an electron microscopic method. *Journal of Neuroscience Methods* 52(2): 153-60.

Aquatic Joseph, D. 1981. partial replacement of concentrated fish food (pellets) with chickendroppings. *Bamidgeh* 33(1): 24-28.

FL Julkunen-Tiitto, R., Rousi, M., Bryant, J., Sorsa, S., Keinaenen, M., and Sikanen, H. 1996. chemical diversity of several betulaceae species: comparison of phenolics and terpenoids in northern birch stems. <original> [chemische diversitaet einiger betulaceae-arten: vergleich von phenolischen verbindungen und terpenoiden in den staemmen nordischer birken]. *Trees. V. 11(1) P. 16-22*

Chem Meth Kacimi, Ghouti, Nguyen Phu Lich, Fabiani, Paul, and Truhaut, Rene. 1986. determination of silver by flameless atomic spectrometry: application to biological materials. *C. R. Acad. Sci.Ser. 2* 302(7): 421-6..

FL Kacmar, P., Samo, A., and Knezik, J. 1980. chemical diagnosis of sodium chloride poisoning in purebred furbearinganimals (fox, coypu), turkeys and pheasants. *Veterinarni Medicina* 25(12): 733-738.

FL Kacmar, P., Samo, A., and Knezik, J. chemical diagnostics of sodium chloride poisoning in thoroughbred fur bearing animals fox coypu and in turkey and pheasants. *Veterinarni Medicina (Prague). 25 (12). 1980 (Recd. 1981). 733-738.*

Bact Kalachnyuk, H. I(A), Marounek, M., Kalachnyuk, L. H., and Savka, O. H. 1994. rumen bacterial metabolism as affected by extracellular redox potential. *Ukrainskii Biokhimicheskii Zhurnal* 66(1): 30-40.

FL Kaleta T. observations and investigations concerning the reproduction of silver foxes (vulpes vulpes). *Zeszyty Problemowe Postepow Nauk Rolniczych No.* 259 1981. 122: 75-80.

No Dose Kaleta, T. and Brozozowski, M. 1985. the activity of farm silver fox (vulpes vulpes) in summer. *Scientifur. V. 9(3) P. 179-180*

No Dose Kaleta, T. and Lewandowska, A. 1987. the escape distance in farm silver foxes with regard to cronism problem. *Scientifur. V. 11(3) P. 187-189*

FL Kaleta T and Plochocka D. 1990. the escape distance in young farm silver foxes. *Scientifur* 14. 127(3): 167-168, illustr.

FL Kaleta, T. and Stosznajder, R. 1990. an attempt to evaluate the relationship between the keeping system and behaviour in young silver foxes. *Scientifur. V. 14(3) P. 163-166*

Prim Kalil, K. 1981. projections of the cerebellar and dorsal column nuclei upon the thalamus of the rhesus monkey. *Journal of Comparative Neurology* 195(1): 25-50.

Bio Acc Kalistratova, V. S., Kogan, A. G., and Kozlova, M. D. behavior of silver-111 in animals. *Raspred. Biol. Deistvie Radioakt. Izot. (1966)* : 146-51.

FL Kalugina, M. A. nervous apparatus of the extraembryonic fetal organs of albino rats. *Arkhiv Anatomii Gistologii i Embriologii. 91 (10). 1986 (Recd. 1987). 21-27.*

In Vit Kanematsu, Nobutake, Hachinohe, Masaki, Naito, Koichi, Oogane, Kiyoshi, Kawahara, Haruyuki, and Kuroda, Yukiaki. effect of metal ions on tissue culture cells. iii. effect of metal ions on aggregation of embryonic quail liver cells in rotation culture. *Shika Kiso Igakkai Zasshi (1979)* 21(3): 498-510.

FL Kang, M. H., Chung, K. H., Choi, W. J., and Kim, C. S. 1980. toxicity of chromium and its interaction with copper and silver in chicks. *Korean Journal of Animal Sciences. 22 (4). 1980 (Recd. 1981). 314-322.* 22(4): 314-322.

No Oral Kapicioglu S(A), Mollamehmetoglu, M., Kutlu, N., Can, G., and Ozgur, G. K(A). 1998. inhibition of penile erection in rats by a long-acting somatostatin analogue, octreotide (sms 201-995). *British Journal of Urology* 81(1): 142-145.

Phys Kar, S., Chabot J-G, and Quirion, R. quantitative autoradiographic localisation of iodine-125 endothelin-1 binding sites in spinal cord and dorsal root ganglia of the rat. *Neuroscience Letters. 133 (1). 1991. 117-120.*

FL Karamanlidis, A. N. 1973. (ascending spinal fibres in the brain stem of the horse. anexperimental study with the silver impregnation method). *Zentralblatt Fur Veterinarmedizin, C* 2(Heft 3): 209-220.

Aquatic Karlsson, L. 1985. behavioral-responses of european silver eels (anguilla-anguilla) to the geomagnetic-field. *Helgolander Meeresuntersuchungen* 39(1): 71-81.

Phys Karoumi, A., Meiniel, R., Belin, M. F., and Meiniel, A. 1991. a comparative immunocytochemical and immunochemical analysis of glycoproteins synthesized in the bovine subcommissural organ. *Journal of Neural Transmission* 86(3): 205-16.

HHE Kasper, L. H. and Ware, P. L. 1985. recognition and characterization of stage-specific oocyst/sporozoite antigens of toxoplasma gondii by human antisera. *Journal of Clinical Investigation* 75(5): 1570-7.

CP Kato, K., Yokose, S., and Tajima, Y. the use of silver enhancement technique for immunohistochemical demonstration of rat egf. *Thirtieth Annual Meeting of the Japan Society of Histochemistry and Cytochemistry, Kyoto, Japan, October 23-25, 1989. Acta Histochem Cytochem. 22 (6). 1989. 718.*

Phys Kato, K., Yokose, S., and Tajima, Y. 1991. use of silver enhancement technique for immunohistochemical detection of epidermal growth factor in rat submandibular gland. *Biotechnic & Histochemistry* 1(2): 87-8.

HHE Kawabata Shigeki, Higgins Gerald A, and Gordon Jon W(A). 1991. alzheimer's retraction. retraction of ba 93055525. amyloid plaques, neurofibrillary tangles and neuronal loss in brains of transgenic mice overexpressing a carboxyl-terminal fragment of human amyloid precursor protein. shigeki kawabata, gerald a. higgins and jon w. gordon. nature (lond) vol. 354. iss. 6353. 1991. pp. 476-478. *Nature (London)* 356(6364): 23.

Phys Kawabuchi, M., Cintra, W. M., Deshpande, S. S., and Albuquerque, E. X. 1991. morphological and electrophysiological study of distal motor nerve fiber degeneration and sprouting after irreversible cholinesterase inhibition. *Synapse* 8(3): 218-28.

No COC Kawakami, I. distribution of ascorbic-acid in chick embryo during development. *Zoological Magazine (Tokyo). 81 (4). 1972 (Recd 1973) 262*

Method Kawamata Seiichi(A) and Igarashi Yoshikazu. 1993. glycoconjugates in the cochlea as revealed by the silver methenamine method. *Hearing Research* 67(1-2): 75-82.

Method KAWAMURA, M., WASHIZU, T., ISHIDA, T., and MOTOYOSHI, S. electron-microscopic observations on the distribution of copper in biopsied liver of toxic milk mice. *Bulletin of the Nippon Veterinary and Animal Science University; 0 (44). 1995. 34-40.*

Phys Kawata, M., Mccabe, J. T., Chung, S. K., Dutt, A., Yuri, K., Hirakawa, M., Kumamoto, K., Hirayama, Y., and Pfaff, D. W. the effect of progesterone on oxytocin messenger rna in hypothalamic neurons of estrogen-treated female rats studied with quantitative in-situ hybridization histochemistry. *BIOMED RES. Biomedical Research. 12 (6). 1991. 405-415.*

No Dose Kayamori, T., Yamada, J., Yamashita, T., and Misu, M. ontogeny of the endocrine cells in the pyloric region of the japanese quail coturnix-coturnix-japonica. *I. Research Bulletin of Obihiro University Series I. 11 (1). 1978 (Recd. 1979). 1-12.*

Phys Kayar, S. R. and Weiss, H. R. 1991. capillary recruitment and heterogeneity of perfused capillary distribution in dog myocardium. *Microcirculation, Endothelium, and Lymphatics* 7(1-3): 77-108.

No Oral Kazimov, M. A. 1984. effect of cadmium and vanadium on the behavior of silver in [experimental] animals. *Aktual. Vopr. Gig. Tr. Profpatol. Prom-Sti. Sel'Sk. Khoz. (1984)* : 63-9. Editor(s): Eglite, M. Ya. Publisher: Rizh. Med. Inst., Riga, USSR.

Drug Kenyon, A. J., Hamilton, S. G., and Douglas, D. M. 1986. comparison of antipseudomonad activity of chlorine dioxide/chlorous acid-containing gel with commercially available antiseptics. *American Journal of Veterinary Research* 47(5): 1101-4.

Chem Meth Khachaturov, E. N. 1980. cytochemical method of detecting dna based on reduction of metallic silver from solution of silver ammine by aldehyde groups of apurinic dna. *Biology Bulletin of the Academy of Sciences of the USSR* 7(3): 188-94.

Aquatic Khangarot, B. S., Ray, P. K., and Chandra, H. daphnia magna as a model to assess heavy metal toxicity: comparative assessment with mouse system. *Acta Hydrochim. Hydrobiol. (1987)* 15(4): 427-32.

FL Kharchenko, P. D., Berdishev, G. D., Stepanenko, P. Z., and Velikoivaneko, O. O. 1973. [changes in the nucleic acid content of the brain and liver in rats following prolonged administration of silver ions in drinking water]. <original> zmina vmistu nukleinovykh kyslot u holovnomu mozku i pechintsi shchuriv pry tryvalomu vvedenni ioniv sribla z pytnoiu vodoiu. *Fiziolohichnyi Zhurnal* 19(3): 362-8.

FL Kharchenko, P. D., Berdyshev, G. D., Stepanenko, P. Z., and Velikoivanenko, A. A. change in the nucleic acid level in rat brain and liver during long-term introduction of silver ions in drinking water. *Fiziol. Zh. (Kiev) (1973)* 19(3): 362-8.

FL Kharchenko, P. D., Berdyshev, G. D., Stepanenko, P. Z., and Velikonvanenko, A. A. change in the content of brain nucleic acids of rats following long-term intake of ionic silver with the drinking water. *Vodopodgotovka i Ochistka Prom. Stokov (1973)* (10): 108-17 From: Ref. Zh., Biol. Khim. 1974, Abstr. No. 15F2345.

FL Kharchenko, P. D., Berdyshev, H. D., Stepanenko, P. Z., and Velykoivanenko, O. O. change in nucleic-acid content in rat brain and liver during long-term introduction of silver ions with drinking water. *FIZIOL ZH (AKAD NAUK UKR RSR). 19 (3). 1973 362-368.*

FL KHARCHENKO, P. D. and STEPANENKO, P. Z. characteristics of disturbances in albino rat higher nervous activity during the action of silver electrolytic solutions. *FIZIOL ZH (AKAD NAUK UKR RSR); 18 (5). 1972 596-600*

FL Kharchenko, P. D. and Stepanenko, P. Z. disturbance of albino rat higher nervous activity during the action of electrolytic solutions of silver. *Fiziol. Zh. (Kiev) (1972)* 18(5): 596-600.

Gene Khatib, H. and Soller, M. 1992. mononucleotide repeat polymorphism at the myhe locus in chicken. *Animal Genetics* 23(5): 478.

FL Khokhol'kova, G. A. and Pestova, A. G. the dynamics of the accumulation and distribution of diptal in the organism of white rats after a single administration via the gastrointestinal tract. *Vrachebnoe Delo No.; 5: 99-102 1969; (REF:4)*

FL Khudoerkov, R. M. 1992. [ammoniacal silver method in alkaline ph range as a technique for detection of morpho-functional features of nerve tissue elements]. <original> ammiachno-serebrianyi metod v shchelochnom diapazone ph kak sposob vyiavleniia morfo-funktsional'nykh osobennostei nervnykh elementov. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 113(6): 660-3.

FL Khudoerkov, R. M. 1991. [autoradiography of protein synthesis as a method of assessment of morphofunctional changes in brain structures]. <original> avtoradiografiia sinteza belka kak metod otsenki morfofuntsional'nykh izmenenii v strukturakh mozga. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 112(9): 321-3.

In Vit Kim G-S and Lee T-H. the activities of glyoxalase i ec-4.4.1.5 in some animal liver and erythrocytes. *Journal of Catholic Medical College. 38 (1). 1985. 55-62.*

In Vit Kim, S. U. 1972. light and electron microscope study of mouse cerebral neocortex in tissue culture. *Experimental Neurology* 35(2): 305-21.

Phys Kim Suhn Hee(A), Cho Kyung Woo, Oh Seon Hee, Hwang Yun Hwa, Lim Seong= Hee, Ryu Hoon, Seul Kyung Hwan, Jeong Goo Bo, and Yoon Sik. 1993. immunoreactive atrial natriuretic peptides in the oocyte. *Comparative Biochemistry and Physiology A Comparative Physiology* 104(2): 219-223.

Prim Kimura, K. and Takahashi, Y. 1985. [application of silver impregnation to peripheral nerve fiber analysis in topographic anatomy--a communicating branch of the lateral sural cutaneous nerve to the sural nerve in the crab-eating monkey (macaca fascicularis)]. *Kaibogaku Zasshi* 60(1): 8-10.

Phys Kingsley Paul D(A), Zinkin Adam S, Silver Louise S, Pendola Frank L, and Palis James. 1996. development regulation and primary structure of murine cellular nucleic acid-binding protein, a zinc finger-containing protein whose general structure is present in evolutionarily diverse eukaryotes. *Development Growth & Differentiation* 38(6): 697-706.

Anat Kirby, M. L., McKenzie, J. W., and Weidman, T. A. 1980. developing innervation of the chick heart: a histofluorescence and light microscopic study of sympthetic innervation. *Anatomical Record* 196(3): 333-40.

Method Kiupel, M., Bostock, D., and Bergmann, V. 1998. a semiquantitative method for the evaluation of agnors in caninemalignant lymphomas. *European Journal of Veterinary Pathology* 4(2): 67-71.

Drug Klaue, P., Aman, G., and Romen, W. chemical debridement of the burn eschar in rats with bromelain combined with topical anti microbial agents. *European Surgical Research. 11 (5). 1979 (Recd. 1980). 353-359.*

FL Kletskin, P. T., Glazov, E. M., Kolchanova, N. V., and Kulikov, N. E. 1983. nutritive value of feather meal for polar foxes and silver-black foxes. *Nauchnye Trudy Nauchno-Issledovatel'Skogo Instituta Pushnogo Zverovodstva i Krolikovodstva* 29: 170-178.

FL Kletskin, P. T., Snytko, V. S., and Glazov, E. M. 1978. using fish meat, silkworm pupae, by-products from fur farms and grainfor feeding foxes and arctic foxes. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Puchnogo Zverovodstva i Krolikovodstva* 18: 125-136.

FL Klimenko, V. M. and Pugovkin, A. P. 1985. [morphofunctional restructuring of the nervous system of the lymphoid organs during electrostimulation of the hypothalamus]. <original> morfofunktsional'naia perestroika nervnogo apparata limfoidnykh organov pri elektrostimuliatsii gipotalamusa. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 99(6): 750-2.

Unrel Klimstra, W. D. and Dooley, A. L. foods of the key deer. *Florida Scientist. 53 (4). 1990. 264-273.*

FL Klinger, G. 1970. [histochemical and electron microscopical studies on the kidney basement membrane in hydronephrotic rats]. <original> histochemische und submikroskopische untersuchungen an renalen basalmembranen der hydronephrotischen ratte. *Experimentelle Pathologie* 4(1): 69-80.

In Vit Kobayashi, T., Tsukagoshi, H., and Shimizu, Y. trophic effects of sympathetic ganglia on normal and dystrophic chicken skeletal muscles in tissue culture. *Experimental Neurology. 77 (2). 1982. 241-253.*

HHE Kobayashi, Y., Cavallotti, D., Ricci, A., and Amenta, F. 1994. localisation of dopamine d2-like receptors in pulmonary artery of the human and rabbit but not of the rat. *European Journal of Pharmacology* 261(3): 229-36.

Nut def Koh, E. T. and Min, K. W. 1991. fructose precipitates calcium phosphate in the kidneys of female rats fed magnesium-deficient diets. *Magnesium Research* 4(3-4): 171-6.

Phys Koh, T., Maeda, T., Nakazawa, M., and Kani, K. 1991. [a double-labeling study of serotonin neurons that project to the visual cortex of developing rat brain]. *Nippon Ganka Gakkai Zasshi* 95(3): 249-53.

Diss Koivisto, M. 1986. [reproductive physiology in silver foxes (vulpes fulva argentata) and arctic foxes (alopex lagopus) with special regard to histological ovarian findings before and during mating season]. <subtitle> [contribution within the scope of the working group "reproduction and insemination" at the tieraerztliche hochschule hannover]. <original> zur fortpflanzungsphysiologie bei silberfuchs (vulpes fulva argentata) und blaufuchs (alopex lagopus) unter besonderer beruecksichtigung histologischer ovarbefunde vor und waehrend der paarungssaison. <original subtitle> beitrag im rahmen der arbeitsgruppe "fortpflanzung und besamung" an der tieraerztlichen hochschule hannover. *70 P.*

No Dose Kojima, T., Soma, T., and Oguri, N. 1988. effect of ice nucleation by droplet of immobilized silver iodide on freezing of rabbit and bovine embryos. *Theriogenology.* 30(6): 1199-1207.

In Vit Kojima, T., Soma, T., and Oguri, N. 1986. effect of silver iodide as an ice inducer on viability of frozen-thawed rabbit morulae. *Theriogenology.* 26(3): 341-352.

FL Kolesnikova L A. 1991. some quantitative characteristics of blastocysts of silver foxes under Domestication. *Sibirskii Biologicheskii Zhurnal* 1991. 128(6): 21-24, illustr.

FL Kolesnikova, L. A. 1996. structural and functional features of the pineal gland of silver foxes: changes under the efect of domestication. *Scientifur. V. 20(1) P. 13-25*

FL Kolesnikova, L. A., Trut, L. N., and Belyaev, D. K. changes in morphology of silver fox pineal gland at domestication. *Zhurnal Obshchei Biologii. 49 (4). 1988. 487-492.*

Method Kolodziejczyk, E., Serrant, P., and Fernandez-Graf, M. R. 1990. a simple rapid method to slice biological specimens: an application for non-embedded and embedded golgi-stained tissue. *Journal of Neuroscience Methods* 31(3): 183-6.

Phys Konaka Shuntaro, Yamada Masanobu(A), Satoh Tetsuro, Ozawa Hitoshi, Watanabe Eri, Takata Kuniaki, and Mori Masatomo. 1997. expression of thyrotropin-releasing hormone (trh) receptor mrna in somatotrophs in the rat anterior pituitary. *Endocrinology* 138(2): 827-830.

Phys Konig, M. F., Weibel, E. R., and Batra, S. 1996. comparison of in vivo microvascular perfusion pattern between skeletal muscle and heart: colloidal gold particles as in vivo plasma marker. *Advances in Experimental Medicine and Biology* 388: 197-204.

Unrel Kool, K. M. food selection by the silver leaf monkey trachypithecus-auratus-sondaicus in relation to plant chemistry. *Oecologia (Heidelb). 90 (4). 1992. 527-533.*

Method Kornhauser, G. V., Krum, J. M., and Rosenstein, J. M. 1992. an innovative coating technique for light and electron microscopic autoradiography. *Journal of Histochemistry and Cytochemistry* 40(6): 879-82.

HHE Kosik, K. S., Gilbert, J. M., Selkoe, D. J., and Strocchi, P. 1982. characterization of postmortem human brain proteins by two-dimensional gel electrophoresis. *Journal of Neurochemistry* 39(6): 1529-38.

No Oral Kotti, T., Halonen, T., Sirvio, J., Riekkinen, P. Sr, and Miettinen, R. comparison of nadph diaphorase histochemistry, somatostatin immunohistochemistry, and silver impregnation in detecting structural and functional impairment in experimental status epilepticus. *Neuroscience (Oxford) (1997)* 80(1): 105-117.

Phys Kouretas, D., Trnovsky, J., Holdridge, M., and Theoharides, T. C. two-dimensional gel electrophoretic profile of rat basophilic leukemia rbl and mast cells. *Life Sciences. 49 (18). 1991. 1289-1294.*

Mix Kramer, J. K. G., Sehat, N., Dugan, M. E. R., Mossoba, M. M., Yurawecz, M. P., Roach, J. A. G., Eulitz, K., Aalhus, J. L., Schaefer, A. L., and Ku, Y. 1998. distributions of conjugated linoleic acid (cla) isomers in tissue lipidclasses of pigs fed a commercial cla mixture determined by gaschromatography and silver ion-high-performance liquid chromatography. *Lipids* 33(6): 549-558.

FL Krass, P. M., Bazhan, N. M., Reshetnikov, S. S., and Trut, L. N. age changes of adrenal reactivity to acth in silver foxes with different heredity determined forms of defensive behavior. *Izvestiya Akademii Nauk Sssr Seriya Biologicheskaya. 0 (3). 1979. 365-370.*

In Vit Kratky, R. G. and Roach, M. R. 1983. relationship between aortic endothelial cell morphology and atherosclerosis in rabbits. *Scanning Electron Microscopy* (Pt 3): 1461-6.

Chem Meth Krikelis, H. and Smith, A. A. 1988. palladium toning of silver-impregnated reticular fibers. *Stain Technology* 63(2): 97-100.

No Dose Kristensen, M. P. 1988. an evaluation of exploratory and fear-motivated behaviour as predictorsof reproductive success in silver fox vixens. *Scientifur* 12(3): 199-205.

No Dose Kristensen, M. P. Copenhagen Univ. Denmark Inst. of Population Biology. 1988. an evaluation of exploratory and fear-motivated behaviour as a predictor of reproductive succes in silver fox vixens. *Scientifur. V. 12(3) P. 199-205*

Drug Krizek, T. J., Robson, M. C., and Groskin, M. G. 1974. experimental burn wound sepsis--evaluation of enzymatic debridement. *Journal of Surgical Research* 17(4): 219-27.

FL Krogmeier, D. and Dzapo, V. 1991. performance traits of new zealand white and giant silver rabbits andtheir reciprocal crosses. 2. heterotic effects on carcass yield andcomposition and meat quality. *Archiv Fur Geflugelkunde* 55(4): 162-169.

FL Krogmeier, D. and Dzapo, V. 1991. performance traits of new zealand white and silver giant rabbits andtheir reciprocal crosses. 1. heterotic effects on growth, reproduction and viability. *Archiv Fur Geflugelkunde* 55(4): 158-162.

FL Krzywiecki, S., Kuzniewicz, J., Filistowicz, A., and Przysiecki, P. 1996. effect of single or group keeping of young common foxes (vulpes vulpes)on feed consumption, growth rate and fur quality. *Scientifur* 20(2): 173-177.

Method Kubis, H. P. and Gros, G. 1997. a rapid electrophoretic method for separating rabbit skeletal muscle myosin heavy chains at high resolution. *Electrophoresis* 18(1): 64-6.

No COC Kubo, H., Otsuki, Y., Magari, S., and Sugimoto, O. comparative study of lymphatics and blood vessels. *Acta Histochemica Et Cytochemica. 23 (5). 1990. 621-636.*

Prim Kucera, P. and Wiesendanger, M. do ipsilateral corticospinal fibers participate in the functional recovery following unilateral pyramidal lesions in monkeys? *BRAIN RES. Brain Research. 348 (2). 1985. 297-303.*

Phys Kuchiiwa, S. 1990. intraocular projections from the pterygopalatine ganglion in the cat. *Journal of Comparative Neurology* 300(3): 301-8.

FL Kueng-Hitz, N., Rol, P., and Niemeyer, G. 1999. [the electroretinogram (erg) of the mouse: normal values, optimal stimulation and recording]. <original> das elektroretinogramm (erg) der maus: normative werte, optimierte stimulation und ableitung. *Klinische Monatsblatter Fur Augenheilkunde* 214(5): 288-90.

FL Kul'skii, L. A., Kharchenko, P. D., and Stepanenko, P. Z. dynamics of cortical activity changes in albino rats after chronic silver intoxication. *Dopov. Akad. Nauk Ukr. RSR.* Ser. B (1972): 34(7), 660-2 .

Herp Kuljis, R. O. and Karten, H. J. 1982. laminar organization of peptide-like immunoreactivity in the anuran optic tectum. *Journal of Comparative Neurology* 212(2): 188-201.

FL Kumar, V. R. and Suryawanshi, S. A. 1980. the histomorphology of pancreatic islets in the bandicoot, bandicota bengalensis (gray). *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 94(4): 743-8.

FL Kupriyanov, V. P. 1989. [without decreasing results [expediency of decreased sizes of cages for silver foxes and arctic foxes]]. <original> bez snizheniya rezul'tatov. *Krolikovodstvo i Zverovodstvo. (No.5) P. 10*

BioX Laakkonen, J. and Sukura, A. 1997. pneumocystis carinii of the common shrew, sorex araneus, shows a discrete phenotype. *Journal of Eukaryotic Microbiology* 44(2): 117-21 .

FL Laborit, H., Baron, C., and Weber, B. 1967. [definitive survival after experimental irreversible hemorrhagic shock. roles of metabolic correction and oral treatment by neomycin. development of acid phosphatases]. <original> survies definitives apres choc hemorrhagique irreversible experimental. roles de la correction metabolique et du traitement oral par la neomycine. evolution des phosphatases acides. *Agressologie: Revue Internationale De Physio-Biologie Et De*

Phys Lacroix, R. P., Duncan, J. R., Jenkins, R. P., Leitch, R. A., Perry, J. A., and Richards, J. C. 1993. structural and serological specificities of pasteurella haemolytica lipopolysaccharides. *Infection And Immunity.* 61(1): 170-181.

Surv LaDelfe, C. M. 1981.*Detailed Geochemical Survey Data Release for the San Andres-Oscura Mountains Special Study Area, New Mexico. GJBX-215-81; LA-8016-MS*

Method Ladukar, O. N. and Pandit, R. V. 1993. nerve supply to buffalo pancreas, gross and microscopic perivascular plexus. *Indian Veterinary Journal* 70(10): 937-941.

Phys Lafarga, M., Andres, M. A., Berciano, M. T., and Maquiera, E. 1991. organization of nucleoli and nuclear bodies in osmotically stimulated supraoptic neurons of the rat. *Journal of Comparative Neurology* 308(3): 329-39.

Drug Lai, C. S., Miskell, P., Gonce, S. J., Alexander, J. W., and Babcock, G. F. 1987. combined use of topical cyclosporin a and silver sulphadiazine on allografts infected with pseudomonas in burned rats. *Burns, Including Thermal Injury* 13(3): 181-4.

No COC LANDAUER, W. genetic and environmental factors in the teratogenic effects of boric acid on chicken embryos. *GENETICS 38:216-228,1953*

FL Lanszki, J. and Lengyel, K. 1996. effect of melatonin treatment on the development of fur in carnivores: review article. *Magyar Allatorvosok Lapja* 51(5): 307-309.

FL Lapenkova, I. Z. effects of gravitational stress and hypo kinesia on the structure of rabbit tongue blood vessels. *Arkhiv Anatomii Gistologii i Embriologii. 69 (10). 1975 (Recd 1976) 55-61.*

BioX Larochelle, R., Sauvageau, R., and Magar, R. 1994. immunohistochemical detection of swine influenza virus and porcinereproductive and respiratory syndrome virus in porcine proliferativeand necrotizing pneumonia cases from quebec. *Canadian Veterinary Journal* 35(8): 513-515.

BioX Larochelle R(A) and Magar, R. 1997. detection of porcine productive and respiratory syndrome virus in paraffin-embedded tissues: comparison of immunohistochemistry and in situ hybridization. *Journal of Virological Methods* 63(1-2): 227-235.

Anat Larsson, L. I., Sundler, F., Hakanson, R., Rehfeld, J. F., and Stadil, F. 1974. distribution and properties of gastrin cells in the gastrointestinal tract of chicken. *Cell and Tissue Research* 154(4): 409-21.

Chem Meth Lascano, E. F., Gomez, R. M., and Berria, M. I. a controlled silver impregnation method to characterize cultured cardiomyocytes. *Stain Technology. 63 (4). 1988. 221-228.*

FL Lassmann, G. 1967. [morphological findings of the innervation of blood vessels]. <original> morphologische befunde zur nervenversorgung der blutgefasse. *Wiener Klinische Wochenschrift* 79(46): 845-50.

Aquatic Latif Muhammad A(A), Alam Mohammad J, and Rahman Mohammad A. 1993. integrated duck-cum-fish farming in bangladesh. *Journal of the World Aquaculture Society* 24(3): 402-409.

HHE Lauweryns, J. M., van Ranst, L., Lloyd, R. V., and O'Connor, D. T. 1987. chromogranin in bronchopulmonary neuroendocrine cells. immunocytochemical detection in human, monkey, and pig respiratory mucosa. *Journal of Histochemistry and Cytochemistry* 35(1): 113-8.

CP Le Douarin, N. M., Teillet, M. A., Ziller, C., and Smith, J. 1978. adrenergic differentiation of cells of the cholinergic ciliary and remak ganglia in avian embryo after in vivo transplantation. *Proceedings of the National Academy of Sciences of the United States of*

No COC Le Vay, S. JR, Meier, C. JR, and Glees, P. JR. effects of tri-ortho-cresyl-phosphate on spinal ganglia and peripheral nerves of chicken. *Acta Neuropathol.; 17(2): 103-13 1971; (REF:17)*

Drug Lee, J. C., Niu, C. S., Hsu, C. T., Kuo, D. H., and Cheng, J. T. 1932. therapeutic effect of two mineral drugs on thermal skin injury in rabbits. *Chin. Pharm. J. (Taiwan)* 50 ISS 1 1998

Plant Lee, J. S. and Sang, C. K. studies on the present status of cultivation and utilization of foliage plants i. present status of cultivation. *J KOREAN SOC HORTIC SCI. 32 (3). 1991. 368-381.*

BioX Lee, K. H., Park, H. W., and Lee, J. B. 1990. detection of keratinolytic proteinase in skin tissues from guinea pigs infected with microsporum canis by an immunoperoxidase technique [published erratum appears in j dermatol sci 1991 jan;2(1):74]. *Journal of Dermatological Science* 1(6): 447-53.

In Vit Lee, T. C., Wu, R., Brody, A. R., Barrett, J. C., and Nettesheim, P. 1984. growth and differentiation of hamster tracheal epithelial cells in culture. *Experimental Lung Research* 6(1): 27-45.

FL Leibnitz, L. 1975. [problems and experience in the light optical and histological presentation of glia cells]. <original> probleme und erfahrungen bei der lichtoptischen histologischen darstellung der gliazellen. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 89(4): 727-43.

FL Leibnitz, L. problems and experiences with the optical microscopic histological preparation of glial cells. *Zeitschrift Fuer Mikroskopisch-Anatomische Forschung (Leipzig). 89 (4). 1975 (Recd 1976) 727-743.*

Prim Leichnetz, G. R. 1981. the median subcallosal fasciculus in the monkey: a unique prefrontal corticostriate and corticocortical pathway revealed by anterogradely transported horseradish peroxidase. *Neuroscience Letters* 21(2): 137-42.

Prim Leichnetz, G. R. and Astruc, J. 1975. efferent connections of the orbitofrontal cortex in the marmoset (saguinus oedipus). *Brain Research* 84(2): 169-80.

Prim Leichnetz, G. R. and Astruc, J. 1976. the efferent projections of the medial prefrontal cortex in the squirrel monkey (saimiri sciureus). *Brain Research* 109(3): 455-72.

Imm Leite, L. T., Resende, M., de Souza, W., Camargos, E. R., and Koury, M. C. 1996. production and characterization of monoclonal antibodies to the edta extract of leptospira interrogans, serovar icterohaemorrhagiae. *Revista Da Sociedade Brasileira De Medicina Tropical* 29(5): 483-9.

CP Lema Gizachew (IAR, Addis Abeba Ethiopia. 1993. comparison of legumes hay, urea, and noug cake as protein supplements to horro sheep fed on tef straw. proceedings of the fourth national livestock improvement conference. *P. 211-215*

HHE Leong, A. S. Y. and Gilham, P. 1989. silver staining of nucleolar organizer regions in malignant-melanoma and melanotic nevi. *Human Pathology* 20(3): 257-262.

Prim Leuba, G. and Garey, L. J. 1984. orientation of dendrites in the lateral geniculate nucleus of the monkey. *Experimental Brain Research. Experimentelle Hirnforschung.*

BioX Leung, K., Nesbitt, W. E., Okamoto, M., and Fukushima, H. 1999. identification of a fimbriae-associated haemagglutinin from prevotella intermedia. *Microbial Pathogenesis* 26(3): 139-48.

Prim LeVay, S., Hubel, D. H., and Wiesel, T. N. 1975. the pattern of ocular dominance columns in macaque visual cortex revealed by a reduced silver stain. *Journal of Comparative Neurology* 159(4): 559-76.

Prim Levay, S., Wiesel, T. N., and Hubel, D. H. the development of ocular dominance columns in normal and visually deprived monkeys. *Journal of Comparative Neurology. 191 (1). 1980. 1-52.*

In Vit Levine, S. and Sowinski, R. tin salts prevent the plasma cell response to metallic tin in lewis rats. *Toxicology and Applied Pharmacology. 68 (1). 1983. 110-115.*

CP Levinson, W., Faras, A., Woodson, B., Jackson, J., and Bishop, J. M. 1973. inhibition of rna-dependent dna polymerase of rous sarcoma virus by thiosemicarbazones and several cations. *Proceedings of the National Academy of Sciences of the United States of*

Phys Lewis, V., Goldfien, A. C., Day, J. P., and Roberts, J. M. 1990. rabbit alveolar beta-adrenergic receptors increase with gestational age. *American Journal of Obstetrics and Gynecology* 162(1): 269-72.

No COC Leyshon-Sorland, K., Jasani, B., and Morgan, A. J. 1994. the localization of mercury and metallothionein in the cerebellum of rats experimentally exposed to methylmercury. *Histochemical Journal* 26(2): 161-9 .

Drug Li, Y., McGivern, R. F., Nagahara, A. H., and Handa, R. J. 1997. alterations in the estrogen sensitivity of hypothalamic proenkephalin mrna expression with age and prenatal exposure to alcohol. *Brain Research. Molecular Brain Research* 47(1-2): 215-22.

FL Liberman, S. S., Kutchak, S. N., Rudzitis, E., and Shakhnazarova, N. G. antiinflammatory activity of estocin. *Farmakol. Toksikol. (Moscow) (1972)* 35(3): 333-5.

In Vit Lim, R., Liu, Y., and Zaheer, A. cell-surface expression of glia maturation factor beta in astrocytes. *FASEB (Federation of American Societies for Experimental Biology) Journal. 4 (15). 1990. 3360-3363.*

Method Limon, I., Coupry, I., Lanier, S. M., and Parini, A. 1992. purification and characterization of mitochondrial imidazoline-guanidinium receptive site from rabbit kidney. *Journal of Biological Chemistry* 267(30): 21645-9.

Phys Lin C-S, Polsky, K., Nadler, J. V., and Crain, B. J. selective neocortical and thalamic cell death in the gerbil after transient ischemia. *NEUROSCIENCE. Neuroscience. 35 (2). 1990. 289-300.*

Phys Lin, L. F., Armes, L. G., Sommer, A., Smith, D. J., and Collins, F. 1990. isolation and characterization of ciliary neurotrophic factor from rabbit sciatic nerves. *Journal of Biological Chemistry* 265(15): 8942-7.

CP Lincoln, G. A. significance of seasonal cycles in prolactin secretion in male mammals. *SERIO, M. (ED.). Serono Symposia Publications from Raven Press, Vol. 53. Perspectives in Andrology; Ivth International Congress of Andrology, Florence, Italy, May 14-18, 1989. Xx+544p. Raven Press: New York, New York, Usa. Illus. ISBN 0-88167-561-X. 0 (0). 1989. 299-306.*

Alt Liu, Z., Yang, Y., Silveira, D. C., Sarkisian, M. R., Tandon, P., Huang L-T, Stafstrom, C. E., and Holmes, G. L(A). 1999. consequences of recurrent seizures during early brain development. *Neuroscience* 92(4): 1443-1454.

Phys Liu, Z. Z., Dalecki, T. M., Kashihara, N., Wallner, E. I., and Kanwar, Y. S. 1991. effect of puromycin on metanephric differentiation: morphological, autoradiographic and biochemical studies. *Kidney International* 39(6): 1140-55.

Fate Llewellyn-Smith, I. J., Minson, J. B., Wright, A. P., and Hodgson, A. J. 1990 . cholera toxin b-gold, a retrograde tracer that can be used in light and electron microscopic immunocytochemical studies. *Journal of Comparative Neurology* 294(2): 179-91 .

FL Lobko, P. I. and Khil'kevich, S. I. 1992. [the intermediate nerve system]. <original> sistema promezhutochnogo nerva. *Morfologiia* 102(5): 42-50.

FL Logvinenko, N. S., Krass, P. M., Trut, L. N., Ivanova, L. N., and Belyaev, D. K. the effect of illumination regimen on ontogenesis of endocrine functions of the gonads and adrenals in female silver foxes vulpes-vulpes of 2 genetically determined behavioral types. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 16 (2). 1980. 143-147.*

No Dose Logvinenko, N. S., Krass, P. M., Trut, L. N., Ivanova, L. N., and Belyaev, D. K. genetics and pheno genetics of hormonal characteristics of animals 5. effect of domestication on the ontogenesis of estrogen and progesterone secreting functions of the ovaries and adrenals in silver fox females. *Soviet Genetics (English Translation of Genetika). 15 (2). 1979. 208-212.*

No Dose Logvinenko, N. S., Krass, P. M., Trut, L. N., Ivanova, L. N., and Belyaev, D. K. genetics and pheno genetics of the hormonal characteristics of animals 4 effect of domestication on ontogenesis

and androgen secreting function of testicles and adrenals in male silver foxes vulpes-fulva *Soviet Genetics (English Translation of Genetika). 14 (12). 1978 (1979). 1516-1521.*

Method Long-Rowe, K. O. and Burnett, J. W. 1994. sea nettle (chrysaora quinquecirrha) lethal factor: purification by recycling on m-aminophenyl boronic acid acrylic beads. *Toxicon* 32(4): 467-78.

FL Loos-Frank, B. 1980. the common vole, microtus arvalis pall. as intermediate host of mesocestoides (cestoda) in germany. *Zeitschrift Fur Parasitenkunde* 63(2): 129-36.

Prim Lovell, M., Sutton, D., and Lindeman, R. C. 1977. muscle spindles in nonhuman primate extrinsic auricular muscles. *Anatomical Record* 189(3): 519-23.

Phys Lowel, S. and Singer, W. 1990. tangential intracortical pathways and the development of iso-orientation bands in cat striate cortex. *Brain Research. Developmental Brain Research* 56(1): 99-116.

Prim Lund, J. S., Hawken, M. J., and Parker, A. J. 1988. local circuit neurons of macaque monkey striate cortex: ii. neurons of laminae 5b and 6. *Journal of Comparative Neurology* 276(1): 1-29.

Method Lundqvist, M., Arnberg, H., Candell, J., Malmgren, M., Wilander, E., Grimelius, L., and Oberg, K. 1990. silver stains for identification of neuroendocrine cells. a study of the chemical background. *Histochemical Journal* 22(11): 615-23.

CP Luque, J. M., Adams, W. B., and Nicholls, J. G. 1997. techniques for visualizing cells labeled by immunohistochemistry and in situ hybridization in wholemounts of newborn opossum and embryonic mouse cns. *Society for Neuroscience Abstracts* 23(1-2): 1163.

FL Lutsenko, N. D. and Ivanova, L. N. studies on the nuclear and nucleolar volume in the reticular zone of the adrenal cortex of wild and domesticated silver fox vulpes-fulva kept at different light regimes. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 21 (1). 1985. 40-43.*

FL Lutsenko, N. D. and Trut, L. N. morphological and functional condition of the adrenal cortex in females of silver fox and the effect of domestication and photoperiod on it. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 23 (6). 1987. 761-764.*

FL Lutsenko N D, Trut L N, and Ivanova L N. 1980. adrenocortical structure of the domesticated silver fox vulpes fulvus during postnatal ontogenesis. *Zhurnal Evolyutsionnoi Biokhimii I Fiziologii* 16. 117(5): 483-487, illustr.

CP Lynch, G., Rose, G., and Gall, C. 1977. anatomical and functional aspects of the septo-hippocampal projections. *Ciba Foundation Symposium* (58): 5-24.

Phys Mackay-Sim, A. and Kittel, P. 1991. cell dynamics in the adult mouse olfactory epithelium: a quantitative autoradiographic study. *Journal of Neuroscience* 11(4): 979-84.

Phys Madison, R. D. and Macklis, J. D. 1993. noninvasively induced degeneration of neocortical pyramidal neurons in vivo: selective targeting by laser activation of retrogradely transported photolytic chromophore. *Experimental Neurology* 121(2): 153-9.

No Oral Maffei Massimo(A), Bertea Cinzia Margherita, Garneri Francesca, and Scannerini Silvano. 1999. effect of benzoic acid hydroxy- and methoxy- ring substituents during cucumber (cucumis sativus l.) germination. i. isocitrate lyase and catalase activity. *Plant Science (Shannon)* 141(2): 139-147.

BioX Magar Ronald(A), Larochelle Renee(A), Robinson Yves(A), and Dubuc Claude. 1993. immunohistochemical detection of porcine reproductive and respiratory syndrome virus using colloidal gold. *Canadian Journal of Veterinary Research* 57(4): 300-304.

FL Mahnel, H., Holejsovsky, J., Bartak, P., and Czerny, C. P. 1993. [congenital "ectromelia" in fur-bearing animals caused by orthopoxvirus muris]. <original> kongenitale "ektromelie" bei pelztieren durch orthopoxvirus muris. *Tierarztliche Praxis* 21(5): 469-72.

FL Majno, G., Underwood, J. M., Zand, T., and Joris, I. 1985. the significance of endothelial stomata and stigmata in the rat aorta. an electron microscopic study. *Virchows Archiv* 408(1): 75-91.

Aquatic Makeeva, A. P. and Shakha, D. N. cytological study of ovulated oocytes and embryos in artificial reproduction of bigheads and grass carps. *BIOL NAUKI (MOSC). Biologicheskie NAUKI (Moscow). 0 (7). 1985. 38-43.*

FL Makevina, V. A. 122. histology of the endocrine part of the pancreas of standard mink,silver-grey foxes and blue (arctic) foxes. *Uchenye Zapiski Kazanskogo Gosudarstvennogo Veterinarnogo Instituta*

Bact Malaisrie, S. C., Malekzadeh, S., and Biedlingmaier, J. F. 1998. in vivo analysis of bacterial biofilm formation on facial plastic bioimplants. *Laryngoscope* 108(11 Pt 1): 1733-8.

Bact Manaresi, S., Marescalchi, O., and Scali, V. silver detected nor and c-banding patterns in bacillus-rossius insecta phasmatodea from sicily. *Caryologia. 44 (3-4). 1991. 265-286.*

No Dose MANKES, R., ESTEL, G., ABRAHAM, R., and SKALKO, R. reproductive effects of intrauterine devices in the rat. *Toxicol Appl Pharmacol 37:125-126,1976*

Prim Maples, W. R., Brown, A. B., and Hutchens, P. M. introduced monkey populations at silver springs florida. *American Journal of Physical Anthropology. 41 (3). 1974 492*

Alt Mapother, M. E., Joens, L. A., and Glock, R. D. 1987. experimental reproduction of porcine proliferative enteritis. *Veterinary Record* 121(23): 533-536.

No Dose Marco, O. N. di and Garrido, G. 1989. weight gain and fur length in nutria fed three balanced diets of 16, 21and 27% of crude protein, without green forage. *Scientifur* 13(4): 305-307.

FL Marco, O. N. di and Garrido, G. G. 1990. effect of feeding growing and finishing balanced rations to coypus,with and without green forages. *Scientifur* 14(1): 37-38.

Method MARHAN, O. and JELINEK, R. efficiency of embryotoxicity testing procedures.2.comparison between the official,mest and chest methods. *TOXICOL LETT 4:389-392,1979*

Aquatic Marking, L. L., Bills, T. D., and Crowther, J. R. effects of 5 diets on sensitivity of rainbow trout salmo-gairdneri to 11 chemicals. *Progressive Fish-Culturist. 46 (1). 1984. 1-5.*

FL Markov, I. u. G., Berzin', N. I., and Val'dman, A. R. 1992. [morphofunctional analysis of zinc-accumulating capacity of digestive system organs]. <original> morfofunktsional'nyi analiz tsinkdeponiruiushchei sposobnosti organovpishchevaritel'noi sistemy. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 113(3): 324-7.

Fate Markov Yu G(A), Berzin', N. I., and Val'dman, A. R. 1992. morphological analysis of zinc-accumulation capacity in organs of the digestive system. *Byulleten' Eksperimental'Noi Biologii i Meditsiny* 113(3): 324-327.

Unrel Structural development of endo cardial cushions :

Method Marsala, J., Sulla, I., Santa, M., Marsala, M., Zacharias, L., and Radonak, J. 1991. mapping of the canine lumbosacral spinal cord neurons by nauta method at the end of the early phase of paraplegia induced by ischemia and reperfusion. *Neuroscience* 45(2): 479-94.

No Tox Martin, P. and Lewis, J. 1989. origins of the neurovascular bundle: interactions between developing nerves and blood vessels in embryonic chick skin. *Vol. 33, No. 3, Pp. 379-387* Int. J. Dev. Biol.

HHE Mascolo, N., Summa, V., and Tateo, F. 1999. characterization of toxic elements in clays for human healing use. *Appl. Clay Sci.* 15(5-6): 491-500.

FL Maslenko, A. A. effect of "silver water" and water preserved with silver on the digestive organs. *Vrach. Delo (1976)* (5): 88-90.

FL Maslenko, A. A. 1976. [effects of "silver water" and silver-treated water on the digestive organs]. <original> vliianie "serebrianoi vody" i vody, konservirovannoi serebrom, na organy pishchvareniia. *Vrachebnoe Delo* (5): 88-90.

FL Maslova, G. B. and Avgustinovich, D. F. 1989. [serotonin receptors in the brain of animals selected for their domesticated type of behavior]. <original> serotoninovye retseptory v mozge zhivotnykh, selektsioniruemykh na domestikatsionnyi tip povedeniia. *Zhurnal Vysshei Nervnoi Deiatelnosti Imeni I P Pavlova* 39(4): 627-32.

Phys Massaro, G. D. and Massaro, D. 1993. postnatal lung growth: evidence that the gas-exchange region grows fastest at the periphery. *American Journal of Physiology* 265(4 Pt 1): L319-22.

CP Masuko, S., Kuromi, H., and Shimada, Y. 1979. isolation and culture of motoneurons from embryonic chicken spinal cords. *Proceedings of the National Academy of Sciences of the United States of*

Phys Matera, G., Liberto, M. C., Berlinghieri, M. C., and Foca, A. 1991. biological effects of veillonella parvula and bacteroides intermedius lipopolysaccharides. *Microbiologica* 14(4): 315-23.

CP Mathur, R. neuro histological investigation of the cardiac tissue of pre natal stages of anas-poecilorhyncha. *Indian Sci Cong Assoc Proc. 62. 1975 (Recd 1976) 141*

Anat Mathur, R. and Mathur, A. 1976. cardiac innnervation in the prenatal stages of anas poecilorhyncha. *Anatomischer Anzeiger* 140(5): 443-50.

In Vit Matsunaga Toshiyuki, Usui Shigeyuki, Ukai Shigeo, Kiho Tadashi, and Hirano Kazuyuki(A). 1999. activation of macrophages and neutrophils by an endothelium growth suppressing factor. *Bioscience Biotechnology and Biochemistry* 63(7): 1228-1237.

In Vit Maxwell, M. H. 1978. electron cytochemistry of developing and mature eosinophils in the bonemarrow of the fowl and the duck. *Histochemical Journal* 10(1): 63-77.

FL Mazurova, Y. and Nemecek, S. 1990. [histological technic for imaging the blood vessels in the central nervous system: impregnation of the basal endothelial membrane using the method of gallyas]. <original> histologicka technika ke znazorneni cev v cns: impregnace bazalni membrany endotelu podle gallyase. *Sbornik Vedeckych Praci Lekarske Fakulty Karlovy Univerzity v Hradci*

Drug McDaniel, M. D., Schned, A. R., and Beck, J. R. 1986. efficacy of silver sulfadiazine in the treatment of prosthetic arterial bypass graft infection. *Surgery, Gynecology & Obstetrics* 162(2): 169-73.

CP MCDERMOTT, J. G., KAMEL, H. MH, GILMORE, R. SC, MCCULLOUGH, S., and CARR, K. E. 1991. radiation changes in small intestinal silver-staining nucleolar organizer regions. *Meeting of the Association for Radiation Research*

Anat McDonald, F. and Houston, W. J. 1990. an in vivo assessment of muscular activity and the importance of electrical phenomena in bone remodelling. *Journal of Anatomy* 172: 165-75.

Chem Meth McIsaac, G. and Kiernan, J. A. 1974. complete staining of neuromuscular innervation with bromoindigo and silver. *Stain Technology* 49(4): 211-4.

No Dose McKenzie, R. A., Dunster, P. J., Twist, J. O., Dimmock, C. K., Oelrichs, P. B., Rogers, R. J., and Reichmann, K. G. 1985. the toxicity of sawfly larvae (lophyrotoma interrupta) to cattle. *<Document Title>Bulletin, Queensland Department of Primary Industries* (QB85001): x + 48pp.

HHE McNamara, D. J., Proia, A., and Miettinen, T. A. 1981. thin-layer and gas--liquid chromatographic identification of neutral steroids in human and rat feces. *Journal of Lipid Research* 22(3): 474-84.

HHE Mcnamara, D. J., Proia, A., and Miettinen, T. A. thin layer chromatographic and gas liquid chromatographic identification of neutral steroids in human and rat feces. *J LIPID RES. Journal of Lipid Research. 22 (3). 1981. 474-484.*

FL Mee, R. 1994. an investigation into feeding carnivorous fur bearing farm animals inestonia. *Scientifur* 18(2): 121-123.

Abstract Meharq, S., Dinh, T. T., and Ritter, S. neurotoxicity of systemic monosodium glutamate in the adult rat analysis with silver stain degeneration techniques. *15th Annual Meeting of the Society for Neuroscience, Part 2, Dallas, Tex., USA, OCT. 20-25, 1985. SOC NEUROSCI ABSTR. 11 (2). 1985. 1195.*

Phys Meller, D., Schmidt-Kastner, R., and Eysel, U. T. 1993. immunohistochemical studies on neurofilamentous hypertrophy in degenerating retinal terminals of the olivary pretectal nucleus in the rat. *Journal of Comparative Neurology* 331(4): 531-9.

FL Meller, K., Breipohl, W., and Glees, P. 1968. synaptic organization of the molecular and the outer granular layer in the motor cortex in the white mouse during postnatal development. a golgi- and electronmicroscopical study. *Zeitschrift Fur Zellforschung Und Mikroskopische Anatomie* 92(2)

No Oral Mello, L. E. and Covolan, L. 1996. spontaneous seizures preferentially injure interneurons in the pilocarpine model of chronic spontaneous seizures. *Epilepsy Research* 26(1): 123-9.

Prim Menetrey, D., de Pommery, J., and Roudier, F. 1985. propriospinal fibers reaching the lumbar enlargement in the rat. *Neuroscience Letters* 58(2): 257-61.

No Tox Merat, P. 1973. possible relationships between embryonic and post-embryonic mortalityrates and the presence of certain known genes in the fowl. *Annales De Genetique Et De Selection Animale* 5(1): 39-51.

FL Mertin D, Rafay J, Berestov V, and Stepanok V. 1991. content of some mineral elements in hair of silver foxes during Ontogenesis. *Scientifur* 15. 128(3): 183-189, illustr.

FL Mertin, D., Suvegova, K., Fl'ak, P., Sviatko, P., Podolanova, E., and Tocka, I. 1998. repeatability of mineral element content in the fur of female silvernutria. *Scientifur* 22(3): 197-201.

CP Mertin, D. Research Inst. of Animal Production Nitra Slovak Republic Dept. of Fur Animal Breeding, Stepanok, V. V. All Russian Research Inst. of Agricultural Using Meliory Soils Tver Russian Federation, Georgijevskij, V. I. Agricultural Academy of K. A. Timiriazev Moscow Russian Federation, and Skrede, A. ed. 1992. effects of dietary zinc, silicium and selenium on mineral content of fur in silver foxes during maturity. progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 620-625. No. 9(Suppl.)*

HHE Meyer, I., Heinrich, J. *., Trepka M.J., Krause, C., Schulz, C., Meyer, E., and Lippold, U. 19980100. the effect of lead in tap water on blood lead in children in a smelter town. *SCI. TOTAL ENVIRON* VOL. 209, NO. 2-3: pp. 255-271.

FL Miadelets, O. D. 1995. [epidermal keratinocyte proliferation, differentiation and apoptosis in rats in postnatal ontogeny]. <original> proliferatsiia, differentsirovka i apoptoz keratinotsitov epidermisa krys v postnatal'nom ontogeneze. *Ontogenez* 26(1): 62-7.

No Tox Miceli, D., Reperant, J., Villalobos, J., and Dionne, L. 1987. extratelencephalic projections of the avian visual wulst. a quantitative autoradiographic study in the pigeon columbia livia. *Journal Fur Hirnforschung* 28(1): 45-57.

An Prod Miclea, M., Papay, Z., Damian, A., and Miresan Vioara. 1994. comparative study of structural features of hair in four mink and two ferret varieties. *Buletinul Universitatii De Stiinte Agricole Cluj-Napoca Seria Zootehnie Si Medicina Veterinara* 48(0): 67-74.

Prim Migaki, G., Schmidt, R. E., Toft, J. D. 2d, and Kaufmann, A. F. 1982. mycotic infections of the alimentary tract of nonhuman primates: a review. *Veterinary Pathology* 7: 93-103.

FL Migunov, V. P. status of the micro circulatory bed in the cat ventricular myo cardium after the effect of gravitational overloading on the body. *Arkhiv Anatomii Gistologii i Embriologii. 73 (10). 1977 (Recd 1978) 44-49.*

FL Mihaly, A. 1982. histochemistry and functional significance of putative neocortical transmitter substances: a review. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 96(6): 916-36.

Anat Mikami, S. 1988 . on the sensory endings in the avian integument. *Vol. 37, No. 2, Pp. 77-82* Jap. J. Ornithol.

Gene Mikawa, T., Takeda, S., Shimizu, T., and Kitaura, T. 1981. gene expression of myofibrillar proteins in single muscle fibers of adult chicken: micro two dimensional gel electrophoretic analysis. *Journal of Biochemistry* 89(6): 1951-62.

In Vit Miki, A. and Mizoguti, H. appearance of acetyl choline receptors in the myotome cells of the early chick embryo. *Acta Histochemica Et Cytochemica. 16 (5). 1983 (Recd. 1984). 445-455.*

Method Miller, C. C(A), Fayrer-Hosken, R. A(A), Timmons, T. M., Lee, V. H., Caudle, A. B., and Dunbar, B. S. 1992. characterization of equine zona pellucida glycoproteins by polyacrylamide gel electrophoresis and immunological techniques. *Journal of Reproduction and Fertility* 96(2): 815-825.

Drug MILLER, M. W. experimental fetal alcohol syndrome. *Crisp Data Base National Institutes Of Health*

FL Milovanov, L. V. and Pereldik, D. N. 1998. rational feeding of furbearing animals in the summer-autumn period. *Krolikovodstvo i Zverovodstvo* (3): 6-9.

No Tox Minezawa, M. and Wakasugi, N. 1977. studies on a plumage mutant (black at hatch) in the japanese quail. *Japanese Journal of Genetics* 52(3): 183-195.

FL Mironov, V. A., Mironov, A. A., Bobyrev, V. N., and Voskresenskii, O. N. relief of the internal aortal surface in mature and old animals. *Arkhiv Anatomii Gistologii i Embriologii. 94 (5). 1988. 23-26.*

Method Mitez, V. I., Angelov, I. V., and Marekov, L. N. identification and purification of a novel serine-threonine messenger-independent growth-related protein kinase from lactating goat mammary gland. *Biochimica Et Biophysica Acta. 1117 (1). 1992. 90-96.*

CP MIURA, K., NIMURA, E., and IMURA, N. 1986. effects of methylmercury on nerve fiber outgrowth of cultured chick dorsal root Ganglia. *Fourth International Congress of Toxicology*

Abstract Miyabara, S. animal model of congenital anomalies induced by chromosome aberrations. *Teratology 1989;40(6):650*

FL Miyake, K., Yamamoto, M., and Mitsuya, H. 1986. pharmacological and histological evidence for adrenergic innervation of the myoid cells in the rat seminiferous tubule. *Tohoku Journal of Experimental Medicine* 149(1): 79-87.

In Vit Moav, R., Wohlfarth, G., Schroeder, G. L., Hulata, G., and Barash, H. intensive poly culture of fish in fresh water ponds part 1 substitution of expensive feeds by liquid cow manure. *Aquaculture. 10 (1). 1977 25-43.*

FL Moe, R. O. 1997. investigation of methods to assess stress in farmed silver foxes(vulpes vulpes). a contribution to the scientific assessment of animalwelfare. *Scientifur* 21(2): 104-109.

Drug Moe, R. O. and Bakken, M. 1998. anxiolytic drugs inhibit hyperthermia induced by handling in farmedsilver foxes (vulpes vulpes). *Animal Welfare* 7(1): 97-100.

Alt Moechars, D., Lorent, K., Dewachter, I., Baekelandt, V., De Strooper, B., and Van Leuven F. 1998. transgenic mice expressing an alpha-secretion mutant of the amyloid precursor protein in the brain develop a progressive cns disorder. *Behavioural Brain Research* 95(1): 55-64.

No Control Moffat, D. B. and Creasey, Margaret. distribution of ingested silver in the kidney of the rat and of the rabbit. *Acta Anat. (1972)* 83(3): 346-55.

FL Mohr, W., Wild, A., and Wolf, H. P. 1978. incorporation of 3h-proline into hyaline articular cartilage. an autoradiographic study in rats with and without adjuvant-induced arthritis. *Virchows Archiv. B: Cell Pathology* 28(1): 1-12.

Unrel Montero Maite, Lebelle Nadine, King Judy A, Millar Robert P, and Dufour Sylvie(A). 1995. differential regulation of the two forms of gonadotropin-releasing hormone (mgnrh and cgnrh-ii) by sex steroids in the european female silver eel (anguilla anguilla). *Neuroendocrinology* 61(5): 525-535.

HHE Montgomery, B. and Lala, P. K. 1983. ontogeny of the mhc antigens on human trophoblast cells during the first trimester of pregnancy. *Journal of Immunology* 131(5): 2348-55.

Unrel Montie, T. C. and Montie, D. B. 1973. selective detoxification of murine toxin from yersinia pestis. reaction of heavy metals with essential sulfhydryl and tryptophan residues. *Biochemistry*. 12(24): 4958-65.

Mix Moore, E. P., Copeland, E. M., Dudrick, S. J., and Weisbrodt, N. W. effect of an elemental diet on the electrical activity of the smallintestine in dogs. *Journal of Surgical Research*| *SN- 0022-4804*| *PY- 1976*| *VO- 20*| *IS- 6* : 533-537| LA- English| DT- Journal article| AB-

Method Moos, T. 1993. simultaneous application of timm's sulphide silver method and immunofluorescence histochemistry. *Journal of Neuroscience Methods* 48(1-2): 149-56.

FL Morinaga, K. histopathological studies of periodontal tissue reactions to perforations in the furcations of dog teeth treated with various materials and agents . *Shikwa Gakuho. 85 (4). 1985. 413-451.*

Phys Morita, T. 1993. radioautographic study on the aging change of 3h-glucosamine uptake in mouse ileum. *Cellular and Molecular Biology* 39(8): 875-84.

No Dose Moriwaki, M. and Horiuchi, T. 1974. histopathological observation on eye abnormality, so-called ocularlymphomatosis, of chickens. *National Institute of Animal Health Quarterly, Japan* 14(No.2): 72-80.

Phys Morrison, S. F., Callaway, J., Milner, T. A., and Reis, D. J. 1991. rostral ventrolateral medulla: a source of the glutamatergic innervation of the sympathetic intermediolateral nucleus. *Brain Research* 562(1): 126-35.

Method Mortarino Michele, Tedeschi Gabriella, Negri Armando, Ceciliani Fabrizo, Gottardi Lucinao, Maffeo Giovanni, and Ronchi Severino(A). 1998. two-dimensional polyacrylamide gel electrophoresis map of bull seminal plasma proteins. *Electrophoresis* 19(5): 797-801.

Method Mortarino Michele, Vigo Daniele, Maffeo Giovanni, and Ronchi Severino(A). 1999. two-dimensional polyacrylamide gel electrophoresis map of bovine ovarian fluid proteins. *Electrophoresis* 20(4-5): 866-869.

Unrel Mosconi, T. M. and Rice, F. L. 1991. sensory innervation of the mystacial pad fur of the ferret. *Neuroscience Letters* 121(1-2): 199-202.

Unrel Mosconi, T. M. and Rice, F. L. 1993. sequential differentiation of sensory innervation in the mystacial pad of the ferret. *Journal of Comparative Neurology* 333(3): 309-25.

In Vit Moses Marsha A(A), Sudhalter Judith(A), and Langer Robert. 1992. isolation and characterization of an inhibitor of neovascularization from scapular chondrocytes. *Journal of Cell Biology* 119(2): 475-482.

Phys Mosgoeller Wilhelm, Kastner Philomena, Fang-Kircher Susanne, Kitzmueller Erwin, Hoeger Harald, Seither Peter, Labudova Olga, Lubec Gert, and Lubec Barbara(A). 2000. brain rna polymerase and nucleolar structure in perinatal asphyxia of the rat. *Experimental Neurology*. 161(1): 174-182.

FL Motorina, M. V. 1976. [distribution of reticulospinal fibers and theri endings in the lumbar segments of the rat spinal cord]. <original> raspredelenie retikulo-spinal'nykh volokon i ikh v poiasnichnykh segmentakh spinnogo mozga krysy. *Zhurnal Evoliutsionnoi Biokhimii i Fiziologii* 12(6): 584-90.

FL Muenke, M. and Schmiady, H. a simple one-step procedure for staining the nucleolus organizer regions. *Experientia (1979)* 35(5): 602-3.

FL Muller, A. and Geyer, G. 1968. [studies on the submicroscopic heavy metal demonstration]. <original> untersuchuungen uber den submikroskopischen schwermetallnachweis. *Acta Histochemica* 31(1): 98-110.

FL Muller-Peddinghaus, R. and Trautwein, G. 1977. analysis of dog urine by sda-polyacrylamide gel electrophoresis.| ti-hund. *Zentralblatt Fur Veterinarmedizin* 24A(9): 731-755.

Anat Muller, T. 1994. large nerve cells with long axons in the granular layer and white matter of the murine cerebellum. *Journal of Anatomy* 184(Pt 2): 419-23.

Alt Munnell, E. R. and Gregg, D. E. 1949.*The Production of Chronic Systemic Hypertension in the Rat With a Small Adjustable Renal Artery Clamp. USAMRL-31*

No Org Murakami, Takuro, Su, Wei Dong, Hong, Luo Jia, Piao, Da Xun, Ohtsuka, Aiji, and Seo, Kenji. physical development of tissue-reacted cationic iron colloid with protein silver and gold chloride. *Okayama Igakkai Zasshi (1997)* 109(7-12): 151-156 .

Chem Meth Murgatroyd, L. B. chemical and spectrometric evaluation of glycogen after routine histological fixatives. *STAIN TECHNOL. Stain Technology. 46 (3). 1971 111-119.*

Gene Muscarella, D. E., Vogt, V. M., and Bloom, S. E. 1985. the ribosomal rna gene cluster in aneuploid chickens: evidence for increased gene dosage and regulation of gene expression. *Journal of Cell Biology* 101(5 Pt 1): 1749-56.

CP Myer Jeannie(A) and Ellison Gaylord(A) . 1999. mapping the neuronal degeneration in new-born rat pups using silver stains. *Society for Neuroscience Abstracts* 25(1-2): 1776 .

Drug Nadeem, Ayesha, Khanna, T., and Vohora, S. B. 1999. silver preparations used in indian systems of medicine: neuropsychobehavioural effects. *Indian J. Pharmacol.* 31(3): 214-221 .

FL Nador, A. newer observations on the clarification of the bacteriological background and epizootiology of urticarial lesions of swine erysipelas introductory article for discussion. *Magyar Allatorvosok Lapja. 44 (12). 1989. 750-754.*

FL Naeser, P. and Rastad, J. 1982. silver labeling of vascular basement membranes in streptozotocin diabetic mice. *Experientia* 38(8): 937-8.

Method Nagato, Y., Sekiguchi, M., Kushida, H., and Shimai, K. 1991. histochemical demonstration of heavy metals in the hippocampal formation embedded in quetol 523m. *Okajimas Folia Anatomica Japonica* 68(5): 299-304.

Prim Nakagawa, S., Tamai, Y., Yasui, M., and Konishi, N. 1982. termination of retinal fibers in lateral preoptic and hypothalamic areas of the crab-eating monkey, macaca irus. *Archivum Histologicum Japonicum* 45(2): 207-12.

Prim Nakagawa, S. and Tanaka, S. 1984. retinal projections to the pulvinar nucleus of the macaque monkey: a re-investigation using autoradiography. *Experimental Brain Research. Experimentelle Hirnforschung.*

Prim Nakaoka, T. 1983. experimental tremor produced by ventromedial tegmental lesion in monkeys. neuroanatomical study. *Applied Neurophysiology* 46(1-4): 92-106.

Phys Namiki, T. 1990. [autoradiographic study on the distribution of gonadotropin-releasing hormone receptor in the rat ovary]. *Nippon Sanka Fujinka Gakkai Zasshi* 42(9): 1175-81.

Phys Napoleone, P., Bronzetti, E., Cavallotti, C., and Amenta, F. predominant epithelial localization of type a gamma aminobutyric acid receptor sites within rat seminal vesicles and prostate glands. *Pharmacology (Basel). 41 (1). 1990. 49-56.*

Rev NAS, Subcommittee on Mineral Toxicity Committee on Animal Nutrition. 1980.: 588.

Phys Nash, S. and Paulsen, D. generalized lentigines in a silver cat. *Journal of the American Veterinary Medical Association. 196 (9). 1990. 1500-1501.*

No Dose Naumenko, E. V., Trut, L. N., Pavlova, S. I., and Belyaev, D. K. genetics and pheno genetics of hormonal characteristics in animals part 1 functional correlation between adrenal and gonadal glands in silver foxes and changes of the correlation under selection according to behavior. *Soviet Genetics (English Translation of Genetika). 10 (10). 1974 (1976) 1232-1235*

FL Negm, H. M., Darwish, M. Y. Tanta Univ. Kafr El Sheikh Egypt Faculty of Agriculture, Abdel Ghany, A. I., and Abdel Salam, F. E. Ministry of Agriculture Cairo Egypt Agricultural Research Inst. 1978. the performance of laying hens [silver montazah and matrouh] fed various dietary protein levels in the starting and growing periods [egypt]. *Agricultural Research Review. <Subtitle>Albohouth Azziraiya. V. 56(6) En Ed.: P. 63-71; Ar Ed.: P. 43-51*

Nutrition Negm, H. M., Ghany, A. I. A., Salam, F. E. A., and Darwish, M. Y. 1978. the effects of diet and breed of chickens on the metabolic efficiencyof nitrogen utilization. *Agricultural Research Review* 56(6): 47-51.

Nut def Nelson, S. D. 1992. response of several wildland shrubs and forbs of arid regions to iron-deficiency stress. *Journal Of Plant Nutrition.* 15(10): 2015-2023.

FL Nguyen Duk Hung. 1988. body weight development of hens of the auto-sexing hybrid type c3-80,and of its parental lines. *Zhivotnov"Dni Nauki* 25(6): 28-32.

Prim Nielsen, J. T. and Moller, M. 1975. nervous connections between the brain and the pineal gland in the cat (felis catus) and the monkey (cercopithecus aethiops). *Cell and Tissue Research* 161(3): 293-301.

Method Niglio, T., Caporali, M. G., Scotti de Carolis, A., Ricci, A., and Amenta, F. 1990. absence of right-left asymmetries in the rat hippocampus as demonstrated by timm staining. *Acta Anatomica* 139(3): 283-6.

Method Niikawa, S., Hara, A., Zhang, W., Sakai, N., Yamada, H., and Shimokawa, K. 1992. proliferative assessment of craniopharyngioma and epidermoid by nucleolar organizer region staining. *Child's Nervous System* 8(8): 453-6.

Phys Nikulina, E. M. 1991. neural control of predatory aggression in wild and domesticated animals. *Neuroscience and Biobehavioral Reviews* 15(4): 545-7.

In Vit Ninomiya, T. morphological changes of rat dorsal root ganglion cells in the process-forming period ii. time-sequential observation of dorsal root ganglion cells in culture. *Sapporo Medical Journal. 55 (1). 1986. 1-10.*

Alt Nixon, B. J., Doucette, R., Jackson, P. C., and Diamond, J. 1984. impulse activity evokes precocious sprouting of nociceptive nerves into denervated skin. *Somatosensory Research* 2(2): 97-126.

Method Noergaard, Jan O. R., Moeller-Madsen, Bjarne, Hertel, Niels, and Danscher, Gorm. silver enhancement of tissue mercury: demonstration of mercury in autometallographic silver grains from rat kidneys. *J. Histochem. Cytochem. (1989)* 37(10): 1545-7.

Method Nogami, Y. Okayama-ken. Center for Animal Husbandry and Research Asahi Japan, Oda, Y., Hanaoka, Y., and Mori, D. 1990. study on cryopreservation of bovine embryos by method of using silver iodine. *Bulletin of the Okayama Prefectural Center for Animal Husbandry and Research. (No.1) P. 1-6*

Gene Nohno Tsutomu(A), Koyama Eiki, Miyokai Fumio, Taniguchi Shigehiko, Ohuchi Hideyo, Saito Taiichi(A), and Noji Sumihare. 1993. a chicken homeobox gene related to drosophila paired is predominantly expressed in the developing limb. *Developmental Biology* 158(1): 254-264.

FL Nojiri, H., Sato, M., and Urano, A. increase in the vasopressin messenger rna levels in the magnocellular neurosecretory neurons of water-deprived rats in-situ hybridization study with the use of synthetic oligonucleotide probe. *Zoological Science (Tokyo). 3 (2). 1986. 345-350.*

Phys Nolan, E. M., Masters, J. N., and Dunn, A. 1990. growth hormone regulation of hepatic glutamine synthetase mrna levels in rats. *Molecular and Cellular Endocrinology* 69(2-3): 101-10.

HHE Nolting, S. F. and Campbell, W. G. Jr. 1981. subepithelial argyrophilic spicular structures in renal amyloidosis--an aid in diagnosis. pathogenic considerations. *Human Pathology* 12(8): 724-34.

QAC Nomiyama, K., Nomiyama, H., Kikuchi, T., and Yotoriyama, M. 1987. tissue metal shifts by a single exposure to metals in rats. *Sangyo Ika Daigaku Zasshi* 9 Suppl: 95-110.

No Oral Nomiyama, Kazuo, Nomiyama, Hiroko, Kikuchi, Toru, and Yotoriyama, Mamoru. tissue metal shifts by a single exposure to metals in rats. *J. UOEH (1987)* 9(Suppl.): 95-110.

Drug Nonclercq, D., Toubeau, G., Laurent, G., Schaudies, R. P., Zanen, J., and Heuson-Stiennon, J. A. 1993. immunocytological localization of epidermal growth factor in the rat kidney after drug-induced tubular injury. *European Journal of Morphology* 31(1-2): 65-71.

No Oral Nonclercq, D., Wrona, S., Toubeau, G., Zanen, J., Heuson-Stiennon, J. A., Schaudies, R. P., and Laurent, G. 1992. tubular injury and regeneration in the rat kidney following acute exposure to gentamicin: a time-course study. *Renal Failure* 14(4): 507-21.

No Oral Norgaard, J. O., Ernst, E., and Juhl, S. 1994. efficiency of autometallographic detection of mercury in the rat kidney. *Histochemical Journal* 26(2): 100-2.

Unrel North, M. O. 1984. commercial chicken production manual. *(Book)* (Ed. 3): viii + 710 pp.

Diss Novero, R. P. 1982. genotype-nutrition interaction in laying performance of japanese quails (coturnix coturnix japonica) [study conducted in the philippines]. *122 Leaves*

FL Novikov, Yu. V., Plitman, S. I., Levin, A. I., Shniger, N. Kh., Ershova, T. N., Kagirov, V. N., Tsareva, L. G., Kochetkova, T. A., Lastochkina, K. O., Tyuleneva, I. S., and Noarov, Yu. A. 1980. health status of the population in relation to use of soft drinkingwater low in minerals. *Gigiena i Sanitariya* (12): 3-6.

Prim Novotny, G. E. 1979. observations on the lateral geniculate nucleus of the monkey (macaca fascicularis) after eye removal: a light and electron microscopic study. i. classification and degeneration of optic fibre terminals. *Journal Fur Hirnforschung* 20(6): 561-80.

Anat Novotny, G. E., Heuer, T., Schottelndreier, A., and Fleisgarten, C. 1994. plasticity of innervation of the medulla of axillary lymph nodes in the rat after antigenic stimulation. *Anatomical Record* 238(2): 213-24.

Anat Novotny, G. E. K(A), Schoettelndreier, A., and Heuer, T. 1993. a light and electron microscopic quantitative analysis of the innervation of axillary lymph nodes in juvenile and old rats. *Journal of Anatomy* 183(1): 57-66.

Phys Nunes Cardozo, B. and Van der Want, J. 1990. ultrastructural organization of the retino-pretecto-olivary pathway in the rabbit: a combined wga-hrp tracing and gaba immunocytochemical study. *Journal of Comparative Neurology* 291(2): 313-27.

FL Nyukhalov, A. P. 1989. [high grade herd of arctic foxes [reproduction of silver fox herd on the "saltikov" farm of the moscow region]]. <original> stado pestsov vysokogo klassa. *Krolikovodstvo i Zverovodstvo. (No.3) P. 6-7*

FL Nyukhalov, A. P., Chekalova, T. M., Maksimov, A. P., and Shumilina, N. N. 1988. breeding colour types of fox. *Krolikovodstvo i Zverovodstvo* (6): 13-15.

HHE O'Rahilly, R. and Muller, F. 1984. the early development of the hypoglossal nerve and occipital somites in staged human embryos. *American Journal of Anatomy* 169(3): 237-57.

Anat O'Reilly, P. M. and FitzGerald, M. J. 1990. fibre composition of the hypoglossal nerve in the rat. *Journal of Anatomy* 172: 227-43.

Unrel O'Toole, D., Williams, E. S., Welch, V., Nunamaker, C. E., and Lynn, C. 1993. subepidermal vesiculobullous filarial dermatitis in free-ranging american badgers (taxidea taxus). *Veterinary Pathology* 30(4): 343-51.

HHE Obara, T. detection of keratin messenger rna and human origin of xenotransplanted human tracheobronchial epithelium by in situ hybridization. *Hokkaido Journal of Medical Science. 64 (6). 1989. 695-704.*

No COC Obara, Y., Mizui, K., and Sato, T. chromosome banding analysis of a new stemline of hypodiploid hirosaki sarcoma established by single cell transplantation. *Cancer Genetics and Cytogenetics. 50 (1). 1990. 75-88.*

An Prod Obispo, N. E. and Dehority, B. A(A). 1999. feasibility of using total purines as a marker for ruminal bacteria. *Journal of Animal Science* 77(11): 3084-3095.

FL Ocetkiewicz, J., Kawinska, J., Niedzwiadek, S., and Tuczynska, J. 1979. the performance of french silver rabbits. *Roczniki Naukowe Zootechniki* 6(1): 117-125.

Chem Meth Ogden, T. E., Green, J. D., and Peterson, R. G. 1974. graded impregnation of nervous tissue stained by the golgi procedure. *Stain Technology* 49(2): 81-3.

Bact Ohno, A., Isii, Y., Tateda, K., Matumoto, T., Miyazaki, S., Yokota, S., and Yamaguchi, K. 1995. role of lps length in clearance rate of bacteria from the bloodstream in mice. *Microbiology* 141(Pt 10): 2749-56.

Phys Ojiro, K., Kitamura, H., Shimada, T., and Nakamura, M. 1993. a morphometrical study of the postnatal development of rat pancreatic islets, with special regard to the differences between wistar and sprague-dawley strains. *Kaibogaku Zasshi* 68(2): 190-203.

FL Okada, A. and Okamoto, E. 1969. [silver impregnation of the peripheral nerves]. *Shinkei Kenkyu No Shimpo* 13(1): 216-9.

Anat Okamoto, T., Sugimura, M., and Kudo, N. 1976. distribution of endocrine cells in duck digestive tracts. *Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University* 15(2): 127-134.

FL Okano, K. Kyushu Univ. Fukuoka Japan Faculty of Agriculture and Koga, O. 1994. genetic study on silver plumage of the kureko-dori [japan]. *Japanese Poultry Science. V. 31(3) P. 195-200*

FL Olausson, A. <translated> genetics and reproduction (arctic fox, silver fox, mink). genetik och reproduktion. *Vara Palsdjur* Nov 15, 1978. v. 49 (11) p. 271-274. ill.

Rev Olcott, CT. 1948. experimental argyrosis. *Am. J. Pathol.* 24: 813.

Method Oliveira, S. F., Nagata, T., Abrahamsohn, P. A., and Zorn, T. M. 1991. electron microscopic radioautographic study on the incorporation of 3h-proline by mouse decidual cells. *Cellular and Molecular Biology* 37(3): 315-23.

Aquatic Olivereau, M. and Olivereau, J. effect of transfer to sea water and back to fresh water on the histological structure of the eel kidney. *Journal of Comparative Physiology B Metabolic and Transport Functions. 115 (2). 1977 223-239.*

Diss Olivier, M. 1985. [investigations on heat diagnosis in silver foxes (vulpes fulva argentata) and blue foxes (alopex lagopus)]. <subtitle> [contribution within the scope of the working group "reproduction and insemination" at the tieraerztliche hochschule hannover]. <original> untersuchungen zur laeufigkeitsdiagnostik beim silberfuchs (vulpes fulva argentata) und blaufuchs (alopex lagopus). <original subtitle> beitrag im rahmen der arbeitsgruppe "fortpflanzung und besamung" an der tieraerztlichen hochschule hannover. *65 P.*

CP Olmos, S., Marquez, M. G., and Roux, M. E. 1998. frequency of ag-nors in chromosomes 3,11 and 12 of wistar rats fed a protein free diet (pf) at weaning and in controls of 21 and 60 days of age. *FASEB Journal* 12(5): A872.

In Vit Oo Tinmarlar F, Blazeski Richard, Harrison Susan M W, Henchcliffe Claire, Mason Carol A, Roffler-Tarlov Suzanne K, and Burke Robert E(A). 1996. neuron death in the substantia nigra of weaver mouse occurs late in development and is not apoptotic. *Journal of Neuroscience* 16(19): 6134-6145.

No COC Opel, H. and Proudman, J. A. 1980. failure of mammalian prolactin to induce incubation behavior inchickens and turkeys. *Poultry Science* 59(11): 2550-2558.

Prim Orstavik, D. and Mjor, I. A. 1992. usage test of four endodontic sealers in macaca fascicularis monkeys. *Oral Surgery, Oral Medicine, and Oral Pathology* 73(3): 337-44.

HHE Ortmann, R. 1989. [the sensory cells of the fetal vomeronasal organ in the human. a contribution to the variability of their differentiation and rudimentary development]. <original> uber sinneszellen am fetalen vomeronasalen organ des menschen. ein beitrag zur variabilitat seiner differenzierung bzw. rudimentierung. *HNO* 37(5): 191-7.

FL Os'kina, I. N., Trut, L. N., and Bazhan, N. M. the effect of domestication on age changes in the pituitary-adrenocortical system of silver fox vulpes-fulva. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 21 (4). 1985. 348-353.*

CP Osadchuk, L. V. 1996. adrenal cortisol biosynthesis and its stimulation by acth in male and female silver foxes during prenatal life. *Journal of Endocrinology* 148(SUPPL.): P64.

FL Osadchuk, L. V. 1999. age-dependent features in the reproductive performance of domesticated silver fox males. *Scientifur. V. 23(2) P. 113-118*

FL Osadchuk, L. V. 1991. endocrine gonadal function in silver fox under domestication. *Scientifur* 16(2): 116-121.

CP Osadchuk, L. V. 1994. fetal sex steroids and cortisol in silver foxes selected for reduced aggressiveness towards man. *European Journal of Endocrinology* 130(SUPPL. 2): 128.

CP Osadchuk, L. V. 1995. fetal testicular and adrenal steroid hormones in silver fox males. *Journal of Endocrinology* 144(SUPPL.): P351.

FL Osadchuk, L. V. significance of zoosocial contacts in control of endocrine function of the testes in silver fox during domestication. *Izvestiya Akademii Nauk Sssr Seriya Biologicheskaya. 0 (1). 1991. 88-93.*

FL Osadchuk, L. V. 1992. some peculiarities in reproduction in silver fox males under domestication. *Scientifur. V. 16(4) P. 285-288*

FL Osadchuk, L. V. 1999. steroid hormone concentrations in relation to sexual activity in domesticated silver fox males. *Scientifur. V. 23(2) P. 119-124*

FL Osadchuk, L. V. 1999. testosterone, estradiol and cortisol responses to sexual stimulation with reference to mating activity in domesticated silver fox males. *Scientifur. V. 23(3) P. 215-220*

FL Osadchuk L V and Trut L N. 1989. gonad endocrine function in female silver fox at selection for domesticative behavior. *Zhurnal Obshchei Biologii* 50. 126(2): 189-198, illustr.

CP Osadchuk, L. V(A). 1999. effects of artificial photoperiod on annual hormonal and reproductive rhythms in silver fox females. *Journal of Endocrinology* 160(SUPPL.): P202.

FL Osadchuk, L. V(A) and Voitenko, N. N. 1992. the sex steroids and brain serotonin in silver foxes during estrus cycle. *Fiziologicheskii Zhurnal SSSR Imeni I M Sechenova* 78(4): 118-123.

CP Osadchuk, L. V. Inst. of Cytology and Genetics Novosibirsk Russian Federation Siberian Branch of the Academy of Sciences of Russia and Skrede, A. ed. 1992. genetic and endocrine aspects in the regulation of the reproductive function in silver fox [vulpes vulpes]. progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 161-166. No. 9(Suppl.)*

FL Osadschuk, L. V. Academy of Sciences Novosibirsk Russian Federation. 1996. effects of domestication on the adrenal cortisol production in silver foxes during embryonic development. *Scientifur. V. 20(4) P. 336-344*

Unrel Osikowicz, G., Booyse, F. M., and Quarfoot, A. J. 1981. effects of chronic oral consumption of nicotine on the rabbit aortic endothelium. *Am. J. Pathol.* 102(2): 229-238.

FL Oskina, I. N. 1996. analysis of the functional state of the pituitary-adrenal axis during postnatal development of domesticated silver foxes (vulpes vulpes). *Scientifur. V. 20(2) P. 159-167*

CP Oskina, I. N. 1995. ontogenesis of endocrine function in silver foxes under domestication. *Applied Animal Behaviour Science* 44(2-4): 273-274.

FL Ostos, M. V., Caballero, J. L., Carmona, R., and Abadia Fenoll, F. 1984. [analysis of various structures of the central nervous system revealed by the "en bloque" procedure of the tartrate-chrome-silver impregnation technic]. <original> analisis de diversas estructuras del s. n. c puestas de manifiesto por el proceder "en bloque" de la tecnica tartrato-cromo- impregnacion argentica. *Trabajos Del Instituto Cajal* 75(1-4): 73-9.

FL Ouyang, Qimei, Zhu, Zhengmei, and Gu, Tianjue. an improved silver-staining method for detection of membrane proteins in polyacrylamide gels. *Shanghai Diyi Yixueyuan Xuebao (1982)* 9(6): 433-6, 22.

Alt Ozeki, H., Ito, S., Wakamatsu, K., and Hirobe, T. 1995. chemical characterization of hair melanins in various coat-color mutants of mice. *Journal of Investigative Dermatology* 105(3): 361-6.

In Vit Paino, C. L., Fernandez-Valle, C., Bates, M. L., and Bunge, M. B. 1994. regrowth of axons in lesioned adult rat spinal cord: promotion by implants of cultured schwann cells. *Journal of Neurocytology* 23(7): 433-52.

FL Pak, Z. P. and Petina, V. P. effect of silver on the activity of the sulfhydryl groups of white rat blood serum. *Vodopodgot. Ochistka Prom. Stokov (1973)* : 10, 80-3.

BioX Palluault, F., Dei-Cas, E., Slomianny, C., Soulez, B., and Camus, D. 1990. golgi complex and lysosomes in rabbit derived pneumocystis carinii. *Biology of the Cell* 70(1-2): 73-82.

No Oral PAMPHLETT, R. and PNG, F. Y. shrinkage of motor axons following systemic exposure to inorganic Mercury. *Journal of Neuropathology & Experimental Neurology; 57 (4). 1998. 360-366.*

Prim Pandya, D. N. and Kuypers, H. G. 1969. cortico-cortical connections in the rhesus monkey. *Brain Research* 13(1): 13-36.

FL Panella, F., Castellini, C., Santi, F., and Costantini, F. 1989. genetic and environmental effects on the main reproductive traits ofpigeons. *Rivista Di Avicoltura* 58(10): 41-43.

HHE Panigrahi, P., Losonsky, G., DeTolla, L. J., and Morris, J. G. Jr. 1992. human immune response to campylobacter jejuni proteins expressed in vivo [published erratum appears in infect immun 1993 mar;61(3):1167]. *Infection and Immunity* 60(11): 4938-44.

CP Panneton, W. M., Arends, J. J. A., and Jacquin, M. F. 1992. new and improved methods for assessing dendritic developing relative to somatotopic patch borders in the barrel neuraxis. *Society for Neuroscience Abstracts* 18(1-2): 620.

FL Pap, K., Pajic, M., and Ivanovic, V. 1989. [effects of anhidrin on dog's dental pulp in vivo]. <original> dejstvo anhidrin-a na pulpu zuba pasa u in vivo uslovima. *Stomatoloski Glasnik Srbije* 36(4): 309-18.

No Oral Parks, T. N. and Rubel, E. W. 1978. organization and development of the brain stem auditory nuclei of the chicken: primary afferent projections. *Journal of Comparative Neurology* 180(3): 439-48.

FL Pavlov, A. V. and Antipanova, E. M. 1989. [biosynthetic activity of parathyroid cells during different function of the parathyroid glands]. <original> biosinteticheskaia aktivnost' paratirotsitov pri razlichnoi funktsii okoloshchitovidnykh zhelez. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 107(1): 98-9.

FL Pearse, A. G. and Bussolati, G. 1972. the identification of gastrin cells as g cells. *Virchows Archiv. A: Pathology. Pathologische Anatomie* 355(2)

No Oral Pecoits-Filho, R. F., Twardowski, Z. J., Kim, Y. L., Khanna, R., Moore, H., and Nolph, K. D. 1998. the absence of toxicity in intraperitoneal iron dextran administration: a functional and histological analysis [see comments]. *Peritoneal Dialysis International* 18(1): 64-70.

FL Pedersen, V. and Jeppesen, L. L. Copenhagen Univ. Denmark Inst. of Population Biology. 1992. defecation patterns in the cage and in various types of whole-year shelters in farmed silver foxes and blue foxes. *Scientifur. V. 16(4) P. 275-284*

FL Pedersen, V. and Jeppesen, L. L. Copenhagen Univ. Denmark Zoological Inst. 1998 . different cage sizes and effects on behaviour and physiology in farmed silver and blue foxes. *Scientifur. V. 22(1) P. 13-22*

CP Pedersen, V. Copenhagen Univ. Denmark Inst. of Population Biology and Skrede, A. ed. 1992. handling of silver foxes at different ages pre-weaning and post-weaning and effects on later behaviour and stress-sensitivity. progress in fur animal science. proceedings from the vth international scientific congress in fur animal production. *P. 529-535. No. 9(Suppl.)*

Phys Pedroni, P., Perez, G. N., and Mattiazzi, A. 1990. calcium sensitivity of isometric tension in intact papillary muscles and chemically skinned trabeculae in different models of hypertensive hypertrophy. *Cardiovascular Research* 24(7): 584-90.

Aquatic Pemberton, D., Brothers, N., and Copson, G. predators on marine fish farms in tasmania. *PAP PROC R SOC TASMAN. Papers and Proceedings Royal Society of Tasmania. 125 (0). 1991. 33-35.*

No Oral Pencheva Ivanka(A), Kostova Irena, Konstantinov Spiro, Naidenova Elinka, Kraivanova Margarita, and Manolov Ilia . 1998. cardioprotective efficacy of new esculin metal complexes. *Acta Pharmaceutica (Zagreb)* 48(2): 127-131.

Phys Pennefather Peter S(A) and Decoursey Thomas E. 1994. a scheme to account for the effects of rb+ and k+ on inward rectifier k channels of bovine artery endothelial cells. *Journal of General Physiology* 103(4): 549-581.

CP Pereira, G. 1977. localization of silver in the spleen of argyric rats by energy dispersive x-ray analysis coupled with scanning and transmission electron microscopy. *Proc. - Annu. Meet. Electron Microsc. Soc. Am.* 35: 504-5 .

Imm Pereira, M. M., Andrade, J., Lacerda, M. D., Batoreu, N. M., Marchevsky, R. S., and Ribeiro, d. o. s. Santos R. 1997. demonstration of leptospiral antigens on tissues using monoclonal antibodies and avidin-biotin peroxidase staining. *Experimental and Toxicologic Pathology* 49(6): 505-11.

FL Perez Casas, A., Vega Alvarez, J. A., Prado Gonzalez, J., Bengoechea GonzalezM. E. , and Lopez Muniz, A. 1985. [innervation of the pulmonary vessels: autonomic microganglia]. <original> innervation des vaisseaux pulmonaires: microganglions vegetatifs. *Bulletin De L'Association Des Anatomistes* 69(205): 49-53.

No Tox Perry, M. M. and Siller, W. G. 1980. incorporation of 3h-oleic acid by the proximal convoluted tubule cells of the chick (gallus domesticus). electron microscopic autoradiographic study. *Cell and Tissue Research* 210(3): 447-59.

Anat Pessacq-Asenjo, T. P. 1984. the nerve endings of the glycogen body of embryonic and adult avian spinal cord: on the existence of two different varieties of nerve fibers. *Growth* 48(3): 385-90.

Prim Peters, E. H. grading in the vocal repertoire of silver springs rhesus monkeys. *ELSE, J. G. AND P. C. LEE (ED.). Selected Proceedings of the Congress of the International Primatological Society, Vol. 3. Primate Ontogeny, Cognition and Social Behavior; 10th Meeting, Nairobi, Kenya, July 1984. Xiii+410p. Cambridge University Press: New York, New York, Usa; Cambridge, England. Illus. Isbn 0-521-31013-x(paper); Isbn 0-521-32452-1(cloth). 0 (0). 1986. 161-168.*

FL 1968. An osmiophilic bilaminar lining film at the respiratory surfaces of avian lungs. 88 (2) :

FL Petrova, E. S., Chumasov, E. I., and Otellin, V. A. 1997. [the developmental characteristics of the embryonic anlagen of rat neocortex and spinal cord when transplanted into the distal end of the dissected sciatic nerve of adult animals]. <original> osobennosti razvitiia embrional'nykh zakladok neokorteksa i spinnogo mozga krys v usloviiakh transplantatsii v distal'nyi konets pererezannogo sedalishchnogo nerva vzroslykh zhivotnykh. *Tsitologiia* 39(9): 784-8.

FL Petrova, E. S., Chumasov, E. I., and Otellin, V. A. implantation of the embryonal cerebral tissue into the regeneration peripheral nerve. *Arkhiv Anatomii Gistologii i Embriologii. 93 (10). 1987. 43-49.*

CP Phares, C. K. and Ruegamer, W. R. 1973. pigeon crop sac stimulation due to a factor produced by plerocercoidsof the tapeworm, spirometra mansonoides. *Proceedings of the Society for Experimental Biology and Medicine* 143(1): 147-151.

FL Phichet Kamonsin (Ban Phai School, Khon Kaen Thailand and Narit Litasuwan. 1987. comparative study on postembryonic and behavioral development between jones's silver pheasant and chinese ring-necked pheasant. <original> kan suksa priap thiap kan charoen toepto lae phatthanakan thang phruttikam rawang luk kai fa lang khao kap luk kai fa kho waen. [proceedings of animal wildlife in thailand 1987]. <original> kan sammana ruang satpa muang thai. *P. 25:1-2*

Nut def Phillips, S. C. and Cragg, B. G. 1984. blood-brain barrier dysfunction in thiamine-deficient, alcohol-treated rats. *Acta Neuropathologica* 62(3): 235-41.

In Vit Pihl, E., Gustafson, G. T., Josefsson, B., and Paul, K. G. 1967. heavy metals in the granules of eosinophilic granylocytes. *Scandinavian Journal of Haematology* 4(5): 371-9.

FL Pino, L. A., Matinella, L., and Morales, G. 1999. [the size polymorphism of the cercariae of a venezuelan strain of schistosoma mansoni]. <original> polimorfismo de tallas en las cercarias de una cepa venezolana de schistosoma mansoni. *Revista Da Sociedade Brasileira De Medicina Tropical* 32(4): 443-6.

Aquatic Pinuela, C., Baatrup, E., and Geneser, F. A. 1992. histochemical distribution of zinc in the brain of the rainbow trout, oncorhynchos myciss. i. the telencephalon. *Anatomy and Embryology* 185(4): 379-88.

Mineral Pittman, T. L. 1992.*Minerals Yearbook, 1990: Alaska. <NOTE> Annual Rept*

Anat Plaschke, M., Souphanthong, M., and Wenzel, J. 1995. morphological alterations of hippocampal pyramidal neurons heterotopically transplanted into the somatosensory cortex of adult rats: a quantitative golgi study. *Anatomy and Embryology* 192(4): 351-61 .

FL Pliusnina, I. Z., Os'kina, I. N., Nikulina, E. M., Serova, L. I., and Kozlova, O. N. 1997. [selection vector and ontogenetic development of behavior under domestication of wild norway rats]. <original> vektor otbora i ontogeneticheskie zakonomernosti formirovaniia povedeniia pri deomestikatsii serykh krys. *Genetika* 33(8): 1149-54.

Nutrition Ploth, D. W. and Mackenzie, H. S. 1991. tubuloglomerular feedback in one-kidney, one-clip hypertensive rats. *Kidney International. Supplement* 32: S115-8.

FL Pluysnina I Z, Oskina I N, Onopchenko L G, and Lutsenko N D. 1988. participation of fear reaction in the limitation of the period of primary socialization in silver foxes. *Zhurnal Vysshei Nervnoi Deyatel'nosti Imeni I P Pavlova* 38. 125(5): 945-951, illustr.

FL Plyusnina, I. Z. and Os'kina, I. N. role of corticosteroids in the ontogenetic development of behavior in silver-black foxes. *Zhurnal Vysshei Nervnoi Deyatel'Nosti Imeni I P Pavlova. 38 (1). 1988. 67-71.*

FL Plyusnina I Z and Oskina I N. 1988. role of corticosteroids in behaviour ontogenetic development of silver-black foxes. *Zhurnal Vysshei Nervnoi Deyatel'nosti Imeni I P Pavlova* 38. 125(1): 67-71, illustr.

FL Plyusnina, I. Z. Russian Academy of Sciences Novosibirsk Russian Federation. 1995. the effects of cross-mating on the development of behaviour during the primary socialization period in silver foxes (vulpes vulpes). *Scientifur. V. 19(3) P. 171-177*

Prim Podlisny, M. B., Stephenson, D. T., Frosch, M. P., Lieberburg, I., Clemens, J. A., and Selkoe, D. J. 1992. synthetic amyloid beta-protein fails to produce specific neurotoxicity in monkey cerebral cortex. *Neurobiology of Aging* 13(5): 561-7.

Prim Poirier, L. J. and Giguere, M. 1980. an autoradiographic study of the striatofugal fibers in the monkey. *Journal of Neural Transmission* (16): 25-31.

FL Polak, J. M., Pearse, A. G., Grimelius, L., and Marks, V. 1975. gastrointestinal apudosis in obese hyperglycaemic mice. *Virchows Archiv. B: Cell Pathology* 19(2): 135-50.

HHE Polak, J. M., Pearse, A. G., and Heath, C. M. 1975. complete identification of endocrine cells in the gastrointestinal tract using semithin-thin sections to identify motilin cells in human and animal intestine. *Gut* 16(3): 225-9.

In Vit Polimeni, P. I., Cutilletta, A. F., and Otten, M. D. 1983. cation distributions in the hypertrophic myocardium (aortic constriction) of the rat. *Cardiovascular Research* 17(3): 170-6.

No Oral Pollitt, C. C. 1994. the basement membrane at the equine hoof dermal epidermal junction. *Equine Veterinary Journal* 26(5): 399-407.

FL Pomytko, V. N. and Miroshnichenko, T. K. 1974. comparison of does of different breeds housed indoors. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Pushnogo Zverovodstva i Krolikovodstva* 12: 90-96.

FL Pomytko, V. N. and Miroshnichenko, T. K. 1973. the growth of young, caged rabbits of several breeds. *Zhivotnovodstvo* (No.10): 77-79.

FL Pomytko, V. N., Vladimirov, A. V., and Bautina, E. P. 1973. use of artificial insemination in hybridisation of the arctic fox withthe silver-black fox. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Pushnogo Zverovodstva i Krolikovodstva* 12: 162-165.

FL Pomytko, V. N., Vladimirov, A. V., Syrnikov, N. I., and Nosova, N. G. 1974. characteristics of reproductive function of hybrids of foxes witharctic foxes. *Nauchnye Trudy. Nauchno-Issledovatel'Skii Institut Pushnogo Zverovodstva i Krolikovodstva* 13: 142-145.

Mix Popham, J. D. and Webster, W. S. 1976. the ultrastructural localisation of cadmium. *Histochemistry*. 46(3): 249-59.

FL Popova N K and Nikulina E M. 1983. the inhibitory role of serotonin in manifestation of predatory aggression in minks and silver-black Foxes. *Zhurnal Vysshei Nervnoi Deyatel'nosti Imeni I P Pavlova* 33. 120(6): 1098-1102, illustr.

FL Popova, N. K. and Nikulina, E. M. 1983. [inhibitory role of serotonin in manifestations of predatory aggression in the mink and silver fox]. <original> ingibiruiushchaia rol' serotonina v proiavlenii khishchnicheskoi agressii u norok i serebristo-chernykh lisits. *Zhurnal Vysshei Nervnoi Deiatelnosti Imeni I P Pavlova* 33(6)

FL Popova, N. K., Nikulina, E. M., Voitenko, N. N., Abgustinovich, D. F., and Trapezov, O. V. 1996. [effect of a single-locus mutation of the silver-blue color allele in mink on the dopaminergic system of the brain]. <original> vliianie odnolokusnoi mutatsii allelia serebristo-goluboi okraski norok (pp) na dofaminovuiu sistemu mozga. *Genetika* 32(3): 452-4.

FL Popova, N. K., Voitenko, N. N., and Trut, L. N. changes in the brain content of serotonin and 5 hydroxy iaa in the selection of silver foxes for behavior. *Dokl Akad Nauk Sssr Ser Biol. 223 (6). 1975 1498-1500.*

FL Popova, N. K., Voitenko, N. N., and Trut, L. N. 1975. determination of the contents of serotonin and 5-oxyindoleacetic acidin the brain of silver-foxes, in relation to the behaviour of theanimals. *Doklady Akademii Nauk SSSR* 223(6): 1498-1500.

Prim Porrino, L. J., Crane, A. M., and Goldman-Rakic, P. S. 1981. direct and indirect pathways from the amygdala to the frontal lobe in rhesus monkeys. *Journal of Comparative Neurology* 198(1): 121-36.

FL Povazhenko, I. O., Teres, M. O., and Borodinya, I. V. 1973. (lymphatics of the synovial membrane of digital tendon sheaths ofhorses, and changes in inflammation). *Visnik Silskogospodarskoi Nauki, Kiev* (No.1): 102-105, 124.

Prim Powell, E. W. 1978. the cingulate bridge between allocortex, isocortex and thalamus. *Anatomical Record* 190(4): 783-93.

Chem Meth Powell, E. W. and Schnurr, R. 1972. silver impregnation of degenerating axons; comparisons of postoperative intervals, fixatives and staining methods. *Stain Technology* 47(2): 95-100.

FL Prasolova, L. A. 1996. coat colour mutations in domesticated foxes. *Krolikovodstvo i Zverovodstvo* (5): 8-9.

Diss Prateep Duengkae. 1996. breeding biology of silver-breasted broadbill, serilophus lunatus (gould) in huai kha kaeng wildlife sanctuary, changwat uthai-thani. <original> chiwawitthaya kan supphan khong nok phaya pakkwang ok si-ngoen (serilophus lunatus (gould)) nai khet raksa phan satpa huai kha kaeng changwat uthai-thani. *76 Leaves*

FL Pribyl, T., Monakhov, N. K., Vasilyev, V. B., Shavlovskii, M. M., Gorbunova, V. N. , and Aleynikova, T. D. 1982. silver-containing ceruloplasmin without polyphenol oxidase activity in rat serum. *Physiol. Bohemoslov. (1982).* 31(6): 569-71 .

Phys Price, D. J., Ferrer, J. M., Blakemore, C., and Kato, N. 1994. functional organization of corticocortical projections from area 17 to area 18 in the cat's visual cortex. *Journal of Neuroscience* 14(5 Pt 1): 2732-46.

Method Prieto, J. J., Beneyto, M., Riquelme, R., and Rueda, J. 1995. ultrastructural detection of glycogen in the supporting cells of the organ of corti with the periodic acid-thiocarbohydrazide-silver proteinate method. *Journal Fur Hirnforschung* 36(1): 67-75.

Aquatic Prinsloo, J. F. and Schoonbee, H. J. 1984. observations on fish growth in polyculture during late summer andautumn in fish ponds at the umtata dam fish research centre, transkei.3. the use of chicken manure with and without pelleted fish feed. *Water S.A.* 10(1): 30-35.

An Prod Prinsloo, J. F., Schoonbee, H. J., and Theron, J. 1999. the production of poultry in integrated aquaculture-agriculturesystems. part ii: the integration of laying hens with fish andvegetables in integrated aquaculture-agriculture food productionsystems. *Water SA* 25(2): 231-238.

FL Privitera, E. 1981. silver staining in drosophila melanogaster: nor behaviour in heteroploid cultured cells. *Experientia* 37(7): 705-6.

HHE Puchner, M. J., Ludecke, D. K., Knappe, U. J., Saeger, W., and Herrmann, H. D. 1992. autoradiographic demonstration of in vivo 125i-growth hormone-releasing hormone (ghrh) binding by human gh-secreting pituitary adenomas transplanted on athymic nude mice. *Molecular and Cellular Endocrinology* 85(3): 157-64.

FL Purwar, R. S. 1977. neuro-histochemical study of the tongue of gallus domesticus (white leghorn). *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 91(1): 119-30.

BioX Putnak, R., Cassidy, K., Conforti, N., Lee, R., Sollazzo, D., Truong, T., Ing, E., Dubois, D., Sparkuhl, J., Gastle, W., and Hoke, C. 1996. immunogenic and protective response in mice immunized with a purified, inactivated, dengue-2 virus vaccine prototype made in fetal rhesus lung cells. *American Journal of Tropical Medicine and Hygiene* 55(5): 504-10.

Phys Qu, M., Lu, Z., and Zilles, K. 1994. aging of nucleolar organizer region in rat basal forebrain neurons related to learning and memory. *Anatomischer Anzeiger* 176(1): 39-43.

FL Quade, R., Halbhuber, K. J., and Stibenz, J. 1970. [use of zapon lacquer membranes as inert medium for the suppression of positive chemography effects in emulsions of light optical autoradiograms]. <original> die verwendung von zaponlackmembranen als inertes intermedium zur verhinderung positiv-chemographischer effekte in emulsionen lichtoptischer autoradiogramme. *Acta Histochemica* 38(2): 270-7.

BioX Quan, N., Mhlanga, J. D. M., Whiteside, M. B., McCoy, A. N., Kristensson, K., and Herkenham, M. 1999. chronic overexpression of proinflammatory cytokines and histopathology in the brains of rats infected with trypanosoma brucei. *Vol. 414, No. 1, Pp. 114-130* Journal Of Comparative Neurology

Gene Querat, B., Cardinaud, B., Hardy, A., Vidal, B., and D'Angelo, G. 1994. sequence and regulation of european eel prolactin mrna. *Vol. 102, No. 1-2, Pp. 151-160* Mol. Cell. Endocrinol.

Abstract Quevedo, W. C. Jr, Fleischmann, R. D., and Dyckman, J. premature loss of melanocytes from hair follicles of light b-l-t and silver si mice. *11th International Pigment Cell Conference, Sendai, Miyagi, Japan, Oct. 14-17, 1980. Yale J Biol Med. 53 (5). 1980 (Recd. 1981). 419.*

Method Quitadamo, I. J. and Schelling, M. E. 1998. efficient purification of mouse anti-fgf receptor igm monoclonal antibody by magnetic beads. *Hybridoma* 17(2): 199-207.

Phys Racekova, E., Vanicky, I., and Zigova, T. 1994. correlation of functional alteration with lesion extent after olfactory bulbectomy in rats. *International Journal of Neuroscience* 79(1-2): 13-20.

Aquatic Rady Amal A(A), Nour, A. M., and Abou-Akkada, A. R. 1992. comparative study on fish farming in egypt. *Acta Universitatis Szegediensis Acta Biologica* 38(1-4): 25-31.

No Dose Radzhabli, S. I., Isaenko, A. A., and Volobuev, V. T. investigation of the nature and role of the supernumerary chromosomes in the silver fox part 4 behavior of the supernumerary chromosomes in meiosis. *Soviet Genetics (English Translation of Genetika). 14 (3). 1978 296-301*

FL Rafay, J., Parkanyi, V., and Jakubicka, I. Vyskumny Ustav Zivocisnej Vyroby Nitra Czechoslovakia. 1989. dynamics of some biochemical indices in the blood of silver foxes before the onset of their sexual activity. <original> dynamika niektorych biochemickych ukazovatelov v krvi lisok striebornych pred nastupom pohlavnej aktivity. *Polnohospodarstvo. V. 35(11) P. 1023-1028*

Chem Meth Rager, G., Lausmann, S., and Gallyas, F. an improved silver stain for developing nervous tissue. *STAIN TECHNOL. Stain Technology. 54 (4). 1979. 193-200.*

Prim Ralston, D. D. and Ralston, H. J. the terminations of corticospinal tract axons in the macaque monkey. *Journal of Comparative Neurology. 242 (3). 1985 (Recd. 1986). 325-337.*

Nutrition Ranaweera, K. N. P., Siriwardene, J. A. De S., Manamperi, H. B., Jayawardena, K. M., and Poulter, R. G. 1979. dried fish silage as a protein source for poultry. 1. feeding trialswith broiler chickens. *Ceylon Veterinary Journal* 27(1/4): 5-9.

Prim Rani, R., Sharma, J. K., Nand, R., and Ghosh, P. K. 1981. heterogeneity of silver staining in the marker chromosome of rhesus monkey (macara mulatta). *Vol. 10, No. 5, Pp. 409-412* J. Hum. Evol.

FL Rapos, M. metallophilic cells in the white pulp of the spleens of young mice. *BIOLOGIA (Bratislava). 34 (9). 1979. 701-708.*

Alt Ras, V. R. and Nava, P. B. 1986. age-related changes of neurites in meissner corpuscles of diabetic mice. *Experimental Neurology* 91(3): 488-501.

Anat Rasmussen, L. E. and Munger, B. L. 1996. the sensorineural specializations of the trunk tip (finger) of the asian elephant, elephas maximus. *Anatomical Record* 246(1): 127-34 .

Phys Rees Sandrra(A), Rawson John, Nitsos Ilias, and Brumley Carolyn. 1994. the structural and functional development of muscle spindles and their connections in fetal sheep. *Brain Research* 642(1-2): 185-198.

Prim Reese, B. E. and Cowey, A. 1983. projection lines and the ipsilateral retino-geniculate pathway in the hooded rat. *Neuroscience* 10(4): 1233-47.

Unrel Reese Benjamin E(A) and Baker Gary E. 1993. the re-establishment of the representation of the dorso-ventral retinal axis in the chiasmatic region of the ferret. *Visual Neuroscience* 10(5): 957-968.

FL Reidy, M. A. and Bowyer, D. E. 1978. scanning electron microscope studies of rabbit aortic endothelium in areas of haemodynamic stress during induction of fatty streaks. *Virchows Archiv. A, Pathological Anatomy and Histology* 377(3)

In Vit Reidy, M. A. and Schwartz, S. M. 1980. developments in the study of endothelial cells by scanning electron microscopy. *Artery* 8(3): 236-43.

Gene Reimer, D. L. and Singh, S. M. in-situ hybridization studies on murine catalase messenger rna expression during embryonic development. *DEV GENET. Developmental Genetics. 11 (4). 1990. 318-325.*

In Vit Reinecke, R. K. and Reinecke, N. D. 1994. identification of first stage larvae l1 of bovine nematodes. *Pesquisa Veterinaria Brasileira* 14(1): 1-4.

Nut def Reis, Brenda L. and Evans, Gary W. hereditary influence on zinc requirements of mice. *Nutr. Rep. Int. (1976)* 13(2): 213-16.

Method Reisinger, P. W. and Unger, J. W. 1990. direct immunoblotting from histological sections of brain onto nitrocellulose: evaluation with the protein neurophysin. *Electrophoresis* 11(8): 631-4.

Phys Rekila, T., Harri, M., Jalkanen, L., and Mononen, J. 1999. relationship between hyponeophagia and adrenal cortex function infarmed foxes. *Physiology & Behavior* 65(4/5): 779-783.

HHE Richmond, F. J., Johnston, W. S., Baker, R. S., and Steinbach, M. J. 1984. palisade endings in human extraocular muscles. *Investigative Ophthalmology & Visual Science* 25(4): 471-6.

No Oral Ridgway, L. P. and Karnofsky, D. A. 1952. the effects of metals on the chick embryo: toxicity and production of abnormalities in development. *Ann N Y Acad Sci.* 55: 203-215.

FL Riegger, A. J. and Kromer, E. P. 1990. [angiotensin-converting-enzyme inhibitor and heart hypertrophy]. <original> angiotensin-converting-enzymhemmer und herzhypertrophie. *Wiener Medizinische Wochenschrift* 140(1-2): 46-9.

FL Risopatron, P. 1990. heritability of fear-motivated responses of silver fox cubs. *Scientifur* 14(3): 211.

Drug Robb, E. C. and Nathan, P. 1981. control of experimental burn wound infections: comparative delivery of the antimicrobial agent (silver sulfadiazine) either from a cream base or from a solid synthetic dressing. *Journal of Trauma* 21(10): 889-93.

Anat Roberts, L. A. 1991. morphological innervation pattern of the developing rabbit heart. *American Journal of Anatomy* 190(4): 370-84.

Anat Roberts, L. A. 1991. the sinoatrial ring bundle: a cardiac neural communication system? *American Journal of Anatomy* 191(3): 250-60.

BioX Rocha, E. M. M., Correa-Oliveira, R., Carneiro, C. R. W., Lopes, J. D., and Krettli, A. U. 1990. the immunodominant surface antigen of plasmodium gallinaceum is presentin both the salivary gland and oocyst sporozoites. *Brazilian Journal of Medical and Biological Research* 23(11): 1117-1125.

BioX Rocha, M. A., Barbosa, E. F., Guedes Rmc, Lage, A. P., Leite, R. C., and Gouveia Amg(A). 1999. detection of bhv-1 in a naturally infected bovine fetus by a nested pcr assay. *Veterinary Research Communications* 23(2): 133-141.

Chem Meth Rodier, P. M. and Kates, B. 1988. histological localization of methylmercury in mouse brain and kidney by emulsion autoradiography of 203hg. *Toxicology and Applied Pharmacology* 92(2): 224-34.

Chem Meth Rodier, P. M., Kates, B., and Simons, R. 1988. mercury localization in mouse kidney over time: autoradiography versus silver staining. *Toxicology and Applied Pharmacology* 92(2): 235-45.

Prim Rodrigo, J., Hernandez, J., Vidal, M. A., and Pedrosa, J. A. 1975. vegetative innervation of the esophagus. ii. intraganglionic laminar endings. *Acta Anatomica* 92(1): 79-100.

BioX Roelke-Parker, M. E., Munson, L., Packer, C., Kock, R., Cleaveland, S., Carpenter, M., O'Brien, S. J., Pospischil, A., Hofmann-Lehmann, R., and Lutz, H. 1996 . a canine distemper virus epidemic in serengeti lions (panthera leo). *Nature.* 379(6564): 441-445.

Plant Rohrbach, H. the european mistletoe-d viscum-album-d. *ARNOLDIA (BOSTON). ARNOLDIA (Boston). 29 (10). 1969 69-72.*

Aquatic Rojik, I., Nemcsok, J., and Boross, L. 1983. morphological and biochemical studies on liver, kidney and gill of fishes affected by pesticides. *Acta Biologica Hungarica* 34(1): 81-92.

Aquatic Roper, J. M., Cherry, D. S., Simmers, J. W., and Tatem, H. E. 1997. bioaccumulation of toxicants in the zebra mussel, dreissena polymorpha, at the times beach confined disposal facility, buffalo, new york. *Environ. Pollut.* 94(2): 117-129 .

BioX Rosengarten Renate(A), Behrens Annett, Stetefeld Anja, Heller Martin, Ahrens Meike, Sachse Konrad, Yogev David, and Kirchhoff Helga. 1994. antigen heterogeneity among isolates of mycoplasma bovis is generated by high-frequency variation of diverse membrane surface proteins. *Infection and Immunity* 62(11): 5066-5074.

Prim Rosiepen, G., Arslan, M., Clemen, G., Nieschlag, E., and Weinbauer, G. F. 1997. estimation of the duration of the cycle of the seminiferous epithelium in the non-human primate macaca mulatta using the 5-bromodeoxyuridine technique. *Cell and Tissue Research* 288(2): 365-9.

CP Rossdale, P. D. Chairman, Koterba, A. M., Adams, R., Rose, R. J., Stewart, J. H., Hillidge, C. J., Webb, A. I., Kosch, P. C., Ousey, J. C., Silver, M., Fowden, A. L., Dudan, F. E., and Cash, R. S. G. 1983. panel: management and treatment of the premature foal. *Proceedings of the Annual Convention of the American Association of Equine Practitioners* 29: 125...211.

Phys Rossi, F., van der Want, J. J., Wiklund, L., and Strata, P. 1991. reinnervation of cerebellar purkinje cells by climbing fibres surviving a subtotal lesion of the inferior olive in the adult rat. ii. synaptic organization on reinnervated purkinje cells. *Journal of Comparative Neurology* 308(4): 536-54.

Method Rossini, K., Rizzi, C., Sandri, M., Bruson, A., and Carraro, U. 1995. high-resolution sodium dodecyl sulfate-polyacrylamide gel electrophoresis and immunochemical identification of the 2x and embryonic myosin heavy chains in complex mixtures of isomyosins. *Electrophoresis* 16(1): 101-4.

Phys Roughan, J. V(A) and Laming, P. R. 1998. epicortical slow potential shifts and sensory-evoked potentials are related to seizure propensity in gerbils. *Journal of Comparative Physiology A Sensory Neural and Behavioral Physiology* 182(6): 827-838.

Aquatic Rouvinen, K. I., Anderson, D. M., and Alward, S. R. 1997. effects of high dietary levels of silver hake and atlantic herring on growing-furring performance and blood clinical-chemistry of mink (mustela vison). *Canadian Journal Of Animal Science.* 77(3): 509-517.

No Dose Rowland, A. C. and Hutchings, D. A. necrotic enteritis and regional ileitis in pigs at slaughter. *Veterinary Record| SN- 0042-4900| PY- 1978| VO- 103| IS- 15| PG-.*

Gene Rubino, R. 1993. goat breeds in italy. *Animal Genetic Resources Information* (11): 47-62.

Drug Rud, J., Munksgaard, E. C., Andreasen, J. O., Rud, V., and Asmussen, E. 1991. retrograde root filling with composite and a dentin-bonding agent. 1. *Endodontics & Dental Traumatology* 7(3): 118-25.

Anat Ruiz Pesini, P., Cifuentes, J. M., and Fernandez-Troconiz, P. 1991. the nucleus of the tractus solitarius of the dog. a morphological and morphometric analysis. *Journal of Anatomy* 176: 113-32.

Bio Acc Rungby, J. and Danscher, G. 1983. localization of exogenous silver in brain and spinal cord of silver-exposed rats. *Acta Neuropathol.* 60(1-2): 92-8 .

In Vit Rungby, J., Ellermann-eriksen, S., and Danscher, G. effects of selenium on toxicity and ultrastructural localization of silver in cultured Macrophages. *Arch Toxicol; 61 (1). 1987. 40-45.*

Abstract Rungby, J., Moller-madsen, B., Thorlacius-ussing, O., Schroder, H. D., and Danscher, G. 1985. experimental silver intoxication of nervous tissue. *Annual Meeting of the Scandinavian Neuropathological Society*

No Oral Rungby, J., Slomianka, L., Danscher, G., Anderseen, A. H., and West, M. J. a quantitative evaluation of the neurotoxic effect of silver on the volumes of the components of the developing rat hippocampus. *TOXICOLOGY.* 43(3): 261-268.

HHE Rungby, J., Thorlacius-ussing, O., Moller-andersen, B., and Danscher, G. 1985 . experimental argyrosis. *Nordic Symposium on Metabolism of Trace Elements Related to Human Diseases*

Abstract Rungby, J., Thorlacius-ussing, O., Moller-madsen, B., and Danscher, G. 1985. distribution of exogenous silver in peripheral nervous system structures. *2ND NORDIC NEUROCHEMICAL SYMPOSIUM*

Bio Acc Rungby, Joergen. experimental argyrosis: ultrastructural localization of silver in rat eye. *Exp. Mol. Pathol. (1986)* 45(1): 22-30 .

No Oral Rungby, Jorgen and Danscher, Gorm. 1984. hypoactivity in silver exposed mice. *Acta Pharmacol. Toxicol.* 55(5): 398-401.

In Vit Rungby, Jorgen, Hultman, Per, and Ellermann-Eriksen, Svend. silver affects viability and structure of cultured mouse peritoneal macrophages and peroxidative capacity of whole mouse liver. *Arch. Toxicol. (1987)* 59(6): 408-12.

No COC Ryan, L. J., Linder, J. C., Martone, M. E., and Groves, P. M. 1990. histological and ultrastructural evidence that d-amphetamine causes degeneration in neostriatum and frontal cortex of rats. *Brain Research* 518(1-2): 67-77.

Phys Sabato, S., Agresta, C. A., Freeman, G. M., and Salzman, S. K. 1991. safety versus efficacy of spinal cord stimulation for the generation of motor-evoked potentials in the rat. *Journal of Neurotrauma* 8(1): 27-44.

FL Saer, J. B., Chen, I., Yates, R. D., and Ichinose, H. 1981. age-related alterations in epicardial arteries of spontaneously hypertensive rats. *Virchows Archiv* 36(1): 77-86.

Drug Safavi, K. E., Pascon, E. A., and Langeland, K. 1983. evaluation of tissue reaction to endodontic materials. *Journal of Endodontics* 9(10): 421-9.

Phys Safronova, L. D(A). 1999. electron microscopic analysis of synaptonemal complexes in male hybrids. *Ontogenez* 30(4): 255-266.

Method Saganova, K., Marsala, J., Orendacova, J., and Orlovsky, V. demonstration of ischemic damage of rabbit ventral spinal cord by nauta impregnation method. *BIOLOGIA (Bratislava). 45 (7). 1990. 547-554.*

No COC Sahota, A. W. and Gillani, A. H. 1995. effect of ascorbic acid supplementation on performance and cost ofproduction in layers maintained under high ambient temperatures. *Pakistan Veterinary Journal* 15(4): 155-158.

Bact Saidi, I. S., Biedlingmaier, J. F., and Whelan, P. 1999. in vivo resistance to bacterial biofilm formation on tympanostomy tubes as a function of tube material. *Otolaryngology--Head and Neck Surgery* 120(5): 621-7.

Imm Sakai, C., Kawakami, Y., Law, L. W., Furumura, M., and Hearing, V. J. Jr. 1997. melanosomal proteins as melanoma-specific immune targets. *Melanoma Research* 7(2): 83-95.

In Vit Salama, G. and Abramson, J. 1984. silver ions trigger ca2+ release by acting at the apparent physiological release site in sarcoplasmic reticulum. *Journal of Biological Chemistry* 259(21): 13363-9.

No Oral Salem, Harry Aberdeen Proving Ground MD and Katz, Sidney A. Rutgers Univ Camden NJ. speciation, bioavailability, and systemic distribution of chromium from. *Sci Total Environ. V86, N1-2, P59(6)*

Drug Salisbury, R. E., Bevin, A. G., Steinkraus, G. E., and Enterline, D. S. 1980. burn wound sepsis: effect of delayed treatment with topical chemotherapy on survival. *Journal of Trauma* 20(2): 120-2.

FL Salyi, G. and Sztojkov, V. 1993. biotin deficiency in foxes. *Magyar Allatorvosok Lapja* 48(3): 157-161.

FL Samkov, Yu. A. and Efremov, Yu. M. 1976. protein nutrition of young coloured mink. *Krolikovodstvo i Zverovodstvo* (5): 15-17.

Nutrition Samy, M. S., El-Hawary, M., Radwan, M. H., and Abdou, S. B. effect of feeding different levels of dietary protein to chicks during the rearing period on the quality of the subsequently produced eggs. *Annals of Agricultural Science (Cairo). 31 (1). 1986. 453-476.*

FL Sanna, L., Zedda, M., Acone, F., Palmieri, G. Sassari Univ. Italy Istituto di Anatomia Normale degli Animali Domestici, and Bo Minelli, L. Parma Univ. Italy Istituto di Anatomia Normale degli Animali Domestici. 1993. sensitive innervation of the femorotibial articulation in the horse.

<original> sulla innervazione sensitiva del comparto articolare femoro-tibiale nel cavallo. *Atti Della Societa Italiana Delle Scienze Veterinarie. V. 47(Pt.1) P. 119-121*

Drug Sanner, C., Elliott, J. L., and Snider, W. D. 1994. upregulation of nmdari mrna induced by mk-801 is associated with massive death of axotomized motor neurones in adult rats. *Neurobiology of Disease* 1(3): 121-9.

Phys Sano, H., Mera, Y., Arai, K., Suzuki, M., Sato, H., and Matsuda, K. 1991. localization of 14c-nizatidine in the gastric wall of rats. *Arzneimittel-Forschung* 41(9): 958-61 .

HHE Santesson, B., BOOK, J. A., and Kjessler, B. 1973. the mortality of human xo embryos. *Journal of Reproduction and Fertility* 34(1): 51-5.

Phys Sasa, M., Hara, M., and Takaori, S. 1991. dopamine d-1 receptor-mediated inhibition of nucleus accumbens neurons from the ventral tegmental area. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 15(1)

No Oral Sasaki, T., Ramamurthy, N. S., and Golub, L. M. 1994. bone cells and matrix bind chemically modified non-antimicrobial tetracycline. *Vol. 15, No. 3, Pp. 373-375* Bone

Prim Sathian, K. and Devanandan, M. S. 1983. receptors of the metacarpophalangeal joints: a histological study in the bonnet monkey and man. *Journal of Anatomy* 137(Pt 3): 601-13.

Imm Sato, R. and Tanaka, M. 1997. intestinal distribution and intraluminal localization of orally administered clostridium butyricum in rats. *Microbiology and Immunology* 41(9): 665-71.

FL Savluk, O. S. effect of anodically dissolved silver on the reticuloendothelial system of experimental animals. *Vodopodgot. Ochistka Prom. Stokov (1973)* : 10, 72-7.

FL Savlyk, O. S. and Moroz, O. G. reaction of rats to long-term intake of silver with the drinking water. *Vodopodgotovka i Ochistka Prom. Stokov (1973)* (10): 99-108 From: Ref. Zh., Biol. Khim. 1974, Abstr. No. 15F2344.

Drug Savory John(A), Rao Jagannatha K S, Huang Yue, Letada Philip R, and Herman Mary M. 1999. age-related hippocampal changes in bcl-2:bax ratio, oxidative stress, redox-active iron and apoptosis associated with aluminum-induced neurodegeneration: increased susceptibility with aging. *Neurotoxicology (Little Rock)* 20(5): 805-818.

Abstract Sawatzki, G. and Wendel, A. 1975. inhibition of the seleno enzyme glutathione peroxidase by silver ions. *Chemica Scripta.* 8a. 115.

Anat Sawicki Boguslaw. 1993. c-cells of the thyroid and of ultimobranchial remnants of the european bison. *Annals of Anatomy* 175(4): 343-347.

Prim Scallet, A. C., Binienda, Z., Caputo, F. A., Hall, S., Paule, M. G., Rountree, R. L., Schmued, L., Sobotka, T., and Slikker, W. Jr. 1993. domoic acid-treated cynomolgus monkeys (m. fascicularis): effects of dose on hippocampal neuronal and terminal degeneration. *Brain Research* 627(2): 307-13.

Phys Scherini, E. and Mares, V. 1993. renewal of dna in purkinje cell nuclei of mouse cerebellum. a 9-month follow-up autoradiographic study. *Physiological Research* 42(3): 193-9.

Unrel Scheuhammer, A. M. and Dickson, K. M. 1996. patterns of environmental lead exposure in waterfowl in eastern canada. *AMBIO.* 25(1): 14-20.

FL Schilew, P. G. and Babmindra, W. P. 1968. [experimental morphological studies on interneuronal synapses]. <original> experimentelle norphologische untersuchungen an den interneuronalen synapsen. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 79(1): 1-13.

FL Schlolaut, W. and Lange, K. 1972. a comparison of fattening and slaughter performance in hybrid andlight-coloured large silver rabbits. *Archiv Fur Geflugelkunde* 36(4): 134-137.

Phys Schmidt, R. E., Spencer, S. A., Coleman, B. D., and Roth, K. A. 1991. immunohistochemical localization of gap-43 in rat and human sympathetic nervous system--effects of aging and diabetes. *Brain Research* 552(2): 190-7.

FL Schmidt, W. 1967. [the argyrophilia of reticular fibers in vivo]. <original> die argyrophilie von retikulinfasern in vivo. *Zeitschrift Fur Anatomie Und Entwicklungsgeschichte* 126(2): 176-81.

FL Schobber, W. 1981. [efferent and afferent connections of the nucleus lateralis posterior thalami ("pulvinar") in the albino rats (author's transl)]. <original> efferente und afferente verbindungen des nucleus laterlia posterior thalami ("pulvinar") der ablinoratte. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 95(5): 827-44 .

FL Schober, W. and Gruschka, H. subcortical projections of the striate cortex in the adult albino rat and during post natal development. *Zeitschrift Fuer Mikroskopisch-Anatomische Forschung (Leipzig). 97 (5). 1983 (Recd. 1984). 797-815.*

FL Schober, W. and Gruschka, H. 1983. [subcortical projections of the visual cortex in the adult albino rat and during postnatal development]. <original> zur subkortikalen projektion des visuellen kortex bei der adulten albinoratte und wahrend der postnatalen entwicklung. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 97(5): 797-815.

In Vit Schoenle, E. J., Adams, L. D., and Sammons, D. W. 1984. insulin-induced rapid decrease of a major protein in fat cell plasma membranes. *Journal of Biological Chemistry* 259(19): 12112-6.

CP Schroeder, G. L. microorganisms as the primary diet in fish farming. *Halver, J. E. and K. Tiews (Ed.). Finfish Nutrition and Fishfeed Technology, Vol. 1. Proceedings of a World Symposium, Hamburg, West Germany, June 20-23, 1978. X+593p. Heenemann Verlagsgesellschaft: Berlin, West Germany. Illus. Paper. ISBN 3-87903-052-9. 0 (0). 1979 (Recd. 1980). P379-386.*

Aquatic Schroeder, G. L. sources of fish and prawn growth in poly culture ponds as indicated by stable carbon isotope analysis. *Aquaculture. 35 (1). 1983. 29-42.*

FL Schultka, R., Schmidt, R., and Drosner, H. P. 1971. [histochemical localization of heavy metal in the kidneys of white rats during embryonal and postnatal development]. <original> histochemischer schwermetallnachweis in den nieren weisser ratten wahrend der embryonalen und postnatalen entwicklung. *Acta Histochemica* 40(1): 123-30.

Chem Meth Schultze, A. E. and Jensen, R. K. 1989. sodium dodecyl sulfate polyacrylamide gel electrophoresis of canineurinary proteins for the analysis and differentiation of tubular andglomerular diseases. *Veterinary Clinical Pathology* 18(4): 93-97.

Alt Schulze, E. and Neuhoff, V. 1983. artificial release of super(3)h-taurine after electrical stimulation of retinae. *Vol. 21, No. 1-2, Pp. 15-24* Int. J. Neurosci.

Prim Schwartz, M. L., Dekker, J. J., and Goldman-Rakic, P. S. 1991. dual mode of corticothalamic synaptic termination in the mediodorsal nucleus of the rhesus monkey. *Journal of Comparative Neurology* 309(3): 289-304.

Chem Meth Schweisthal, M. R., Frost, C. C., and Brinn, J. E. 1975. stains for a, b, and d cells in fetal rat islets. *Stain Technology* 50(3): 161-70.

No Dose Sciesinski, K. and Kaleta, T. 1986. the effect of suacron on silver fox matings. *Scientifur. V. 10(1) P. 42-43*

FL Sciesinski, K. and Pieta, B. 1995. the use of receptal (busereline) in the course of reproduction in female silver foxes, 2. *Scientifur. V. 19(3) P. 201-205*

FL Seeland, G., Rossler, B., and Roder, B. 1996. analysis of growth in rabbits of different breeds with selected growthfunctions. *Archiv Fur Tierzucht* 39(5): 533-544.

CP Sefton, A. J., Lund, R. D., and Perry, V. H. co-transplantation of appropriate target regions prolongs the survival and stimulates the outgrowth of ganglion cells in retinae transplanted to cortex. *Seventh Meeting of the Australian Neuroscience Society, Newcastle, North South Wales, Australia, February 3-5, 1987. Neurosci Lett Suppl. 0 (27). 1987. S122.*

In Vit Seil, F. J. 1972. neuronal groups and fiber patterns in cerebellar tissue cultures. *Brain Research* 42(1): 33-51.

Gene Selkirk, J. K., Hite, M. C., Godfrey, V., Merrick, B. A., He, C., Griesemer, R. A., Daluge, D. R., and Mansfield, B. K. 1992. two-dimensional polyacrylamide gel electrophoretic characterization of proteins from organs of c3h mice expressing the scurfy (sf) genetic mutation during early and late stages of disease progression. *Applied and Theoretical Electrophoresis* 3(2): 97-107.

Prim Seltzer, B. and Pandya, D. N. 1980. converging visual and somatic sensory cortical input to the intraparietal sulcus of the rhesus monkey. *Brain Research* 192(2): 339-51.

FL Seo, K. D., Kwon, K. Yonam Junior Coll. of Livestock and Horticulture Sungwhan Korea R. Dept. of Animal Science, Han, K. Y. Ansung Junior Coll. Ansung Korea R., and Kim, S. K. Taejon Junior Coll. Taejon Korea R. 1989. a survey on the reproductive statistics of silver fox raised in korea. *Korean Journal of Animal Sciences. V. 31(5) P. 281-283*

HHE Sergi, I., Papandreou, M. J., Medri, G., Canonne, C., Verrier, B., and Ronin, C. 1991. immunoreactive and bioactive isoforms of human thyrotropin. *Endocrinology* 128(6): 3259-68.

Prim Sesack, S. R., Snyder, C. L., and Lewis, D. A. 1995. axon terminals immunolabeled for dopamine or tyrosine hydroxylase synapse on gaba-immunoreactive dendrites in rat and monkey cortex. *Journal of Comparative Neurology* 363(2): 264-80.

FL Sharma, R. and Schumacher, U. 1996. the diet and gut microflora influence the distribution of enteroendocrine cells in the rat intestine. *Experientia* 52(7): 664-70.

No COC Sharp FrankR, M. D. National Technical Information Service (NTIS). drug induced neurotoxicity. *FEDRIP DATABASE*

FL Shavlovskii, M. M., Chebotar', N. A., Konopistseva, L. A., Zakharova, E. T., Kachurin, A. M., Vasil'ev, V. B., and Gaitskhoki, V. S. 1994. [influence of ceruloplasmin on the embryotoxic effect of silver ions]. <original> vliianie tseruloplazmina na embriotoksicheskii effekt ionov serebra. *Biokhimiia* 59(8): 1164-74.

FL Shavlovsky, M. M., Chebotar, N. A., Konopistseva, E. A., Zakharova, E. T., Kachurin, A. M., Vasilyev, V. B., and Gaitskhoki, V. S. effect of ceruloplasmin on silver embryotoxicity. *Biokhimiya (Moscow) (1994)* 59(8): 1164-73 .

In Vit Sherif, M. F., al-Zuhair, A. G., and Kharbat, B. A. 1991. identification of sensory neurons supplying receptors in lingual muscles of the rat: histochemical and retrograde labeling study with horseradish peroxidase. *Histology and Histopathology* 6(4): 549-58.

Prim Shi, L., Liu, R., and Chen, Y. observation on silver-stained synaptonemal complex in rhesus monkey spermatocytes by light microscopy. *Acta Genetica Sinica. 11 (4). 1984 (Recd. 1985). 302-305.*

Method Shibata, Noriharu. light microscopic histochemical methods for the detection of acidic glycoconjugates by means of a physical development procedure and their application to rat connective tissues. *Connect. Tissue (1995)* 26(4): 307-16..

No Oral Shinogi, Masaki and Maeizumi, Satoko. effect of preinduction of metallothionein on tissue distribution of silver and hepatic lipid peroxidation. *Biol. Pharm. Bull. (1993)* 16(4): 372-4 .

FL Shiota, T., Yamada, M., and Yoshida, Y. 1986. morphology, development and behavior of pneumocystis carinii observed by light-microscopy in nude mice. *Zentralblatt Fur Bakteriologie, Mikrobiologie, Und Hygiene. Series A,*

No Oral Shipley, L. A., Blomquist, S., and Danell, K. 1998. diet choices made by free-ranging moose in northern sweden in relationto plant distribution, chemistry, and morphology. *Canadian Journal of Zoology* 76(9): 1722-1733.

No COC Shirasawa, N., Hirano, M., and Ishikawa, H. immunocytochemistry of mammotroph and somatotroph in fetal and adult bovine pituitary by three different methods. *Jikeikai Medical Journal. 37 (4). 1990. 433-446.*

FL Shmuter, G. M., Izotova, P. V., Maslenko, A. A., Furman, A. A., and Sobolevskaya, T. T. hygienic evaluation of the electrochemical method of water decontamination with silver. *Gigiena i Sanitariya. 0 (12). 1986 (Recd. 1987). 10-12.*

In Vit Sholley, M. M., Ferguson, G. P., Seibel, H. R., Montour, J. L., and Wilson, J. D. 1984. mechanisms of neovascularization. vascular sprouting can occur without proliferation of endothelial cells. *Laboratory Investigation* 51(6): 624-34.

Drug Shteffens, V., Lider, I., Virt, M., and Mit, G. 1992. importance of the silver carp as a component of a diet in the prevention and treatment of cardiovascular diseases. *Voprosy Ikhtiologii* 32(1): 180-182.

FL Shvarts, G. I. a., Liberman, S. S., Mashkovskii, M. D., and Berliand, E. A. 1975. [experimental study of the anti-inflammatory action of pyridinolcarbamate]. <original> eksperimental'noe izuchenie protivovospalitel'nogo deistviia piridinolkarbamata. *Farmakologiia i Toksikologiia* 38(4): 434-6.

FL Shvarts, G. Ya., Liberman, S. S., Mashkovskii, M. D., and Berlyand, E. A. antiinflammatory action of pyridinol carbamate. *Farmakol. Toksikol. (Moscow) (1975)* 38(4): 434-6.

CP Silver Daniel P(A), Spanopoulou Eugenia, Mulligan Richard C(A), and Baltimore David. 1993. dispensable sequence motifs in the rag-1 and rag-2 genes for plasmid v(d)j recombination. *Proceedings of the National Academy of Sciences of the United States of America* 90(13): 6100-6104.

FL Simkova, M. and Vrabec, J. 1970. [experimental corneal trepanation with subsequent freezing. ii. study of silver impregnations]. <original> experimentalni rtrepance rohovsky s naslednym zmrazenim. ii. studie impregnaci stribrem. *Sbornik Lekarsky* 72(8): 224-30.

Anat Singh, G. D. and Moxham, B. J. 1993. cellular activity in the developing palate of the rat assessed by the staining of nucleolar organiser regions. *Journal of Anatomy* 182(Pt 2): 163-8.

HHE Singh, J. P. and Bonin, P. D. 1988. purification and biochemical properties of a human monocyte-derived growth factor. *Proceedings of the National Academy of Sciences of the United States of*

FL Sirotina, M. F. morphological and functional changes in the micro vascular bed under development of adrenal hypertension. *Fiziologicheskii Zhurnal (Kiev). 25 (1). 1979. 68-75.*

FL Sirotkina, L. N. and Tyutyunnik, N. N. 1998. endocrine thyroid gland, adrenal cortex and gonadal functions in furanimals in the postnatal period and reproductive season. *Scientifur* 22(4): 299-302.

FL Skrede, A. 1987. trials with concentrated fish silage for foxes and mink. *Va Ra Palsdjur* 58(5-6): 192, 194-196.

FL Skuba, N. D., Adamian, A. A., Dan, V. N., Trosteniuk, N. V., and Lopour, P. 1989. [morphological validation of the use of polyhydroxyethyl methacrylate-based x-ray contrast emboli for vascular occlusion]. <original> morfologicheskoe obosnovanie primeneniia rentgenokontrastnykh embolov na osnove poligidroksietilmetakrilata dlia okkliuzii sosudov. *Biulleten' Eksperimental'Noi Biologii i Meditsiny* 107(3): 379-82.

Method Slany Robert K(A) and Mueller Stefan O. 1995. trna-guanine transglycosylase from bovine liver: purification of the enzyme to homogeneity and biochemical characterization. *European Journal of Biochemistry* 230(1): 221-228.

FL Slesarenko, N. A. and Babichev, N. V. 1996. skin characteristics of fur bearers. *Krolikovodstvo i Zverovodstvo* (5): 14-15.

Prim Slikker, W. Jr, Ali, S. F., Scallet, A. C., Frith, C. H., Newport, G. D., and Bailey, J. R. neurochemical and neurohistological alterations in the rat and monkey produced by orally administered methylenedioxymethamphetamine mdma. *Toxicology and Applied Pharmacology. 94 (3). 1988. 448-457.*

In Vit Smetana, K. Jr(A) and Broulik, P. 1994. nuclear and nucleolar kinetics in multinucleate osteoclasts in the chick development and after the hormonal treatment. *Folia Biologica (Prague)* 40(4): 201-207.

FL Smielewska-Los, E. and Klimentowski, S. 1996. microbiological investigations into mortality of newborn foxes. *Medycyna Weterynaryjna* 52(6): 397-399.

An Prod Smielewska-Los Ewa&&Ast And Stanislaw Klimentowski. 1996. death rate of new-born foxes in the light of the bacteriological examinations. *Medycyna Weterynaryjna* 52(6): 397-399.

Prim Smith, A. W., Skilling, D. E., and Benirschke, K. 1985. calicivirus isolation from three species of primates: an incidental finding. *American Journal of Veterinary Research* 46(10): 2197-9.

Anat Smith, C. E., Dahan, S., Fazel, A., Lai, W., and Nanci, A. correlated biochemical and radioautographic studies of protein turnover in developing rat incisor enamel following pulse-chase

labeling with l sulfur-35 and l methyl-tritiated methionine. *Anatomical Record. 232 (1). 1992. 1-14.*

Anat Smith, C. E. and Nanci, A. 1996. protein dynamics of amelogenesis. *Anatomical Record* 245(2): 186-207.

Unrel Smith, D. H., Soares, H. D., Pierce, J. S., Perlman, K. G., Saatman, K. E., Meaney, D. F., Dixon, C. E., and McIntosh, T. K. 1995. a model of parasagittal controlled cortical impact in the mouse: cognitive and histopathologic effects. *Journal of Neurotrauma* 12(2): 169-78.

Rev Smith, I. C. and Carson, B. L. 1977.*(Book)* : 469 pp.

In Vit Smith, R. A. and McInnes, I. B. 1986. phase contrast and electron microscopical observations of adult mouse dorsal root ganglion cells maintained in primary culture. *Journal of Anatomy* 145: 1-12.

Prim Smith, R. L. 1975. axonal projections and connections of the principal sensory trigeminal nucleus in the monkey. *Journal of Comparative Neurology* 163(3): 347-75.

Alt Smith, S. D. and Winter, W. G. 1980.*Studies of Rat Limb Peripheral Nerve Regeneration. <NOTE> Annual Rept. 1 Apr 79-1 Jan 80. TR-1*

BioX Smyth, J. M., Sheahan, B. J., and Atkins, G. J. 1990. multiplication of virulent and demyelinating semliki forest virus in the mouse central nervous system: consequences in balb/c and sjl mice. *Journal of General Virology* 71(Pt 11): 2575-83.

Drug Snelling, C. F., Roberts, F. J., Germann, E., Gillespie, K., Coderre, S., and Henry, D. 1988. comparison of standard and chlorhexidine-derivative topical antibacterial agents on the infected burned rat wound. *Burns, Including Thermal Injury* 14(2): 91-100.

Phys Snyder, D. C., Coltman, B. W., Muneoka, K., and Ide, C. F. 1991. mapping the early development of projections from the entorhinal cortex in the embryonic mouse using prenatal surgery techniques. *Journal of Neurobiology* 22(9): 897-906.

FL Sobolev, A. D. 1988. [for feed purposes [experiments into the use of feed meal produced from hide industry wastes in the diet of silver foxes on the state farm "saltykovsky", moscow region]]. <original> na kormovye tseli. *Krolikovodstvo i Zverovodstvo. (No.6) P. 14-15*

Alt Soh, B. M., Fox, L. E., and Moscona, A. A. changes in patterns and synthesis of proteins in embryonic neural retina studied by 2 dimensional gel electrophoresis. *Developmental Brain Research. 3 (3). 1982. 329-340.*

FL Soldatov, I. B., Peshtein, N. N., and Kvetnoi, I. M. endocrine cells of the internal ear in normal rabbits and rabbits with a specific labyrinthine lesion. *Vestnik Otorinolaringologii. 0 (2). 1989. 20-24.*

FL Soldatov, I. B., Reshtein, N. N., and Kvetnoi, I. M. 1989. [endocrine cells of the internal ear in the normal state and in specific labyrinthine lesion in rabbits]. <original> endokrinnye kletki vnutrennego ukha v norme i pri spetsificheskom porazhenii labirinta u krolika. *Vestnik Otorinolaringologii* (2): 20-4.

Diss Somsak Wanichachiwa, Pansiri Puchito, and Sombun Anantalaphochai (Chiang Mai Univ. (Thailand). Faculty of Science, Dept. of Biology. 1984. development of the tibia in japanese quail. <original> kan charoen khong kraduk tibia nai nok kratha phan yipun. *5 Leaves*

FL Sonderup, M. 1986. it pays to provide shelter for silver foxes. *Va Ra Palsdjur* 57(11): 368-369.

Phys Soonpaa, M. H. and Field, L. J. 1997. assessment of cardiomyocyte dna synthesis in normal and injured adult mouse hearts. *American Journal of Physiology* 272(1 Pt 2): H220-6.

Phys Sorensen, M. B(A), Stoltenberg, M., Juhl, S., Danscher, G., and Ernst, E. 1997. ultrastructural localization of zinc ions in the rat prostate: an autometallographic study. *Prostate* 31(2): 125-130.

Phys Sotelo, C. 1990. axonal abnormalities in cerebellar purkinje cells of the 'hyperspiny purkinje cell' mutant mouse. *Journal of Neurocytology* 19(5): 737-55.

HHE Sotelo, C. and Guenet, J. L. 1988. pathologic changes in the cns of dystonia musculorum mutant mouse: an animal model for human spinocerebellar ataxia. *Neuroscience* 27(2): 403-24.

In Vit Spanakis, E., Lamina, P., and Bennett, D. C. 1992. effects of the developmental colour mutations silver and recessive spotting on proliferation of diploid and immortal mouse melanocytes in culture. *Development* 114(3): 675-80.

Drug Sparago, M., Wlos, J., Yuan, J., Hatzidimitriou, G., Tolliver, J., Dal Cason, T. A., Katz, J., and Ricaurte, G. 1996. neurotoxic and pharmacologic studies on enantiomers of the n-methylated analog of cathinone (methcathinone): a new drug of abuse. *Journal of Pharmacology and Experimental Therapeutics* 279(2): 1043-52.

Phys Sparks, R. L., Zschunke, M. A., Seibel-Ross, E. I., Tracy, R., Zalitis, J. G., Boman, B. M., Hoerl, B. J., and Scott, R. E. specific expression of proteins and phosphoproteins in 3t3 t mesenchymal stem cells at distinct growth arrest and differentiation states. *Cell and Tissue Kinetics. 23 (2). 1990. 71-88.*

Anat Spiga, S., Lallai, L., Mulargia, C., Loy, F., Orru, F., Siddi, A., Argiolas, M., and Serra, G. P. 1997. application of the cajal-de castro method to the laser scanning confocal microscope in studying the peripheral nervous system. *Italian Journal of Anatomy and Embryology* 102(3): 179-93.

Phys Sprick, U. 1991. transient and long-lasting beneficial behavioral effects of grafts in the damaged hippocampus of rat. *Behavioural Brain Research* 42(2): 187-99.

Phys Springer, J. E., Robbins, E., Meyer, S., Baldino, F. Jr, and Lewis, M. E. localization of nerve growth factor receptor messenger rna in the rat basal forebrain with in situ hybridization histochemistry. *Cellular and Molecular Neurobiology. 10 (1). 1990. 33-40.*

FL Springorum, H. W., Bertram, E., Kohnlein, H. E., and Winckler, S. 1975. [the local effect of a silver chelate on standardized scald wounds of the rat]. <original> die lokale wirkung eines silberchelates auf die standardisierte verbruhungswunde der ratte. *Arzneimittel-Forschung* 25(11): 1782-3.

No Oral Srivastava, R. C., Hasan, S. K., Jyotsana, and Gupta, Sanjay. protective role of metallothionein in nickel induced oxidative damage. *Biochem. Mol. Biol. Int. (1993)* 30(2): 261-70.

No Oral Srivastava, R. C., Husain, M. M., Srivastava, S. K., Hasan, S. K., and Lal, A. 1995. effect of pre-exposure to cadmium and silver on nickel induced toxic manifestations in mice : possible role of ceruloplasmin and metallothionein. *Bull. Environ. Contam. Toxicol. (1995)* 54(5): 751-9

In Vit St-Pierre Jacques-Andre, Dumont Yvan, Nouel Dominique, Herzog Herbert, Hamel Edith, and Quirion Remi(A). 1998. preferential expression of the neuropeptide y y|1 over the y|2 receptor

subtype in cultured hippocampal neurones and cloning of the rat y|2 receptor. *British Journal of Pharmacology* 123(2): 183-194.

Chem Meth Steele, K. E., Rikihisa, Y., and Walton, A. M. 1986. ehrlichia of potomac horse fever identified with a silver stain. *Veterinary Pathology* 23(4): 531-533.

FL Steffens, W. 1996 . fat in fish feed - necessary and beneficial. *Muhle + Mischfuttertechnik* 133(32): 509-514.

Alt Steward Oswald. 1992. signals that induce sprouting in the central nervous system: sprouting is delayed in a strain of mouse exhibiting delayed axonal degeneration. *Experimental Neurology* 118(3): 340-351.

Diss Stewart, P. S. 1973. a study of methods for the preservation and identification of lactosewithin the lactating mammary secretory cell of the rat. *Dissertation Abstracts International, B* 34(3): 939.

CP Stewart, W. L., Anderson, D. M., and Rouvinen, K. I. 1994. relationship between organ development and body size of ranched silver foxes birth 10 120 days of age. *Canadian Journal of Animal Science* 74(1): 165.

No Oral Stinnett, J. D., Alexander, J. W., Morris, M. J., Dreffer, R. L., Craycraft, T. K., Anderson, P. E., Ogle, C. K., and MacMillan, B. G. 1981. improved survival in severely burned animals using intravenous corynebacterium parvum vaccine post injury. *Surgery* 89(2): 237-42.

Anat Stocker Susanne, Guettinger Hans Rudolf(A), and Herth Guenther. 1994. exogenous testosterone differentially affects myelination and neurone soma sizes in the brain of canaries. *Neuroreport* 5(12): 1449-1452.

No Oral Stozowska, W., Yilinkou, R. Gami, and Kaliszan, R. urinary silver and sulfathiazole levels in thermally injured guinea pigs during treatment with silver sulfathiazole cream. *S.T.P. Pharma Sci. (1995)* 5(6): 452-5.

Prim Strom, D., Holm, S., and Moller, A. 1994. fatigue development during electrical stimulation in the masseter muscle of rhesus monkeys (macaca mulatta). *Archives of Oral Biology* 39(5): 417-23.

Prim Strom, D., Holm, S., and Moller, A. 1998. frequency-dependent fatigue development during electrical stimulation in the masseter muscle of pigtail monkeys. *Journal of Orofacial Pain* 12(4): 279-86.

Phys Styrna, J., Klag, J., and Moriwaki, K. 1991. influence of partial deletion of the y chromosome on mouse sperm phenotype. *Journal of Reproduction and Fertility* 92(1): 187-95.

Phys Suematsu, N. and Mizuno, T. analysis of epithelial protein profiles of prostatic glands induced heterotypically in the bladder epithelium of the rat. *Development Growth & Differentiation. 33 (4). 1991. 379-390.*

Acu Sugawara, N. and Sugawara, C. 1984. comparative-study of effect of acute administration of cadmium and silver on ceruloplasmin and metallothionein - involvement of disposition of copper, iron, and zinc. *Environmental Research* 35(2): 507-515.

Bact Summers, A. O., Wireman, J., Vimy, M. J., Lorscheider, F. L., Marshall, B., Levy, S. B., Bennett, S., and Billard, L. 1993. mercury released from dental "silver" fillings provokes an increase in mercury- and antibiotic-resistant bacteria in oral and intestinal floras of primates [see comments]. *Antimicrobial Agents and Chemotherapy* 37(4): 825-34.

CP Suvegova, K. and Mertin, D. 1997. health in the fur animals breeding. <original> zdravie v chove kozusinovych zvierat. topical and prospective tasks in rearing and breeding of farm animals. part 2. [proceedings from the international conference held on the occasion of the 50th aniversary of the research institute of animal production]. <original> aktualne a perspektivne ulohy v chove a slachteni hospodarskych zvierat. 2 cast. zbornik referatov z konferencie s medzinarodnou ucastou poriadanej pri prilezitosti 50. vyrocia zalozenia ustavu. *(Pt.2) P. 256-258*

FL Suvorova, L. V., Zavalishina, O. A., and Katinas, G. S. thyroxine and methyl thio uracil effect on development of intra mural ganglia in the chick embryo digestive tube*Arkhiv Anatomii Gistologii i Embriologii. 82 (2). 1982. 24-31.*

In Vit Suzuki, Keiji, Kawaharada, Umeko, Tamura, Yuji, and Nakajima, Katsuyuki. 1991. effects of metals on rat glioma cells (c6). *Biomed. Res. Trace Elem* 2(2): 111-12 .

Mineral Swainbank, R. C., Bundtzen, T. K., and Wood, J. 1990.*Alaska's Mineral Industry, 1990. <NOTE> Special Rept. SR-45*

Abstract Swanson, A. B., Wagner, P. A., Ganther, H. E., and Hoekstra, W. G. antagonistic effects of silver and tri-o cresyl phosphate on selenium and glutathione peroxidase in rat liver and erythrocytes. *FED PROC; 33 (3 PART 1). 1974 693*

Unrel Switonski, M. and Stranzinger, G. 1998. studies of synaptonemal complexes in farm mammals-a review. *Journal of Heredity.* 89(6): 473-480.

FL Szito, A., Simonne Kiss, I. Ontozesi Kutatoint. Szarvas Hungary, Janurik, E., Liska, J, Gorda, S., and Szabo, P. Halteny. Kut. Int. Szarvas Hungary. 1996. experiments with rice field fish culture technologies. <original> kiserletek rizsfoldi halnevelesi technologiak kidolgozasahoz. *Halaszat. V. 89(1) P. 41-47*

No Oral Taha, A. A. and King, A. S. 1983. autoradiographic observations on the innervation of the carotid body of the domestic fowl. *Brain Research* 266(2): 193-201.

BioX Tajima, Y., Kato, K., Maruyama, S., and Hosoi, K. 1996. in vivo modulation of proliferating cell nuclear antigen in growth plate chondrocytes from normal, hypophysectomized, growth hormone-treated hypophysectomized rats: a comparative immunohistochemical study with image analysis. *Journal of Histochemistry and Cytochemistry* 44(7): 713-20.

HHE Takahashi, J. A., Fukumoto, M., Igarashi, K., Oda, Y., Kikuchi, H., and Hatanaka, M. 1992. correlation of basic fibroblast growth factor expression levels with the degree of malignancy and vascularity in human gliomas. *Journal of Neurosurgery* 76(5): 792-8.

Anat Takehana, K., Abe, M., Yamaguchi, M., Iwasa, K., Hiraga, T., Masty, J., Miyata, H., and Yamada, O. 1994. ultracytochemistry of glycoconjugates in pig duodenal gland. *Annals of Anatomy* 176(6): 565-570.

FL Talakin Yu N, Chernykh, L. V., and Ivanova, L. A. toxicity of silver palladium resistive pastes r 075 rapan 2000 rm 07100 rm 07500 rm 071k rm 073k rm 076k rm 072k rm 0750k and conductor pastes p-0701 and p-0703. *Gigiena i Sanitariya. 0 (4). 1991. 89.*

No Oral Tamimi, Salah O., Zmeili, Suheil M., Gharaibeh, Munir N., Shubair, Mohammad S., and Salhab, Abdulazim S. toxicity of a new antismoking mouthwash 881010 in rats and rabbits. *J. Toxicol. Environ. Health* Part A (1998): 53(1), 47-60.

Method Tan, Yanxi, Ager, Patrick, and Marshall, William D. 1996. approaches to the determination of metallothionein(s) by high-performance liquid chromatography-quartz tube atomic absorption spectrometry. *J. Anal. At. Spectrom. (1996)* 11(12): 1183-1187 .

Prim Tanaka, D. and Goldman, P. S. 1976. silver degeneration and autoradiographic evidence for a projection from the principal sulcus to the septum in the rhesus monkey. *Brain Research* 103(3): 535-40.

No COC Tanaka, D. Jr and Bursian, S. J. 1989. degeneration patterns in the chicken central nervous system induced by ingestion of the organophosphorus delayed neurotoxin tri-ortho-tolyl phosphate. a silver impregnation study. *Brain Research* 484(1-2): 240-56.

Unrel Tanaka, D. Jr., Bursian, S. J., and Aulerich, R. J. 1994. age-related effects of triphenyl phosphite-induced delayed neuropathy on central visual pathways in the european ferret (mustela putorius furo). *Fundamental And Applied Toxicology.* 22(4): 577-587.

Phys Tanaka, E., Habu, T., Letic-Gavrilovic, A., and Abe, K. 1990. protein secretion by rat submandibular glands in response to isoproterenol, alpha-methylnoradrenaline and clonidine during aging. *Mechanisms of Ageing and Development* 54(3): 221-33.

Phys Tanaka, M., Ichitani, Y., Okamura, H., Tanaka, Y., and Ibata, Y. 1993. the direct retinal projection to vip neuronal elements in the rat scn. *Brain Research Bulletin* 31(6): 637-40.

BioX Tanaka, S., Kaji, Y., Taniyama, H., Matsukawa, K., Ochiai, K., and Itakura, C. 1994. pneumocystis carinii pneumonia in a thoroughbred foal. *Journal of Veterinary Medical Science* 56(1): 135-137.

Unrel Tang Yu Ping, Kashon Michael L, and Sisk Cheryl L(A). 1997. brain region-specific regulation of luteinizing hormone-releasing hormone messenger ribonucleic acid in the male ferret: interactions between pubertal maturation and testosterone. *Endocrinology* 138(11): 4740-4747.

Prim Taub, E., Harger, M., Grier, H. C., and Hodos, W. some anatomical observations following chronic dorsal rhizotomy in monkeys. *Neuroscience. 5 (2). 1980. 389-402.*

FL Tavitov, M. D. and Uisinbaev, B. S. 1982. types of bokhara sur karakul lambs produced from different mating typesin relation to nutrition of the dam. *Vestnik Sel'Skokhozyaistvennoi Nauki Kazakhstana* (10): 63-65.

HHE Taylor, G. N. and Mays, C. W. fetal injury induced by ca-dtpa in dogs. *HEALTH PHYSICS| VO-35(6)| PG- 858-860| PY- Dec. 1978*

HHE Ten, S. A., Pak, T. S., and Gainulin, N. R. nervous connections of the heart and the superior vena cava in the rabbit and the human. *Arkhiv Anatomii Gistologii i Embriologii. 94 (3). 1988. 36-39.*

CP Tennessen, T. growth of silver fox pups to age 16 weeks. *Meeting of Eastern Branch of the Canadian Society of Animal Science, Truro, Nova Scotia, Canada, June 14-15, 1988. CAN J ANIM SCI. 68 (4). 1988. 1327.*

CP Tennessen, T. some effects of early handling on the behavior of ranched silver foxes. *Symposium on Energy Usage in Livestock Production Systems Held at the Canadian Society of Animal Science Annual Meeting, Calgary, Alberta, Canada, August 24, 1988. Can J Anim Sci. 69 (1). 1989. 280.*

HHE Terner, K. and Javor, T. 1983. the effect of pgf sub(2) alpha on human and rat oral mucosa. *Vol. 5, No. 3, Pp. 279-284* Int. J. Tissue React.

HHE Terner, K. and Javor, T. 1983. the effect of pgf2 alpha on human and rat oral mucosa. *International Journal of Tissue Reactions* 5(3): 279-84.

Drug Teuchert-Noodt, G. and Dawirs, R. R. age-related toxicity in prefrontal cortex and caudate-putamen complex of gerbils meriones-unguiculatus after a single dose of methamphetamine. *Neuropharmacology. 30 (7). 1991. 733-744.*

In Vit Thampy, K. G., Sauls, C. D., Brinkley, B. R., and Barnes, E. M. Jr. neurons from chick embryo cerebrum ultrastructural and biochemical development in-vitro. *Developmental Brain Research. 8 (1). 1983. 101-110.*

In Vit Thiebaut, F., Rigaut, J. P., Feren, K., and Reith, A. 1984. smooth-surfaced control and transformed c3h/10t-1/2 cells differ in cytology: a study by secondary electron, backscattered electron and image analysis. *Scanning Electron Microscopy* (Pt 3): 1249-55.

In Vit Thomas, B. R., Vekilov, P. G., and Rosenberger, F. 1996. heterogeneity determination and purification of commercial hen egg-white lysozyme. *Acta Crystallographica Section D Biological Crystallography* 52(4): 776-784.

Phys Thor, P. J., Sendur, R., and Laskiewicz, J. effect of stimulation of the vagus nerves and vagotomy on myoelectric activity of small bowel. *ACTA PHYSIOL POL. Acta Physiologica Polonica. 40 (2). 1989 (1990). 255-261.*

Abstract Thorlacius-ussing, O., Rungby, J., Moller-madsen, B., Schroder, H. D., and Danscher, G. 1985. ultrastructural localization of exogenous silver and mercury in the anterior pituitary of the rat. *Annual Meeting of the Scandinavian Neuropathological Society*

Drug Thornton, J. W., Hess, C. A., Cassingham, V., and Bartlett, R. H. 1982. epidermal growth factor in the healing of second degree burns: a controlled animal study. *Burns, Including Thermal Injury* 8(3): 156-60.

Prim Tiber, A. 1971. the pattern of incorporation of (3 h)-leucine by the enamel and dentine matrices of the rhesus monkey: an autoradiographic study. *Archives of Oral Biology* 16(10): 1231-6.

Phys Tien, L. F., McLaughlin, B. J., and Cooper, N. G. 1991. glycoproteins in the retinal pigment epithelium of normal and dystrophic rats. *Investigative Ophthalmology & Visual Science* 32(2): 319-26.

Prim Tigges, M., Hendrickson, A. E., and Tigges, J. 1984. anatomical consequences of long-term monocular eyelid closure on lateral geniculate nucleus and striate cortex in squirrel monkey. *Journal of Comparative Neurology* 227(1): 1-13.

BioX Tilley, M. and Upton, S. J. 1990. identification of sporozoite surface proteins and antigens of eimerianieschulzi (apicomplexa). *Journal of Protozoology* 37(2): 86-90.

Phys Tokuno, H., Nakamura, Y., Kudo, M., and Kitao, Y. 1990. laminar organization of the substantia nigra pars reticulata in the cat. *Neuroscience* 38(1): 255-70.

Abstract Tolbert, D. L., Marshall, C. A., Vogler, G. A., and Dunn, R. C. Jr. post natal development of cortico trigeminal projections in kittens. *95th Annual Meeting of the American Association of Anatomists, Indianapolis, Indiana, Usa, April 4-8, 1982. Anat Rec. 202 (3). 1982. 191a-192a.*

FL Tolivia, D. 1977. [silver impregnation of the nervous centers in paraffin sections]. <original> impregnacion argentica de los centros nerviosos en cortes por parafina. *Trabajos Del Instituto Cajal De Investigaciones Biologicas* 69(3-4)

Method Tomczok, J., Sliwa-Tomczok, W., and Grzybek, H. 1991. the small intestinal enterocytes of rats during lead poisoning: the application of the timm sulphide silver method and an ultrastructural study. *Experimental Pathology* 42(2): 107-13.

Imm Tomita, A., Radike, E. L., and Parker, C. J. 1993. isolation of erythrocyte membrane inhibitor of reactive lysis type ii. identification as glycophorin a. *Journal of Immunology* 151(6): 3308-23.

FL Toshkov, I. and Zafirova, M. histologic and immunocytochemical studies on the endocrine pancreas of the guinea fowl numida-meleagris. *Obshta i Sravnitelna Patologiya. 16 (0). 1984 (Recd. 1985). 8-14.*

FL Treilhou-Lahille, F. 1976. [uptake and storage of indolamines in the ultimobranchial body of the fetal murine thyroid. 1-autoradiographic histological study]. <original> captage et stockage d'indolamines dans le corps ultimobranchial et la thyroide de foetus de souris. i. etude histologique autoradiographique. *Comptes Rendus Des Seances De La Societe De Biologie Et De Ses Filiales*

No Dose Tribe, G. W., Whitbread, T. J., and Watson, G. L. 1989. fatal enteritis in rabbits associated with a spirochaete. *Veterinary Record* 124(22): 595.

Method Trigoso, C. I., Tato, A., Ferrer, J. M., and Stockert Juan C(A). 1992. localization of metal cations in horse eosinophil leucocytes as revealed by the timm sulphide-silver method and energy dispersive x-ray microanalysis. *European Archives of Biology* 103(4): 231-237.

No Oral Trolliet, M. R., Kurnjek, M. L., Mikulic, L., Basso, N., and Taquini, A. C. 1990. development of renovascular hypertension after central serotonin depletion. *Hypertension* 15(2 Suppl): I166-9.

HHE Trott, D. J., Huxtable, C. R., and Hampson, D. J. 1996. experimental infection of newly weaned pigs with human and porcinestrains of serpulina pilosicoli. *Infection and Immunity* 64(11): 4648-4654.

FL Trut, L. N. 1995. domestication of the fox: roots and effects. *Scientifur* 19(1): 11-17.

No Dose Trut, L. N., Naumenko, E. V., and Belyaev, D. K. change in the pituitary adrenal function of silver foxes during selection according to behavior. *Soviet Genetics (English Translation of Genetika). 8 (5). 1972 (1974) 585-591*

FL Tsarenko, R. and Shnur, A. 1975. the effect of spermosan-3 and silver ions on turkey spermatozoa. *Ptitsevodstvo* (7): 26-27.

FL Tsarenko, R. G. and Shnur, A. I. 1976. the improvement of media for the dilution and storage of turkey semen. *Sbornik Nauchnykh Trudov. Vsesoyuznyi Nauchno-Issledovatel'Skii Institut Razvedeniya i Genetiki Sel'Skokhozyaistvennykh Zhivotnykh* (23): 104-110.

Phys Tsuji, Hiroshi, Sato, Hiroko, Baba, Takahiro, Gotoh, Yasuhito, and Ishikawa, Junzo. a negative ion beam application to artificial formation of neuron network in culture. *Rev. Sci. Instrum. (2000)* 71(2, Pt. 2): 797-799 .

Method Tsukise, A., Fujimori, O., and Yamada, K. an efficient histochemical method for deoxyribonucleic acids using a silver enhancement procedure. *Histochem. J. (1990)* 22(8): 409-15.

Method Tsukise, A., Fujimori, O., and Yamada, K. an efficient histochemical method for dna using a silver enhancement procedure. *Histochemical Journal. 22 (8). 1990. 409-415.*

Phys Tsuyama Shinichiro, Yang Dong Hua, Kanae Takako, Kasamo Hiroshi, and Murata Fusayoshi. 1994. immunoelectron microscopic labelling of digestive tract stem cells by means of bromodeoxyuridine antibody. *Acta Histochemica Et Cytochemica* 27(4): 339-345.

Chem Meth Tunturi, A. R. 1973. a method for impregnating myelinated axons in adult central nervous system. *Stain Technology* 48(6): 297-304.

Prim Turner, B. H. and Zimmer, J. 1984. the architecture and some of the interconnections of the rat's amygdala and lateral periallocortex. *Journal of Comparative Neurology* 227(4): 540-57.

Phys Ueda, T., Hokimoto, M., Shibata, N., Fujimori, O., and Yamada, K. 1993. lectin-binding glycoconjugates in the tongues of the rat and guinea pig as revealed by lectin-gold-silver methods. *Okajimas Folia Anatomica Japonica* 70(1): 13-27.

Method Ueda, T., Kawamura, S., Hattori, O., and Fujimori, O. 1994. dual staining methods for carbohydrates using lectin-gold silver techniques. *Okajimas Folia Anatomica Japonica* 70(6): 301-11.

Method Ueda, T., Terada, S., Fujimori, O., and Yamada, K. 1993. a dual staining method for neutral carbohydrates and dna (deoxyribonucleic acid) using periodic acid-thiocarbohydrazide-silver protein-physical development (pa-tch-sp-pd) and feulgen (hot hcl-schiff) techniques. *Okajimas Folia Anatomica Japonica* 69(6): 315-9.

Method Ueda, Takashi, Fujimori, Osamu, and Yamada, Kazuyori. a new histochemical method for detection of sialic acids using a physical development procedure. *J. Histochem. Cytochem. (1995)* 43(10): 1045-51.

Method Ueda, Takashi, Fujimori, Osamu, and Yamada, Kazuyori. the use of periodic acid-thiocarbohydrazide-silver protein-physical development (pa-tch-sp-pd) procedure for the histochemical detection of neutral carbohydrates in the circumventricular organs of the rat. *Okajimas Folia Anat. Jpn. (1994)* 71(5): 325-33.

Phys Uemura, Y., Kowall, N. W., and Beal, M. F. 1990. selective sparing of nadph-diaphorase-somatostatin-neuropeptide y neurons in ischemic gerbil striatum. *Annals of Neurology* 27(6): 620-5.

FL Umurzakov, T. 1984. the use of wool growth rate in selection of grey karakul sheep. *Doklady Vsesoyuznoi Akademii Sel'Skokhozyaistvennykh Nauk* (4): 22-23.

Prim Usai, C., Ratto, G. M., and Bisti, S. 1991. two systems of branching axons in monkey's retina. *Journal of Comparative Neurology* 308(2): 149-61.

Anat Usenko, V. S., Kornilovskaya, I. N., Lizogubov, V. V., Apostolov, E. O., Gubkina, E. A., Ushakova, G. A., and Lepekhin, E. A. 1997. some morphological changes in the rat thyroid gland during experimental hyperphenylalaninemia. *Anatomical Record* 248(2): 251-8.

Anat Ushiki, T., Ohtani, O., and Abe, K. 1995. scanning electron microscopic studies of reticular framework in the rat mesenteric lymph node. *Anatomical Record* 241(1): 113-22.

FL Vagin Yu V. deviation from expected fur coloration segregation in color hetero zygous mink progeny. *Tsitologiya i Genetika. 13 (3). 1979. 221-227.*

Bact Valladares De La Cruz J C, Cervantes Olivares R, and Trigo Tavera F. pathogenesis of lung aspergillosis in rabbits diagnosed by immunoperoxidase technique. *Revista Latinoamericana De Microbiologia. 32 (1). 1990. 11-15.*

CP Valtonen, M. and Jalkanen, L. species-specific features of oestrous development and blastogenesis in domestic canine species. *Fertility And Infertility In Dogs, Cats And Other Carnivores : Proceedings Of The Second International Symposium On Canine And Feline Reproduction, Held At The University Of Liege, Liege, Belgium, August 1992 /* p. 133-137.

FL Valueva, T. K. 1987. [improvement of rabbit breeds: vienna blue and silver]. <original> sovershenstvovat' porody [krolikov] venskij goluboj i serebristyj. *Krolikovodstvo i Zverovodstvo. (No.1) P. 14*

Anat van den Berge, H. and van der Wal, J. C. 1990. the innervation of the middle ear muscles of the rat. *Journal of Anatomy* 170: 99-109.

In Vit Van Der Elst Josiane, Van Den Abbeel Etienne, Nerinckx Sigrid, and Van Steirteghem Andre. 1992. parthenogenetic activation pattern and microtubular organization of the mouse oocyte after exposure to 1,2-propanediol. *Cryobiology* 29(5): 549-562.

Unrel Van der Horst, G., Curry, P. T., Kitchin, R. M., Burgess, W., Thorne, E. T., Kwiatkowski, D., Parker, M., and Atherton, R. W. 1991. quantitative light and scanning electron microscopy of ferret sperm. *Molecular Reproduction and Development* 30(3): 232-40.

Prim Van Hoesen, G. and Pandya, D. N. 1975. some connections of the entorhinal (area 28) and perirhinal (area 35) cortices of the rhesus monkey. i. temporal lobe afferents. *Brain Research* 95(1): 1-24.

Prim Van Hoesen, G., Pandya, D. N., and Butters, N. 1975. some connections of the entorhinal (area 28) and perirhinal (area 35) cortices of the rhesus monkey. ii. frontal lobe afferents. *Brain Research* 95(1): 25-38.

Prim Van Hoesen, G. W. and Pandya, D. N. 1975. some connections of the entorhinal (area 28) and perirhinal (area 35) cortices of the rhesus monkey. iii. efferent connections. *Brain Research* 95(1): 39-59.

Prim Van Hoesen, G. W., Yeterian, E. H., and Lavizzo-Mourey, R. 1981. widespread corticostriate projections from temporal cortex of the rhesus monkey. *Journal of Comparative Neurology* 199(2): 205-19.

HHE Van Rooyen, R. J., Kouwenberg, J., and Bressers, J. 1974. the biological standardisation of human growth hormone (hgh stroud). *South African Medical Journal* 48(54): 2247-52.

Mix Van Vleet, J. F. 1982. amounts of 8 combined elements required to induce selenium vitamin e deficiency in ducklings and protection by supplements of selenium and vitamin e. *AM J VET RES.* 43(6): 1049-1055.

Mix Van Vleet, J. F. 1982. amounts of twelve elements required to induce selenium vitamin e deficiency in ducklings. *Am. J. Vet. Res.* 43(5): 851-857.

Nut def Van Vleet, J. F. and Ferrans, V. J. 1992. etiologic factors and pathologic alterations in selenium-vitamin e deficiency and excess in animals and humans. *Biological Trace Element Research* 33: 1-21.

Mix Van Vleet, John F. amounts of eight combined elements required to induce selenium-vitamin e deficiency in ducklings and protection by supplements of selenium and vitamin e. *Am. J. Vet. Res. (1982)* 43(6): 1049-55.

Phys Vandenbulcke, F., Pollard, H., Mitchell, V., and Beauvillain, J. C. 1993. radioimmunocytochemical distribution of neutral endopeptidase (enkephalinase e.c.3.4.24.11) at the ultrastructural level in the rat median eminence. *Journal of Neuroendocrinology* 5(2): 205-12.

Plant Vanha-Majamaa Ilkka(A), Tuittila Eeva-Stiina, Tonteri Tiina, and Suominen Raili. 1996. seedling establishment after prescribed burning of a clear-cut and a partially cut mesic boreal forest in southern finland. *Silva Fennica* 30(1): 31-45.

Anat Vanicky, I., Marsala, M., Orendacova, J., and Marsala, J. 1992. silver impregnability of ischemia-sensitive neocortical neurons after 15 minutes of cardiac arrest in the dog. *Anatomy and Embryology* 186(2): 167-73.

Method Varnell, R. J., Maitchouk, D. Y., Beuerman, R. W., Salvatore, M. F., Carlton, J. E., and Haag, A. M. 1997. analysis of rabbit tear fluid using capillary electrophoresis with uv or laser-induced fluorescence detection. *Journal of Capillary Electrophoresis* 4(1): 1-6.

FL Vasil'eva, L. L. and Chepkasov, I. L. 1991. phenogenetic analysis of domesticated behaviour of silver foxes: 2. comparative analysis of inheritance and variability of three domesticated behavioural phenotypes. *Sibirskii Biologicheskii Zhurnal* 0(6): 24-27.

Method Vasil'eva, L. L. and Trut, L. N. the use of the method of principal components for phenogenetic analysis of the integral domestication trait. *Genetika. 26 (3). 1990. 516-524.*

FL Vasilyeva, L. L. 1995. changes in behavioural traits of the silver fox (vulpes vulpes) under domestication and specific genotype-environment interactions. *Scientifur. V. 19(2) P. 87-94*

FL Vasilyeva L L. 1991. phenogenetic analysis of domesticated behaviour of silver foxes 1. correlations and genotype-environment interaction of three domesticated behavioural phenotypes. *SIBIRSKII BIOLOGICHESKII ZHURNAL* 1991. 128(5): 22-27, illustr.

FL Vassalli, G. and Russi, E. 1991. [cat-scratch disease]. <original> katzenkratzkrankheit. *Schweizerische Rundschau Fur Medizin Praxis* 80(47): 1324-6.

In Vit Vaughn, J. E., Barber, R. P., and Sims, T. J. 1988. dendritic development and preferential growth into synaptogenic fields: a quantitative study of golgi-impregnated spinal motor neurons. *Synapse* 2(1): 69-78.

Prim Veazey, R. B., Amaral, D. G., and Cowan, W. M. 1982. the morphology and connections of the posterior hypothalamus in the cynomolgus monkey (macaca fascicularis). i. cytoarchitectonic organization. *Journal of Comparative Neurology* 207(2): 114-34 .

Phys Venkatesh, N., Lynch, J. J., Uprichard, A. C., Kitzen, J. M., Singh, B. N., and Lucchesi, B. R. 1991. hypothyroidism renders protection against lethal ventricular arrhythmias in a conscious canine model of sudden death. *Journal of Cardiovascular Pharmacology* 18(5): 703-10.

In Vit Vertel Barbara M(A), Walters Linda M, Flay Nina, Kearns Ann E, and Schwartz Nancy B. 1993. xylosylation is an endoplasmic reticulum to golgi event. *Journal of Biological Chemistry* 268(15): 11105-11112.

FL Vetesi, F. 1982. occurrence of tyzzer's disease on hungarian rabbit farms. *Magyar Allatorvosok Lapja* 37(8): 519-524.

Chem Meth Vice, P. 1968. collagenase digestion for distinguishing neural from reticular fibres in silver stains. *Stain Technology* 43(4): 183-6.

Plant Victoria Ana Ines(A), Pons Patricia, Harte Cornelia, and Noher De Halac= Ines. 1999. immunolabelling of alpha and beta tubulin in pollen of oenothera hhookeri. velans. *Biocell* 23(1): 37-42.

Phys Viebahn, C., Miething, A., and Wartenberg, H. 1998. primordial germ cells of the rabbit are specifically recognized by a monoclonal antibody labelling the perimitochondrial cytoplasm. *Histochemistry and Cell Biology* 109(1): 49-58.

In Vit Vielvoye, G. J. and Voogd, J. 1977. time dependence of terminal degeneration in spino-cerebellar mossy fiber rosettes in the chicken and the application of terminal degeneration in successive degeneration experiments. *Journal of Comparative Neurology* 175(2): 233-42.

Anat Viglietti-Panzica, C. and Besse, M. C. 1984. the organum vascolosum laminae terminalis of the domestic fowl: a golgi and ultrastructural study. *Anatomischer Anzeiger* 155(1-5): 341-53.

Method Vocanson, C., Honnorat, J., Aguera, M., Antoine, J. C., Caudie, C., and Belin, M. F. 1994. high resolution two-dimensional polyacrylamide gel electrophoresis using immobilines. application to the study of brain proteins. *Cellular and Molecular Biology* 40(1): 9-16.

Method Volonte Cinzia(A) and Greene Lloyd A. 1992. nerve growth factor-activated protein kinase n: characterization and rapid near homogeneity purification by nucleotide affinity exchange chromatography. *Journal of Biological Chemistry* 267(30): 21663-21670 .

FL Votyakov, A. V. and Krasovskii, G. N. activity of .beta.-galactosidase in seminal fluid and gonad tissue as a biochemical criterion of gonadotoxic effects of chemical substances. *Gig. Sanit. (1989)* (3): 62-3.

FL Vrablic, J. contribution to the understanding of macro gamogony and oogony of toxoplasma-gondii. *BIOLOGIA (Bratislava). 32 (11). 1977 841-850.*

FL Vshivtseva, V. V. and Lesova, L. D. innervational features of the rat fasciae and their microvessel bed. *Arkhiv Anatomii Gistologii i Embriologii. 88 (5). 1985. 16-22.*

Drug Waeber, B., Evequoz, D., Aubert, J. F., Fluckiger, J. P., Juillerat, L., Nussberger, J., and Brunner, H. R. 1990. prevention of renal hypertension in the rat by neuropeptide y. *Journal of Hypertension* 8(1): 21-5.

FL Wagner K-U, Schueler L(A), Saar, W., and Apitz, M. 1996. comparison of activity of chromosomal nucleolus organizer regions in embryonic tissues and fibroblast cultures of japanese quail. *Archiv Fuer Gefluegelkunde* 60(2): 58-64.

Diss Wagner, Patricia Anthony. 1975. studies on the interaction of selenium with silver and methylmercury in the rat. *Avail.: Xerox Univ. Microfilms. Ann Arbor, Mich., Order No. 75-28,033 From: Diss. Abstr. Int. B 1976, 36. 9. 4394.* 229 pp.

Phys Wahnschaffe, U., Fredow, G., Heintz, P., and Loscher, W. 1990. neuropathological studies in a mutant hamster model of paroxysmal dystonia. *Movement Disorders* 5(4): 286-93 .

CP Wakeling, E. L(A), Abu-Amero, S. N(A), Stanier P(A), Preece, M. A., and Moore, G. E. A. 1997. imprinted genes on chromosome 7: their role in silver-russell syndrome. *American Journal of Human Genetics* 61(4 SUPPL.): A322.

Nutrition Waldie, G. A., Olomu, J. M., Cheng, K. M., and Sim, J. 1991. effect of two feeding systems, two protein levels, and differentdietary energy sources and levels on performance of squabbing pigeons. *Poultry Science* 70(5): 1206-1212.

No Org Walkenhorst William F(A), Krezel Andrzej M, Rhyu Gyung Ihm, and Markley John L. 1994. solution structure of reactive-site hydrolyzed turkey ovomucoid third domain by nuclear magnetic resonance and distance geometry methods. *Journal of Molecular Biology* 242(3): 215-230.

BioX Warner, C. K., Whitfield, S. G., Fekadu, M., and Ho, H. 1997. procedures for reproducible detection of rabies virus antigen mrna and genome in situ in formalin-fixed tissues. *Journal of Virological Methods* 67(1): 5-12.

FL Watanabe, G. and Honma, K. 1982. analysis of abnormal oviduct function in a mutant japanese quail line(recessive silver) by immunoelectrophoresis and enzyme histochemistry. *Japanese Poultry Science* 19(3): 157-164.

FL Watanabe, G. NKKGA and Honma, K. <translated> concurrent analysis for the abnormal oviducal function in a nutant line of the japanese quail (recessive silver) with immunoelectrophoresis and enzyme histochemistry. *Japanese Poultry Science* May 1982. v. 19 (3) p. 157-164. ill.

No Oral Waterfall, A. H., Clarke, R. W., and Bennett, G. W. 1993. detection of thyrotrophin releasing hormone in rat brain in vivo using novel antibody microprobes: effects of amphetamine. *Neuroscience Letters* 151(1): 97-100.

Prim Weber, J. T. 1985. pretectal complex and accessory optic system of primates. *Brain, Behavior and Evolution* 26(2): 117-40.

Prim Weber, J. T., Young, R., and Hutchins, B. 1981. morphologic and autoradiographic evidence for a laminated pretectal olivary nucleus in the squirrel monkey. *Brain Research* 224(1): 153-9.

Mineral Weinreb, M., Shinar, D., and Rodan, G. A. 1990. different pattern of alkaline phosphatase, osteopontin, and osteocalcin expression in developing rat bone visualized by in situ hybridization. *Journal of Bone and Mineral Research* 5(8): 831-42.

Prim Weller, R. E., Dagle, G. E., Malaga, C. A., and Baer, J. F. 1990. hypercalcemia and disseminated histoplasmosis in an owl monkey. *Journal of Medical Primatology* 19(7): 675-80.

FL Wenzel, J. and Barlehner, E. 1969. [regeneration of the cortex cerebri of mus musculus. ii. morphological findings in regenerative processes after reimplantation of cortex segment]. <original> zur regeneration des cortex cerebri bei mus musculus. ii. morphologische befunde regenerativer vorgange nach replantation eines cortexabschnittes. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 81(1): 32-70.

FL Wenzel, J., Barlehner, E., Wenzel, M., and Ilius, D. 1969. [regeneration of the cortex cerebri of mus musculus. i. morphological findings in regenerative processes after extirpation of a cortex segment]. <original> zur regeneration des cortex cerebri bei mus musculus. i. morphologische befunde regenerativer vorgange nach exstirpation eines cortexabschnittes. *Zeitschrift Fur Mikroskopisch-Anatomische Forschung* 81(1): 1-31.

Phys Westrum, L. E. and Henry, M. A. 1991. contralateral degeneration in the cat spinal trigeminal nucleus following unilateral retrogasserian trigeminal rhizotomy. *Neuroscience Letters* 121(1-2): 143-6.

FL Weyrauch, K. D. and Schnorr, B. 1978. [the fine structure of the epithelium of the main outlets from the liver and pancreas of the domestic chicken (author's transl)]. <original> die feinstruktur des epithels der hauptausfuhrungsgange der leber und des pankreas vom haushuhn. *Anatomischer Anzeiger* 143(1): 37-49.

Rev Whanger, P. D. 1985. metabolic interactions of selenium with cadmium, mercury, and silver. *Advances In Nutritional Research* 7: 221-250.

No Control Whanger, P. D. and Deagen, J. T. 1962. rat liver metallothionein. interactions of silver, zinc, and cadmium. *Biol. Trace Elem. Res.* 4(2-3): 199-210 .

Nut Def Whanger, P. D., Weswig, P. H., Schmitz, J. A., and Oldfield, J. E. 1976. effects of selenium, cadmium, mercury, tellurium, arsenic, silver and cobalt on white muscle disease in lambs and effect of dietary forms of arsenic on its accumulation in tissues. *Nutr Rep Int.* 14(1): 63-72.

In Vit Whittemore, S. R., White, L. A., and Sanon, H. R. 1991. acidic and basic fibroblast growth factor levels in spinal cord cultures are not regulated by alterations in heparan sulfate proteoglycan expression. *International Journal of Developmental Neuroscience* 9(6): 521-35.

Aquatic Whittington, R. J(A), Kearns C(A), Hyatt, A. D., Hengstberger, S., and Rutzou, T. 1996. spread of epizootic haematopoietic necrosis virus (ehnv) in redfin perch (perca fluviatilis) in southern australia. *Australian Veterinary Journal* 73(3): 112-114.

Abstract Wiener, S. L., Shahoda, P., and Venton, D. 1984. inhibition of an inflammatory fluid and cell growth inhibitor and cytocidal factor by zinc-ii or cadmium-ii or mixtures of metals. *24th Annual Meeting of the American Society for Cell Biology, Kansas City, Mo., Usa, Nov. 12-16, 1984. J Cell Biol.* 99 (4 Part 2).: 390a.

Phys Wilczynski, E. A., Yuan, B., and Leenen, F. H. 1992. dietary sodium restriction and the development of two-kidney, one-clip hypertension in young versus adult rats. *Canadian Journal of Physiology and Pharmacology* 70(4): 452-7.

Drug Wilson, M. E., Bollnow, M. R., and Handa, R. J. gonadotropin releasing hormone (gnrh) mrna and gonadotropin beta-subunit mrna expression in the adult female rat exposed to ethanol in utero. *Alcohol Clin Exp Res 1995 Apr;19(2 Suppl):19A*

Plant Wilson, S. Mcg(A), Malcolm, D. C(A), and Rook, D. A(A). 1999. locating natural populations of scottish native trees. *Scottish Forestry* 53(4): 215-224.

FL Wirth, M., Moritz, V., Heine, H., Wagenknecht, C., Mieth, G., Friedrich, M., Steffens, W., and Lieder, U. 1990. [the effect of silver carp oil on the blood pressure and lipids of spontaneously hypertensive rats]. <original> zur wirkung von silberkarpfenol auf blutdruck und lipide von spontanhypertonen ratten. *Die Nahrung* 34(6): 575-8.

Phys Wirth, P. J., Fujimoto, Y., Takahashi, H., Mori, M., Yoshida, M. C., Sugimura, T., and Nagao, M. 1990. two-dimensional electrophoretic analysis of hepatitis-associated polypeptides in liver of lec rats developing spontaneous hepatitis. *Japanese Journal of Cancer Research* 81(5): 477-82.

Anat Wold, J. E. 1979. the vestibular nuclei in the domestic hen (gallus domesticus). vii.--afferents from the spinal cord. *Archives Italiennes De Biologie* 117(1): 30-44.

Anat Wold, J. E. and Hall, J. G. 1975. the distribution of primary afferents to the cochlear nuclei in the domestic hen (gallus domesticus). *Anatomy and Embryology* 147(1): 75-89 .

Prim Wolfe, L. D. reproductive biology of rhesus macaca-mulatta and japanese macaques macaca-fuscata. *Primates. 27 (1). 1986. 95-102.*

Prim Wolfe, L. D., Kollias, G. V., Collins, B. R., and Hammond, J. A. 1991. sterilization and its behavioral effects on free-ranging female rhesus monkeys (macaca mulatta). *Journal of Medical Primatology* 20(8): 414-8.

Prim Wolfe L D and Peters E H. 1987. history of the freeranging rhesus monkeys (macaca mulatta) of silver springs. *Florida Scientist* 50. 125(4): 234-245, illustr.

Method Wong M(A), Wuethrich, P., Eggli, P., and Hunziker, E. 1996. zone-specific cell biosynthetic activity in mature bovine articular cartilage: a new method using confocal microscopic stereology and quantitative autoradiography. *Journal of Orthopaedic Research* 14(3): 424-432.

FL Woohsmann, H. and Treptow, K. 1966. [histological and histochemical studies on the tissue ability to tolerate depth electrodes and their insulation in the central nervous system]. <original> histologische und histochemische untersuchungen uber die gewebevertraglichkeit von tiefenelektroden und ihrer isolierung im zentralnervensystem. *Acta Biologica Et Medica Germanica* 17(2): 207-16.

FL Woossmann, H., Thybusch, D., Zeschke, G., and Treptow, K. 1969. [histological and histochemical studies of the tissue tolerance to deep electrodes and their isolation in the central nervous system. ii]. <original> histologische und histochemische untersuchungen uber die gewebevertraglichkeit von tiefenelektroden und ihrer isolierung im zentralnervensystem. ii. *Acta Biologica Et Medica Germanica* 22(3): 577-88.

Chem Meth Wouterlood, F. G., Paniry, S., and Pattiselanno, A. 1987. stabilization of silver chromate golgi impregnation in rat central nervous system neurons using photographic developers. ii. electron microscopy. *Stain Technology* 62(1): 7-21.

No Oral Wu, H. Q. and Schwarcz, R. 1998. focal microinjection of gamma-acetylenic gaba into the rat entorhinal cortex: behavioral and electroencephalographic abnormalities and preferential neuron loss in layer iii. *Experimental Neurology* 153(2): 203-13.

Anat Wullimann, M. F. and Puelles, L. 1999. postembryonic neural proliferation in the zebrafish forebrain and its relationship to prosomeric domains. *Anatomy and Embryology* 199(4): 329-48.

Phys Xu, Q. and Grant, G. 1990. the projection of spinocerebellar neurons from the sacrococcygeal region of the spinal cord in the cat. an experimental study using anterograde transport of wga-hrp and degeneration. *Archives Italiennes De Biologie* 128(2-4): 209-28.

Method Yamada, A. T. 1993. timely and topologically defined protein synthesis in the peri-implanting mouse endometrium revealed by light and electron microscopic radioautography. *Cellular and Molecular Biology* 39(1): 1-12.

Anat Yamada, J., Yoshino, M., Yamashita, T., Misu, M., and Yanaihara, N. 1979. distribution and frequency of gastrin cells in the digestive tract of the japanese quail. *Archivum Histologicum Japonicum* 42(1): 33-9.

No COC Yamada, S., Kubota, R., Kubota, K., Ishiwata, K., and Ido, T. localization of fluorine-18 fluorodeoxyglucose in mouse brain neurons with micro-autoradiography. *Neuroscience Letters. 120 (2). 1990. 191-193.*

QAC Yamaguchi, K., Barbe, M. F., Brown, I. R., and Tytell, M. 1990. induction of stress (heat shock) protein 70 and its mrna in rat corneal epithelium by hyperthermia. *Current Eye Research* 9(9): 913-8.

Nutrition Yamashiro, S., Umemura, T., Bhatnagar, M. K., David, L., Sadiq, M., and Slinger, S. J. 1977. haemorrhagic liver syndrome of broiler chickens fed diets containing rapeseed products. *Research in Veterinary Science* 23(2): 179-84.

Anat Yamauchi, K. and Yasuda, M. 1985. cyto-, dendro- and fibro-architectonic studies on the chicken hypothalamus. *Journal Fur Hirnforschung* 26(5): 509-19.

Aquatic Yan, Y., Bi, R., Lin, Z., Tang, Y., and Fang, J. crystallographic studies of silver carp insulin. *Scientia Sinica Series B (Chemical Biological Agricultural Medical & Earth Sciences). 28 (3). 1985. 273-280.*

In Vit Yano, M. and Tanishima, T. shrinkage of corneal endothelial cells during tissue processing. *Acta Societatis Ophthalmologicae Japonicae. 89 (1). 1985. 235-238.*

Anat Yazama Futoshi(A), Esaki Michiyo, and Sawada Hajime. 1997. immunocytochemistry of extracellular matrix components in the rat seminiferous tubule: electron microscopic localization with improved methodology. *Anatomical Record* 248(1): 51-62.

Prim Yeager, C. P(A), Silver, S. C., and Dierenfeld, E. S. 1997. mineral and phytochemical influences on foliage selection by the proboscis monkey (nasalis larvatus). *American Journal of Primatology* 41(2): 117-128.

HHE Yokoya, S. and Friesen, H. G. 1986. human growth hormone (gh)-releasing factor stimulates and somatostatin inhibits the release of rat gh variants. *Endocrinology* 119(5): 2097-105.

HHE Yokoya, S. and Friesen, H. G. human growth hormone releasing factor stimulates and somatostatin inhibits the release of rat growth hormone variants. *Endocrinology. 119 (5). 1986. 2097-2105.*

Nut def Yoshida, M. changes in serum thyroid hormone levels and urinary ketone body excretion caused by a low selenium diet or silver loading in rats. *J. Trace Elem. Electrolytes Health Dis. (1993)* 7(1): 25-8 .

Nut def Yoshida, Munehiro. 1992. variation of urinary ketone body excretion and serum thyroid hormone levels by feeding a low selenium diet and its modification by silver loading. *Biomed. Res. Trace Elem.* 3(2): 189-90.

Nut def Yoshida, Munehiro, Tashiro, Hiroyuki, Iwami, Kimikazu, Yasumoto, Kyoden, and Iwai, Kazuo. 1983. bioavailability of selenite, selenomethionine and selenocystine in rats with silver loading. *Agric. Biol. Chem.* 47(4): 807-13 .

Acu Yoshikawa, Hiroshi. preventive effect of pretreatment with low dose of metals on the acute toxicity of metals in mice. *Ind. Health (1970)* 8(4): 184-91.

FL Yoshikawa, Mikio. subacute toxicities of silver ammonium fluoride in rats. *Shika Igaku (1975)* 38(5): 459-75.

Phys Yoshiki, A., Sakakura, T., and Kusakabe, M. 1993. the mouse chimera during intrauterine stages: immunohistochemical analysis with the c3h strain-specific antibody. *Journal of Histochemistry and Cytochemistry* 41(10): 1583-90.

No Oral Yoshimura Noriaki(A), Kida Kazuyuki, Usutani Saburo, and Nishimura Masahiko. 1995. histochemical localization of copper in various organs of brindled mice after copper therapy. *Pathology International* 45(1): 10-18.

Aquatic Yu, J. Y. L. Academia Sinica Taipei Taiwan Inst. of Zoology, Shen, S. T., Liu, C. T., Weng, C. F., Peng, H. K., and Liu, F. G. 1995. comparative effects of avian and piscine gonadotrophins on gonadal steroidogenesis, and of avian and piscine pituitaries on induction of spermiation and ovulation in the loach and white silver carp. *Aquaculture. V. 135(1-3) P. 59-72*

In Vit Yu John Yuh-Lin(A), Shen San-Tai, Yang Wei-Hsiung, Papkoff Harold, and Ishii Susumu. 1996. comparative effects of diverse vertebrate gonadotropins on estradiol-17-beta formation in vitro in an immature rat sertoli cell bioassay. *General and Comparative Endocrinology* 104(2): 253-261.

FL Yurisova, M. N. functional condition of the hypothalamo hypophyseal neuro secretory system in the silver fox vulpes-fulva at the beginning and the end of rut. *ZH EVOL BIOKHIM FIZIOL. Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 19 (3). 1983. 256-261.*

FL Yurisova M N. 1983. functional condition of the hypothalamo-hypophysial neurosecretory system in the silver fox vulpes fulvus at the beginning and the end of rut. *Zhurnal Evolyutsionnoi Biokhimii I Fiziologii* 19. 120(3): 256-261, illustr.

FL Yurisova M N, Kolesnikova L A, and Ivanova L N. 1987. morpho-functional properties of hypothalamic and pineal gland structures in relatively wild and domesticated silver foxes during oestrus. *Zhurnal Evolyutsionnoi Biokhimii I Fiziologii* 23. 123(3): 355-360, illustr.

FL Yurisova, M. N., Kolesnikova, L. A., and Ivanova, L. N. morphofunctional properties of hypothalamic and pineal gland structures in relatively wild and domesticated silver foxes during estrus. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii. 23 (3). 1987. 355-360.*

Phys Zaccheo, D., De Michele, M., Mancini, M., and Amenta, F. 1991. decreased density of beta-adrenergic and muscarinic cholinergic receptor sites in the vasa nervorum of aged rats. *Mechanisms of Ageing and Development* 60(3): 255-65.

HHE Zang, X. and Nilaver, G. astrocytes of the human ovine rat and guinea-pig brain an immunocytochemical analysis with gfap antiserum. *Chinese Medical Journal (English Edition). 99 (9). 1986 (Recd. 1987). 708-712.*

FL Zapadnyuk, V. I., Stepanenko, P. Z., Savluk, O. S., and Elmuratov, S. N. biological role of copper and silver and their effect on the passive defense reactions of white rats. *Vodopodgot. Ochistka Prom. Stokov (1973)* : 10, 91-9 .

CP ZDOLSEK, J. M., FREDRIKSSON, B. A., and BRUNK, U. T. 1990. visualization of heavy metals in cultured macrophages and hepatocytes a cytochemical light and electron microscopical study using the silver enhancement technique physical development. *42nd Annual Meeting of the Scandinavian Society for Electron Microscopy*

FL Zelnik, J. and Granat, J. 1973. growth and meat production in reciprocal crosses of californian whiteand french silver rabbits. *Zivocisna Vyroba* 18(5): 373-384.

FL Zelnik, J and Granat, J. rast a masova uzitkovost reciprocnych krizencov kalifornskeho a francuzskeho strieborneho kralika; the growth and meat efficiency of the reciprocal crossbreds of thecalifornian and french silver rabbits. *Zivocisna Vyroba* May 1973 18 (5): 373-384. Ref. Eng. sum.

FL Zelnik, J., Granat, J., and Terlanday, L. heritability of growth and effect of inbreeding on live weight in rabbits. *Vedecke Prace Vyskumneho Ustavu Zivocisnej Vyroby v Nitre. (11). 1973 (Recd 1974) 147-154.*

FL Zelnik, J., Granat, J., and Terlanday, L. 1973. inheritance of growth and the effect of inbreeding on body weight ofrabbits. *Vedecke Prace Vyskumneho Ustavu Zivocisnej Vyroby v Nitre* (11): 147-154.

Bact Zimmer, C., Daeschlein, G., Patt, S., and Weigel, K. 1991. strategy for diagnosis of toxoplasma gondii in stereotactic brain biopsies. *Stereotactic and Functional Neurosurgery* 56(1): 66-75.

No Oral Zipper, J., Medel, M., and Prager, R. 1969. suppression of fertility by intrauterine copper and zinc in rabbits. a new approach to intrauterine contraception. *American Journal of Obstetrics and Gynecology* 105(4): 529-34.

CP Zipper, J., Mendel, M., and Prager, R. 1970. experimental suppression of fertility by intrauterine copper and zinc in rabbits. *Proc. World Congr. Fert. Steril. 6th.* Meeting Date 1968, 380-5 Publisher: Isr. Acad. Sci. Humanities, Jerusalem, Israel.

FL Zybina E V, Zybina T G, Zhelezova A I, Kiknadze I I, and Stein G I. 1989. trophoblast cells in the placenta of the silver fox: their peculiarities and polyploidization. *Tsitologiya* 31. 126(4): 492-495, illustr.

CP Zybina, T. and Zybina, E. 1994. ultrastructure and nor activity in the cambial trophoblast cells of the rat placenta. *Cell Biology International* 18(5): 412.

CP Zybina T(A), Zybina E(A), Kiknadze I(A), and Zhelezova A(A). 1999. growth and polyploidization of the trophoblast and uterine epithelium in silver fox placentation. *Placenta* 20(5-6): A74.

This Page Intentionally Left Blank

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations.	Wildlife Plants and Soil Invertebrates
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Wildlife
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Wildlife Plants and Soil Invertebrates
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Wildlife
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms.	Wildlife Plants and Soil Invertebrates
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Wildlife
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection.	Wildlife Plants and Soil Invertebrates
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Wildlife Plants and Soil Invertebrates
BIOLOGICAL PRODUCT (BioP)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Wildlife Plants and Soil Invertebrates
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Wildlife
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Wildlife Plants and Soil Invertebrates
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Wildlife Plants and Soil Invertebrates
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Wildlife Plants and Soil Invertebrates
DEAD (Dead)	Studies reporting results for dead organisms. Studies reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Wildlife Plants and Soil Invertebrates
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations are flagged for possible future use.	Wildlife
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Wildlife Plants and Soil Invertebrates
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Wildlife Plants and Soil Invertebrates
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Wildlife Plants and Soil Invertebrates
ECOLOGICALLY RELEVANT ENDPOINT (ERE)	Studies reporting a result for endpoints considered as ecologically relevant but is not used for deriving Eco-SSLs (e.g., behavior, mortality).	Plants and Soil Invertebrates
CONTAMINANT FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Wildlife Plants and Soil Invertebrates
FOREIGN LANGUAGE (FL)	Studies in languages other than English.	Wildlife Plants and Soil Invertebrates
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Wildlife
FUNGUS (Fungus)	Studies on fungus.	Wildlife Plants and Soil Invertebrates
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Wildlife Plants and Soil Invertebrates
HUMAN HEALTH (HHE)	Studies with human subjects.	Wildlife Plants and Soil Invertebrates
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Wildlife Plants and Soil Invertebrates
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Wildlife
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Wildlife Plants and Soil Invertebrates
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Wildlife
MEDIA (Media)	Authors must report that the study was conducted using natural or artificial soil. Studies conducted in pore water or any other aqueous phase (e.g., hydroponic solution), filter paper, petri dishes, manure, organic or histosoils (e.g., peat muck, humus), are not considered suitable for use in defining soil screening levels.	Plants and Soil Invertebrates
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Wildlife Plants and Soil Invertebrates
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Wildlife
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Wildlife Plants and Soil Invertebrates
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern.	Wildlife Plants and Soil Invertebrates
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Wildlife Plants and Soil Invertebrates
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose (wildlife).	Wildlife Plants and Soil Invertebrates
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported, or an insufficient number of doses/concentrations are used based on Eco-SSL SOPs. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or lactation by doses to parents and then after weaning to similar concentrations as their parents. Dose cannot be determined.	Wildlife Plants and Soil Invertebrates
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Wildlife Plants and Soil Invertebrates
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Wildlife Plants and Soil Invertebrates
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Wildlife
NO ORGANISM (No Org) or NO SPECIES	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Wildlife Plants and Soil Invertebrates
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Wildlife Plants and Soil Invertebrates
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Wildlife Plants and Soil Invertebrates
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Wildlife Plants and Soil Invertebrates
NO TOX DATA (No Tox Data)	Studies where toxicant used but no results reported that had a negative impact (plants and soil invertebrates).	Plants and Soil Invertebrates
NUTRIENT (Nutrient)	Nutrition studies reporting no concentration related negative impact.	Plants and Soil Invertebrates
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Wildlife
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Wildlife
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Wildlife Plants and Soil Invertebrates
OM, pH (OM, pH)	Organic matter content of the test soil must be reported by the authors, but may be presented in one of the following ways; total organic carbon (TOC), particulate organic carbon (POC), organic carbon (OC), coarse particulate organic matter (CPOM), particulate organic matter (POM), ash free dry weight of soil, ash free dry mass of soil, percent organic matter, percent peat, loss on ignition (LOI), organic matter content (OMC). With the exception of studies on non-ionizing substances, the study must report the pH of the soil, and the soil pH should be within the range of $4 and #8.5. Studies that do not report pH or report pH outside this range are rejected.	Plants and Soil Invertebrates
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Wildlife
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Wildlife
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Wildlife
PLANT (Plant)	Studies of terrestrial plants are excluded.	Wildlife
PRIMATE (Prim)	Primate studies are excluded.	Wildlife
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Wildlife Plants and Soil Invertebrates
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships (QSAR) is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Wildlife Plants and Soil Invertebrates
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Wildlife Plants and Soil Invertebrates
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Wildlife Plants and Soil Invertebrates

Literature Rejection Categories		
Rejection Criteria	**Description**	**Receptor**
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SCORE (Score)	Papers in which all studies had data evaluation scores at or lower then the acceptable cut-off (#10 of 18) for plants and soil invertebrates).	Plants and Soil Invertebrates
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Wildlife Plants and Soil Invertebrates
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge.	Wildlife Plants and Soil Invertebrates
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Wildlife
SPECIES	Studies in which the species of concern was not a terrestrial invertebrate or plant or mammal or bird.	Plants and Soil Invertebrates Wildlife
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Wildlife Plants and Soil Invertebrates
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Wildlife Plants and Soil Invertebrates
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Wildlife Plants and Soil Invertebrates
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Wildlife
WATER QUALITY STUDY (Wqual)	Studies of water quality.	Wildlife Plants and Soil Invertebrates
YEAST (Yeast)	Studies of yeast.	Wildlife Plants and Soil Invertebrates

This Page Intentionally Left Blank

Appendix 5-1

Avian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Silver

---

September 2006

This page intentionally left blank

Appendix 5.1 Avian Toxicity Data Extracted for Wildlife Toxiicty Reference Value (TRV)
Silver
Page 1 of 1

Ref			Exposure																										Test Location	Endpoint #	Effects						Conversion to mg/kg bw/day				Result		Data Evaluation Score										
Result #	Ref No.	Reference	Chemical Form	MW%	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type			General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg/day or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																																		
1	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	2	3	0/300/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	3	BIO	CHM	PCLV	BL	300	900	Y	0.662	N	0.04449	20.2	60.5	10	10	5	5	6	1	10	10	10	4	71
2	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	1	4	0/100/300/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	2	BIO	CHM	PCLV	BL	300	900	Y	0.380	N	0.03100	24.5	73.4	10	10	5	5	6	1	10	10	10	4	71
3	9232	Peterson et al, 1973	Silver nitrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	3	BIO	CHM	HMGL	BL		900	Y	0.422	N	0.03319		70.8	10	10	5	10	6	1	4	10	10	4	70
Behavior																																																	
4	1403	Jensen , 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	ppm in mg/kg	N	na	ADL	U	FD	14	d	1	d	JV	NR	C	Lab	3	BEH	FDB	FCNS	WO		1000	Y	0.1730	Y	0.0153		88.4	10	10	5	10	7	4	4	10	10	4	74
Physiology																																																	
5	6899	Petersen and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	NR	C	Lab	4	PHY	PHY	GPHY	WO		900	Y	0.390	N	0.03153		72.8	10	10	5	10	6	4	4	10	10	4	73
Pathology																																																	
6	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	2	3	0/300/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	2	PTH	HIS	GHIS	HE	300	900	Y	0.662	N	0.04449	20.2	60.5	10	10	5	5	6	4	10	10	10	4	74
7	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	1	4	0/100/300/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	3	PTH	HIS	GHIS	HE	300	900	Y	0.380	N	0.03100	24.5	73.4	10	10	5	5	6	4	10	10	10	4	74
8	9232	Peterson et al, 1973	Silver nitrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	2	PTH	ORW	SMIX	HE		900	Y	0.422	N	0.03319		70.8	10	10	5	10	6	4	4	10	10	4	73
9	6901	Peterson and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	B	C	Lab	2	PTH	ORW	ORWT	HE		900	Y	0.286	N	0.02576		81.1	10	10	5	10	6	4	4	10	10	4	73
10	6778	Van Vleet, 1977	Silver acetate	64.6	Duck (*Anas platyrhynchos*)	1	2	0/0.2	% in diet	N	na	ADL	U	FD	3	w	1	d	JV	M	C	Lab	1	PTH	HIS	GHIS	MU		0.2	N	0.460	N	0.03511		98.6	10	10	5	5	5	4	4	10	10	4	67
11	80	Van Vleet et al, 1981	Silver acetate	100	Duck (*Anas platyrhynchos*)	1	2	0/3000	mg/kg	N	na	ADL	U	FD	15	d	1	d	JV	M	C	Lab	1	PTH	HIS	NCRO	GZ		3000	N	0.092	N	0.01231		401	10	10	5	5	5	4	4	10	10	4	67
Growth																																																	
12	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	2	3	0/300/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	1	GRO	GRO	BDWT	WO		300	Y	0.662	N	0.04449		20.2	10	10	5	5	6	8	4	10	10	4	72
13	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	3	2	0/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	1	GRO	GRO	BDWT	WO		900	Y	0.528	N	0.03840		65.5	10	10	5	5	6	8	4	10	10	4	72
14	9232	Peterson et al, 1973	Silver nitrate	100	Turkey (*Meleagris gallopavo*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	1	GRO	GRO	BDWT	WO		900	Y	0.422	N	0.03319		70.8	10	10	5	10	6	8	4	10	10	4	77
15	6899	Petersen and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	NR	C	Lab	2	GRO	GRO	BDWT	WO		900	Y	0.390	N	0.03153		72.8	10	10	5	10	6	8	4	10	10	4	77
16	6901	Peterson and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	B	C	Lab	1	GRO	GRO	BDWT	WO		900	Y	0.286	N	0.02576		81.1	10	10	5	10	6	8	4	10	10	4	77
17	1403	Jensen , 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	ppm in mg/kg	N	na	ADL	U	FD	14	d	1	d	JV	NR	C	Lab	1	GRO	GRO	BDWT	WO		1000	Y	0.173	Y	0.01530		88.4	10	10	5	10	7	8	4	10	10	4	78
Survival																																																	
18	1403	Jensen , 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/1000	ppm in mg/kg	N	na	ADL	U	FD	14	d	1	d	JV	NR	C	Lab	2	MOR	MOR	MORT	WO		1000	Y	0.1890	Y	0.0135		71.4	10	10	5	10	7	9	4	10	10	4	79
19	6899	Petersen and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	NR	C	Lab	1	MOR	MOR	MORT	WO		900	Y	0.3900	N	0.0315		72.8	10	10	5	10	6	9	4	10	10	4	78
20	6901	Peterson and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	B	C	Lab	4	MOR	MOR	MORT	WO		900	Y	0.2860	N	0.0258		81.1	10	10	5	10	6	9	4	10	10	4	78
21	6778	Van Vleet, 1977	Silver acetate	64.6	Duck (*Anas platyrhynchos*)	1	2	0/0.2	% in diet	N	na	ADL	U	FD	3	w	1	d	JV	F	C	Lab	2	MOR	MOR	MORT	WO		0.2	N	0.4600	N	0.0351		98.6	10	10	5	5	5	9	4	10	10	4	72
22	80	Van Vleet et al, 1981	Silver acetate	100	Duck (*Anas platyrhynchos*)	1	2	0/3000	mg/kg	N	na	ADL	U	FD	15	d	1	d	JV	M	C	Lab	3	MOR	MOR	MORT	WO		3000	N	0.0920	N	0.0123		401	10	10	5	5	5	9	4	10	10	4	72
Data Not Used to Derive TRV																																																
23	6899	Petersen and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	M	C	Lab	3	BIO	CHM	PCLV	BL	900		Y	0.3900	N	0.0315	72.8		10	10	5	10	6	1	4	1	10	4	61
24	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	1	4	0/100/300/900	ppm in mg/kg	N	na	ADL	U	FD	4	w	1	d	JV	B	C	Lab	1	GRO	GRO	BDWT	WO	900		Y	0.316	N	0.02749	78.3		10	10	5	5	6	8	4	1	10	4	63
25	6901	Peterson and Jensen, 1975	Silver nitrate	100	Chicken (*Gallus domesticus*)	1	2	0/900	ppm in mg/kg	N	na	ADL	U	FD	28	d	1	d	JV	B	C	Lab	3	BIO	CHM	PCLV	BL	900		Y	0.2860	N	0.0258	81.1		10	10	5	10	6	1	4	1	10	4	61
26	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	3	2	0/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	2	BIO	CHM	PCLV	BL		900	Y	0.5280	N	0.0384		65.5	10	10	5	5	6	1	4	10	10	4	65
27	9892	Jensen et al, 1974	Silver acetate	100	Turkey (*Meleagris gallopavo*)	3	2	0/900	mg/kg	N	na	ADL	U	FD	5	w	1	d	JV	B	C	Lab	3	PTH	HIS	GHIS	HE		900	Y	0.5280	N	0.0384		65.5	10	10	5	5	6	4	4	10	3	4	61
28	80	Van Vleet et al, 1981	Silver acetate	100	Duck (*Anas platyrhynchos*)	1	2	0/3000	mg/kg	N	na	ADL	U	FD	15	d	1	d	JV	M	C	Lab	2	BIO	ENZ	GLPX	BL		3000	N	0.0920	N	0.0123		401	10	10	5	5	5	1	4	10	10	4	64

Appendix 6-1

Mammalian Toxicity Data Extracted and Reviewed for Wildlife Toxicity Reference Value (TRV) - Silver

---

September 2006

This page intentionally left blank

Appendix 6.1 Mammalian Toxicity Data Extracted for Wildlife Toxicity Reference Value (TRV)
Silver

Ref			Exposure																							Control Type	Test Location	Effects					Conversion to mg/kg bw/day					Result		Data Evaluation Score										
Result #	Ref N.	Reference	Chemical Form	MW %	Test Species	Phase #	# of Conc/ Doses	Conc/ Doses	Conc/Dose Units	Wet Weight Reported?	Percent Moisture	Application Frequency	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Control Type	Test Location	General Effect Group	Effect Type	Effect Measure	Response Site	Study NOAEL	Study LOAEL	Body Weight Reported?	Body Weight in kg	Ingestion Rate Reported?	Ingestion Rate in kg or L/day	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Source	Dose Route	Test Concentrations	Chemical form	Dose Quantification	Endpoint	Dose Range	Statistical Power	Exposure Duration	Test Conditions	Total
Biochemical																																																
1	23825	Pribyl et al, 1980	Silver nitrate	100	Rat (*Rattus norvegicus*)	1	2	0/6.47	mg/org/d	N	na	ADL	U	FD	4	d	NR	NR	JV	M	C	FieldU	BIO	ENZ	GENZ	SR		6.47	Y	0.2	N	0.018298		32.3	10	10	5	10	6	1	4	10	10	4	70
Behavior																																																
2	1244	Cabe, et al., 1979	Silver nitrate	100	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	na	ADL	U	DR	13	w	50	d	JV	M	C	Lab	BEH	FDB	WCON	WO		1000	Y	0.2	N	0.023257		116	10	5	5	10	6	4	4	10	10	4	68
Pathology																																																
3	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	2	2	0/0.2	% in diet	N	na	ADL	U	FD	40	d	NR	NR	JV	NR	C	Lab	PTH	HIS	NCRO	LI	0.2		Y	8.86	N	0.41281	60.2		10	10	5	5	6	4	4	10	10	4	68
4	149	Van Vleet et al, 1981	Silver acetate	100	Pig (*Sus scrofa*)	1	2	0/3000	mg/kg diet	N	na	ADL	U	FD	25	d	NR	NR	JV	M	C	Lab	PTH	HIS	GLSN	HE		3000	Y	16.4	N	0.68479		125	10	10	5	5	6	4	4	10	10	4	68
5	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	1	2	0/0.5	% in diet	N	na	ADL	U	FD	28	d	NR	NR	JV	NR	C	Lab	PTH	HIS	NCRO	LI		0.5	Y	13.52	N	0.58428		140	10	10	5	5	6	4	4	10	10	4	68
Reproduction																																																
6	21093	Shavlovski et al, 1995	Silver chloride	75.2	Rat (*Rattus norvegicus*)	1	2	0/50	mg/org/d	N	na	DLY	U	FD	20	d	NR	NR	GE	F	C	Lab	REP	REP	PROG	WO		50	Y	0.2	N	0.018298		188	10	10	5	10	6	10	4	10	10	4	79
Growth																																																
7	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	2	2	0/0.2	% in diet	N	na	ADL	U	FD	40	d	NR	NR	JV	NR	C	Lab	GRO	GRO	BDWT	WO		0.2	Y	8.86	N	0.41281		60.2	10	10	5	5	6	8	4	10	10	4	72
8	14503	Wagner et al, 1975	Silver acetate	100	Rat (*Rattus norvegicus*)	1	2	0/751	mg/L	N	na	ADL	U	DR	15	w	21	d	JV	B	C	Lab	GRO	GRO	BDWT	WO		751	N	0.4702	N	0.050198		80.2	10	5	5	5	5	8	4	10	10	4	66
9	149	Van Vleet et al, 1981	Silver acetate	100	Pig (*Sus scrofa*)	1	2	0/3000	mg/kg diet	N	na	ADL	U	FD	4	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO		3000	Y	15.8	N	0.66413		126	10	10	5	5	6	8	4	10	10	4	72
10	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	1	2	0/0.5	% in diet	N	na	ADL	U	FD	28	d	NR	NR	JV	NR	C	Lab	GRO	GRO	BDWT	WO		0.5	Y	13.52	N	0.58428		140	10	10	5	5	6	8	4	10	10	4	72
11	22823	Matuk et al, 1981	Silver nitrate	63.5	Rat (*Rattus norvegicus*)	1	2	0/0.25	% in diet	N	na	ADL	U	DR	16	w	NR	NR	JV	M	C	Lab	GRO	GRO	BDWT	WO		0.25	Y	0.365	N	0.039967		174	10	5	5	10	6	8	4	10	10	4	72
Survival																																																
12	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	2	2	0/0.2	% in diet	N	na	ADL	U	FD	40	d	NR	NR	JV	NR	C	Lab	MOR	MOR	MORT	WO	0.2		Y	8.86	N	0.41281	60.2		10	10	5	5	6	9	4	10	10	4	73
13	1244	Cabe, et al., 1979	Silver nitrate	100	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	na	ADL	U	DR	13	w	50	d	JV	M	C	Lab	MOR	MOR	MORT	WO	1000		Y	0.2	N	0.023257	116		10	5	5	10	6	9	4	10	10	4	73
14	149	Van Vleet et al, 1981	Silver acetate	100	Pig (*Sus scrofa*)	1	2	0/3000	mg/kg diet	N	na	ADL	U	FD	25	d	NR	NR	JV	M	C	Lab	MOR	MOR	MORT	WO		3000	Y	16.4	N	0.68479		125	10	10	5	5	6	9	4	10	10	4	73
15	22589	Van Vleet, 1976	Silver acetate	64.63	Pig (*Sus scrofa*)	1	2	0/0.5	% in diet	N	na	ADL	U	FD	28	d	NR	NR	JV	NR	C	Lab	MOR	MOR	MORT	WO		0.5	Y	13.52	N	0.58428		140	10	10	5	5	6	9	4	10	10	4	73
Data Not Used to Derive TRV																																															
16	1244	Cabe, et al., 1979	Silver nitrate	100	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	na	ADL	U	DR	13	w	50	d	JV	M	C	Lab	GRO	GRO	BDWT	WO	1000		Y	0.2	N	0.023257	116		10	5	5	10	6	8	4	1	10	4	63
17	1244	Cabe, et al., 1979	Silver nitrate	100	Rat (*Rattus norvegicus*)	1	2	0/1000	mg/L	N	na	ADL	U	DR	13	w	50	d	JV	M	C	Lab	PTH	ITX	INCO	WO	1000		Y	0.2	N	0.023257	116		10	5	5	10	6	4	4	1	10	4	59
18	21093	Shavlovski et al, 1995	Silver chloride	75.2	Rat (*Rattus norvegicus*)	1	2	0/50	mg/org/d	N	na	DLY	U	FD	20	d	NR	NR	GE	B	C	Lab	BIO	ENZ	CCOX	LI	50		Y	0.2	N	0.018298	188		10	10	5	10	6	1	4	1	10	4	61
19	14503	Wagner et al, 1975	Silver acetate	100	Rat (*Rattus norvegicus*)	1	2	0/751	mg/L	N	na	ADL	U	DR	15	w	21	d	JV	B	C	Lab	BIO	ENZ	GLPX	ER	751		N	0.4702	N	0.050198	80.2		10	5	5	5	5	1	4	1	10	4	50
20	22300	Whanger and Weswig, 1970	Silver acetate	100	Rat (*Rattus norvegicus*)	1	5	0/10/25/50/100	mg/kg diet	N	na	ADL	U	FD	8	w	21	d	JV	B	C	Lab	BIO	CHM	GBCM	BL		10	N	0.235	N	0.020892		0.889	10	10	5	5	5	1	4	10	10	4	64
21	149	Van Vleet et al, 1981	Silver acetate	100	Pig (*Sus scrofa*)	1	2	0/3000	mg/kg diet	N	na	ADL	U	FD	2	w	NR	NR	JV	M	C	Lab	BIO	ENZ	GLPX	BL		3000	Y	12.7	N	0.55499		131	10	10	5	5	6	1	4	10	10	4	65

Attachment 3-2

Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)

Eco-SSL Standard Operating Procedure (SOP) #2: Plant and Soil Invertebrate Literature Evaluation, Data Extraction, and Eco-SSL Calculation

OSWER Directive 92857-55

November 2003

This page intentionally left blank

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 EVALUATION AND SCORING OF STUDY ATTRIBUTES 1

3.0 DATA EXTRACTION 2

4.0 ECO-SSL DERIVATION 4

5.0 QUALITY ASSURANCE REVIEW 4

ATTACHMENT A - STUDY EVALUATION CRITERIA

ATTACHMENT B - STUDY EVALUATION CRITERIA SCORE SHEET

ATTACHMENT C - CRITICAL NOTES SPREADSHEET

This Page Intentionally Left Blank

1.0 INTRODUCTION

This standard operating procedure (SOP) describes how nine criteria are used for assessing the applicability of published studies for deriving a terrestrial plant or soil invertebrate Ecological Soil Screening Level (Eco-SSL), provides a set of rules for extracting and reporting the most appropriate study data, and presents the method for calculating an Eco-SSL. Only those studies that meet the study acceptance criteria in SOP #1 (Appendix 3-1) should be evaluated and scored using this SOP. This SOP is intended to ensure that the data most appropriate for deriving an Eco-SSL are selected and used.

2.0 EVALUATION AND SCORING OF STUDY ATTRIBUTES

Nine study evaluation criteria are used to score each reported study (Attachment A). Scoring is based on a three-point scale (i.e., 0, 1, or 2) with a score of "2" being the highest score. The scores for each study evaluation criteria are recorded in a Score Sheet spreadsheet (Attachment B) and summed to generate a total evaluation score for each study. A study must receive a total evaluation score greater than ten to be considered for deriving an Eco-SSL.

Users of this SOP should recognize that toxicity studies reported in published literature were generally not conducted or intended for the purpose of deriving Eco-SSLs. Therefore, the specific information addressed by each criterion may not be reported for each study. Scoring should be objective, however, in some instances professional judgement may be needed to ascertain the appropriate score for a criterion.

Some publications will contain the results of several different experimental designs, or studies, each of which should be scored separately. When a publication reports toxicity data for more than one test species, chemical, or soil type (defined below) these should be considered different studies for the purpose of deriving an Eco-SSL. Studies that vary in other parameters, such as temperature, photoperiod, or species life stage (e.g., immature versus mature), should not be considered different studies for the purpose of deriving an Eco-SSL. Distinct artificial soil types are defined as having different bioavailability scores as determined with study evaluation criteria #1, which is based on pH and percent organic matter. Natural soils from two different sampling locations are considered distinct soils regardless of their bioavailability scores.

When multiple studies are presented in a paper, the reviewer should assign a unique identification code to each study, and document information for each study separately on the Score Sheet. For example, a publication by Jones et al. (Publication No.1022) contains results for three separate experimental designs. In this example, results of each experimental design (i.e., study) should be evaluated and scored separately, and identified on the Score Sheets with an unique experiment identification code such as a, b, and c for the respective publication number (e.g., 1022a, 1022b, 1022c).

A publication may include some studies that do not pass the study acceptance criteria. The reviewer should only score those individual studies that meet the requirements of the study

acceptance criteria (see Appendix 3-1). For example, if a study reports the results of both a topical application and artificial soil study, the topical application study (which does not meet the study acceptance criteria) would not be scored. Reviewers should provide comments on which studies were scored and which were excluded. These comments should be entered in the "comment" field of the Critical Notes spreadsheet (see Section 3.0).

3.0 DATA EXTRACTION

For each study reviewed, a set of Critical Notes (Figure 1) are recorded in a spreadsheet (Attachment C). As with the Study Evaluation Criteria Score Sheet, individual studies are assigned separate experiment identification codes.

Figure 1. Critical Notes

- Paper identification code
- Study identification code
- First author and year of publication
- Chemical
- Receptor
- Common name
- Species name
- Soil pH
- Percent organic matter (OM)
- Bioavailability score
- Total evaluation score
- Ecologically relevant endpoint (ERE)
- Preferred toxicity parameter
- Preferred toxicity value
- Secondary toxicity parameter
- Secondary toxicity value
- Other available toxicity parameters and concentrations
- Preference level
- Comments

Details on the soil parameters including soil pH and percent organic matter (%OM) are recorded. If a study reports the pH at both test initiation and completion only the initial pH should be recorded. If a pH range is reported the arithmetic mean of the minimum and maximum should be calculated and reported. However, if a range is reported and it includes a pH value that is outside of the acceptable soil parameters (i.e., pH < 4 or > 8.5), this study should be rejected and this information should be noted in the comment field of the Critical Notes. Likewise, if %OM is reported as a range for a single soil type and the range extends outside of the acceptable range (i.e., >10%), the study should be rejected and not used for deriving an Eco-SSL. This information should be noted in the comment field of the Critical Notes.

Toxicity values are reported in the Critical Notes spreadsheet. Toxicity values are chemical concentrations related to measurements of a defined ecologically relevant endpoint (ERE). The EREs are presented in Table 1. Toxicity values should be reported as milligram per kilogram (mg/kg) dry weight of the chemical in soil. If the concentrations are reported in units other than mg/kg, or are reported as the concentration of a salt, the reviewer should convert these values to mg/kg of the chemical. If the concentrations are reported as wet weight of the chemical in soil, they should be converted to dry weight concentration based on the percent soil moisture reported in the publication. Any calculations or assumptions by the reviewer must be noted in the comment field of the Critical Notes. If the toxicity value is reported as a range of concentrations rather than a point estimate, no value should be recorded on the Critical Notes and a notation should be made in the comment field.

Table 1. Ecologically Relevant Endpoints (ERE) for Deriving Eco-SSLs	
Ecologically Relevant Endpoint	**Definition**
Reproduction	Measures of the effect of toxicants on offspring production. Examples of EREs associated with reproduction include changes in fecundity, number of progeny produced (eggs, cocoons, etc.), rate of reproduction (hatching rates, etc.), rate of maturation, sexual development, change in sex expression, and sterility number or proportion of abnormal progeny.
Population	Measurements and endpoints regarding a group of soil invertebrates of the same species occupying the same area at a given time. Measurement includes population dynamics. Examples of EREs associated with population include changes in size and age class structures, changes in sex ratio, intrinsic population growth rate, survivability of subsequent generations, diversity, evenness, index to population size (count, number, abundance), life table data, population density (number/area).
Growth	Broad category which encompasses measures of weight/mass and length. EREs associated with growth and development responses such as a change in body weight.
Biomass (plants only)	Measurement of plant products including seed production, standing corp biomass, seedling emergence, shoot length/growth, root elongation/growth, fresh or dry mass, or yield.
Physiology (plants only)	For the purposes of developing Eco-SSLs, only plant studies reporting EREs associated with physiological responses will be used. Physiological endpoints for plants include net photosynthesis (CO_2 uptake, oxygen release), decrease in chlorophyll content or chlorophyll fluorescence, increased deformation, membrane damage, desiccation/decrease in water content, detrimental changes in dormancy measures, decreased flowering, and increased senescence.

Toxicity values are categorized in the Critical Notes by standard measurements of dose-response relationships, or toxicity parameters. Acceptable toxicity parameters include No Observed Adverse Effect Concentrations (NOAEC), Lowest Observed Adverse Effect Concentrations (LOAEC), or Effect Concentrations for 10 - 20% of the population (EC_{10} and EC_{20}). Acute toxicity data (e.g., LC_x) and, $EC_{<10}$ or $EC_{>20}$ are not considered acceptable toxicity parameters for deriving Eco-SSLs. If these are the only parameters reported for a study this information should be recorded in the comment field.

If a publication does not identify acceptable toxicity parameters, but sufficient data are provided, the reviewer should determine and record the toxicity value under the appropriate toxicity parameter. For example, if a study does not identify LOAECs and NOAECs but treatments with and without significant adverse effects are reported, the reviewer should record these toxicity values as LOAECs and NOAECs and note in the comment field that these toxicity parameters were assigned by the reviewer, instead of reported in the publication.

When a study provides NOAEC and LOAEC values, these data are used to calculate a Maximum Acceptable Threshold Concentration (MATC). The MATC is the geometric mean of the NOAEC and LOAEC values:

$$\mathbf{GM = exp(average(LnY_1, Y_2, Y_3 \ldots Y_n))}$$

If data for more than one toxicity parameter are reported for a study (e.g., EC_{20} and EC_{10}), all acceptable toxicity data are reported on the Critical Notes Form and a single preferred toxicity parameter is selected for Eco-SSL derivation based on the following hierarchy:

$$\mathbf{EC_{20} > MATC > EC_{10}}$$

If a study reports more than one toxicity value for the same type of toxicity parameter, a preferred toxicity value for invertebrates is selected according to the following hierarchy of EREs:

Reproduction > Population > Growth

For plants the most sensitive measurement of biomass production is selected. If no measurement of biomass production is reported some physiological endpoints are acceptable EREs for plants. If a publication reports multiple "preferred" toxicity values for the same study (e.g., two reproductive EC_{20} values), the lowest value is recorded on the Critical Notes.

4.0 ECO-SSL DERIVATION

The first step in deriving an Eco-SSL is to sort the studies by their literature evaluation score. Studies with a total evaluation score $\leq$10 (out of 18 possible points) are removed from further consideration for deriving an Eco-SSL. Studies that receive an evaluation score >10 are then ranked by bioavailability score. The Eco-SSL is calculated as the geometric mean of the toxicity values at the highest bioavailability score for which sufficient data exists ($\geq$3 data points). For example, if there are two high bioavailability data points (score = 2) and five medium bioavailability data points (score = 1) the Eco-SSL would be calculated as at the medium bioavailability score using all seven data points. If there are less than three acceptable data points an Eco-SSL can not be calculated.

An Eco-SSL is calculated by taking the geometric mean (GM) of the preferred toxicity values (where $N \geq 3$) with the highest bioavailability scores:

$$\mathbf{GM = exp(average(LnY_1\ Y_2))}$$

Where Y_1 = NOAEC and Y_2 = LOAEC

5.0 QUALITY ASSURANCE REVIEW

A quality assurance review of the data in studies used to derive an Eco-SSL must be preformed by a panel of experts. The reviewers must verify that all of the studies that will be used to derive an Eco-SSL were correctly evaluated and scored. All publications are checked by at least two individuals, and then reported to the panel of experts for final quality assurance evaluation. The Quality Assurance review consists of the following multi-step process:

- The Literature Acceptance Criteria Checklist (SOP# 1) are reviewed to verify that all of the Acceptance Criteria were met.

- The study evaluation scores are checked to verify that only studies that scored greater than 10 are considered for deriving Eco-SSLs.

- Each publication is reviewed to ensure that toxicity data for all of the available studies are reported on the Critical Notes.

- The soil pH, OM and bioavailability score for each study is verified.

- Selection of the appropriate ecological endpoints, toxicity parameter(s) and toxicity values are verified.

- The preferred toxicity parameter and toxicity value for each study are verified.

- The units of the toxicity value (wet weight/dry weight, chemical form) are verified.

- Calculations (e.g., converting organic carbon to organic matter) and any assumptions made by the reviewer (e.g., assigning toxicity values where values are not reported) documented in the comment field are verified.

ATTACHMENT A
STUDY EVALUATION CRITERIA

Criteria #1 Testing was Done Under Conditions of High Bioavailability

Bioavailability of metals and polar organic compounds is influenced by pH and soil organic matter. The scoring is intended to favor relatively high bioavailability. If the authors do not present the organic matter content, but present another measure of organic content (total organic carbon, particulate organic carbon, or organic carbon) these measurements are converted to organic matter content by multiplying them by a factor of 1.72. If neither the percent organic matter nor the organic carbon content is provided in the publication but this information is available from the United States Department of Agriculture (USDA) National Cooperative Soil Survey (NRCS) database, the data reported in the soil database may be used.

Natural Soils

Natural soils are scored using one of the three Bioavailability Tables provided below. These tables are the same as those reported in Chapter 2 where very high or high = 2, medium = 1, and low or very low = 0.

QUANTITATIVE BIOAVAILABILITY FOR CATIONIC METALS IN NATURAL SOILS

	Low OM (< 2%)	Medium OM (2 - 6%)	High OM (> 6 -10%)
4 ≤ Soil pH ≤ 5.5	V. High (score = 2)	High (score = 2)	Medium (score = 1)
5.5 < Soil pH < 7	High (score = 2)	Medium (score = 1)	Low (score = 0)
7 ≤ Soil pH ≤ 8.5	Medium (score = 1)	Low (score = 0)	V. Low (score = 0)

QUANTITATIVE BIOAVAILABILITY FOR ANIONIC METALS IN NATURAL SOILS

	Low OM (< 2%)	Medium OM (2 - 6%)	High OM (> 6 - 10%)
4 ≤ Soil pH ≤ 5.5	Medium (score = 1)	Low (score = 0)	V. Low (score = 0)
5.5 < Soil pH < 7	High (score = 2)	Medium (score = 1)	Low (score = 0)
7 ≤ Soil pH ≤ 8.5	V. High (score = 2)	High (score = 2)	Medium (score = 1)

QUANTITATIVE BIOAVAILABILITY FOR ORGANIC CHEMICALS IN NATURAL SOILS

Soil Type	Chemical Type	Organic Matter (%)		
		< 2	2 - 6	> 6 - 10
4 ≤ Soil pH ≤ 5.5	Pesticides/PCBS (Log Koc > 3.5)	High (score = 2)	Medium (score = 1)	Low (score = 0)
	Other Organics (Log Koc < 3.5)	V. High (score = 2)	High (score = 2)	Medium (score = 1)
5.5 < Soil pH < 7	Pesticides/PCBS (Log Koc > 3.5)	Medium (score = 1)	Low (score = 0)	Low (score = 0)
	Other Organics (Log Koc < 3.5)	High (score = 2)	Medium (score = 1)	Low (score = 0)
7 ≤ Soil pH ≤ 8.5	Pesticides/PCBS (Log Koc > 3.5)	Low (score = 0)	Low (score = 0)	Low (score = 0)
	Other Organics (Log Koc < 3.5)	Medium (score = 1)	Low (score = 0)	Low (score = 0)

Standard Artificial Soils

Standard artificial soils (i.e., ASTM, ISO, OECD, i.e., 10% OM, 20% Kaolinite, 69% sand, 1% $CaCO_3$) with pH of 4.0 to 8.5 are assigned a medium bioavailability score of 1. All other artificial soils are scored according to the Bioavailability Tables for natural soils.

Criteria #2 Experimental Designs for Laboratory and Field Studies are Documented and Appropriate

There are two sections that may apply for this criterion. Apply the criteria in 2A when the paper describes laboratory studies. Criteria 2A is used for laboratory studies and Criteria 2B are used when a field study is described. Experimental design can significantly influence the quality of a study. Higher quality studies use experimental design(s) sufficiently robust to allow analysis of the test variables and discriminate non-treatment effects.

Criteria #2A: Experimental Designs for Laboratory Studies

The following scores are applied to laboratory studies. A **Score of 2** is assigned if a standard method or protocol is cited (e.g., US EPA, OECD, ASTM, ISO), or if a standard method is not cited but the study includes a description of the experimental design, the test conditions, and the nature of the test units, as indicated in the following subsections.

Experimental Design. The number of exposure concentrations must be ≥6 including a control, the exposure concentrations (nominal or measured), the number of test organisms per test unit (i.e., loading rate), and the time of observations must be reported in the publication. In addition, if an ANOVA or factorial design was used, there must be at least 3 replicate test units per exposure concentration; or if the study used a regression design, there must be at least two replicates and the toxicity estimate must encompass the range of responses needed to describe the dose-response (e.g., interpolation).

Test Conditions. Test conditions reported in the publication should include, at a minimum: exposure temperature. If it is a plant study, it must also report photoperiod (or conditions, e.g., natural light June-August), and type (e.g. sunlight) or intensity of light.

Test Units. Volume or dimensions, and material comprising the test unit, amount/type of soil in each test unit.

A **Score of 1** is assigned if an analysis of variance (ANOVA) or factorial design is used and the number of exposure concentrations is 4 or 5 including a control, or if number of replicate test units are 2 (duplicates). A Score of 1 is also assigned in the following instances:

- the study uses a regression design and the number of exposure concentrations is 4 or 5 including a control, or ≥6 without replication (i.e., only one test unit per exposure concentration); or
- the reported toxicity estimate (e.g., effect concentration or ECx) encompasses the range of responses needed to describe the dose-response,
- the extrapolation does not exceed 10% of the highest test concentration.
- the conditions described in the preceeding experimental design are met but those in either Test Conditions and/or Test Units are not met.

A **Score of 0** is assigned in all other cases.

Criteria #2B: Experimental Designs for Field Studies

A **Score of 2** is assigned if the study includes a description of the experimental design, the test conditions, and the nature of the test plots, as described in the following subsections.

Experimental Design.. If experimental plots are used, the study should report the number of exposure concentrations, the number of replicate plots per exposure concentration, the location or method of selecting the sampling locations, and the time of

sampling or number of sampling times. If transects are used, the method for selecting the location of the transects, the number of transects, the location or method of selecting the sampling locations along the transects, and the time of sampling, or number of sampling times, should be reported.

Test Conditions. Information on the physico-chemical characteristics of the soil should be reported and, at a minimum, include: soil texture or particle size description (sand, silt, or clay, or some combination thereof), pH, and organic matter content.

Test Plots. The size of the test plots, or length of transects should be reported or they can be cited elsewhere.

A Score of 1 is assigned in the following instances:

- the experimental design is an ANOVA design and has 5 exposure concentrations including controls
- less than 3 replicate test units per exposure concentration are reported,
- a regression design is used with <6 treatments, including a control and no replication,
- the test conditions, the test units, or the test plots, are only partially described or are not reported and are not cited elsewhere.

A Score of 0 is assigned in all other cases.

Criteria #3: Concentration of Test Substance in Soil is Reported

The concentration of the chemical tested must be reported unambiguously. It is unacceptable, for instance to report application rates (e.g., lbs./acre, to 500 ppm in sludge applied at 10 tons per acre). Studies that only report application rates are not accepted and should not be used to derive an Eco-SSL. In some cases, greenhouse studies may report soil mass of pots that would make it possible to convert an application rate to a concentration, however, this is rare. Pot volume alone is not be an adequate parameter to calculate concentrations as one would have to approximate the mass. If the concentrations are reported on a wet weight or fresh weight basis, this is recorded in the Comments field, along with any information that allows conversion to dry weight.

A **Score of 2** is assigned if the measured concentrations are reported. A Score of 1is assigned if the toxicity values are based on nominal concentrations and are used in calculating toxicity values. A **Score of 0** is assigned in all other cases.

Criteria #4: Control Responses are Acceptable

Negative controls are a crucial part of toxicity tests in order to distinguish treatment effects from non-treatments effects. A **Score of 2** is assigned if a standardized procedure is followed and negative control values are within procedural guidelines of the standard procedure cited. A Score of 2 is also assigned if non-standardized procedure are used and the control values are within an acceptable range (e.g., earthworms mortality <10%, plants germination < 20%). A **Score = 1** is assigned f results of control are not reported or are ambiguous. A **Score of 0** is assigned if control results are not within an acceptable range.

Criteria #5: Chronic or Life Cycle Test

Chronic toxicity tests, or those assessing long-term adverse sub-lethal impacts on the life-cycle phases of an organism, are considered superior to acute toxicity tests. **A Score of 2** is applied if chronic exposures, or life-cycle phase studies are used. A **Score of 1** is applied if acute tests are used and a **Score of 0** if very short term exposures are used (i.e., for physiological measurements).

Criteria #6: **Chemical Dosing Procedure is Reported and Appropriate for Chemical and Test**

Chemical dosing procedure may affect the outcome of a test. The type of chemical dosing procedure depends on the chemical and the type of test. Typically dosing procedure should include:

(A) The form or species of the chemical used in the test,
(B) The carrier or vehicle used to deliver the chemical (e.g., solvent, water, etc.)
(C) How the carrier is handled following dosing (i.e., allowed to volatilize, controls, etc.),
(D) How the soil and chemical are mixed to ensure homogeneity.

A Score of 2 is assigned if a study includes information for the dosing procedure including items items A to D (above). A Score of 1 is assigned if information for items A and B are included but not information for items C or D. A **Score of 0** is assigned if the study does not specify details of the dosing procedure, the dosing procedures cannot be inferred, or it does not meet the other scoring criteria.

The evaluator should exercise judgement regarding technical details of all four components (A thru D above), and if questionable or unacceptable methods are used, the scores should be lowered by 1 (i.e., the score becomes either 1 or 0) and the rationale for scoring should be stated in the comment section**.**

Criteria #7: Dose-Response Relationship is Reported or can be Established from Reported Data

A benchmark concentration is intended to represent the location on the dose-response curve that is the threshold between absence and presence of the effects of concern for a relevant ecological endpoint. Two methodologies can be used to identify this benckmark concentration. The first is a method that generates a no observed effect concentration (NOEC) and a lowest observed effect concentration (LOEC). The NOEC is the concentration that did not cause statistically significant effects when compared to controls. The LOEC is the lowest concentration that resulted in statistically significant effects when compared to controls. The threshold lies somewhere between these two values. The second method involves a statistical model to calculate a dose response curve and estimate an effect concentration for some percentage of the population (EC_{xx}), usually between an EC_5 and an EC_{20}. Lethal concentration (LC_{xx}) and $EC_{<10}$ or $EC_{>20}$ are not used for calculating an Eco-SSL and are not scored but the information is recorded on the Critical Notes form. Tests with relatively small upper and lower confidence limits around the NOEC or LOEC and ECx values are preferred. Studies where at least two test concentrations produced adverse effects < 100% are also preferred.

A **Score of 2** is applied if an EC_{10}- EC_{20}; are reported or a NOEC and LOEC within 3x of each other. A **Score of 1** is applied if the difference between the NOEC or LOEC is > 3x but < 10x. A **Score of 0** is applied if a study does not report an ECx; or the difference between the NOEC and LOEC > 10, or only a NOEC *or* LOEC.

Criteria # 8: The Statistical Tests used to Calculate the Benchmark and the Level of Significance were Described

When no observed effect concentrations (NOECs) and lowest observed effect concentrations (LOECs) are reported, an ANOVA or other statistical test should be conducted to determine that the NOEC is the highest test concentration that did not produce a statistically significant effect and the LOEC is the lowest concentration tested that did produce a significant effect when compared to the control. When EC values are reported, the confidence levels around these values should be reported and should be based on a 95% probability level.

A **Score of 2** is applied if the results of the ANOVA or statistical method based on a P = 0.05; or the 95% CI of the ECx are presented. A **Score of 1** is applied if the ANOVA was completed but a P level is not provided, or the P level is > 0.05. If EC data are presented, a **Score of 1** is applied if the 95% CI is not reported or a CI of 90% is used. A **Score of 0** is applied if no

NOEC, LOEC, or EC/LCx data are reported, or if they are reported but no description of the methods used for their calculation are provided.

Criteria #9: The Origin of the Test Organisms is Described

The results of a toxicity test can be influenced by the condition of the test organisms. Test organisms should be healthy and have had no exposure above background to contamination prior to testing.

A Score = 2 is applied if the source and condition of the test organisms are known and described (for seeds unambiguous information should be provided on species identity), and the organisms come from a non-contaminated or commercial source. A **Score of 1** is assigned if the organisms are obtained from a non-commercial source that is not adequately described, or sufficient information is not provided about either the seed stock or the commercial source. A **Score of 0** is applied if organisms are from a known contaminated site, or adequate information is not provided about the seed stock nor the commercial source.

ATTACHMENT B
STUDY EVALUATION CRITERIA SCORE SHEET

Criterion	Title	IP#	IP#	IP#	IP#	IP#	IP#
1	Testing was Done Under Conditions of High Bioavailability (See Soil Evaluation Matrix).						
2	Experimental Designs were Documented and Appropriate.						
3	Concentration of Substance of Interest in Soil was Reported.						
4	Control Measures were Applied.						
5	Chronic or Life Cycle Test was Used.						
6	Chemical Dosing Procedure was Reported and Appropriate for Chemical and Test.						
7	A Dose-Response Relationship is Reported or can be Estimated from Reported Data.						
8	The Statistical Tests used to Calculate the Benchmark and the Levels of Significance were Described.						
9	The Origin of the Test Organisms were Described.						
Total Score							

ATTACHMENT C
CRITICAL NOTES SPREADSHEET

Chemical	Receptor	IP Number	Study ID	First Author, Pub. Year	Species Common Name	Total Eval. Score	Bio-availability Score Soil	pH	OM	ERE	EC20	NOAEC	LOAEC	MATC	EC10	EC50	Level	COMMENTS	

Guidance for Developing Ecological Soil Screening Levels

OSWER Directive 9285.7-55

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

November 2003

This Page Intentionally Left Blank

EXECUTIVE SUMMARY

This document describes the process used to derive a set of risk-based ecological soil screening levels (Eco-SSLs) for many of the soil contaminants that are frequently of ecological concern for plants and animals at hazardous waste sites and provides guidance for their use. The Eco-SSL derivation process represents the group effort of a multi-stakeholder workgroup consisting of federal, state, consulting, industry, and academic participants led by the U.S. Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (OSRTI). The Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. These values can be used to identify those contaminants of potential concern in soils requiring further evaluation in a baseline ecological risk assessment. The Eco-SSLs should be used during Step 2 of the Superfund Ecological Risk Assessment process, the screening-level risk calculation. The Eco-SSLs are not designed to be used as cleanup levels and EPA emphasizes that it is inappropriate to adopt or modify these Eco-SSLs as cleanup standards.

EPA derived the Eco-SSLs in order to conserve resources by limiting the need for EPA and other risk assessors to perform repetitious toxicity data literature searches and data evaluations for the same contaminants at every site. This effort should also allow risk assessors to focus their resources on key site-specific studies needed for critical decision-making. EPA also expects that the Eco-SSLs will increase consistency among screening risk analyses and decrease the possibility that potential risks from soil contamination to ecological receptors will be overlooked.

EPA prepared a list of twenty-four (24) contaminants to be addressed initially by the Eco-SSL guidance. This list was based on a review of the contaminants of concern reported in recent Record of Decisions at Superfund National Priority List sites. The Eco-SSL contaminant list also included contaminants nominated by the EPA regional Biological Technical Assistance Group Coordinators. The list of 24 Eco-SSL contaminants contained 17 metals including aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, vanadium, and zinc. The organic contaminants on the list were dieldrin, Hexahydro -1,3,5-trinitro-1,3,5-triazine (RDX), trinitrotoluene (TNT), 1,1,1-Trichloro-2,2-bis (p-chlorophenyl)ethane (DDT) and metabolites (DDE and DDD), pentachlorophenol, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

The omission of other contaminants, such as phthalates, cyanides, dioxins and mercury, does not imply that these contaminants can be excluded from the ERA screening process for soil contamination. The processes and procedures established here for developing the Eco-SSLs were intended to be sufficiently transparent to allow others to derive values for additional contaminants, as needed. PCBs were included by the workgroup in the original Eco-SSL contaminant list. However, it became apparent early in the process, that development of a PCB soil screening value was not warranted. Because of the known high persistence and toxicity of PCBs, and the conservative nature of the Eco-SSLs, it was acknowledged that soil screening

levels derived for PCBs would normally be lower than the soil analyses detection limits. EPA believes that if PCBs are detected in soil above background levels, the PCBs are probably site-related and therefore should be included as a contaminant of potential concern in the baseline risk assessment.

The approach developed for deriving the Eco-SSLs for plants and soil invertebrates was similar to the approach taken for deriving the wildlife Eco-SSLs (specifically the toxicity reference values). The general approach included four steps: (1) conduct literature searches, (2) screen identified literature with exclusion and acceptability criteria, (3) extract, evaluate, and score test results for applicability in deriving an Eco-SSL, and (4) derive the value. These procedures were finalized as standard operating procedures prior to initiating any work to derive the actual values.

Chapter 3 provides a description of the procedures used for deriving plant and soil invertebrate Eco-SSL values. The values were derived directly after an evaluation of all available plant and soil invertebrate chronic toxicity test data (measured toxicity related to soil contaminant concentrations). Chapter 4 provides a description of the procedures for deriving the wildlife Eco-SSLs. The wildlife Eco-SSLs were the result of back-calculations from a hazard quotient of 1.0. The hazard quotient is equal to the estimated exposure dose divided by the toxicity reference value (TRV). An HQ of 1.0 is the condition where the exposure and the dose associated with no adverse chronic effects are equal, indicating adverse effects at or below this soil concentration are unlikely. A generic food-chain model was used to estimate the relationship between the concentration of the contaminant in soil and the dose for the receptor (mg per kg body weight per day). The TRV represents a receptor-class specific estimate of a no-observed adverse effect level (dose) for the respective contaminant for chronic exposure.

The Eco-SSLs apply to sites where terrestrial receptors may be exposed directly or indirectly to contaminated soil. Seven groups of ecological receptors were initially considered in the development of the Eco-SSLs. These included mammals, birds, reptiles, amphibians, soil invertebrates, plants, and soil microbes and their processes. After investigation, the toxicity data for amphibians and reptiles were deemed insufficient to derive Eco-SSLs. EPA recognizes that the Eco-SSL may not be protective of these receptor groups. Eco-SSLs protective of microbes and soil microbial processes were also not derived. Like amphibians and reptiles, EPA recognizes their importance within terrestrial systems, but concurs with the workgroup that data are insufficient and the interpretation of test results too uncertain for establishing risk-based thresholds.

Eco-SSLs are appropriate to all sites where key soil parameters fall within a certain range of chemical and physical parameters. The Eco-SSLs for plants and soil invertebrates were derived to apply to soils where the pH is greater than or equal to 4.0 and less than or equal to 8.5, and the organic matter content is less than or equal to 10%. Based on these stated parameters, it is expected that there are certain soils and situations to which Eco-SSLs do not apply. These situations include (but may not be limited to) wetland soils that are regularly flooded (i.e., sediments), sewage sludge amended soils where the organic matter content is > 10%, and waste types where the pH is < 4.0.

Because of the diversity of the workgroup scientists, the process developed to derive the Eco-SSLs underwent constant peer review. There were also two external peer reviews performed during the development process. The first was a consultation requested by EPA's Office of Solid Waste and Emergency Response of EPA's Science Advisory Board (SAB). This consultation was held on April 6, 1999. At this meeting, the SAB provided verbal comments to the presenters which were subsequently addressed, as appropriate, by the workgroup as they prepared the guidance. A peer review of the draft guidance document was also performed. The peer review workshop was held on July 26 and 27, 2000 and was open to the public. Each of the comments received was carefully considered by the workgroup Steering Committee and appropriate changes were made to both the procedures for establishing Eco-SSLs and to the guidance document.

After developing the procedures and completing the peer review process, the workgroup focused primarily on deriving Eco-SSL values for the list of contaminants. The results of the application of the derivation procedures reported in this document are provided as separate contaminant-specific documents. In cases where data were limited or not available and Eco-SSL values could not be derived for specific contaminants and receptor groups, EPA may at some point in the future revise the contaminant-specific documents or add contaminants as appropriate.

This Page Intentionally Left Blank

ACKNOWLEDGMENTS

The development of this guidance was a team effort led by the U.S. Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (OSRTI). A Steering Committee coordinated the activities of four task groups. A team of scientists from Syracuse Research Corporation (SRC) managed by Janet Burris provided technical and administrative support in the development of this guidance. Listed below are the members of the Steering Committee and each task group.

Steering Committee
Steve Ells, U.S. EPA OSRTI, Co-Chair
Ralph Stahl, DuPont, Co-chair
Randy Wentsel, U.S. EPA ORD, Co-chair

Bill Adams	Rio Tinto
Doris Anders	U.S. Air Force Center for Environmental Excellence (AFCEE)
John Bascietto	U.S. Department of Energy (DOE)
David Charters	U.S. EPA OSRTI
Ron Checkai	U.S. Army Edgewood Chemical Biological Center (ECBC)
Stiven Foster	U.S. EPA, Office of Research and Development (ORD)
Dale Hoff	U.S. EPA, Region 8
Charlie Menzie	Menzie-Cura & Associates
Chris Russom	U.S. EPA, ORD
Brad Sample	CH2MHill
Jason Speicher	North Division of the Naval Facilities Engineering Command
Mike Swindoll	Exxon Mobile Biomedical Sciences, Inc.

Task Group on Soil Chemistry
Randy Wentsel, U.S. EPA, Co-Chair
Charlie Menzie, Menzie-Cura & Associates, Co-Chair

Bill Berti	DuPont
Ron Checkai	U.S. Army Edgewood Chemical Biological Center (ECBC)
Mary Goldade	U.S. EPA, Region 8
Roman Lanno	Oklahoma State University
Charles R. Lee	U.S. Army Corps of Engineers, Waterways Experiment Station
Linda Lee	Purdue University
Mike Ruby	Exponent
John Samuelian	OGDEN Environmental and Energy Services

Task Group on Eco-SSLs for Soil Invertebrates and Plants
Ron Checkai, U.S. Army ECBC, Co-Chair
Mike Swindoll, Exxon Mobile Biomedical Sciences, Inc., Co-Chair

David Barclift	North Division of the Naval Facilities Engineering Command
Ron Checkai	U.S. Army ECBC
William Desmond	Tetra Tech EM, Inc.
Steve Ells	U.S. EPA, OSRTI
Charlene Falco	Illinois EPA
Stiven Foster	U.S. EPA, ORD.
Dave Gannon	Zeneca Corp.
Andrew Green	International Lead Zinc Research Org. (ILZRO)
Larry Kapustka	ecological, planning & toxicology, Inc.
Roman Kuperman	U.S. Army ECBC
Les Morrow	Illinois EPA
Daniel Mazur	U.S. EPA, Region 5
Chris Russom	U.S. EPA, ORD
Jason Speicher	North Division of the Naval Facilities Engineering Command
Gladys Stephenson	ESG International, Ltd. / University of Guelph

Task Group on Wildlife Toxicity Reference Values
Dale Hoff, U.S. EPA, Co-Chair
Doris Anders, U.S. Air Force, Co-Chair

Nelson Beyer	U.S. Geological Survey
David Charters	U.S. EPA OSRTI
David Cozzie	U.S. EPA Office of Solid Waste
Dave Cragin	Elf-Atochem North America
Steve Dole	Exponent
Anne Fairbrother	U.S. EPA, ORD, Corvallis, Oregon
Bob Fares	Environmental Standards, Inc.
Gary Friday	Westinghouse Savannah River Co.
Kinzie Gordon	Parsons Engineering Science, Inc.
Gerry Henningsen	U.S. EPA, Region 8 (retired)
Mark Johnson	U.S. Army Center for Health Promotion and Preventative Medicine
Paul Kuhlmeier	Dames & Moore
Jackie Little	TN & Assoc.
Patricia Newell	Environmental Health Associates, Inc.
Drew Rak	U.S. Army Corps of Engineers, Baltimore District
Linda Schmeising	Exponent

Task Group on Exposure Models for Wildlife Species
John Bascietto, U.S. Department of Energy (DOE), Co-Chair
Brad Sample, CH2M Hill, Co-Chair

Amber Brenzikofer	Parsons Engineering Science
Bridgette Deshields	Harding Lawson Associates
Will Gala	Chevron
Tracy Hammon	Colorado Department of Health and Environmental Protection
Rob Pastorok	Exponent
Phillip Rury	Arthur D. Little, Inc.
Randy Ryti	Neptune and Co.
William Schew	Environmental Standards, Inc.
Ralph Stahl	DuPont
Jeff Yurk	U.S. EPA, Region 6

TABLE OF CONTENTS

EXECUTIVE SUMMARY

LIST OF FIGURES
LIST OF TABLES
LIST OF ATTACHMENTS
LIST OF ACRONYMS AND ABBREVIATIONS

1.0 INTRODUCTION 1-1
1.1 Scope of the Eco-SSLs 1-4
1.2 The General Process for Establishing Eco-SSLs 1-7
1.3 Peer Review Process 1-11
1.4 Quality, Objectivity, Utility, and Integrity of Information 1-12
1.5 Using Eco-SSLs to Screen Contaminated Soils 1-12

2.0 SOIL PROPERTIES 2-1
2.1 Introduction 2-1
2.2 Soil Properties Influencing Contaminant Bioavailability 2-1
2.3 Using Soil Properties to Guide Eco-SSL Derivation 2-8

3.0 DERIVATION OF PLANT AND SOIL INVERTEBRATE ECO-SSLs 3-1
3.1 Literature Search, Acquisition, and Screening 3-2
3.2 Identification of Potentially-Acceptable Literature 3-3
3.3 Extraction of Data and Scoring Studies 3-3
3.4 Derivation of Eco-SSLs 3-6
3.5 Soil Toxicity Test Methods 3-8

4.0 DERIVATION OF WILDLIFE ECO-SSLs 4-1
4.1 The Wildlife Risk Model for Eco-SSLs 4-1
4.2 Selection of Surrogate Wildlife Species 4-2
4.3 The Exposure Dose 4-4
4.4 Derivation of Toxicity Reference Values (TRVs) 4-12
4.5 Calculation of Wildlife Eco-SSLs 4-19

5.0 ECO-SSL DOCUMENTS 5-1

6.0 REFERENCES 6-1

LIST OF FIGURES

	Title	Page
Figure 1.1	Eight Step Process Recommended in Ecological Risk Assessment Guidance for Superfund (ERAGS)	1-2
Figure 1.2	Eco-SSL Contaminants	1-4
Figure 1.3	Comparison of Eco-SSL Derivation Procedures for Wildlife and Plant and Soil Invertebrates	1-9
Figure 3.1	The Four-Step Process for Deriving Eco-SSLs for Plants and Soil Invertebrates	3-1
Figure 3.2	Literature Exclusion Criteria	3-2
Figure 3.3	Eleven Study Acceptance Criteria	3-3
Figure 4.1	The Wildlife Risk Model for Eco-SSLs (Equation 4-1)	4-2
Figure 4.2	Summary of Method Used for Estimation of Contaminant Concentrations in Biota Types (B_i)	4-7
Figure 4.3	Comparison of Soil-to-Foilage and Soil-to-Seed Bioaccumulation for Cadmium, Copper, Lead and Zinc	4-8
Figure 4.4	Comparison of Mean Concentrations in Multiple Species near a Smelter	4-9
Figure 4.5	Steps of the Wildlife TRV Derivation Process	4-12
Figure 4.6	Ten Attributes Scored as Part of the Wildlife Toxicological Data Evaluation	4-12
Figure 4.7	Example of a Toxicological Plot for the TRV Derivation Process (Cobalt)	4-16
Figure 4.8	Procedure for Deriving the Wildlife Toxicity Reference Value (TRV)	4-17
Figure 4.9	Example of Wildlife TRV Derivation (Cobalt)	4-18

LIST OF TABLES

	Title	Page
Table 1.1	Comparison of Eco-SSL Derivation Procedures	1-10
Table 2.1	General Contaminant Classification	2-3
Table 2.2	Log K_{ow} Values for Organic Contaminants	2-5
Table 2.3	Mean Reported Soil Metal Background Concentrations (ppm dry weight) by State	2-9
Table 2.4a	Qualitative Bioavailability of Metal Cations in Natural Soils to Plants	2-10
Table 2.4b	Qualitative Bioavailability of Metal Cations in Natural Soils to Soil Invertebrates	2-10
Table 2.5	Qualitative Bioavailability of Non-Ionizing Organic Contaminants in Natural Soils	2-11
Table 2.6	Qualitative Bioavailability of Metal Anions in Natural Soils	2-11
Table 3.1	Ecologically Relevant Endpoints (EREs) for Soil Invertebrate Eco-SSLs	3-4
Table 3.2	Ecologically Relevant Endpoints (EREs) for Plant Eco-SSLs	3-5
Table 3.3	Summary of Nine Study Evaluation Criteria for Plant and Soil Invertebrate Eco-SSLs	3-7
Table 3.4	Standard Methods Appropriate for use in Generating Data for the Derivation of Plant or Soil Invertebrate Eco-SSLs	3-9
Table 4.1	Parameterization of the Eco-SSL Wildlife Exposure Model	4-5
Table 4.2	Cases where the Median of the BAF Distribution for Metals is Greater or Less than One	4-10
Table 4.3	Summary of Estimated Wet and Dry Weight Food Ingestion Rates for Surrogate Wildlife Species	4-11
Table 4.4	Example of Extracted and Scored Toxicity Data for Wildlife TRV (Cobalt)	4-14
Table 4.5	Summary of Conservatism Associated with the Wildlife Eco-SSL Risk Model Parameters.	4-22

LIST OF ATTACHMENTS

Attachment 1-1	Review of Existing Soil Screening Guidelines
Attachment 1-2	Discussion Concerning Soil Microbial Processes
Attachment 1-3	Review of Dermal and Inhalation Exposure Pathway for Wildlife
Attachment 1-4	Review of Background Concentrations for Metals
Attachment 3-1	Eco-SSL Standard Operating Procedure #1: Plant and Soil Invertebrate Literature Search and Acquisition
Attachment 3-2	Eco-SSL Standard Operating Procedure #2: Plant and Soil Invertebrate Literature Evaluation and Data Extraction, Eco-SSL Derivation, Quality Assurance Review, and Technical Write-up
Attachment 4-1	Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs
Attachment 4-2	Eco-SSL Standard Operating Procedure # 3: Wildlife TRV: Literature Search and Retrieval
Attachment 4-3	Eco-SSL Standard Operating Procedure # 4: Wildlife TRV Literature Review, Data Extraction and Coding
Attachment 4-4	Eco-SSL Standard Operating Procedure # 5: Wildlife TRV Data Evaluation
Attachment 4-5	Eco-SSL Standard Operating Procedure #6: Wildlife TRV Derivation

Due to the length of many of these Attachments, they are only available on the EPA Superfund web site at www.epa.gov/superfund/programs/risk/tooleco.htm

LIST OF ACRONYMS AND ABBREVIATIONS

AEC	Anion exchange capacity
ASTM	American Society of Testing and Materials
AUF	Area use factor
AF_{ij}	Absorbed fraction of contaminant (j) from biota type (i)
AF_{sj}	Absorbed fraction of contaminant (j) from soil (s)
B_i	Contaminant concentration in biota type (i)
$B0_{ij}$	Intercept from log-linear bioaccumulation model for contaminant (j) for biota type (i)
$B1_{ij}$	Slope from log-linear bioaccumulation model for contaminant (j) for biota type (i)
BAF	Bioaccumulation factor
BEH	Behavior
BIO	Biochemical
BTAG	Biological Technical Assistance Group
BW	Body weight
C_{soil}	Concentration of contaminant in soil
CCME	Canadian Council of Ministers of the Environment
CEC	Cation exchange capacity
CI	Confidence interval
COC	Contaminant of concern
COPC	Contaminant of potential concern
DDT	1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane
DQO	Data quality objective
dw	Dry weight
EC_{xx}	Effect concentration for the xx% of the test population
Eco-SSL	Ecological soil screening level
EPA	U.S. Environmental Protection Agency
ERA	Ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERE	Ecologically relevant endpoint
f_{oc}	fraction organic carbon content
FBRC	Federal Biology Research Cooperative
FIR	Food ingestion rate
g	Grams
GRO	Growth
HQ	Hazard quotient
HQ_j	Hazard quotient for contaminant (j)
HSDB	Hazardous Substance Data Bank
ISO	International Standards Organization
kg	Kilogram
K_{oc}	Organic carbon-normalized partition coefficient
K_{ow}	Octanol water partition coefficient
LC_{50}	Concentration lethal to 50 percent of test population
LOAEC	Lowest-observed adverse effect concentration
LOAEL	Lowest-observed adverse effect level

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

MATC	Maximum acceptable toxicant concentration
mg	Milligram
mmol	Millimole
MOR	Mortality
MPA	Maximum permissible addition
MPC	Maximum permissible concentration
NC	Negligible concentration
NOAEL	No-observed adverse effect level
NOAEC	No-observed adverse effect concentration
NOC	Non ionic organic compounds
OC	Organic carbon
OECD	Organization for Economic Cooperation and Development
OM	Organic matter
ORNL	Oak Ridge National Laboratory
OSRTI	Office of Superfund Remediation and Technology Innovation
P_i	Proportion of biota type (i) in diet
P_s	Soil ingestion as proportion of diet
pKa	Acid dissociation constant
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCP	Pentachlorophenol
PHY	Physiology
PTH	Pathology
QA	Quality assurance
QSAR	Quantitative Structure Activity Relationship
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
REP	Reproduction
RIVM	Dutch National Institute of Public Health and the Environment
ROD	Record of decision
SAB	Science Advisory Board
SMDP	Scientific Management Decision Point
$Soil_j$	the Eco-SSL for contaminant j for wildlife
SOP	Standard operating procedure
SQG	Soil quality guideline
T_{ij}	Soil-to-biota bioaccumulation factor for contaminant (j) for biota type (i)
T_{ver}	diet-to-biota BAF
TNT	Trinitrotoluene
TRV	Toxicity reference value
TRV_j	Toxicity reference value for contaminant (j)
UCL	Upper confidence limit
U.S.	United States
µm	micrometer

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

VOC	Volatile organic compound
ww	Wet weight

This Page Intentionally Left Blank

1.0 INTRODUCTION

This guidance describes the process used to derive a set of risk-based ecological soil screening levels (Eco-SSLs) for many of the soil contaminants that are frequently of ecological concern for plants and animals at hazardous waste sites and further provides guidance on using Eco-SSLs. The specific Eco-SSL values and the data upon which they were derived are described in separate contaminant specific Eco-SSL documents. The Eco-SSL derivation process represents the group effort of a multi-stakeholder workgroup consisting of federal, state, consulting, industry, and academic participants led by the U.S. Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI). The workgroup developed the following mission statement at the initiation of the Eco-SSL project:

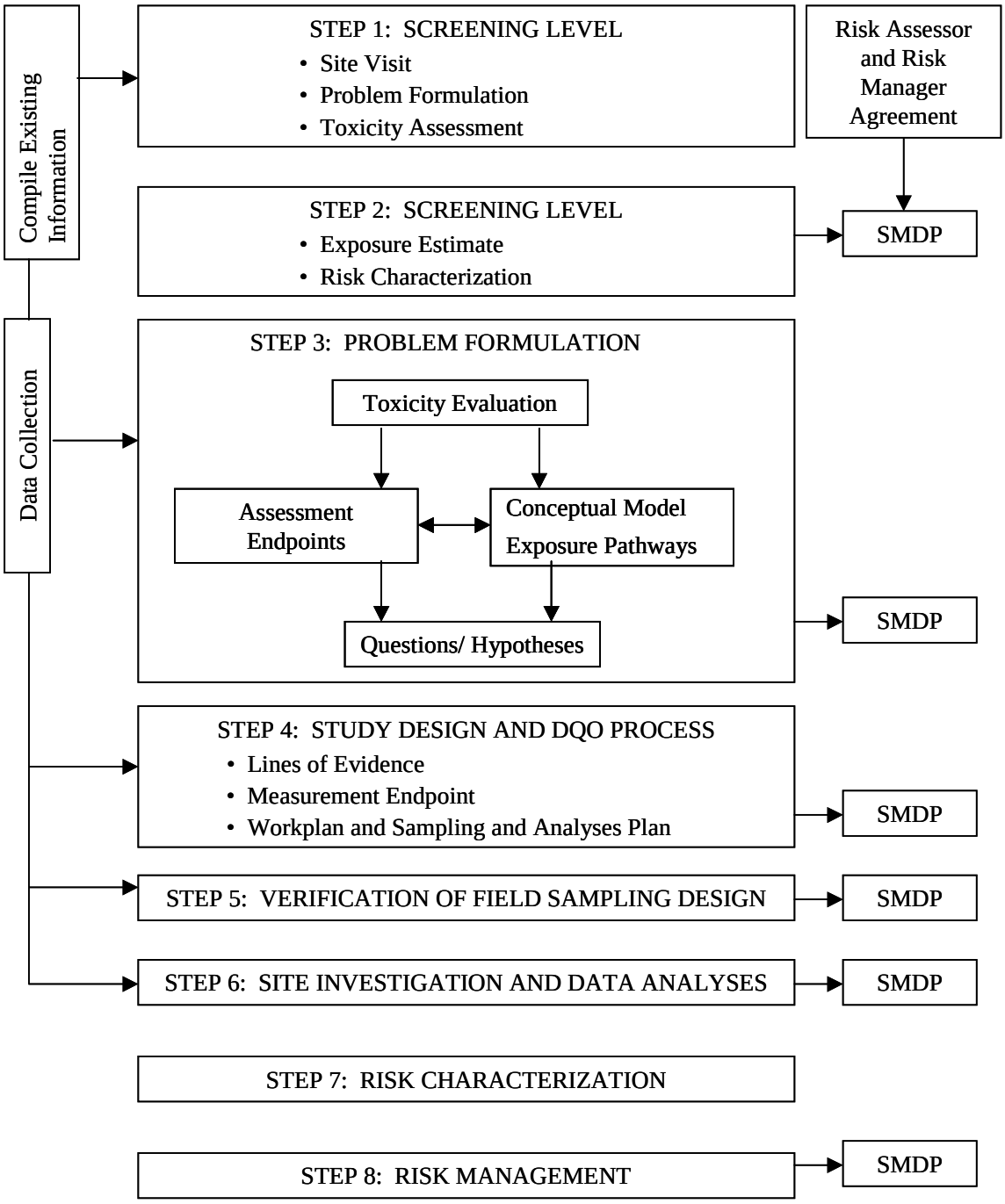
> *Develop a set of generic, scientifically sound, ecologically based, soil screening levels that are protective of the terrestrial environment for up to 24 contaminants of concern; and methodologies and models that use site-specific exposure data to modify these screening levels. The screening levels and methodologies should be sufficiently specific and transparent to allow for consistent implementation by EPA and other Federal Agencies, States, and private parties at all Superfund sites.*

The Eco-SSLs are screening values that can be used routinely to identify those contaminants of potential concern (COPCs) in soils requiring further evaluation in a baseline ecological risk assessment (ERA). Although these screening levels were developed specifically to be used during Step 2 of the Superfund ecological risk assessment process, EPA envisions that any federal, state, or private environment assessment or cleanup program could use these values to screen soil contaminants and sites in order to determine if additional ecological site study was warranted. **The Eco-SSLs were not designed to be used as cleanup levels and EPA emphasizes that it would be inappropriate to adopt or modify these Eco-SSLs as cleanup standards.**

This document provides guidance and is designed to communicate national policy on identifying contaminants in soil that may present an unacceptable ecological risk to terrestrial receptors. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances of the site. EPA and state personnel may use and accept other technically sound approaches, either on their own initiative, or at the suggestion of potentially responsible parties, or other interested parties. Therefore, interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this document to a particular situation. EPA welcomes public comments on this guidance at any time and may consider such comments in future revisions of this guidance.

What are Eco-SSLs?

Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals.



SMDP = Sample Management Decision Point

DQO = Data Quality Objective

Figure 1.1 Eight Step Process Recommended in Ecological Risk Assessment Guidance for Superfund (ERAGs) (U.S. EPA, 1997)

Protection of Rare, Endangered and Threatened Species

Eco-SSLs should be protective of rare, endangered, and threatened species. However, the final decision should be made on a site-specific basis in consultation with the United States Fish and Wildlife Service and other natural resource trustees.

As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Eco-SSLs for wildlife are derived to be protective of the representative of the conservative end of the distribution in order to make estimates for local populations. The Eco-SSLs are conservative and are intended to be applied at the screening stage of the assessment. These screening levels should be used in the ERA process to identify the COPCs that require further evaluation in the site-specific baseline risk assessment. This Eco-SSL guidance was written with the assumption that the reader is familiar with Superfund's guidance on performing ERAs (Ecological Risk Assessment Guidance for Superfund (ERAGS)), U.S. EPA, 1997, Figure 1.1), with Superfund's ecological risk assessment and risk management principles (U.S. EPA, 1999) and with EPA's risk assessment guidelines (U.S. EPA, 1998).

The Eco-SSLs should be used during Step 2 of the Superfund ERA process, the screening-level risk calculation. This step normally is completed at a time when limited soil concentration data are available, and other site-specific data (e.g., contaminant bioavailability information, area use factors) are not available. It is expected that the Eco-SSLs will be used to screen the site soil data to identify those contaminants that are not of potential ecological concern and do not need to be considered in the subsequent baseline ERA. The Eco-SSLs are intentionally conservative in order to provide confidence that contaminants which could present an unacceptable risk are not screened out early in the ERA process. EPA believes that the Eco-SSLs generally provide an appropriate balance of protectiveness and reasonableness.

Why are Eco-SSLs Needed?

EPA derived the Eco-SSLs with the intent to conserve resources by limiting the need for EPA, state, contractor, and other federal risk assessors to perform repetitious toxicity data literature searches and toxicity data evaluations for the same contaminants at every site. These Eco-SSLs are also intended to increase consistency among screening risk analyses, decrease the possibility that potential risks from soil contamination to ecological receptors will be overlooked, and allow risk assessors to focus their resources on identifying key site studies needed for critical decision-making.

In the process of deriving the Eco-SSLs, the workgroup examined currently available soil screening guidelines (see text box) for their potential use within the Superfund process.

Some Other Available Soil Screening Guidelines

Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (SQGs). The CCME guidelines are numerical limits for contaminants intended to maintain, improve, or protect environmental quality and human health. They are intended for use in the assessment and remediation of contaminants at sites in Canada (CCME, 1997).

The Dutch National Institute of Public Health and the Environment (RIVM). Maximum permissible concentrations (MPCs), maximum permissible additions (MPAs), and negligible concentrations (NCs) were developed in a series of reports for soils, sediments, and water for metals and pesticides (RIVM, 1997a and 1997b).

Oak Ridge National Laboratory (ORNL). A series of reports have been issued from ORNL that provide screening levels for plants (Efroymson et al., 1997a), soil invertebrates and microbial processes (Efroymson et al., 1997b), wildlife (Sample et al., 1996), and sediments (Jones et al., 1997).

Because these existing guidelines were developed in response to country-specific legislation and/or included policies not totally consistent with current EPA policies, EPA believes use of these guidelines may not be appropriate. A summary and evaluation of the available guidelines was completed and provided as Attachment 1-1.

How Are the Eco-SSLs Derived?

Eco-SSLs were derived using standardized procedures for literature review, toxicity data selection, and data evaluation. Where acceptable data were judged to be adequate, four Eco-SSLs were derived for each contaminant: one each for plants, soil invertebrates, birds, and mammals.

Plant and soil invertebrate Eco-SSL values were derived directly from an evaluation of available plant and soil invertebrate toxicity test data (measured toxicity related to soil contaminant concentrations), as described in Chapter 3. The process for deriving mammalian and avian Eco-SSLs is described in Chapter 4. The wildlife Eco-SSLs were the result of back-calculations from a Hazard Quotient (HQ) of 1.0. The HQ is equal to the estimated exposure dose divided by a toxicity reference value (TRV). An HQ of 1.0 is the condition where the exposure and the dose associated with no adverse effects are equal, indicating adverse effects at or below this soil concentration are unlikely. A generic food-chain model was used to estimate the relationship between the concentration of the contaminant in soil and the dose for the receptor (milligrams per kilogram body weight per day (mg/kg bw/d)). The TRV represents a receptor-class specific estimate of a no-observed adverse effect level (NOAEL) (dose) for the respective contaminant.

1.1 Scope of the Eco-SSLs

Contaminants Considered

EPA prepared a list of twenty-four (24) contaminants to be addressed initially by the Eco-SSL guidance. This list was based on a review of the contaminants of concern reported to be the subject of soil remediation in recent Record of Decisions (ROD) at Superfund National Priority List sites. The Eco-SSL contaminant list also included contaminants nominated by the EPA regional Biological Technical Assistance Group (BTAG) Coordinators. The list of 24 Eco-SSL contaminants contained seven organics and17 metals (see Figure 1.2).

Figure 1.2 Eco-SSL Contaminants

Organics

- Dieldrin
- Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
- Trinitrotoluene (TNT)
- 1,1,1-Trichloro-2,2-bis (p-chlorophenyl)ethane (DDT) and metabolites DDE and DDD.
- Pentachlorophenol (PCP)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Polychlorinated biphenyls (PCBs)

Metals

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Nickel
- Selenium
- Silver
- Vanadium
- Zinc

The omission of other contaminants, such as phthalates, cyanides, dioxin, and mercury, does not imply that these contaminants can be excluded from the ERA screening process for soil contamination, only that these 24 contaminants have historically been of greatest ecological concern in soil. The process and procedures

established here for developing the Eco-SSLs are intended to be sufficiently transparent to allow others to derive values for additional contaminants, as needed. Polychlorinated biphenyls (PCBs) were included by the workgroup in the original 24 identified Eco-SSL contaminants. However, it became apparent early in the process that development of a screening value would not be appropriate. Because of the known persistence and toxicity of PCBs, and the conservative nature of the Eco-SSLs, any soil screening level derived for PCBs would often be lower than the detection limits used in a screen. EPA recommends that if PCBs are detected in soil above background levels, then they should be considered site-related and therefore should be included as a COPC in a baseline ERA.

Ecological Receptors of Concern

The Eco-SSLs generally apply to sites where terrestrial receptors may be exposed directly or indirectly to contaminated soil. Seven groups of ecological receptors were initially considered in the development of the Eco-SSLs. These initial groups included mammals, birds, reptiles, amphibians, soil invertebrates, plants, and soil microbes and their processes. After further investigation, the toxicity data for amphibians and reptiles were deemed insufficient to derive Eco-SSLs. EPA recognizes that the Eco-SSL values do not address possible risks for reptiles and amphibians and may not be protective of these receptor groups. The user should consider including these receptors in the site-conceptual model for the site-specific risk assessment.

Eco-SSLs protective of microbes and soil microbial processes were also not derived. Like amphibians and reptiles, EPA recognized their importance within terrestrial systems, but believes that data are insufficient and the interpretation of test results too uncertain for establishing risk-based thresholds for risk screening purposes. While Eco-SSLs for microbes and soil microbial processes were not established at this time, they may be considered in the future as the science develops and appropriate studies are completed. A summary of the task group discussion concerning establishing Eco-SSLs for soil microbes and their processes was documented as Attachment 1-2.

Eco-SSLs were derived for four general groups of ecological receptors: mammals, birds, plants, and soil invertebrates. By deriving conservative soil screening values considered protective of these groups, it is assumed that these receptor groups are protected from possible adverse effects associated with soil contamination. This assumption is consistent with the use of "generic assessment endpoints" as discussed in Section 1.2.5 of ERAGS.

Exposure Pathways for Ecological Receptors

A complete exposure pathway is defined in ERAGS as "one in which the contaminant can be traced or expected to travel from the source to a receptor that can be affected by the contaminant." Exposure pathways can be classified as incomplete, complete, or potentially complete. An exposure pathway is not considered complete if natural habitat for ecological receptors is not present and is not expected to be present in the future.

The Eco-SSLs for plants considered direct contact of contaminants in soils. The Eco-SSLs for soil invertebrates considered ingestion of soil and direct contact exposures with a preference for conditions of high bioavailability (refer to Chapters 2 and 3).

The Eco-SSLs for birds and mammals considered two potentially complete exposure pathways: 1) incidental ingestion of soils during feeding, grooming and preening; and 2) ingestion of food contaminated as a result of the uptake of soil contaminants. Two potentially complete exposure pathways (dermal contact and inhalation) were not considered in the derivation of wildlife Eco-SSLs. The rationale for this decision included the following:

What is a Complete Ecological Exposure Pathway for Contaminants in Soil?

For an exposure pathway to be complete, a contaminant must be able to travel from the source to ecological receptors and be taken up by the receptors via one or more exposure routes (U.S. EPA, 1997).

Exposure pathways may not be complete for ecological receptors if:

✓ Soil contamination exists only below the root zone, and deep burrowing mammalian species are not identified as potential receptors in the site conceptual model.

✓ The site is within urban and/or industrialized areas where natural habitat and receptors are absent.*

*Urban settings may in some cases be used by protected species. The appropriate trustees should be consulted.

- Burrowing animals could be exposed to relatively high concentrations of volatile organic compounds (VOCs) in their burrows via inhalation. However, with the exception of some of the polynuclear aromatic hydrocarbons (PAHs), none of the Eco-SSL contaminants were VOCs. At sites with high VOC and/or certain PAH concentrations in soils with burrowing mammals present, the inhalation exposure pathway should be considered in the baseline ERA. In this case, the contaminants would not be excluded in the screening step.

Exposure Pathways Considered in Eco-SSLs

Birds and Mammals

- Ingestion of soils during grooming, feeding, and preening
- Ingestion of food contaminated as a result of uptake of soil contaminant

Plants

- Direct contact

Soil Invertebrates

- Direct contact
- Soil ingestion

- Soil particles containing non-VOC contaminants (by either adsorption or absorption) could also be inhaled by wildlife. Respirable particles (greater than five µm) are, however, most likely ingested as a result of mucocilliary clearance rather than being inhaled (Witschi and Last, 1996). At equal exposure concentrations, inhalation of contaminants associated with dust particles is expected to contribute less than 0.1 % of total risk compared to oral exposures (Attachment 1-3).

- Birds and mammals may also be exposed to contaminants in soils via dermal contact. Studies investigating dermal exposures to birds from the application of pesticides by spray to tree branches have shown this exposure route to be significant relative to oral exposures for some substances; e.g. organophosphate pesticides, (Abou-Donia and Graham 1978, Driver et al. 1991, and Henderson et al. 1994). However, current information is

insufficient to evaluate dermal exposure for the 24 selected Eco-SSL contaminants in various soil matrices, or to predict possible rates of absorption for many species. For most contaminants, the dermal exposure is expected to contribute less than one percent to 11 % of the total risk (Attachment 1-3) compared to oral exposures.

This approach is consistent with Section 9.2.4 of ERAGS (U.S. EPA, 1997), which states that the ingestion route is most important for terrestrial animals and that "although other exposure routes can be important, more assumptions are needed to estimate exposure levels for these routes, and the results are less certain". Exclusion of dermal and inhalation exposure routes for the Eco-SSLs does not preclude their inclusion in the site-specific baseline ERA. If it is expected that receptors may be more exposed to contaminant(s) via dermal and/or inhalation exposures relative to oral exposures due to site-specific conditions, these exposure routes should be evaluated as part of the baseline ERA.

Soils for Which Eco-SSLs are Applicable

It is recommended that Eco-SSLs be considered at sites where key soil parameters fall within a certain range of chemical and physical parameters. The Eco-SSLs for plants and soil invertebrates are usually appropriate for application to soils where: the pH is greater than or equal to 4.0 and less than or equal to 8.5 and the organic matter content is less than or equal to 10 %.

The Eco-SSLs are intended for use in upland soils. However, they may also be useful for screening wetland soils. The wildlife Eco-SSLs are derived for several general receptor groups that are likely to be representative of wildlife found in wetlands. A major caveat, however, is the omission of the amphibians and reptiles from derivation of the wildlife Eco-SSLs. These groups could be especially important in wetlands. The Eco-SSLs for plants and soil invertebrates are expected to be broadly applicable (i.e., conservative enough for most soils) as preference was given to studies with high bioavailability of the contaminants in soils. For this reason, the Eco-SSLs for plants and soil invertebrates may be useful for screening for contaminants in wetland soils. In general, wetland soils are expected to exhibit a lower bioavailability (compared to those used to derive Eco-SSLs) as a result of the high organic content.

Based on these stated parameters, it is expected that there are certain soils and situations to which Eco-SSLs may not be appropriate. These situations include (but may not be limited to):

- Wetland soils that are regularly flooded (i.e., sediments).
- Sewage sludge amended soils where the organic matter (OM) content is > 10 %.
- Waste types where the pH is < 4.0.

1.2 The General Process for Establishing Eco-SSLs

Four separate task groups were formed to develop the procedures for establishing Eco-SSLs and to accomplish the work necessary to derive the Eco-SSL values for the 24 listed contaminants. The task groups were composed of a cross-section of the stakeholders represented in the larger work

Eco-SSL Task Groups

Soil Chemistry. This task group provided information on the factors that influence bioavailability of contaminants from soils. The task group developed the soils matrix used to select studies for establishing plant and soil invertebrate Eco-SSLs, the background soils database, and Chapter 2 of this guidance document.

Plant and Soil Invertebrate Eco-SSLs. This task group developed the procedures for establishing plant and soil invertebrate Eco-SSLs (Chapter 3). The task group derived the plant and soil invertebrate Eco-SSL values according to these procedures.

Wildlife Eco-SSLs. The wildlife Eco-SSLs were developed by the combined efforts of two separate task groups:

Wildlife Toxicity Reference Values (TRVs). This task group developed the procedures for establishing the wildlife toxicity reference values as presented in Chapter 4.

Wildlife Exposure Model. This task group developed the equations, assumptions, and factors for establishing the exposure model for wildlife. The model is presented in Chapter 4. The model estimates the soil contaminant concentration associated with no adverse effects to representative wildlife species.

group with efforts directed by a steering committee. One task group focused on information related to the factors that influence the bioavailiblity of contaminants from soils. A second task group focused on deriving the Eco-SSLs protective of plants and soil invertebrates. The third and fourth task groups focused on deriving Eco-SSLs protective of wildlife. One group developed the procedures for deriving wildlife TRVs (mammalian and avian receptors) while the other group developed the models necessary for estimating contaminant transfer from soils to the terrestrial food chain and for deriving exposures for wildlife.

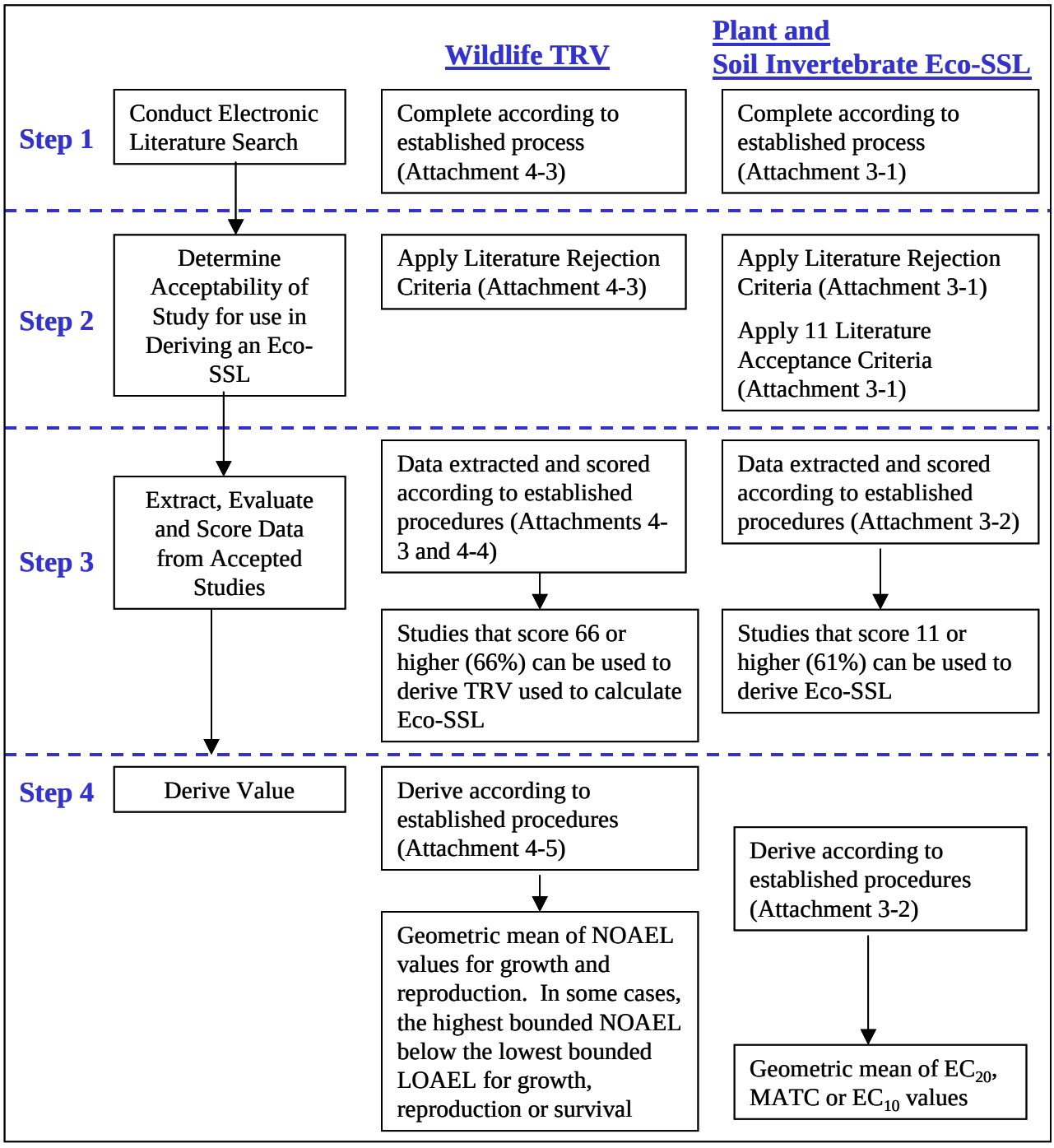
Although the task groups worked independently, the approach taken for deriving the Eco-SSLs for plants and soil invertebrates was similar (see Figure 1.3) to the approach taken for deriving the wildlife Eco-SSLs (specifically the TRVs). The general approach included four steps (1) conduct literature searches, (2) screen identified literature with exclusion and acceptability criteria, (3) extract, evaluate, and score test results for applicability in deriving an Eco-SSL, and (4) derive the value.

Step 1: Literature Search

For all receptors, potentially relevant publications were identified through literature searches of computerized abstracting databases combined with the examination of citations associated with published literature review articles. The literature searches for avian and mammalian species included all publication years, while those for plants and soil invertebrates included only publications after 1987 (Table 1.1). The task group theorized that most of the pre-1988 publications would be identified through the review bibliographies, and this was confirmed in subsequent analysis of the literature search results with approximately 40 % of potentially applicable papers identified through non-computerized search techniques. In cases where contaminant/receptor pairings had less than 20 potentially applicable articles, searches were completed for all publication years.

Step 2: Determine Acceptability of Study for Use in Deriving Eco-SSL

Both task groups used similar exclusion criteria to assess the potential applicability of publications identified through the literature searches. Publications were excluded for similar reasons as



NOAEL = No-Observed Adverse Effect Level
LOAEL = Lowest-Observed Adverse Effect Level
EC_{20} = Effect Concentration 20%
EC_{10} = Effect Concentration 10%
MATC = Maximum Acceptable Toxicant Concentration

Figure 1.3 Comparison of Eco-SSL Derivation Procedures for Wildlife and Plant and Soil Invertebrates

Table 1.1. Comparison of Eco-SSL Derivation Procedures			
Step in Eco-SSL Process	**Common to Both Approaches**	**Unique to Wildlife Approach**	**Unique to Plant and Soil Invertebrate Approach**
Step 1: Conduct electronic literature search	Searches were conducted with appropriate abstracting databases finding the intersection of contaminant, species and toxicological terms. The final electronic search result was reviewed to determine potentially applicable studies. Bibliographies of review articles were skimmed to identify additional publications.	All publication years were searched.	Searches were limited to 1988 to present. For limited data sets, searches included literature published prior to 1988. Holdings of U. S. EPA MED-Duluth library were searched.
Step 2: Determine acceptability of study for use in deriving an Eco-SSL	• Must be the primary source of the data • Exposure to single contaminant • Control must be included • Duration of exposure must be reported • Effects must be reported for relevant endpoints • Dose or concentration must be reported • Laboratory or field studies accepted • Beneficial effects not considered • Species must be reported • Percent metal or purity used to calculate nominal concentrations	• Oral route of exposure • At least two exposures: 1 control and 1 contaminant • Endpoints are behavioral, biochemical, growth, mortality, pathology, population, physiology, and reproduction • Chronic studies only (> 3 days exposure duration)	• Application rates not used • Natural or artificial soils • At least three exposures: 1 control and 2 contaminant • Test media must have: % organic matter (OM) content ≤ 10 %; pH ≥ 4 and ≤ 8.5 • Endpoints are growth , physiology (plants only), population, and reproduction • Priority given to chronic studies, but acute studies with sublethal effects or plant emergence as an endpoint were used
Step 3: Extract, evaluate and score data from accepted studies	Papers were reviewed and the results were extracted according to established guidelines.	Separate results were used if any of the following varied: test organism (species or strains), contaminant form, test location, control type, doses, application frequency, or route of exposure.	Separate results were used if any of the following parameters varied: test species (not strain), contaminant (not form), soil (natural vs. artificial), pH, or % OM content.
	Each result was scored according to established guidelines.	All endpoints were scored in order of preference based on: source of data; chemical form, measurement or no measurement in substrate; ability to calculate a dose; bounded vs unbounded NOAEL/LOAEL, route of exposure, endpoint type, duration of exposure, statistical power, and adherence to test guidelines. Studies that scoreed > 65 % were used to derive a TRV.	Within a study with multiple endpoints only one was used in the following order of preference: reproduction > population > growth > physiology. Score was based on soil bioavailability score; experimental design (i.e.,adherence to ideal test guidelines); reporting of chemical concentration; use of appropriate controls; duration of exposure; NOAEC and LOAEC or EC_{10},EC_{20} reported (or can be estimated); statistical analysis; and origin of test organism. Studies that scored ≥ 11 out of 18 (≥ 61 %) were used to derive an Eco-SSL.
Step 4: Calculation of value	Results that scored above a cutoff were used in and established approach to determine value.	The TRV was equal to the geometric mean of NOAEL values for growth and reproduction or the highest bounded NOAEL below the lowest bounded LOAEL for growth, reproduction or survival. The process considered NOAEL and LOAEL endpoints and included unbounded NOAEL values, but not unbounded LOAEL values.	The Eco-SSL was equal to geometric mean of EC_{20}, MATC or EC_{10} values. Only EC_{20}, MATC and EC_{10} values were considered. NOAEC and LOAEC values were used to calculate the MATC. Unbounded NOAECs and LOAECs were not used. When a study reported multiple endpoints, the selection followed the following order of preference: EC_{20} > MATC > EC_{10}

specified later in Chapters 3 and 4 and summarized in Table 1.1. Acceptable plant and soil invertebrate studies were further restricted to those that followed state-of-the-art soil testing requirements (e.g., $4.0 \leq pH \leq 8.5$, organic matter content ≤ 10 %, use of natural or artificial soil). Both task groups agreed that three or more treatment levels (including the control) were preferred, but a substantial portion of the avian and mammalian studies would have been excluded if this requirement was applied. Therefore only two treatment levels were required for mammalian and avian receptors and five were required for plants and soil invertebrates. Only chronic toxicity studies (greater than a three-day exposure) were accepted for mammalian and avian studies. Although acute studies were not excluded for plants and soil invertebrates, the exposure duration was considered later in the process for selecting the most appropriate test results for deriving the Eco-SSL.

Step 3: Extract, Evaluate and Score Data

The extraction of toxicity data from the acceptable literature, evaluation of test methods and results, and scoring of each test result also followed similar processes. When the methods diverged, it was due mainly to inherent differences in study designs (e.g., direct exposures to soils versus exposures in the diet or drinking water). Both task groups determined a cutoff for acceptable results for use in deriving the wildlife TRV or plant or soil invertebrate Eco-SSL by plotting data for various data sets and identifying logical breaks. For mammalian and avian species this break occurred at an evaluation score of 66 out of a possible 100 (i.e., studies with a score greater than or equal to 66 % were used to derive the TRV), while the break for plants and soil invertebrates occurred with a score of 11 out of 18.

Step 4: Select Value

For both task groups, only the results from studies scoring above the respective cutoffs were used to determine the value. For mammals and birds the TRV was equal to the geometric mean of NOAEL values for growth and reproduction, or the highest bounded NOAEL (NOAEL with paired LOAEL) below the lowest bounded lowest-observed adverse effect level (LOAEL) for growth, reproduction or survival (whichever was lower). For contaminants with no growth, reproduction, or survival data, the TRV was derived from biochemical, behavioral, pathology and physiology results. The methodology considered both NOAEL and LOAEL endpoints including unbounded NOAEL values but not unbounded LOAEL values.

For plants and soil invertebrates, the Eco-SSL was equal to the geometric mean of values for the maximum acceptable toxicant concentration (MATC), the effective concentration that affects 20 % of the test population (EC_{20}), or the effective concentration that affects 10 % of the test population (EC_{10}). When a study reported multiple endpoints, the selection of endpoints for use in deriving the Eco-SSL followed an order of preference of the EC_{20}, then the MATC, then the EC_{10}. The MATC was either reported in the study or was calculated from the geometric mean of the no-observed adverse effect concentration (NOAEC) and the lowest-observed adverse effect concentration (LOAEC).

1.3 Peer Review Process

The Eco-SSL procedures received both internal and external peer review. Because of the diversity of the workgroup scientists, the process developed to derive the Eco-SSLs underwent constant peer review. There were also two external peer reviews performed during the development of the Eco-SSLs. The first was a consultation requested by EPA's Office of Solid Waste and Emergency Response of EPA's Science Advisory Board (SAB). This consultation was held April 6, 1999. At this meeting the SAB provided verbal comments to presenters at the SAB review, which were passed on to the workgroup and incorporated into the guidance as appropriate. A formal external peer review of the draft guidance document was also performed. The peer review workshop was held on July 26 and 27, 2000 and was open to the public. The results of this peer review are provided in separate documentation on the Eco-SSL website. Each of the comments received was carefully considered by the Steering Committee and the individual work groups and appropriate changes were made to both the procedures for establishing Eco-SSLs and the associated guidance document.

1.4 Quality, Objectivity, Utility, and Integrity of Information

The EPA is committed to a policy of ensuring that the information it provides to the public, and uses to make its decisions, maintain a basic standard of quality, which includes objectivity, utility, and integrity. The Eco-SSLs are primarily derived from information the EPA obtained from external sources that may not have used the same standards, guidelines, and controls that EPA imposes on itself, and those who gather data on behalf of the agency. The agency has recently proposed five assessment factors for evaluating the quality of information it obtains from external sources (67 FR 57225, September 9, 2002):

- Soundness The extent to which the procedures, measures, methods, or models employed to generate the information are reasonable for, and consistent with, the intended application and are scientifically/technically appropriate.

- Applicability and Utility The extent to which the information is applicable and appropriate for the Agency's intended use.

- Clarity and Completeness The degree of clarity and completeness with which the data, assumptions, methods, quality controls, and analyses employed to generate the information are documented.

- Uncertainty and Variability The extent to which the variability and uncertainty in the information or in the procedures, measures, methods, or models are evaluated or characterized.

- Evaluation and Review The extent of independent application, replication, evaluation, validation, and peer review of the information or of the procedures, measures, methods, or models.

Because these five assessment factors were developed after this guidance document was prepared, they are not addressed by name. However, all five of these principles were embedded in the standardized procedures for literature review, toxicity data selection, and data evaluation that were used to derive the Eco-SSLs.

1.5 Using Eco-SSLs to Screen Contaminated Soils

The Eco-SSLs are intended for use in identifying soil contaminants (i.e., COPCs) and/or areas of soil contamination that warrant further consideration in a baseline ERA. Screening is typically completed during Step 2 of the 8-step Superfund ERA process, as depicted in Figure 1.1. Prior to using the Eco-SSLs, it is assumed that the risk assessor has completed Step 1, including the site visit and initial problem formulation. With the information gathered in Step 1, it is recommended that the risk assessor completes a screening of soils data using the Eco-SSLs in the risk calculation performed during Step 2.

Comparing the Site Conceptual Model to the General Eco-SSL Model

The user should compare the preliminary site conceptual model developed for their site during Step 1, with the assumptions and limitations inherent in the Eco-SSLs to determine if additional or more detailed assessments are needed for any exposure pathways or contaminants. Early identification of areas, conditions, or receptors where Eco-SSLs are not appropriate is important for adequate planning and sampling strategies for the ERA.

Are There Soil Exposure Pathways for Ecological Receptors?

The Eco-SSLs are designed for use at sites where terrestrial receptors may be exposed directly or indirectly to contaminated soil. Therefore, generally the first step in determining whether use of the Eco-SSLs is appropriate is to identify all complete and potentially complete soil pathways present at the site. The following are the receptor group-specific pathways of exposure to soil contaminants considered in deriving the Eco-SSLs:

Mammals and Birds

- Incidental ingestion of soil
- Ingestion of food (soil invertebrates and plants)

Soil Invertebrates and Plants

- Direct contact
- Ingestion of soil (by soil invertebrates)
- Uptake (by plants)

For surface soils (i.e., those soils within the root zone at the specific site), all the above pathways were considered. Ecological risks from potential exposure to contaminated subsurface soils were generally not considered. In some site-specific cases, however, there may be risks to animals that

burrow beneath the root zone. It should also be noted that, for some plants, the root zone can extend several feet.

As part of Step 1 of the ERAGS process, the site manager and risk assessor generally need to know enough about the site to answer at least the following questions:

- What contaminants are known or suspected to exist at the site?
- What complete exposure pathways might exist at the site?
- What habitat types located on or near the site are potentially contaminated?

If it is determined that there are no complete soil exposure pathways (e.g., the current and future land-use is industrial and there are no terrestrial habitats, or the only soil contamination is well below both the root zone and the burrow zone at the site), then additional screening for soil effects on ecological receptors is generally not needed.

Are There Exposure Pathways at the Site <u>Not</u> Addressed by the Eco-SSLs?

In some cases, the site-specific conceptual model may identify complete or potentially complete ecological soil exposure pathways that are not considered in the derivation of the Eco-SSLs. In these instances, the additional pathways should be considered in a separate screening analysis or as part of the baseline ERA. Examples of such instances include:

- The contaminated soil is near a surface water body or wetland where there is potential for contamination of surface water and/or sediments by transport during rain events.

- There are other likely ecological exposure routes not considered in the derivation of the Eco-SSLs. For example, inhalation of VOCs may be of concern for burrowing animals.

- Some site conditions may be a source of contamination to groundwater. For example, contaminants from soils may leach to groundwater, which could result in exposures for ecological receptors upon discharge to surface waters.

Comparing Site Soil Concentrations to the Eco-SSLs

Comparisons of site soil concentrations to the Eco-SSLs during Step 2 of the ERAGS process may be used to answer the following questions:

- Are there any potential ecological risks associated with soil contamination, and is it necessary to proceed with a baseline ERA (Steps 3 to 8 of ERAGS)?

- Which contaminants in soil can be dropped from further consideration and which ones should be the focus of the baseline ERA?

- Which geographic areas of soil contamination may result in ecological risks?

- Which receptors/functional groups (e.g., birds or soil invertebrates) appear to be at most risk and should be the focus of the baseline ERA?

Are the Existing Site Soil Contaminant Data Adequate?

At this point of the process, the user should make a decision concerning the adequacy of the available contaminant concentration data for soils for use in completing a screening level analysis. This decision, typically made by the site manager and risk assessor, usually considers the following:

- Are all expected areas of soil contamination sampled, or are there other areas of potential exposure for ecological receptors for which soil data are not available?

- Are the parameters of the soil analyses sufficient to identify the possible contaminants deposited as part of known waste disposal processes and practices? For example, if DDT is suspected as part of the deposited waste, are soil analyses available for DDT? Or are data only available for metals?

- Are the quantification limits adequate to measure the contaminants at the Eco-SSL levels?

How do you Calculate the Concentration Term for Comparison to the Eco-SSLs?

The appropriate soil contaminant concentration for comparison to the Eco-SSL is dependent on a number of factors, including the size of the site, the nature and extent of the contamination, and the level of confidence in the site sampling data. In most cases, there are limited soil data available at Step 2 of the ERAGS process; therefore, it is recommended that the maximum soil contaminant concentrations be compared to the Eco-SSLs. However, if the data set is large, the 95 % upper confidence limit (UCL) of the arithmetic mean may be the appropriate value to use. Decisions concerning concentration terms used for comparisons should be made in consultation with the site manager, site risk assessor, and the regional BTAG (as applied in Superfund).

Which Eco-SSL Should be Used?

Assuming there is a complete exposure pathway, the lowest of the four reported Eco-SSLs should generally be used to compare to the site soil concentrations. The ERA process assumes that complete exposure pathways exist for each of the four receptor groups; i.e., every terrestrial habitat at or near a hazardous waste site is, or should be, suitable for mammals, birds, plants, and soil invertebrates.

What if Soil Contaminant Concentrations Exceed Eco-SSLs?

If the appropriate site soil contaminant concentration exceeds an Eco-SSL, then the user should retain that contaminant as a COPC for further consideration in the baseline ERA. If soil concentrations exceed some receptor-specific Eco-SSLs and not others, then it is recommended that the contaminant be retained as a COPC only for those receptor groups where Eco-SSLs are exceeded.

What if Soil Contaminant Concentrations Do Not Exceed Eco-SSLs?

Contaminants in soils with concentrations lower than Eco-SSLs can be excluded as COPCs in the subsequent ERA. However, the user should recognize that new information may become available during the baseline ERA which may show that initial assumptions are no longer valid (e.g., site contaminant levels are higher than reported earlier). In this case, contaminants may be placed back on the list of COPCs. If there are no soil contaminant concentrations that exceed the Eco-SSLs, a baseline ERA for soils is generally not needed for that site.

What if There is No Eco-SSL?

At this time, Eco-SSLs are not available for all four receptor groups and for all 24 soil contaminants. For some of the Eco-SSL contaminants, there was an insufficient number of acceptable toxicity studies to establish an Eco-SSL. For some contaminants, EPA had not completed the review of toxicity data for derivation of Eco-SSLs. The current Eco-SSLs are available on the EPA Eco-SSL website http://www.epa.gov/superfund/programs/risk/tooleco.htm. The user should consult this source for the current values.

For those contaminants with an insufficient number of acceptable toxicity studies to establish an Eco-SSL, a summary of the toxicity studies evaluated in the Eco-SSL process was made available in the contaminant specific Eco-SSL documents. The information from these studies can be used according to the process described in Section 1.3.1 of ERAGS to derive screening values. As more toxicity information becomes available, EPA may use these processes to revise existing Eco-SSLs or to develop new ones.

Can I Use Site-specific Data to Modify an Eco-SSL or Should I Proceed to a Baseline Risk Assessment?

If one or more Eco-SSL values are exceeded it is recommended that the user proceed to a baseline ERA. The Eco-SSLs are intended to be conservative values used to identify those contaminants that should be the focus of a baseline ERA and as such they should not be modified as part of the screening step. During the baseline ERA, it will be possible for the user to collect and use site-specific data as part of development of the site-specific exposure and toxicity assessments in the baseline ERA.

Consideration of Background Soil Concentrations

Due to conservative modeling assumptions (e.g., metal exists in most toxic form or highly bioavailable form, high food ingestion rate, high soil ingestion rate) which are common to screening processes, several Eco-SSLs are derived below the average background soil concentration for a particular contaminant as presented in Attachment 1-4. Since Eco-SSLs are not designed to be used as clean-up levels, EPA is not promoting clean-up to below background concentrations. It is EPA's policy to not screen against background levels. Background concentrations, the speciation of metals, and the effects of conservative modeling assumptions are generally taken into account in the initial steps of the baseline risk assessment. Specific procedures for comparing risk information to site specific background levels is addressed in the Office of Solid Waste and Emergency Response document *Role of Background in the CERCLA Cleanup Program* (OSWER 9285.6-07P) (U.S. EPA, 2002). However, if a specific exposure parameter or toxicity endpoint is found to consistently produce an Eco-SSL that is below background concentrations (taking into account natural species of metals), EPA may reevaluate specific Eco-SSL values as they are updated.

Information on background concentrations of contaminants in soils was collected and reviewed during the Eco-SSL derivation process to examine how the Eco-SSL values compare to natural soil conditions. These comparisons were used to guide the process and are presented as Attachment 1-4. The review indicated that there are regions of the country where natural background levels for some metals exceed Eco-SSLs. For these regions and for specific local areas, the acquisition of adequate data on background soil concentrations is an important step toward evaluating, on a site-specific basis, if observed concentrations are related to releases or are naturally occurring. Background concentrations are further discussed in each of the contaminant-specific Eco-SSL documents.

Definitions

Contaminants of concern (COCs) are the contaminants that, at the completion of the risk assessment, are found to pose unacceptable human or ecological risks. The COCs drive the need for a remedial action.

Contaminants of potential concern (COPCs) generally comprise the contaminants that are investigated during the baseline risk assessment that may or may not pose unacceptable risks.

Screening is a common approach used by risk assessors to refine the list of COPCs to those hazardous substances, pollutants and contaminants that may pose substantial risks to health and the environment.

Background refers to constituents or locations that are not influenced by the releases from a site, and is usually described as naturally occurring or anthropogenic (US EPA, 2002)

- **Anthropogenic** -natural and human-made substances present in the environment as a result of human activities (not specifically related to the release in question); and,
- **Naturally occurring** - substances present in the environment in forms that have not been influenced by human activity.

This Page Intentionally Left Blank

2.0 SOIL PROPERTIES

2.1 Introduction

Soil properties influence the toxicity of contaminants to invertebrates, plants, and wildlife. Therefore, they are generally important to consider in the development of Eco-SSLs and provide a basis for guiding site-specific evaluations that may follow application of Eco-SSLs. This chapter discusses the primary soil parameters that influence bioavailability of contaminants from soils. This soil property information provides the rationale for defining a set of soil parameters used in the selection of the most appropriate studies for deriving Eco-SSLs for plants and soil invertebrates and specific recommendations for screening soils for aluminum and iron.

This chapter focuses primarily on the relationship between soil chemistry factors that influence the toxicity to and accumulation of contaminants in soils to plants and soil invertebrates. The absorption of contaminants bound to incidentally ingested soil particles in the animal gut is influenced by other parameters including gut residence time as well as toxicokinetic and physiological factors that may affect the uptake of contaminants in wildlife. Because wildlife species vary in the anatomy and physiology of their digestive systems (e.g., herbivores vs. carnivores), generalizations can not and should not be made concerning bioavailability of contaminants on soil incidentally ingested by wildlife at the screening level.

2.2 Soil Properties Influencing Contaminant Bioavailability

Bioavailability is a measure of the potential for entry of the contaminant into ecological or human receptors and is specific to the receptor, the route of entry, time of exposure, and the soil matrix containing the contaminant (Anderson et al., 1999). In order to ensure that Eco-SSLs are adequately conservative for a broad range of soils, an effort is made in the procedures developed to select studies that favor the bioavailability of the selected contaminants. To accomplish this, it is first necessary to develop a basic understanding of how various soil properties may influence bioavailability. Several authors stress the importance of physical and chemical properties of contaminants that influence the bioavailability in soils and thus exposure and toxicity (Alexander, 1995; Allen et al., 1999; Linz and Nakles, 1997; and Loehr and Webster, 1996). The behavior and bioavailability of contaminants are greatly influenced by their interactions with soil parameters, such that not all contaminants are equally available to biota. However, estimating the availability of metals and organic contaminants in soil to soil biota and plant toxicity is not a straightforward process.

The bioavailability of contaminants depends on their chemical properties and the specific physical and geochemical binding mechanisms that vary among contaminants and soil types. Contaminants interact with soil through interactions with the surface of particulate material in soils (adsorption), by penetration through the particulate surfaces where the contaminant becomes associated with the internal material (absorption or partitioning), and through specific contaminant reactions sometimes referred to as chemisorption. Also some contaminants, in particular metals, can associate with inorganic ligands and precipitate. The affinity of a

contaminant to be removed from solution and become associated with soil particulates irrespective of mechanism, is generally referred to as "sorption". The exception are precipitation reactions, which are often discussed independently from sorption processes. Contaminants are generally considered to be bioavailable when they are released from interactions with the soil and soil constituents and released into the soil pore-water. The exception to this rule is the direct ingestion of soil by terrestrial wildlife.

Identifying and quantifying soil properties that control the distribution of a contaminant in soil/water systems at equilibrium are useful for exposure situations where time is sufficient for equilibrium conditions to develop. For exposure situations that are dominated by discrete events often of short duration (e.g., incidental ingestion of soil), the kinetics of contaminant release from soils into another medium (i.e., the amount released per unit time) and residence time (i.e., time allowed for transfer to occur) controls the fraction of a contaminant that would be labile to target biota. Both adsorption and absorption partitioning processes are considered reversible, although mass transfer from the particle to the pore-water can be constrained. In the case of interactions within a particle, a contaminant can become sequestered or trapped through various physical and contaminant alterations that occur over time, such that contaminant release is completely constrained. The decline of the availability of many organic contaminants in soil over months or years has been well-documented (Alexander, 1995; Loehr and Webster, 1996). For chemisorption, the binding mechanism is considered irreversible under most environmental conditions. For precipitation reactions, release to pore-water is controlled by the factors affecting the stability or solubility of the contaminant precipitate. Overall, bioavailability of a contaminant in soil strongly depends on its physical and chemical properties, the characteristics of the soil, the interactions between the contaminant and the medium, including time of exposure, and the physiological and biochemical conditions of the receptor.

Contaminant Characteristics Impacting Lability

The soil parameters important in affecting sorption and precipitation reactions and the extent of their influence and thus contaminant bioavailability, are dependent on the intrinsic properties of the contaminants. The 24 contaminants considered in this guidance include both metals and organic contaminants. Metals can exist as either cations or anions in the soil environment, which significantly affects their sorption, mobility, and solubility in soils. For example, soil is primarily negatively charged, thus, metal cations have a higher propensity to be sorbed by soil particles relative to metal anions. For organics, lipophilicity and persistence alter their availability, as well as ionic potential in the case of organic contaminants with ionizable functional groups. Collectively, the 24 contaminants are classified into the four groups (Table 2.1).

Metals. Metals occur naturally in soils primarily as amorphous oxides and hydroxides, and to a lesser extent as carbonates, phosphates, sulfates, and sulfides, which are relatively insoluble. The same is generally true for metal-contaminated soils, because metals quickly undergo precipitation and coprecipitation reactions forming relatively insoluble solid phases, and/or are strongly complexed by soil minerals or organic matter (Lindsay, 1979). Toxicity testing on the

other hand usually employs very soluble metals not commonly found in any appreciable amounts in soils relative to total metal concentrations.

Table 2.1 General Contaminant Classification	
Contaminant Class	**Eco-SSL Contaminant**
Metal Cations	aluminum, antimony, barium, beryllium, cadmium, cobalt, copper, iron, lead, manganese, nickel, silver, and zinc
Metal Anions	arsenic, chromium, selenium, and vanadium
Nonionic Organics	PCBs, DDT and metabolites, dieldrin, PAHs, TNT, and RDX
Ionizable Organics	PCP

As identified in Table 2.1, most of the 24 contaminants considered for Eco-SSLs are metals that typically exist as cationic species. These metals can complex with inorganic soil constituents, e.g., carbonates, sulfates, hydroxides, sulfides, to form either precipitates or positively charged complexes. Both complexation and precipitation reactions are pH dependant. Therefore, although these metals can form complexes with a net negative charge, under most environmentally relevant scenarios (pH = 4 to 8.5), these metals either precipitate or exist as cations.

Arsenic, chromium, selenium, and vanadium complex with oxygen and typically exist as anionic species under most environmentally relevant scenarios (Bohn et al., 1985; Lindsay, 1979). The most common forms of arsenic are arsenate (arsenic V) and arsenite (arsenic III), which are present in soil solution in the form of AsO_4^{3-} and AsO^{2-}, respectively. The chemistry of arsenic resembles that of phosphate (Barber, 1995; Bohn et al., 1985). Chromium can exist as chromate (chromium VI or CrO_4^{2-}), which is usually considered more soluble, mobile and bioavailable than the sparingly soluble chromite (chromium (III)), which is normally present in soil as the precipitate $Cr(OH)_3$ (Barnhart, 1997; James et al., 1997). Similarly, selenium can be present as selenates (SeO_4^{2-}) and selenites (SeO_3^{2-}). For vanadium, vanadate (VO_4^{3-}) is the most common form.

Metals in their various forms can exist in the pore-water as charged species, as soluble complexes, or precipitate out of solution. Retention by soil is usually electrostatic with cationic species and anionic species being associated with negatively and positively charged sites on the soil, respectively. For most soils in the United States, negatively charged sites are more plentiful with less than 5% of the total available charge on the soil surface being positively charged. Therefore, metals existing as cationic species have a greater propensity to associate with the soil and are less bioavailable, whereas, distribution of anionic metals is generally more towards the pore-water for most soil/water systems. The soil pH and availability of charged sites on soil surfaces are the primary soil factors controlling their release to the pore-water, and subsequently, bioavailability.

Organic Contaminants. Of the seven organic contaminants identified in Table 2.1, DDT and metabolites, dieldrin and PCBs are very hydrophobic, highly lipophilic, and persistent nonionic organic contaminants. These contaminants are highly sorbed to soil surfaces and organic matter and tend to bioaccumulate and biomagnify in the food chain. The structure and degree of chlorination of PCBs and associated congeners directly impacts their behavior, persistence, and bioavailability (e.g., see citations in Hansen et al., 1999). As solubility decreases, sorption increases, and bioavailability generally decreases with increasing chlorination. However, uptake, degradability, and toxicity are also impacted by placement of the chlorines in the biphenyl structure. The remaining nonionic organic contaminants, PAHs and explosives (TNT and RDX) are generally considered less persistent and more bioavailable than pesticides or PCBs under identical soil conditions. PAHs are compounds with two or more aromatic rings in their structure and consist of only carbon and hydrogen. PAHs can be highly retained by soil in a similar manner as pesticides or PCBs, but are considered less persistent due to their higher affinity to be degraded microbially. TNT and RDX, a trinitro aromatic and trinitro nitrogen-heterocyclic respectively, are explosive materials and are more polar than PCBs or PAHs. The only ionizable organic contaminant being considered at this time in the development of Eco-SSLs, is the organic acid pentachlorophenol (PCP). Organic acids can exist as either a nonionic species or as an organic anion, which is dependent on the acid dissociation constant (pKa) and pH. In the pH range relevant to most environmental scenarios, PCP can exist as both a neutral species and as an anionic species; however, the majority will exist as the organic anion (Lee et al., 1990).

For all nonionic organic compounds (NOC) and the neutral form of PCP, sorption by soil is primarily related to their hydrophobicity and the amount of organic matter present in the soil (Lagrega, 1994; Lee et al., 1990), with the exception of the more polar, nitro-substituted organic contaminants (i.e., the explosives). Differences in the distribution of several NOCs in diverse soil-water and sediment-water systems have been minimized by normalization to organic matter or more specifically organic carbon (OC) with OC-normalized distribution coefficients, referred to as K_{oc} values (e.g., Gertsl, 1990; Lyman et al., 1990;). The greater the affinity of a contaminant for organic matter, the larger the organic carbon-normalized partition coefficient (K_{oc}), and a soil with higher amounts of organic matter has a higher propensity to sorb NOCs. The hydrophobicity and K_{oc}, of organic compounds increases with the size of the compound and with increasing chlorine content, as in the case of chlorinated organics. Therefore, sorption of PAHs by soils increases with the number of aromatic rings. For compounds like PCBs, sorption increases with increasing chlorination. Increasing compound hydrophobicity also reflects increasing lipophilicity, which will result in a greater propensity to bioaccumulate in the lipid fraction of biota. For PCP, an ionic contaminant, the anionic species has a greater tendency relative to the neutral PCP to remain in the pore-water similar to metal anions. Therefore, pH-dependent speciation drastically modifies the solubility, sorption, transport, and bioavailability of PCP. Although organic matter is the primary sorption domain in soils, all contaminants have some affinity to be associated with any surface through weak physical forces (Schwarzenbach et al., 1993). In addition, the nitro-substituted NOCs are known to have specific interactions with clay surfaces that are impacted by the inorganic cations present and

clay charge density, and less so by the amount of organic matter present (Weissmahr et al., 1998; 1999).

A common contaminant index representing the degree of hydrophobicity and lipophilicity of an organic contaminant is the octanol-water partition coefficient (K_{ow}), which is the contaminant distribution between octanol and water phases. K_{ow} values are positively correlated to both K_{oc} values and bioconcentration factors (Lyman et al., 1990). For reference, log K_{ow} values for selected organic contaminants are summarized in Table 2.2.

Table 2.2. Log K_{ow} Values for Organic Contaminants

Analyte	CAS no.	log K_{ow}	Source
RDX	121824	0.87	Syracuse Research Corporation (SRC)
TNT	118967	1.6	SRC
DDT	50293	6.53	U.S. EPA (1996)
DDD	72548	6.1	U.S. EPA (1996)
DDE	72559	6.76	U.S. EPA (1996)
Dieldrin	60571	5.37	U.S. EPA (1996)
Pentachlorophenol (PCP)	87865	5.09	U.S. EPA (1996)
PCBs		4.5 (1 chlorine) >8 (10 chlorines)	Verschueren (1996) Schwarzenbach et al. (1993)
PAHs			
Naphthalene (2 rings)	91203	3.36	U.S. EPA (1996)
Acenaphthene (3 rings)	83329	3.92	U.S. EPA (1996)
Phenanthrene (3 rings)	85018	4.55	U.S. EPA (1995)
Anthracene (3 rings)	120127	4.55	U.S. EPA (1996)
Chrysene (4 rings)	218019	5.7	U.S. EPA (1996)
Benzo(a)anthracene (4 rings)	56553	5.7	U.S. EPA (1996)
Benzo(a)pyrene (5 rings)	50328	6.11	U.S. EPA (1996)
Dibenzo(ah)anthracene (5 rings)	53703	6.69	U.S. EPA (1996)
Benzo(b)fluoranthene (5 rings)	92240	6.2	U.S. EPA (1996)
Benzo(k)fluoranthene (5 rings)	207089	6.2	U.S. EPA (1996)
Benzo(ghi)perylene (6 rings)	191242	6.7	U.S. EPA (1995)

Key Soil Parameters Affecting Contaminant Bioavailability in Soils

From the preceding overview of how contaminants interact with soil constituents, it is clear that soil plays a very significant role in reducing the potential bioavailability of contaminants in the environment. Given the types of contaminant-soil interactions presented, the primary soil factors controlling the potential bioavailability of all contaminants are identified as soil pH, available charged sites on soil surfaces, clay content, and soil organic matter. Below is a discussion

briefly detailing the key soil parameters affecting the various contaminants' availability to the pore-water, thus bioavailability.

Soil pH. Soil pH is often termed the master soil variable because it controls virtually all aspects of contaminant and biological processes in soil. These processes include solubility, precipitation, speciation, and sorption processes as well as microbial activity. Soil pH controls the speciation of both ionizable organic contaminants such as PCP, and metals. For metals, the net charge of the metal complexes and their precipitation/dissolution reactions are directly impacted by soil pH. For organic acids such as PCP, the fraction of contaminant existing as an anion increases with increasing pH. The anion has a lower affinity for the soil relative to the neutral species. Increasing soil pH also results in an increase in the number of negatively charged soil sites with a concomitant decrease in the positively charged sites. Therefore, increasing the soil pH directly impacts the sorption and removal from the pore-water of metal or organic ions (Bohn et al., 1985). The impact of pH on the behavior and bioavailability of nonionic organic contaminants is less marked and is generally achieved through its influence on organic matter and on microbial activity.

Cation and Anion Exchange Capacities. The available charges on soil surfaces are quantified in the soil parameters known as cation exchange capacity (CEC) and anion exchange capacity (AEC). CEC is a measure of the soil's ability to adsorb and release cations, which is directly proportional to the number of available, negatively charged sites. Likewise, AEC is a measure of the soil's ability to adsorb and release anions. As a result, the AEC is a measure of available positively-charged surface sites. CEC is directly related to the clay mineral content and type, organic matter and soil pH. CEC is greater for 2:1 clays such as montmorillonite (600 to 1,000 millimole (mmol)/kg) compared to 1:1 clays such as kaolinite (20 to 160 mmol/kg). CEC in organic matter ranges from 2,000 to 4,000 mmol/kg; however, the organic matter fraction of a soil is usually much less than the clay fraction. CEC arising from pH-dependent charge, which includes organic matter contributions to CEC, increases with increasing pH. CEC in soil ranges from values as low as 10 millimole (mmol) per kg for extremely coarse-textured soil to as much as 600 mmol/kg for fine textured soil, containing large amounts of 2:1 clays and organic matter (Bohn et al., 1985). AEC, which is primarily associated with amorphous oxides, decreases with increasing soil pH. As previously mentioned, the number of positively charged sites (i.e., AEC) on the majority of soil types is very small, and in environmentally-relevant pH ranges, is usually negligible. Therefore, AEC is not generally considered an important parameter in assessing contaminant availability at most sites in the United States.

Clay Minerals. Clays, by definition, are soil particles less than 2 microns in size (Miller and Gardiner, 1998); therefore, high clay soils have higher surface areas relative to sandy soils (sand particle size ranges from: 20 microns to 2 millimeters (mm)). For nonionic organic contaminants, the primary sorption domain is organic matter; however, soils with high surface area will result in enhanced sorption of organic contaminants through weak physical interactions, as well. Much of the CEC of a soil comes from the negatively charges sites on clay surfaces. Therefore, high clay soils will have a higher affinity to sorb cationic species whether organic or

inorganic due to CEC, and to sorb nonionic organic contaminants due to high surface areas, thus making contaminants less bioavailable relative to sandy soils. In addition to charged sites available in clays, siloxane oxygens present in clays can interact specifically with contaminants such as the nitro-substituted explosives. Metals can form precipitates with inorganic soil constituents, such as carbonate and phosphate minerals under certain soil conditions. Carbonate- and phosphate-metal complexes have varying degrees of solubility and reactivity depending on the metal, its oxidation state, the ligand to which it is bound, and pH. Precipitation removes a contaminant from the pore-water, thus decreasing bioavailability.

Organic Matter (Organic Carbon) Content. Organic matter includes plant and animal remains in various stages of decomposition (e.g., cells and tissues, of soil organisms and substances from plant roots and soil microbes) (Sumner, 2000). Organic matter is primarily composed of carbon, oxygen, and nitrogen. Organic matter is often reported or analytically determined on a carbon basis. On average, approximately 58% of organic matter is organic carbon. Soils encompass a range in organic matter from <1% for a sandy soil to almost 100% for a peat soil, with most soils having organic matter contents <10% (Bohn et al., 1985). Also, organic matter content is usually higher in surface soils or in the root zone and decreases with depth in the soil profile.

Organic matter has a high affinity to bind organic compounds as well as some metals in soils thereby, reducing their availability. Organic contaminants preferentially partition to organic matter relative to the polar aqueous phase, while the organic acid functional groups typically present in organic matter have a high affinity to attract metal cations. For nonpolar or neutral organic contaminants at equilibrium, sorption is positively correlated to the amount of organic matter, usually reported as the fraction of organic carbon (f_{oc}), and inversely proportional to aqueous solubility. Sorption of organic contaminants increases with increasing amounts of soil organic matter. The greater the hydrophobicity or lipophilicity of an organic contaminant, the greater potential it has to be sorbed onto organic matter. The latter has led to the use of K_{oc} for estimating contaminant sorption with the soil-specific distribution coefficient estimated by K_{oc} multiplied by f_{oc}. Another indirect effect of soil organic matter is its role on limiting contaminant mass-transfer. The rate of mass-transfer of an organic contaminant from soil particles to the surrounding pore-water is inversely proportional to the contaminant's soil-water distribution coefficient (Pignatello, 2000). Therefore, with increasing organic matter content, retention of an organic contaminant increases and rates of release decrease, thereby, decreasing overall contaminant bioavailability.

Other Factors

Background. Background refers to constituents or locations that are not influenced by the releases from a site, and is usually described as naturally occurring or anthropogenic background (US EPA, 2002). Background contaminant concentrations can vary due to soil type, depth, and region of the country. Due to this variation, background metal levels in soils are addressed on a

site-specific basis in the baseline ERA. As part of the development of Eco-SSLs, background metal concentrations from the literature were compiled to provide a general comparison of the screening levels with current available information. Background metal concentrations were reviewed and compiled in Attachment 1-4. For reference, background levels by state are provided in Table 2.3. In the contaminant specific Eco-SSL documents, the Eco-SSL values are compared to a summary box-and-whisker chart depicting background concentrations in eastern and western United States soils. A discussion on the quality of available toxicity data and the reasonableness of the Eco-SSL values when compared to background concentrations is presented. Background data is site-specific and should be derived for each site investigated**.**

Aging. The issue of adsorption, complexation, lability of contaminants in soils, and the corresponding reduction in toxicity over time is an important issue in understanding the fate of contaminants in soils. In the evaluation of the available toxicological literature for plants and soil biota, few studies incorporated a step to age or weather spiked contaminants in soils. The use of contaminated soils from the field in laboratory tests is a viable option; however, due to the common presence of mixtures and the specific soil chemistry parameters, the use of field contaminated soils is primarily useful only for site-specific studies. While no standard setting organization has established methods for aging contaminants in soils, an aging step has been added by some investigators in plant and soil invertebrate test methods that involves several cycles of wetting and drying of a freshly spiked soil (Kuperman et al., 2002 and Phillips et al., 2002).

2.3 Using Soil Properties to Guide Eco-SSL Derivation

In identifying a set of soil parameters for use in selecting studies for deriving Eco-SSLs for plants and soil invertebrates, four soil parameters were selected: soil pH, CEC, clay content, and organic matter. However, when the plant and soil invertebrate task group evaluated the current literature, they observed that CEC and clay content were not routinely reported. Thus, these parameters were not used and the matrices were constructed using only pH and organic matter content as the primary soil parameters affecting bio-availability and toxicity. For these soil parameters, ranges were within that typically found in soils. Tests that used soils with characteristics that fell outside the selected ranges were not considered. Although other soil factors can be significant, combinations of these two soil parameters are sufficient for use in this screening process as a qualitative guide to address how most soils across the United States may influence bioavailability of contaminants. Qualitative rankings of high, medium, and low bioavailability were used to categorize each combination of the soil parameters and their ranges. Information on bioavailability was used to help select and score studies to include in the derivation of the Eco-SSL values. Greater weight was given to those studies that had higher bioavailability. Using the selected soil parameters and defining ranges that correspond qualitatively to the soil's affinity for the contaminant and thus for bioavailability, Tables 2.4a and 2.4b, 2.5, and 2.6 are provided for metal cations, nonionic organics, and anionic species, respectively. For each of the soil parameters, the values typically found in soils were divided into three ranges. For example, most environmentally relevant scenarios fall between pH values

Table 2.3. Mean Reported Soil Metal Background Concentrations (mg/kg dry weight) by State*																	
	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Manganese	Nickel	Lead	Selenium	Silver	Vanadium	Zinc
Alabama	23100	3.6	4.7	200	0.6		30.6	4.4	9.6	11950	420	11	9.3	0.3		38	26
Arkansas	33429	1.2	9.7	336	0.9		53.1	12	17	19857	731	18	21	0.7		52	39
Arizona	32933	1.4	9.6	364	1.0	0.4	37.3	9.9	23	20787	447	23	16	0.4	0.5	42	51
California	75633	0.8	5.1	598	1.1	0.4	119.9	14	39	36867	640	48	26	0.2	0.8	118	113
Colorado	61557	1.1	6.7	662	1.4		41.7	6.8	21	23048	343	13	31	0.4		74	87
Connecticut	85000		4.1	400	0.5		40.0	7.5	15	17500	450	13	5.0	0.8		60	40
Delaware	22500	1.0	1.4	400	0.5		30.0	3.3	5.0	7500	85	6.0	15	0.3		20	23
Florida	9944	0.9	3.0	48	0.6	0.1	15.4	1.6	5.6	3705	86	8.5	12	0.3	0.5	11	12
Georgia	38250	1.0	5.0	232	0.6		32.4	6.9	21	16976	252	17	19	0.4		43	47
Iowa	64667	1.0	7.3	617	1.3		64.7	11	31	23278	603	26	19	0.4		97	57
Idaho	58500	1.0	6.4	757	1.1		52.1	12	28	32000	580	22	22	0.3		90	83
Illinois	48714	1.1	7.1	551	0.7		48.4	9.8	24	19159	646	19	39	0.5		62	67
Indiana	50000	1.0	7.5	500	0.7		46.8	10	27	21364	518	18	18	0.4		74	56
Kansas	61818	1.1	6.8	694	1.0		49.0	8.9	25	18788	452	17	32	0.4		77	67
Kentucky	54123	1.0	7.8	349	1.1		79.8	11	17	30432	483	23	16	0.5		66	35
Louisiana	42188	1.0	7.6	441	0.6		60.8	8.6	33	19688	470	33	16	0.7		76	55
Massachusetts	34083	1.0	8.6	203	1.3	0.2	39.5	7.8	16	19000	439	13	13	1.9		87	54
Maryland	39167	1.2	3.8	393	1.3		47.9	7.5	20	28571	291	13	22	0.2		63	39
Maine	65385	1.0	9.4	319	1.6		71.2	10	28	45385	581	30	19	0.7		98	80
Michigan	10964	1.3	4.2	127	0.7	0.9	13.8	4.6	12	10520	230	12	9.2	0.3	0.5	44	33
Minnesota	49457	1.0	5.5	571	0.7	0.3	25.4	7.2	20	19581	583	14	9.9	0.3		72	38
Missouri	42094	1.0	10	499	1.0		50.0	12	19	24733	940	20	23	0.5		72	53
Mississippi	45368	1.0	8.8	390	0.9		53.2	12	20	19684	471	21	18	0.5		68	45
Montana	70938	1.1	8.8	739	1.1		63.3	7.5	29	27766	366	20	14	0.4		101	69
Nebraska	59474	1.0	5.5	711	1.1		32.5	5.9	15	16000	306	15	16	0.4		62	54
North Carolina	60105	1.0	4.8	356	0.6		64.8	15	34	37053	563	24	17	0.4		107	56
North Dakota	62857	1.0	7.0	682	0.9		53.2	6.9	23	25357	530	20	13	0.4		83	64
New Hampshire	66667		4.4	500	2.3	0.6	18.4	5.3	12	33333	633	10	28	0.3		57	23
New Jersey	10075	1.4	7.0	54	0.3	0.3	13.9	1.7	14	11632	221	3.8	35	0.9		30	22
New Mexico	54423	1.0	5.9	727	1.0		55.5	8.8	21	20898	367	28	18	0.3		72	44
Nevada	66078	1.0	9.0	822	1.3		36.8	8.4	25	22725	481	15	25	0.3		78	69
New York	58800	1.0	6.4	666	1.4	0.2	66.9	9.1	36	38900	418	21	20	0.3		132	82
Ohio	54615		12	469	1.0		55.0	13	28	27308	550	25	23	0.6		88	69
Oklahoma	39200	1.0	7.0	430	1.1		46.0	7.1	16	19320	465	15	18	0.3		50	50
Oregon	94412	1.2	5.1	682	0.9		121.6	16	53	50147	725	23	15	0.3		168	70
Pennsylvania	63438	1.0	13	366	1.4		52.8	15	37	36063	609	24	23	0.5		80	81
Rhode Island	100000		3.5	500	0.5		50.0	10	15	30000	500	15	15	0.9		70	30
South Carolina	39143		3.9	151	1.4		21.4	3.5	16	12500	87.1	7.8	5.0	0.3		45	25
South Dakota	74333	1.3	8.5	1043	1.4		58.7	7.7	29	25667	1013	28	16	0.5		108	75
Tennessee	31894	0.7	16	193	0.8	0.2	40.3	14	17	28479	1112	18	23	0.6	1.2	49	57
Texas	41958	1.1	6.4	404	0.9		39.6	5.3	15	16328	303	12	14	0.3		52	39
Utah	45638	1.1	8.0	493	0.9		45.6	6.6	26	18830	371	13	35	0.3		70	96
Virginia	60438	1.2	5.1	436	0.9		54.3	9.7	33	27750	441	17	36	0.4		77	233
Vermont	56667		3.6	333	1.7		66.7	12	18	30000	800	25	20	0.4		70	43
Washington	66834	1.0	4.5	606	0.9	0.8	49.9	18	31	42635	760	23	14	0.3	0.7	160	78
Wisconsin	48000	1.0	4.4	543	2.0		40.3	7.7	12	15667	365	14	12	0.3		48	44
West Virginia	67000	1.3	8.6	360	1.0		46.0	14	22	28500	770	23	17	0.5		65	60
Wyoming	56125	1.1	6.5	756	0.7		47.9	8.3	21	25250	416	16	17	0.5		84	57

* Summary of background soil concentration data provided as Attachment 1-4.

of 4.0 and 8.5. This pH range was divided into the following sub-ranges: 4.0 to 5.5, 5.5 to 7.0, and 7.0 to 8.5. Qualitative bioavailability indices of very high, high, medium, low, and very low were assigned for each combination of soil parameters within each class of the contaminants (Tables 2.4a, 2.4b, 2.5, and 2.6). For example, a soil with a pH between 5.5 to 7.0, and organic matter content between 2 and 6%, would bind metal cations to a moderate extent. Therefore, a bioavailability index of 'medium' for metal cations was assigned (see Table 2.4a and 2.4b).

These tables simplified and facilitated the use of soil chemistry information in the derivation of Eco-SSLs for plants and soil invertebrates. The ranges given in these tables were used in selecting the most appropriate plant and soil invertebrates toxicity data for deriving Eco-SSLs (Chapter 3).

Table 2.4a.
Qualitative Bioavailability of Metal Cations in Natural Soils to Plants

Soil Type	Soil pH		
	Low Organic Matter (< 2%)	Medium Organic Matter (2 to < 6%)	High Organic Matter (6 to 10%)
4 ≤ Soil pH ≤ 5.5	Very High	High	Medium
5.5 < Soil pH < 7	High	Medium	Low
7 ≤ Soil pH ≤ 8.5	Medium	Low	Very Low

Table 2.4b.
Qualitative Bioavailability of Metal Cations in Natural Soils to Soil Invertebrates

Soil Type	Soil pH		
	Low Organic Matter (< 2%)	Medium Organic Matter (2 to <6%)	High Organic Matter (6 to 10%)
4 ≤ Soil pH ≤5.5	Very High	High	Medium
5.5 < Soil pH < 7	High	Medium	Low
7 ≤ Soil pH ≤ 8.5	Medium	Medium	Very Low

Soil Type	Log K_{ow}	< 2	2 to <6	
4 ≤ Soil pH ≤5.5	Log K_{ow} > 3.5	High	Medium	Low
	Log K_{ow} < 3.5	Very High	High	Medium
5.5 < Soil pH < 7	Log K_{ow} > 3.5	Medium	Low	Low
	Log K_{ow} < 3.5	High	Medium	Low
7 ≤ Soil pH ≤ 8 .5	Log K_{ow} > 3.5	Low	Low	Low
	Log K_{ow} < 3.5	Medium	Low	Low

Table 2.6
Qualitative Bioavailability of Metal Anions in Natural Soils

Soil Type	Soil pH		
	Low Organic Matter (< 2%)	Medium Organic Matter (2 to <6%)	High Organic Matter (6 to 10%)
4 ≤ Soil pH ≤5.5	Medium	Low	Very Low
5.5 < Soil pH < 7	High	Medium	Low
7 ≤ Soil pH ≤ 8.5	Very High	High	Medium

This Page Intentionally Left Blank

3.0 DERIVATION OF PLANT AND SOIL INVERTEBRATE ECO-SSLs

Eco-SSLs for plants and soil invertebrates were derived using a four-step process. These procedures built upon previous efforts (CCME, 1997; Efroymson *et al.*, 1997 a,b), and established a process for evaluating published studies and selecting relevant data from the literature. The process (Figure 3.1) was guided by a set of standard operating procedures (SOPs) that specified the steps for identifying and evaluating data for appropriateness in deriving an Eco-SSL as well as the actual calculation of the screening values (Attachments 3-1 and 3-2). The process was intended to ensure that the Eco-SSLs for plants and soil invertebrates were based on sound science. The process required data from ecotoxicity studies that met prescribed requisites including but not limited to a thorough experimental design, appropriate quality control, and specific soil boundary conditions.

When appropriate and sufficient data were available for a specific contaminant, Eco-SSLs for plants and soil invertebrates generally could be derived using the prescribed process. Alternatively, if sufficient data does not exist, then toxicity testing could be completed under the preferred Eco-SSL experimental conditions (refer to Section 3.5) to generate the data needed to derive an Eco-SSL for the contaminant of interest.

Eco-SSLs for plants and soil invertebrates were derived using data from tests performed within soil boundary conditions favoring relatively high bioavailability for upland aerobic soils (refer to Tables 2.4 - 2.6 of Chapter 2). The soil chemistry conditions of relatively high bioavailability were defined by low soil pH and organic matter. These parameters were frequently found to be the predominant factors affecting contaminant bioavailability to plants and soil invertebrates in aerobic soils. Extreme pH values (< 4 and > 8.5) will substantially affect the solubility, precipitation, speciation, and sorption processes of contaminants, and therefore were not appropriate for use in Eco-SSL derivation. Similarly, organic matter, composed primarily of carbon, oxygen, and nitrogen, at elevated levels in the soils (i e. >10%) has a high affinity to bind organic compounds as well as some metals, thereby reducing their bioavailability.

Figure 3.1 The Four-Step Process for Deriving Eco-SSLs for Plants and Soil Invertebrates

Step 1. Literature search, acquisition, and screening (Attachment 3-1). Apply 22 Literature Exclusion Criteria.

Step 2. Identify acceptable literature by applying eleven Study Acceptance Criteria to retrieved papers (Attachment 3-1).

Step 3. Extract and score data from acceptable literature according to nine Study Evaluation Criteria (Attachment 3-2).

Step 4. Derive soil invertebrate and plant Eco-SSLs according to specified procedures (Attachment 3-2).

- Sort study data by bioavailability score
- Complete QA review
- Calculate value

3.1 Literature Search, Acquisition, and Screening

The first step in the process of developing Eco-SSLs for plants and soil invertebrates was to identify, retrieve, and screen published papers that reported data for soil toxicity to terrestrial plants or soil invertebrates. The procedures used to complete the literature search, retrieval and review are provided as Attachment 3-1.

The literature search included both paper-based searches and searches of computerized abstracting databases. The paper-based literature search process consisted primarily of the manual review of bibliographies, guidance documents, and review articles. This manual search was not limited by publication year. Searches of computerized abstracting databases included the use of DIALOG, SilverPlatter and Ovid commercial database vendors. Within DIALOG, the targeted databases included AGRICOLA, BIOSIS and ChemAbstracts. The searches were supplemented with other electronic databases including Toxline, PolTox1, Toxnet, and Current Contents. Searches of computerized abstracting databases were limited to papers published after 1988, except in cases when fewer than 20 publications were identified for a contaminant- receptor pairing (e.g., cadmium- plants). In these cases, the electronic search was expanded to include all publication years in the databases. It was assumed that relevant studies prior to 1988 would be identified in the bibliographies of review articles. A list of 22 Literature Exclusion Criteria (see Figure 3.2) was then used to screen out those studies not appropriate for use in deriving Eco-SSLs. These Literature Exclusion Criteria were applied to retrieved abstracts, or to the entire publication if the needed information was not available in the abstract.

Figure 3.2 Literature Exclusion Criteria

Biological Product	Biological toxins (venoms, etc.)
Chemical Methods	Methods for measuring contaminants
Drug	Testing for drug effects
Effluent	Effluent, sewage, polluted run-off
Contaminant Fate	Fate and transport of substance in the environment (only)
Human Health	Human or primate subjects
In Vitro	In vitro studies, including cell cultures and excised tissues
Methods	Methods reported but no usable specific toxicity test results
Mixture	Combinations of chemicals in laboratory testing
Modeling	Only modeling results reported
No Conc	No dose or concentration reported, or not able to calculate from information given
No Duration	No exposure duration reported
No Effect	No effect reported for a biological test species
No Species	No viable plant or animal present or tested
No Toxicant	No toxicant used
No Tox Data	Toxicant used, but no results reported that had a negative impact
Nutrient	Nutrition studies reporting no concentration-related negative impact
Oil	Oil and petroleum products
Publ As	Author states information is published in another source
QSAR	Data developed only from quantitative-structure activity relationships
Review	Data reported are not primary data
Survey	Assessment of toxicity in the field over a period of time

QSAR = Quantitative Structure Activity Relationship

For the 24 contaminants listed in the Chapter 1, EPA completed the literature searches according to the SOP (Attachment 3-1). The searches identified more than 7,600 papers. These publication abstracts and titles were screened to determine if they were likely to meet the Eco-SSL requirements using the 22 Literature Exclusion Criteria. This process resulted in the acquisition of more than 5,200 papers.

Figure 3.3 Eleven Study Acceptance Criteria

1. The document is the primary source of the test result.
2. Adverse effects are caused by an identified chemical stressor (i.e., no mixture testing in laboratory studies).
3. The chemical form (e.g., metal salt used) and concentration are reported by the author(s).
4. The test medium used in the study is a natural or artificial soil.
5. The study reports the organic matter content and it is ≤10 % of the composition of the soil; or equivalent concentration reported on the basis of organic carbon.
6. Except for studies on non-ionizing substances (e.g., PCP), the study reports the pH of the soil, and the soil pH is within the range 4.0 ≤ soil pH ≤ 8.5.
7. The study includes at least one control treatment.
8. The duration of the exposure is reported, or a standard study method with a defined duration is used.
9. For studies conducted in a laboratory setting, at least three treatment levels are used (i.e., control plus two chemical exposures).
10. Biological effects are reported for ecologically relevant endpoints (ERE).
11. Either the test species' scientific name, common name, variety, or strain is reported.

3.2 Identification of Potentially-Acceptable Literature

The second step of the process identified which publications acquired through Step 1 included at least the minimum information necessary for deriving an Eco-SSL. Eleven Study Acceptance Criteria (see Figure 3.3) were applied to each of the acquired publications. Publications that meet all 11 Study Acceptance Criteria were further evaluated in Step 3. Detailed descriptions of the Study Acceptance Criteria are presented in Attachment 3.1. Approximately seven percent of the plant and soil invertebrate publications reviewed by EPA (identified during Step 1) met all 11 Study Acceptance Criteria.

3.3 Extraction of Data and Scoring Studies

In Step 3, each of the publications that met all 11 Study Acceptance Criteria were reviewed and study data extracted and scored. If a publication contained more than one study, each study was evaluated and scored separately. For each study reviewed, a set of critical notes were recorded in a spreadsheet. A separate "study" was defined if any of the following parameters varied: test species (not strain), contaminant (not form), soil (natural vs. artificial), pH or percent organic matter (% OM) content. The specific procedures used to extract and record study data are provided as Attachment 3-2.

Ecologically Relevant Endpoints

For each of the studies reviewed, the measures of toxic effects to either plants or soil invertebrates were grouped into one of four ecologically relevant endpoints (EREs) (see Table 3.1). If a study reported toxic effects for multiple EREs, only the preferred ERE and corresponding contaminant concentration were recorded in the critical notes. For soil invertebrates, the preferred ERE followed the order: reproduction > population > growth. For soil invertebrates, reproduction was the preferred ERE because it is necessary for sustaining populations, and reproductive endpoints are good indicators of longer term (i.e., chronic) exposure. Although population endpoints were considered less robust than reproductive endpoints, they were next in preference because screening ecological risk assessments focus on protection at the population level. Growth measurements on individuals were the traditional measurement endpoints, and are frequently extrapolated to represent impact at the population level.

For plants, the preferred ERE was biomass production as it is normally the most sensitive measurement. If no measurement of biomass production was reported, some physiological endpoints were accepted as there were established linkages between certain measures of photosynthesis and productivity (refer to Table 3.1).

Ecologically Relevant Endpoint	
Reproduction	Measures of the effect of toxicants on offspring production. Examples of EREs associated with reproduction included changes in fecundity, number of progeny produced (eggs, cocoons, etc.), rate of reproduction (hatching rates, etc.), rate of maturation, sexual development, change in sex expression, and sterility number or proportion of abnormal progeny.
Population	Measurements and endpoints regarding a group of soil invertebrates of the same species occupying the same area at a given time. Measurement included population dynamics. Examples of EREs associated with population included changes in size and age class structures, changes in sex ratio, intrinsic population growth rate, survivability of subsequent generations, diversity, evenness, index to population size (count, number, abundance), life table data, population density (number/area).
Growth	Broad category which encompassed measures of weight/mass and length. EREs associated with growth and development included responses such as a change in body weight.

Table 3.2 Ecologically Relevant Endpoints (EREs) for Plant Eco-SSLs	
Ecologically Relevant Endpoint	**Definition**
Growth (Biomass)	Measurement of plant products including standing crop biomass, seedling emergence, shoot length/growth, root elongation/growth, fresh or dry mass, yield or production (e.g., seed production).
Physiology	For the purposes of developing Eco-SSLs, plant studies reporting EREs associated with physiological responses were used. Physiological endpoints for plants included net photosynthesis (CO_2 uptake, oxygen release), decrease in chlorophyll content or chlorophyll fluorescence, increased deformation, membrane damage, desiccation/decrease in water content, detrimental changes in dormancy measures, decreased flowering, and increased senescence.

Toxicity Parameters

For each study, a toxicity parameter was recorded. The toxicity parameter was the concentration-response measurement associating the adverse effect with the contaminant exposure. Toxicity parameters considered acceptable for deriving Eco-SSLs were the EC_{20} (effective concentration that affects 20% of the test population), the MATC and the EC_{10} (effective concentration that affects 10% of the test population). The MATC was equal to the geometric mean of the NOAEC and the LOAEC. Some toxicity data were not used to derive Eco-SSLs including acute toxicity data such as the concentration lethal to 50% of the test population (LC_{50}) or the effective concentrations affecting more than 50% of the test population (EC_{50}). Effect concentrations affecting less than 5% of the test population (EC_x <5) were also not considered acceptable for deriving Eco-SSLs. The LC_{50} and EC_{50} values were not considered sufficiently protective of ecological resources, while EC_5 values have low levels of confidence due to natural variability.

When NOAEC and LOAEC values were reported, these data were used to calculate an MATC. A bounded value was a study result with both a NOAEC and LOAEC reported (other than control). Unbounded NOAEC or LOAEC values do not describe a dose-response curve and thus were not used due to the high uncertainty over where the real threshold of toxicity lies. If a study reported multiple toxicity parameters, a single preferred toxicity parameter was selected. Selection of the preferred toxicity parameter followed the order:

$$\mathbf{EC_{20} > MATC > EC_{10}}$$

If a study reported more than one adverse effect concentration with the "preferred" ERE and toxicity parameter, the lowest effect concentration was then selected. If a publication did not report an EC_{20}, MATC or EC_{10}, but sufficient data were provided, the reviewer calculated and recorded the toxicity value under the appropriate toxicity parameter. Toxicity data were reported as mg/kg of the chemical on the critical notes form (Attachment 3-2). Data not reported in these units were converted to mg/kg or converted from formulation to active ingredient. When metal

concentrations were reported, these were converted to an elemental basis. The only data extracted were for results where an adverse effect was significantly different from the control.

Scoring Each Study

Each study was scored according to nine specific Study Evaluation Criteria (Table 3.3) and the results documented in the critical notes. If a single publication contained data for multiple studies (e.g., reports toxicity data for more than one species or soil type, etc.), each study within the publication was scored separately. The information recorded for each study included test species, soil characteristics (e.g., pH, %OM), relative bioavailability score, the ERE, toxicity parameter, and toxicity value (Attachment 3.2). The specific procedures used to score studies and document the results are provided as Attachment 3-2.

Scoring for each Study Evaluation Criterion used a three-point scale (i.e., 0, 1, or 2). The maximum score for a study was 18. Studies were deemed inappropriate for deriving Eco-SSLs for plants and soil invertebrates if they did not score above ten. Studies with an evaluation score of 10 or less were presumed to lack sufficient detail about the study to enable reviewers to assess the quality of the data. These studies results were not included in the pool of data considered for deriving the Eco-SSL values.

3.4 Derivation of Eco-SSLs

Sorting Data by Bioavailability Score

The first step in deriving an Eco-SSL was to sort the studies accepted at Step 3 (receiving a Study Evaluation Score greater than ten out of 18 possible points) by their bioavailability score. The bioavailability score was determined as part of the scoring process in Step 3 (Table 3.3). This score was based on the soil matrix tables presented in Chapter 2 (Tables 2.4 to 2.6), the type of soil (natural versus artificial), pH and OM content. A score of two was applied to natural soils with relatively high or very high bioavailability, a score of one was applied to natural soil with medium bioavailability and to standard artificial soil, and a score of zero was applied for natural soil with low or very low relative bioavailability.

Quality Control Review

A quality assurance review of the sorted data was preformed by a panel of experts. The reviewers verified that all studies used to derive the Eco-SSLs were correctly evaluated and scored. All studies were reviewed by at least two individuals (other than the original reviewer). The quality control review provided a forum for confirming that the appropriate data were identified and documented, resolving any comments or concerns, and ensuring consensus on data selection. For example, in cases where a study reported data for multiple test species and for several endpoints, the quality control review provided a forum to reach a consensus that the most

Table 3.3 Summary of Nine Study Evaluation Criteria for Plant and Soil Invertebrate Eco-SSLs		
Criteria Title	**Rationale**	**Scoring**
#1: Testing was Done Under Conditions of High Bioavailability	Bioavailability of metals and polar organic compounds is influenced by pH and soil organic matter, cationic exchange capacity, and clay content. The scoring is intended to favor relatively high bioavailability.	Scores were based on the bioavailability matrix (see Chapter 2). Scored 2 if bioavailability of natural soil was high or very high. Scored 1 for natural soil with medium bioavailability or standard artificial soil. Scored 0 for natural soil with low and very low bioavailability.
#2A (laboratory) and **#2B** (field): Experimental Designs for Studies are Documented and Appropriate	Experimental design can significantly influence the quality of a study. Higher quality studies will use an experimental design sufficiently robust to allow analysis of the test variables and discriminate non-treatment effects.	Scored based on experimental design and methods used for statistical analyses. Scored 2, 1 or 0. Specific criteria used provided in Attachment 3-2.
#3: Concentration of Test Substance in Soil is Reported	The concentration of the contaminant tested must be reported unambiguously.	Scored 2 if measured concentrations were reported. Scored 1 for nominal concentrations and scored 0 in all other cases.
#4: Control Responses are Acceptable	Negative controls are critical to distinguish treatment effects from non-treatment effects.	Scored 2 if a standardized procedure were used and control values were within procedural guidelines or acceptable range (if non-standard procedure used). Scored 1 if results of control were not reported or were ambiguous. Score d0 if control results were not within an acceptable range.
#5: Chronic or Life Cycle Test was Used	Chronic toxicity tests assessing long-term adverse sub-lethal impacts on the life-cycle phases of an organism are considered superior to acute toxicity tests.	Scored 2 if chronic exposures were used. Scored 1 if acute tests were used. Scored 0 if very short term exposures were used.
#6: Contaminant Dosing Procedure is Reported and Appropriate for Contaminant and Test	Contaminant dosing procedure may affect the outcome of a test. Dosing procedure should include: (A) the form of the contaminant; (B) the carrier or vehicle (e.g., solvent, water, etc.); (C) how the carrier was dealt with following dosing (i.e., allowed to volatilize, controls, etc.); (D) procedure for mixing of soil with contaminant (homogeneity).	Score applied based on how well the study reports the four contaminant dosing procedures (A to D). Scored 2 if study reported all. Scored 1 if information for items A and B, but not C or D; Scored 0 if details were not provided and could not be inferred.
#7: A Dose-Response Relationship is Reported or can be Established from Reported Data	Two methodologies can be used to identify this benchmark concentration. The first method generates a no observed adverse effect concentration (NOAEC) and a lowest observed adverse effect concentration (LOAEC). The second method uses a statistical model to calculate a dose response curve and estimate an effect concentration for some percentage of the population (EC_x), usually between an EC_5 and an EC_{50}.	Scored 2 if an EC_{10}- EC_{20}; or a NOEC and LOEC were within a factor of 3. Scored 1 if the difference between the NOEC and LOEC was > 3x but < 10x. Scored 0 if an EC_x was not reported or the difference between the NOEC and LOEC was > 10, or only a NOEC or LOEC was reported.
#8: The Statistical Tests used to Calculate the Benchmark and the Level of Significance were Described	Statistical tests and results reported in the study should be sufficient to determine the significance of the results.	Scored 2 if ANOVA or statistical method were based on a P = 0.05; or the 95% CI of the EC_x. Scored 1 if an ANOVA was completed but P level not provided or > 0.05; or if EC data did not include the 95% CI or used a 90% CI. Scored 0 if a NOEC, LOEC, or EC/LC_x were not reported, or were reported without a description of the method used to calculate the values.
#9: The Origin of the Test Organisms is Described	The results of a toxicity test can be influenced by the condition of the test organisms. Culture conditions should be maintained such that the organisms are healthy and have had no exposure above background to contamination prior to testing (inverts) or detailed information is provided about the seed stock (plants).	Scored 2 if the source and condition of the test organisms were known and described. Scored 1 for a non-commercial source not adequately described, or if insufficient information was provided about a commercial source. Scored 0 if organisms were from a known contaminated site, or insufficient information was provided on the a commercial source.

appropriate data were used to derive the Eco-SSL. The quality assurance review consisted of verifying the following information:

- Adherence to all eleven Study Acceptance Criteria
- Accuracy of study evaluation scores
- Accuracy of soil pH, OM, and relative bioavailability score for each study
- Selection of preferred EREs, toxicity parameter(s), and toxicity results
- Units of the toxicity result (wet weight/dry weight, contaminant form)

Calculation of the Eco-SSL Values

The Eco-SSL was calculated as the geometric mean of all the toxicity values at the highest relative bioavailability score for which sufficient data existed (i.e., ≥ three data points). If less than three data values were available at the highest relative bioavailability level, data from the next highest bioavailability level were included in that Eco-SSL data set. This process proceeded until a combined data set of three or more data values were identified for calculating the Eco-SSL. For example, if there were only two toxicity values from studies using soils with relatively high bioavailability (i.e., score = two), but there were data from four medium bioavailability studies (i.e., score = one), then an Eco-SSL was calculated using the combined six data values. If there were less than three acceptable studies (score > ten) an Eco-SSL was not calculated.

3.5 Soil Toxicity Test Methods

If sufficient data for deriving an Eco-SSL were not available from the published literature, additional plant or soil invertebrate data could be generated through completion of appropriately designed soil toxicity studies. The Agency recommends that such studies be designed with consideration of the nine Study Evaluation Criteria (Table 3.3) to generate the highest quality data to derive an Eco-SSL. For example, the ideal studies would be conducted using natural soils within the specified soil chemistry conditions, have the highest relative bioavailability (i.e., score = two), and satisfy the other evaluation criteria.

Several standardized soil test procedures are available that can be used to generate the data for deriving Eco-SSLs. Alternative test methods or designs could also be used if they use the appropriate EREs. Whether standardized or other methods are used, experimental design options should be selected that best fit the Study Evaluation Criteria outlined in Table 3.3. To obtain data that best represent natural conditions, investigators are encouraged to incorporate aging/weathering of contaminated soil into their study design. Examples of standard procedures that may be used are described in the following subsections and are listed in Table 3.4.

Soil Invertebrate Toxicity Testing

Several internationally standardized soil invertebrate toxicity tests may be used to generate data for Eco-SSLs. Specifically, three soil toxicity tests are identified as generally appropriate: 1) a 21-day chronic earthworm reproduction (cocoon production) toxicity test (ISO/11268-2:1998),

2) the enchytraeid reproduction test (ISO/16387:2001), and 3) the collembolan reproduction test (ISO/11267:1998) (Table 3.4). These specific tests are recommended as they measure contaminant toxicity during chronic assays, and include at least one reproductive component among the measurement endpoints. Guidelines for these methods have been approved by the International Standards Organization (ISO), and similar efforts are in the final stages of review or approval by one of several national and international organizations (e.g., the Organization for Economic Cooperation and Development (OECD), the American Society for Testing and Materials (ASTM), the European Community, and the Federal Biology Research Cooperative (FBRC)).

Plant Toxicity Testing

There are relatively few standardized plant toxicity test procedures that EPA expects would generate data acceptable for deriving Eco-SSLs (Table 3.4). The EPA guidelines for the early seedling growth and vigor plant test may be used, as well as similar ASTM methods (e.g., ASTM E 1963-98). The use of these procedures may require a modified design to best meet the nine Study Evaluation Criteria.

Table 3.4 Standard Methods Appropriate for use in Generating Data for the Derivation of Plant or Soil Invertebrate Eco-SSLs

Species	Citation
Eisenia fetida	ISO (International Standardization Organization). 1998. Soil Quality – Effects of Pollutants on Earthworms (*Eisenia fetida*) – Part 2: Determination of Effects on Reproduction. ISO 11268-2:1998
Enchytraeus sp.	ISO (International Standardization Organization) (2001). Soil Quality – Effects of Pollutants on Enchytraeidae (*Enchytraeus sp.*) – Determinations of effects on reproduction and survival. ISO/CD 16387.
Folsomia candida	ISO (International Standardization Organization) (1999). Soil Quality – Inhibition of Reproduction of Collembola (*Folsomia candida*) by Soil. ISO 11267:1999.
Terrestrial Plants	ASTM (American Society for Testing and Materials). 2002. Standard Guide for Conducting Terrestrial Plant Toxicity Tests. Designation: E 1963-98 Annual Book of Standards. American Society for Testing and Materials. West Conshohocken, PA.
Terrestrial plants	U.S. EPA (U.S. Environmental Protection Agency). 1996. Ecological effects test guidelines. OPPTS 850.4230: Early seedling growth toxicity test. Report Number EPA 712–C–96–347. Office of Prevention, Pesticides and Toxic Substances, Washington, DC.
Terrestrial plants	U.S. EPA (U.S. Environmental Protection Agency). 1996. *Ecological effects test guidelines. OPPTS 850.4250. Vegetative vigor, Tier II.* Report Number EPA 712–C–96–364. Office of Prevention, Pesticides and Toxic Substances, Washington, DC.
Terrestrial plants	U.S. EPA (U.S. Environmental Protection Agency). 1996. *Ecological effects test guidelines. OPPTS 850.4150. Terrestrial Plant Toxicity, Tier 1: Vegetative vigor*. Report Number EPA 712–C–96–163. Office of Prevention, Pesticides and Toxic Substances, Washington, DC.

This Page Intentionally Left Blank

4.0 DERIVATION OF WILDLIFE ECO-SSLs

Eco-SSLs for wildlife were derived using a five-part process that included: selecting a wildlife risk model, selecting a surrogate species, estimating an exposure dose model, deriving the TRVs, and calculating the Eco-SSL. Wildlife Eco-SSLs were derived for two groups of receptors: mammals and birds. Eco-SSLs were not derived for amphibians or reptiles at this time, as described in Chapter 1.

4.1 The Wildlife Risk Model for Eco-SSLs

The basic equation that was used for estimating potential risks to wildlife was:

$$\text{Hazard Quotient (HQ)} = \frac{\text{Exposure Dose (mg / kg bw / day)}}{\text{No Effect Dose (mg / kg bw / day)}}$$

Contaminant exposure for terrestrial wildlife was expressed as an Exposure Dose in mg/kg bw/day, and the No Effect Dose was represented by a TRV for no adverse effects expressed in the same units.

Steps for Establishing a Wildlife Eco-SSL

1. **Identify the Wildlife Risk Model** - Equation relates the contaminant soil concentration to an acceptable threshold based on a food-chain exposure model.
2. **Select Surrogate Wildlife Species** - Specific indicator species were identified for parameterization of the exposure model.
3. **Estimate Exposure Dose** - Parameterization of the exposure dose model for the estimation of exposure doses for each contaminant.
4. **Derive the Effects Dose or TRV**- Identification of an acceptable dose.
5. **Calculate the Eco-SSL** - Calculation of the Eco-SSLs by solving equation for an HQ=1.

The Eco-SSL is the soil concentration that results in an HQ=1, that is, when the No Effect Dose (TRV) and the Exposure Dose are equal. The Exposure Dose for wildlife was equal to the amount of contaminant in the diet that is taken up or transferred from the soil. Therefore, it was necessary to model the contaminant specific soil concentration that would result in a dietary concentration equal to the Exposure Dose that was equal to the TRV. Estimation of the Exposure Dose is described in Section 4.3. Derivation of the Effect Dose or TRV is described in Section 4.4. Calculation of the Eco-SSLs to solve for an HQ =1 is described in Section 4.5. The full HQ equation is provided in Figure 4.1. In this model, incidental oral soil exposure was added to the total dietary (food-based) exposure, making the total oral exposure greater than 100%. This equation also included terms for the absorbed fraction of the contaminant from soil and the diet as well as an area use factor (AUF) (representing the fraction of time an animal would be exposed). For the purposes of establishing Eco-SSLs, which are conservative screening values, these terms were set equal to one.

Figure 4.1. The Wildlife Risk Model for Eco-SSLs (Equation 4-1)

$$HQ_j = \frac{\left([Soil_j * P_s * FIR * AF_{js}] + [\sum_{i=1}^{N} B_i * P_i * FIR * AF_{ij}] \right) * AUF}{TRV_j}$$

where:

HQ_j	=	Hazard quotient for contaminant (j) (unitless),
$Soil_j$	=	Contaminant concentration for contaminant (j) in soil (mg/kg dry weight),
N	=	Number of different biota types in diet,
B_i	=	Contaminant concentration in biota type (i) (mg/kg dry weight),
P_i	=	Proportion of biota type (i) in diet,
FIR	=	Food ingestion rate (kg food [dry weight]/ kg BW [wet weight] /day),
AF_{ij}	=	Absorbed fraction of contaminant (j) from biota type (i) (for screening purposes set equal to 1).
AF_{sj}	=	Absorbed fraction of contaminant (j) from soil (s) (for screening purposes set equal to 1).,
TRV_j	=	The no adverse effect dose (mg/kg BW/day) (Section 4.4),
P_s	=	Soil ingestion as proportion of diet,
AUF	=	Area use factor (for screening purposes set equal to 1).

4.2 Selection of Surrogate Wildlife Species

It was neither feasible nor necessary to derive an Eco-SSL for each and every wildlife species potentially present at a hazardous waste site; therefore, surrogate species were used to derive wildlife Eco-SSLs. In this approach, specific species were selected as "representatives" for other species within the same class (mammalian or avian) with similar diets. The advantages of focusing Eco-SSLs on representatives within generic trophic groups included, but were not limited to, the following:

- This approach provided generic screening values that could be applied to any site, regardless of the presence or absence of a particular species. The trophic groups selected were expected to be present or potentially present at all sites across the nation.

- This approach provided results that could be used to examine comparative risks associated with different exposure routes (e.g., ingestion of food versus ingestion of soil) representing different contaminant transport pathways (e.g., soil to herbivore, soil to ground insectivore, soil to soil invertebrate, and soil to plant) versus direct soil ingestion.

- This approach was consistent with ERAGS which states: "for the screening-level ERA, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments." (p. 1-7; U.S. EPA, 1997)

Criteria for Selection of Surrogate Taxa

Three general trophic groups (e.g., herbivore, ground insectivore, and carnivore) for both mammals and birds were used for the Eco-SSL wildlife exposure model. Within each of these trophic groups, a specific species was identified as a "surrogate" species. Surrogate species were selected to provide a conservative representation of their respective trophic groups. Selected species were generally small in size relative to other species within their respective trophic groups (e.g., weasels and voles vs. foxes and coyotes or rabbits and deer). Because small size was considered to be associated with higher metabolic rates (Nagy et al., 1999) and smaller home ranges (McNab, 1963), exposure for small receptors was assumed to be high. Eco-SSLs based on these species were therefore likely to be protective of other, larger species in their trophic group.

Selection of specific surrogate species was necessary for parameterizing the Eco-SSL wildlife model, which required estimates of body weights, food ingestion rates, and soil ingestion rates. The following criteria were used to guide the selection of surrogate species for each trophic group:

1) **Exposure pathway link to soil.** Each surrogate species had to have a clear direct or indirect exposure pathway link to soil. Direct exposure pathways to soil included ingestion of soil dwelling biota (e.g., plants or soil invertebrates) and incidental ingestion of soil as a result of foraging at the soil surface (as opposed to from plants). Species with direct exposure pathways to soil were assumed to be the most highly exposed to soil contamination with the exception of contaminants that biomagnify. Indirect exposure included ingestion by carnivores of prey that have direct contact with soil.

2) **Diet Composition.** The selected, surrogate species must forage in terrestrial, upland habitats. This criteria ensured that only potential exposures related to soil contamination were considered and consumption of aquatic prey items (exposures to the aquatic environment) were not considered.

3) **Diet composition can be simplistically classified.** The dietary composition of each surrogate species had to be easily classified into one of the three selected trophic groups (herbivore, ground insectivore, carnivore). Clear classification of diet served to

What Wildlife Groups are not Considered Appropriate for Eco-SSLs?

Some specific wildlife groups were not considered suitable for deriving wildlife Eco-SSLs. These groups include:

- ✕ **Generalist species (e.g., raccoons, jays)** were excluded due to difficulty in defining diet and, therefore, exposure. These species forage opportunistically and are likely to consume different foods in different parts of their range.
- ✕ **Piscivores (e.g., herons, otter)** were excluded due to the lack of a direct exposure pathway to soil.
- ✕ **Aerial Insectivores (e.g., swallows) and Arboreal Insectivores (e.g., warblers)** were excluded as they do not forage primarily from terrestrial environments.

simplify the exposure assumptions related to dietary composition into three classes: plants, invertebrates and animals. Further, the dietary composition for the surrogate species needed to be realistically assumed to consist of a single food type. This assumption allowed for the evaluation of the potential maximum exposure and risk from that dietary pathway. Evaluation of the maximum risk that may be presented by a given pathway (i.e., plants, invertebrates, or vertebrates) produced results that are protective of species with more varied diets. Omnivorous species were assumed to be more likely to consume foods with differing contaminant concentrations. As a result, their total exposure would be less than that for species whose diets that consisted of the single most contaminated food type. By selecting surrogate species that foraged exclusively on a specific food type (plants, invertebrates, or vertebrates), maximum risks were expressed for any given contaminant. This helped to ensure protectiveness of all other species.

4) **Mammalian and avian species identified.** Because toxic responses for the same contaminant could differ among wildlife taxa, surrogate species were selected for both mammals and birds. Based upon the above factors, three mammalian and three avian species (listed in Table 4.1) were selected to represent some of the most highly exposed species. It was assumed that the use of these six species also protected other herbivores, ground insectivores, and carnivores.

4.3 The Exposure Dose

Estimation of the exposure dose associated with contaminant concentrations in soil required parameterization of the general model provided as Equation 4-1.

Reduced Wildlife Risk Model for Screening

The Eco-SSLs are intended to be conservative screening values that can be used to eliminate contaminants clearly not associated with unacceptable risks. Therefore, several simplifying, conservative assumptions were made in the parameterization of the general wildlife risk model (Equation 4-1). These assumptions included:

- Surrogate species were assumed to reside and forage exclusively on and within the contaminated site. Therefore, the area use factor (AUF) was set equal to 1.

- Bioavailability of the contaminant in both soil and food was assumed to be comparable to the bioavailability of the contaminant in the laboratory studies used to establish the TRVs. Therefore, the absorbed fraction from soil (AF_{sj}) and absorbed fraction from biota type i (AF_{ij}) were both equal to 1.

- The surrogate species' diet consisted of just one food type. Therefore, the proportion of biota type in the diet (P_i) was equal to 100% and the number of biota types (N) in diet was equal to 1.

Based on these assumptions, the equation in Figure 4.1 (Equation 4-1) was reduced to:

$$HQ_j = \frac{\left([Soil_j * P_s * FIR] + [\sum_{i=1}^{N} B_i * P_i * FIR] \right)}{TRV_j}$$

Equation 4-2

Parameterizing the Model for Estimating the Exposure Dose

Parameterization of the model included using exposure factors related to the surrogate species (see Table 4.1) and estimating the contaminant concentrations in biota items (B_i) consumed in the diet. The exposure factors identified and derived for surrogate species-specific exposure factors are described in Attachment 4-1. The food and soil ingestion rates used in the exposure model were represented by the 90th percentiles from their respective distributions. Use of exposure parameter values from the upper tails of the distributions ensures the protectiveness of the Eco-SSLs for other wildlife species.

Receptor Group (Surrogate Species)	Body Weight (kg) [1]	Food Ingestion Rate (kg dw/kg bw day) [2]	Soil Ingestion (P_s) [3]	
Mammalian Herbivore (Meadow Vole)	0.039	0.28	0.029	100% foliage
Mammalian Ground Insectivore (Short-tailed shrew)	0.018	0.20	0.03	100% earthworms
Mammalian Carnivore (Long-tailed weasel)	0.202	0.10	0.04	100% small mammals
Avian Grainivore (Mourning dove)	0.115	0.23	0.16	100% seeds
Avian Ground Insectivore (American woodcock)	0.159	0.17	0.12	100% earthworms
Avian Carnivore (Red-tailed hawk)	1.076	0.12	0.05	100% small mammals

Parameterization details provided in Attachment 4-1.
[1] Mean value for both males and females. Derivation of mean presented in Attachment 4-1.
[2] Mean value is presented but the full distribution of body weights (not a conservatively skewed value) was used to derive the food ingestion distributions.
[3] Soil ingestion as proportion of diet.
dw = dry weight

Estimating Contaminant Concentrations in Biota (Dietary Items)

The contaminant concentrations in biota types (B_i) composing the wildlife diets were estimated by assuming that the concentration of the contaminant in the food type could be predicted from the concentration of the contaminant in the soil (C_{soil}) by using a bioaccumulation factor (BAF). The function that typically relates B_i to C_{soil} is a constant, which is referred to as the BAF:

$$B_i = BAF * C_{soil}$$

However, the concentration of the contaminant in the food item may be better described by linear or nonlinear functions that predict bioaccumulation, such as:

$B_i = a * C_{soil} + b$	(linear)
$\ln(B_i) = a * \ln(C_{soil}) + b$	(logarithmic)
$B_i = a + b * (1 - \exp(-c * C_{soil}))$	(exponential)

where a, b, and c are the parameters of the best-fit equation through the paired data (soil versus soil organism or plant). These are referred to as regression models. A hierarchy was established for decision-making concerning the use of available data to estimate contaminant concentrations in biota types (B_i). The following values were used in order of preference:

1) **Existing Regression (R).** If regression models were available and the r-square values were > 0.2, then these were preferentially used. The primary sources of existing regression models were: Sample et al. (1999) for earthworms; Sample et al. (1998a) for small mammals; and Bechtel-Jacobs (1998) for plants.

2) **New Regression (R).** If paired data (contaminant concentrations in soil organism or plant versus soil) were sufficient to establish regression models and these models were significant with r-square values > 0.2, then these regression models were developed and used.

3) **Ratio (BAF).** BAFs (or ratios of the contaminant in soil to the contaminant in the food item) were available from the scientific literature. If reported ratios were not available, then paired data (contaminant in soil versus contaminant in food item) were collected from the literature to derive these ratios.

4) **Estimating BAFs or B_i (M for modeled).** If BAFs were not available in the literature or the paired data were not available to derive the BAF, then the B_i was estimated using existing relationships that estimated B_i based on the physical or chemical parameters of the COC. Existing or new models associating contaminant parameters of the contaminant with the potential for accumulation in biota or plant tissue were used to estimate B_i. These estimation models that were evaluated and reviewed are provided in Attachment 4-1.

5) **Assumptions (A)**. In instances where data were not available to complete any of the previously listed options in the hierarchy (1 to 4) then it was necessary to make assumptions concerning the bioaccumulation of contaminants for soil into B_i. These assumptions are discussed in following subsections.

Figure 4.2 summarizes the method (based on the hierarchy) used for estimating contaminant concentrations in biota types (dietary items) for each of the Eco-SSL contaminants. The following subsections describe how contaminant concentrations were estimated in each of the dietary items including plants and soil invertebrates and small mammals.

How Contaminant Concentrations Are Estimated for Plants and Soil Invertebrates as Dietary Items (B_i)

The specific information concerning how contaminant concentrations were estimated for the plant and soil invertebrate components (B_i) of the diets of the surrogate species is provided as Attachment 4-1. Regressions (R), BAFs, models (M) and assumptions (A) were all used (Figure 4.2).

The existing models for plants produce estimated contaminant concentrations in foliage. Although these data are suitable for receptors that consume foliage (e.g., meadow vole), their suitability for receptors whose diets consist of seeds (e.g., mourning dove) is unknown. To address this issue, a literature search was performed to locate studies in which contaminant concentrations in seeds and in soil were evaluated. The few data located (limited to metals) were plotted over reported soil-to-plant foliage bioaccumulation data (Figure 4.3).

Figure 4.2 Summary of Method Used for Estimation of Contaminant Concentrations in Biota Types (B_i)

COC	Soil to Plant	Soil to Earthworm	Diet to Mammal	Soil to Mammal
Antimony	R	BAF	BAF	NA
Arsenic	BAF	R	NA	R
Barium	BAF	BAF	BAF	NA
Beryllium	BAF	BAF	BAF	NA
Cadmium	R	R	NA	R
Chromium	BAF	BAF	NA	R
Cobalt	BAF	BAF	NA	R
Copper	R	BAF	NA	R
Lead	R	R	NA	R
Manganese	BAF	R	NA	R
Nickel	R	BAF	NA	R
Selenium	R	R	NA	R
Silver	BAF	BAF	NA	BAF
Vanadium	A	A	A	NA
Zinc	R	R	NA	R
Dieldrin	R	M	BAF	NA
DDT	BAF	M	BAF	NA
DDD	BAF	M	BAF	NA
DDE	BAF	M	BAF	NA
PCP	BAF	M	R	NA
PAHs		Specific to Individual PAH		
TNT	M	M	A	NA
RDX	M	M	A	NA

A = Assumption (see text).

BAF = Bioaccumulation Factor.

M = Estimated based on equation relating physical-chemical factor to bioaccumulationl (model).

NA = Not applicable. Only one method is needed for estimating tissue concentrations in mammals based on either diet or soil concentrations.

R = Either existing or new regression uptake model (Attachment 4-1)

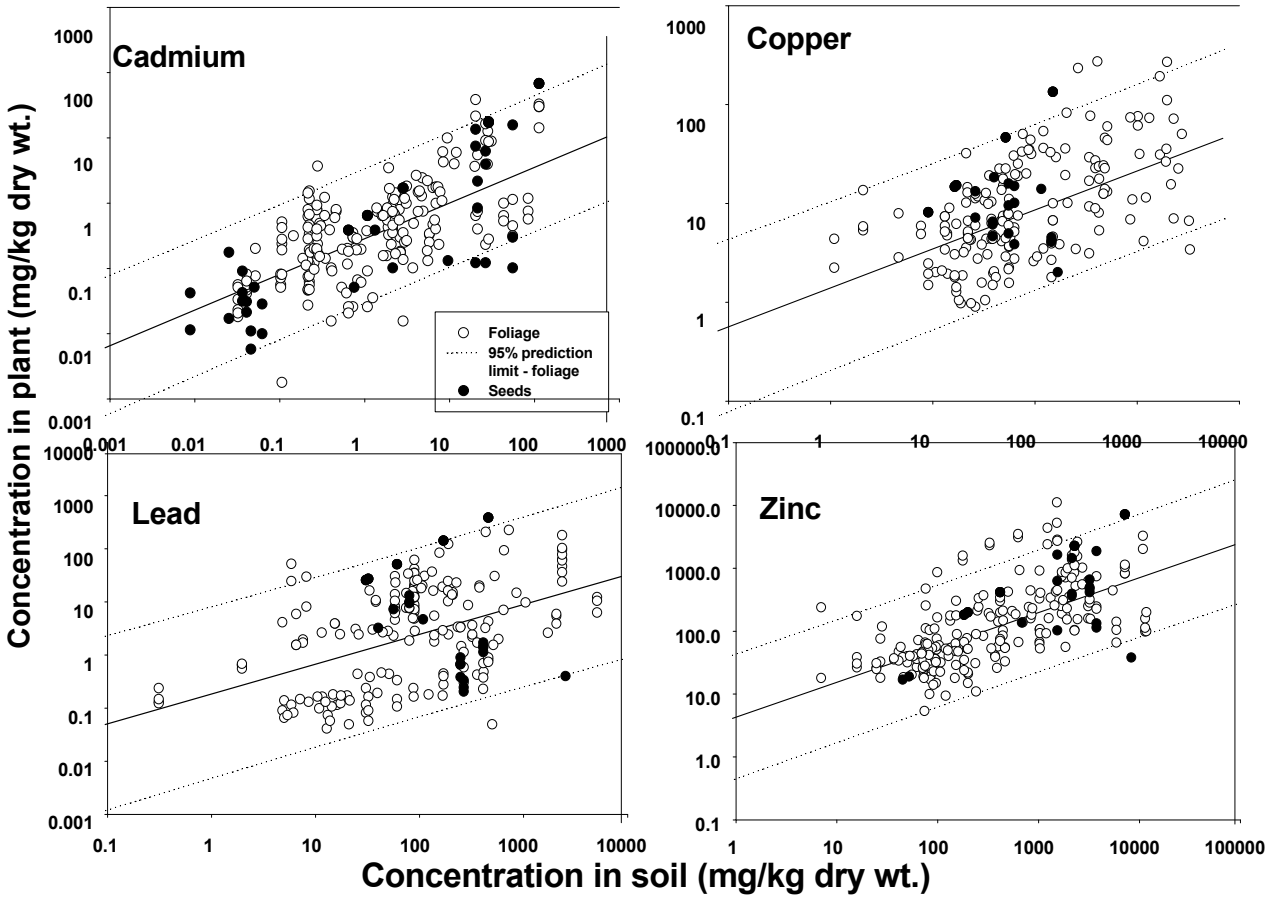


Figure 4.3 Comparison of Soil-to-Foilage and Soil-to-Seed Bioaccumulation for Cadmium, Copper, Lead and Zinc

For cadmium, copper, lead, and zinc soil-to-seed bioaccumulation mirrors the pattern observed for soil-to-foliage bioaccumulation. The degree of spread in the seed bioaccumulation data was comparable to that for foliage data. Based on these data, the models estimating contaminant concentrations in foliage were assumed to be suitable surrogates (at least for metals) for estimating contaminant concentrations in seeds.

How Contaminant Concentrations Are Estimated for Mammals as Dietary Items (B_i)

Empirical soil-whole body log-linear regression models and BAFs were available from Sample et al. (1998a) for 11 of the 24 contaminants. For the remaining organic contaminants for which empirical regression models or BAFs were not available, diet-to-tissue BAFs were estimated using the methods presented in Attachment 4-1.

Although many species of predatory wildlife consume both birds and mammals as prey, few data were available to estimate bioaccumulation of contaminants into birds. As a consequence, the bioaccumulation models for mammals were assumed to produce estimates that adequately represent concentrations in birds. The validity of this assumption was supported by data presented in Beyer et al. (1985). Birds (representing multiple species), white-footed mice, and short-tailed shrews were collected from two locations in the vicinity of a zinc smelter in Pennsylvania. Analyses were available for carcasses (tissue remaining after removal of the gastrointestinal tract, skin, feet, and beaks) for lead, zinc, cadmium, and copper. Mean analyte concentrations (and 95% confidence limits) in birds and mammals from both locations are presented in Figure 4.4. Based on these data, concentrations in birds appear to be approximately equivalent to or less than those found in omnivorous or insectivorous small mammals.

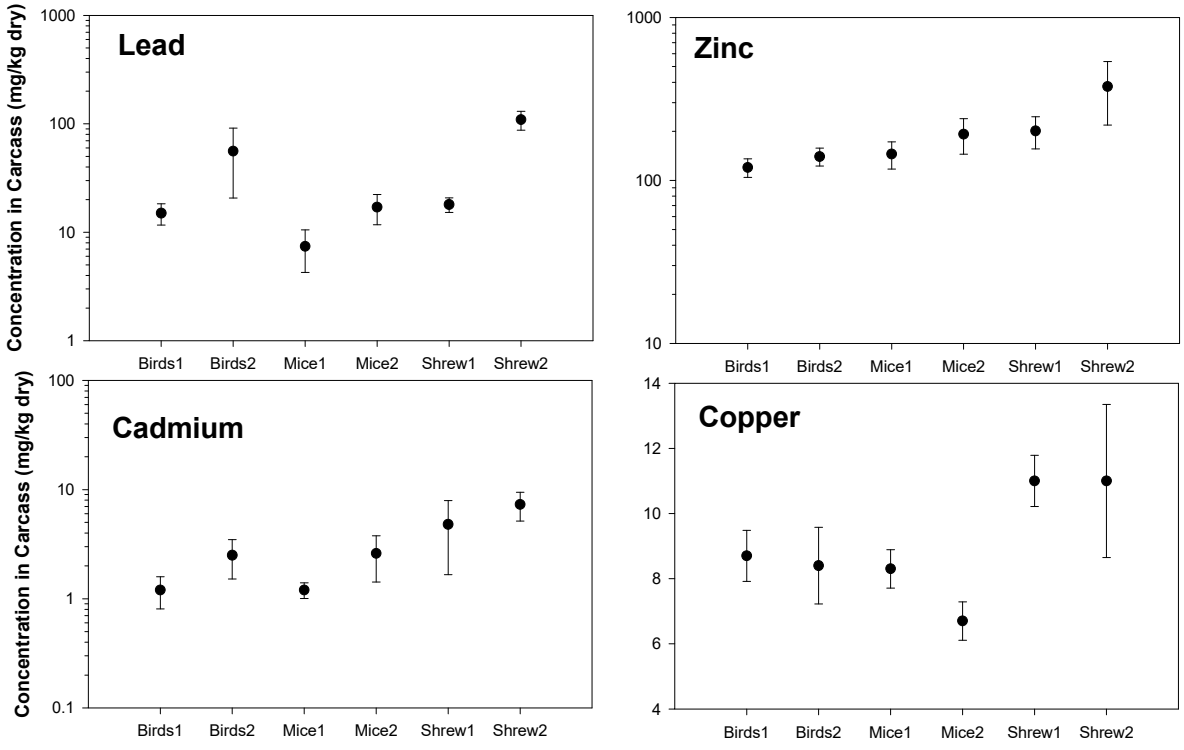


Figure 4.4 Comparison of Mean Concentrations in Multiple Species near a Smelter

What if Data are not Available to Estimate Concentrations in Dietary Items (B_i)?

For some contaminants and biota types (i.e., earthworms and small mammals for antimony, plants and small mammals for beryllium, and earthworms for chromium), data were not available to derive BAFs (as described in Attachment 4-1). For these contaminants, an assumption or default BAF of 1 was used. This assumption was supported by analyses of BAFs for plants, earthworms, and small mammals from Bechtel Jacobs (1998), Sample et al. (1998b), and Sample et al. (1998a), respectively (refer to Table 4.2). Approximately 90% of plant BAFs, 68% of earthworm BAFs and 83% of small mammal BAFs were less than one. Assuming BAFs for inorganic contaminants when data are absent generally over-estimate uptake and are, therefore, suitable for screening purposes only. A default BAF of 1 was also used for organic compounds.

Table 4.2 Cases where the Median of the BAF Distribution for Metals is Greater or Less than One

Biota Type	Total Number of Contaminants	BAFs < 1	BAFs > 1
Plants	21	19	2
Earthworms	31	21	10
Small Mammals	24	20	4

Validation of the Food Ingestion Model

To verify that the food ingestion model was generating realistic values, the modeled food ingestion distributions used in calculating the Eco-SSLs were compared to observed food ingestion rates for each of the six surrogate species. Because the modeled values were expressed as dry weight and food ingestion rates in the literature were generally reported as fresh or wet weight, the modeled food ingestion values were converted to wet weight using water content data for dietary items as reported in U. S. EPA (1993) where assumed water content for plant foliage, earthworms, seeds, and small mammals are 85%, 84%, 9.3%, and 68%, respectively.

The estimated wet-weight (ww) food ingestion rates (and corresponding dry weight (dw) estimates) were calculated for each species (Table 4.3). For all surrogate species the estimated food ingestion rates were within the ranges reported in the literature for actual food consumption by each species. A more detailed discussion and the literature consulted is provided in Attachment 4-1.

Table 4.3 Summary of Estimated Wet and Dry Weight Food Ingestion Rates for Surrogate Wildlife Species.							
Surrogate Species	**Food Intake Units**	**Used in Eco-SSL Calculation (90th percentile)**	**Minimum**	**25th percentile**	**Median**	**75th percentile**	**Maximum**
Meadow Vole	g dw/g bw/d	0.28	0.03	0.1	0.14	0.2	0.70
	g ww/g bw/d (85% moisture)	1.87	0.20	0.67	0.93	1.33	4.67
Mourning Dove	g dw/g bw/d	0.23	0.05	0.11	0.14	0.18	0.52
	g ww/g bw/d (9.3% moisture)	0.25	0.06	0.12	0.15	0.20	0.57
Short-tailed Shrew	g dw/g bw/d	0.20	0.02	0.08	0.11	0.15	0.65
	g ww/g bw/d (84% moisture)	1.25	0.13	0.50	0.69	0.94	4.06
American Woodcock	g dw/g bw/d	0.17	0.05	0.1	0.12	0.14	0.26
	g ww/g bw/d (84% moisture)	1.06	0.31	0.63	0.75	0.88	1.63
Long-tailed Weasel	g dw/g bw/d	0.10	0.01	0.04	0.05	0.07	0.24
	g ww/g bw/d (68% moisture)	0.31	0.03	0.13	0.16	0.22	0.75
Red-tailed Hawk	g dw/g bw/d	0.12	0.03	0.06	0.08	0.1	0.24
	g ww/g bw/d (68% moisture)	0.38	0.09	0.19	0.25	0.31	0.75

4.4 Derivation of Toxicity Reference Values (TRVs)

The wildlife TRV is defined as:

> *Dose above which ecologically relevant effects might occur to wildlife species following chronic dietary exposure and below which it is reasonably expected that such effects will not occur.*

As presented in Figure 4.5, a four-step process was used to select TRVs appropriate for calculating wildlife Eco-SSLs. The four steps included: 1) conduct a literature search, 2) complete a review of the literature and extract data, 3) complete an evaluation of the extracted data and score data, and 4) derive a TRV.

Figure 4.5. Steps of the Wildlife TRV Derivation Process

The wildlife TRV derivation process is composed of four general steps that are documented as separate standard operating procedures (SOPs):

- **Literature Search and Retrieval**
  Wildlife TRV Literature Search and Retrieval (Attachment 4-2). A literature search identifies dose-response literature for retrieval.
- **Literature Review and Data Extraction**
  Wildlife TRV Literature Review, Data Extraction and Coding (Attachment 4-3). The retrieved literature studies are reviewed and data are extracted according to an established coding system. Data are entered into an electronic data base.
- **Data Evaluation**
  Wildlife TRV Data Evaluation (Attachment 4-4). Each of the results identified in the reviewed literature is scored for quality and applicability for TRV derivation.
- **TRV Derivation**
  Wildlife TRV Derivation (Attachment 4-5). This procedure plots the collective dose-response information and establishes the process for estimating the TRV.

Literature Search and Retrieval

The first step in deriving the TRVs was to conduct a literature search to identify toxicological studies for mammals and birds for retrieval and review. The search procedure was described in detail in Attachment 4-2. EPA completed a literature search for 23 of the Eco-SSL contaminants (PCBs were excluded). The search process identified over 44,000 records for review. The literature search process was documented in sufficient detail that others may use it to identify relevant data for additional contaminants not completed by EPA.

Literature Review and Data Extraction

The toxicological literature identified from the literature search was next reviewed for usefulness in establishing wildlife TRVs. Literature exclusion criteria (similar to those discussed in Chapter 3 for plants and soil invertebrates) and listed in detail in Attachment 4-3 were applied to the identified literature. Additional types of studies excluded specifically for wildlife included those that only report genotoxic, mutagenic, or carcinogenic effects, acute or non-oral exposures (inhalation, injection, dermal, etc.), or studies unrelated to the contaminant and receptor groups of interest. Where possible, the literature exclusion criteria were applied to identified titles and abstracts prior to

retrieval of the paper. For retrieved studies that passed the literature exclusion criteria, the relevant toxicological data were extracted and entered into an electronic database according to established extraction and coding procedures detailed as Attachment 4-3. These extraction and coding procedures were consistent with EPA's EcoTox database (USEPA, 2003).

The primary purpose of the data extraction process was to identify two values associated with each study result:

- A no-observed adverse effect level (NOAEL), which is the highest dose that does not cause a statistically significant adverse effect; and
- A lowest-observed adverse effect level (LOAEL), which is the lowest dose that caused a statistically significant adverse effect.

In theory, the threshold for the particular adverse effect lies between the NOAEL and the LOAEL.

Data Evaluation

Each test result extracted during the literature review process was scored for quality and applicability for TRV derivation. The data evaluation process was provided as Attachment 4-4. In instances where more than one "experiment" (i.e., different combinations of test organism (species or strains), contaminant form, test location, control type, doses, application frequency, or route of exposure) were reported in a paper, the individual "experiments" were scored separately. In cases of more than one experiment, the scoring system was applied independently to each experimental result. The scoring system was based on the evaluation of ten attributes of the toxicological study (Figure 4.6) assigning a score for each attribute, ranging from zero (no merit in setting a TRV) to 10 (extremely valuable and relevant to setting a TRV). Note that a low score does not necessarily imply the study itself is poor, only that the study design is not the most appropriate for deriving an oral TRV. The

Figure 4.6 Ten Attributes Scored as Part of the Wildlife Toxicological Data Evaluation

1. **Data Source**
   Primary sources only considered.
2. **Dose Route**
   Dietary studies scored higher than gavage, capsule and liquid. Non oral exposures are excluded.
3. **Test Substance Concentrations**
   Studies with measured exposures scored higher than nominal exposures.
4. **Contaminant Form**
   Contaminant forms similar to soil forms scored higher compared to dissimilar forms.
5. **Dose Quantification**
   Exposures reported as doses scored higher than those reported as concentrations.
6. **Endpoint**
   Reproductive effects scored higher than lethality and growth. Physiology, behavioral, biochemical and pathology changes are scored lower and biomarkers scored lowest.
7. **Dose Range**
   Studies with both NOAEL and LOAEL values scored higher than studies which report only one value. Narrower ranges between NOAEL and LOAEL scored higher.
8. **Statistical Power**
   The statistical power of a NOAEL is scored.
9. **Exposure Duration**
   Exposure durations encompassing multiple generations and critical life stages scored higher than chronic, subchronic, and acute.
10. **Test Conditions**
    Studies that report standard exposure conditions scored higher then those that report fewer or none.

total score was calculated by adding the results of the evaluation of each attribute. The use of total Data Evaluation Score was interpreted as follows:

80 to 100	High confidence
71 to 79	Medium confidence
66 to 70	Low confidence
0 to 65	Not used in Eco-SSL derivation

A web-based data entry system and database was created by EPA as a tool to facilitate efficient, accurate, and consistent data extraction from individual reviewed toxicological studies as well as data evaluation scoring. Extraction of the data directly into an electronic database facilitated necessary sorting, searching and presentation of the data for the purposes of TRV derivation. The TRV database was focused on extracting the NOAEL and LOAEL doses from each of the toxicological studies.

TRV Derivation

The dose-response information for mammals and birds was plotted separately, and a TRV was derived for each class using an established procedure. The process used was documented in Attachment 4-5. The following general steps were completed to derive the TRVs:

Data Sorted. The toxicity data (effect doses) were downloaded from the database into spreadsheet files for each contaminant using a consistent tabular format. One table was constructed for avian data and a second for mammalian data. The tables provided the essential information concerning each of the toxicity testing results. Table 4.4 provides an example using the results for mammals and cobalt. The results were numbered sequentially and sorted by general effect group, then by effect measure.

Data Plotted. Summary plots were constructed depicting the NOAELs and LOAELs for each contaminant. Separate plots were completed for mammalian and avian data. The data plots (example provided as Figure 4.7) were organized by General Effect Group in order from left to right as: biochemical (BIO), behavior (BEH), physiology (PHY), pathology (PTH), reproduction (REP), growth (GRO), and mortality (MOR). Within each toxicological study there may be several effect measures reported that have the same NOAEL and/or LOAEL values. Inclusion of the NOAEL and LOAEL values for all endpoint measures would result in repetitive values on the plots. To avoid the inclusion of repetitive and duplicative data, the results for only one Effect Measure per Effect Group were recorded on the plots. For example a study may report more the one adverse reproductive effect such as reduced progeny weight and also progeny survival and also reduced number of litters. In this case only one effect was coded for the most conservative "worst case" result.

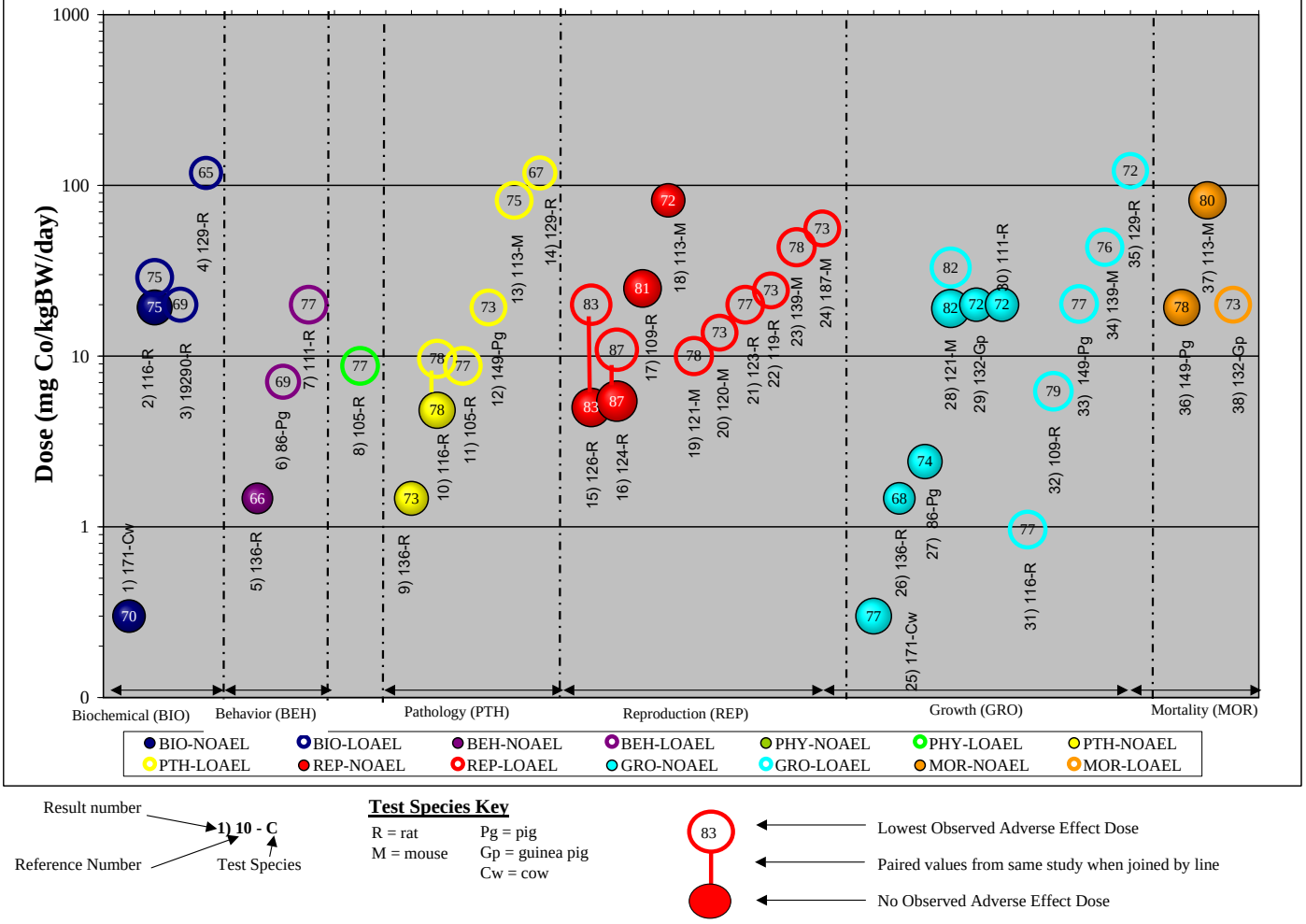
Exclusion of Data with Limited Utility in Establishing an Eco-SSL. Each NOAEL and LOAEL result was evaluated according to the Data Evaluation process (Attachment

Table 4.4. Example of Extracted and Sorted Data for Wildlife TRV Derivation (Cobalt)

Result #	Reference	Ref No.	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	General Effect Group	Effect Measure	Response Site	NOAEL Dose (mg/kg/day)	LOAEL Dose (mg/kg/day)	Data Evaluation Score
Biochemical Effects																		
1	Maro et al., 1980	171	Cow (*Bos taurus*)	2	M	FD	45	d	7	mo	JV	F	BIO	HMGL	BL	0.30		70
2	Chetty et al., 1979	115	Rat (*Rattus norvegicus*)	6	U	FD	4	w	NR	NR	NR	B	BIO	HMGL	BL	19	29	75
3	Kadiiska et al., 1985	19290	Rat (*R. norvegicus*)	2	U	DR	30	d	NR	NR	JV	M	BIO	P450	LI		20	69
4	Derr et al., 1970	129	Rat (*R. norvegicus*)	2	U	DR	35	d	NR	NR	JV	M	BIO	HMCT	BL		118	65
Behavioral Effects																		
5	Gershbein et al., 1983	136	Rat (*R. norvegicus*)	2	U	FD	80	d	44	d	JV	M	BEH	NMVM	WO	1.5		66
6	Huck and Clawson, 1976	86	Pig (*Sus scrofa)*	4	U	FD	28	d	NR	NR	NR	NR	BEH	FCNS	WO		7.1	69
7	Bourg et al., 1985	111	Rat (*R. norvegicus*)	2	M	DR	57	d	80	d	JV	M	BEH	ACTP	WO		20	77
Physiology Effects																		
8	Haga et al., 1996	105	Rat (*R. norvegicus*)	2	U	FD	16	w	NR	NR	NR	M	PHY	Other	HE		8.8	77
Pathology Effects																		
9	Gershbein et al., 1983	136	Rat (*R. norvegicus*)	2	U	FD	80	d	44	d	JV	M	PTH	GHIS	NR	1.5		73
10	Chetty et al., 1979	116	Rat (*R. norvegicus*)	6	U	FD	4	w	NR	NR	NR	B	PTH	SMIX	TS	4.8	9.6	78
11	Haga et al., 1996	105	Rat (*R. norvegicus*)	2	U	FD	16	w	NR	NR	NR	M	PTH	BDWT	WO		8.8	77
12	Van Vleet et al., 1981	149	Pig (*S. scrofa)*	2	U	FD	10	w	NR	NR	JV	M	PTH	GLSN	HE		19	73
13	Seidenberg et al., 1986	113	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	GE	F	PTH	BDWT	WO		82	75
14	Derr et al., 1970	129	Rat (*R. norvegicus*)	2	U	DR	35	d	NR	NR	JV	M	PTH	SMIX	HE		118	67
Reproductive Effects																		
15	Nation et al., 1983	126	Rat (*R. norvegicus*)	3	U	FD	69	d	80	d	MA	M	REP	TEWT	TE	5.0	20	83
16	Domingo et al., 1985	124	Rat (*R. norvegicus*)	4	U	GV	28	d	NR	NR	MA	F	REP	PRWT	WO	5.4	11	87
17	Paternain et al., 1988	109	Rat (*R. norvegicus*)	4	U	GV	9	d	NR	NR	GE	F	REP	PRWT	WO	25		81
18	Seidenberg et al., 1986	113	Mouse (*M. musculus*)	2	U	GV	5	d	NR	NR	GE	F	REP	PROG	WO	82		72
19	Pedigo et al., 1988	121	Mouse (*M. musculus*)	4	U	DR	13	w	10	w	MA	B	REP	RSUC	WO		10	78
20	Anderson et al., 1992	120	Mouse (*M. musculus*)	2	U	DR	9	w	12	w	MA	M	REP	TEWT	TE		14	73
21	Corrier et al., 1985	123	Rat (*R. norvegicus*)	2	U	FD	70	d	100	d	SM	M	REP	TEDG	TE		20	77
22	Mollenhauer et al., 1985	119	Rat (*R. norvegicus*)	2	U	FD	98	d	100	d	MA	M	REP	TEWT	TE		24	73
23	Anderson et al., 1993	139	Mouse (*M. musculus*)	2	U	DR	13	w	12	w	MA	M	REP	TEWT	TE		43	78
24	Pedigo et al., 1993	187	Mouse (*M. musculus*)	2	U	DR	10	w	8 to 10	w	JV	M	REP	PRFM	WO		56	73
Growth Effects																		
25	Maro et al., 1980	171	Cow (*Bos taurus*)	2	M	FD	45	d	7	mo	JV	F	GRO	BDWT	WO	0.30		77
26	Gershbein et al., 1983	136	Rat (*R. norvegicus*)	2	U	FD	80	d	44	d	JV	M	GRO	BDWT	WO	1.5		68
27	Huck and Clawson, 1976	86	Pig (*S. scrofa)*	4	U	FD	16	w	NR	NR	NR	NR	GRO	BDWT	WO	2.4		74
28	Pedigo et al., 1988	121	Mouse (*M. musculus*)	4	U	DR	5	w	6 to 7	w	SM	M	GRO	BDWT	WO	19	33	82
29	Mohiuddin et al., 1970	132	Guinea pig (*Cavia porcellus*)	2	U	OR	5	w	NR	NR	MA	M	GRO	BDWT	WO	20		72
30	Bourg et al., 1985	111	Rat (*R. norvegicus*)	2	M	DR	57	d	80	d	JV	M	GRO	BDWT	WO	20		72
31	Chetty et al., 1979	116	Rat (*R. norvegicus*)	6	U	FD	4	w	NR	NR	NR	B	GRO	BDWT	WO		0.96	77
32	Paternain et al., 1988	109	Rat (*R. norvegicus*)	4	U	GV	9	d	NR	NR	GE	F	GRO	BDWT	WO		6.2	79
33	Van Vleet et al., 1981	149	Pig (*Sus scrofa)*	2	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO		20	77
34	Anderson et al., 1993	139	Mouse (*M. musculus*)	2	U	DR	13	w	12	w	MA	M	GRO	BDWT	WO		43	76
35	Derr et al., 1970	129	Rat (*R. norvegicus*)	2	U	DR	24	d	NR	NR	JV	M	GRO	BDWT	WO		122	72
Mortality Data																		
36	Van Vleet et al., 1981	149	Pig (*S. scrofa)*	2	U	FD	10	w	NR	NR	JV	M	MOR	MORT	NR	19		78
37	Seidenberg et al., 1986	113	Mouse (*M. musculus*)	2	U	GV	5	d	NR	NR	GE	F	MOR	MORT	NR	82		80
38	Mohiuddin et al., 1970	132	Guinea pig (*Cavia porcellus*)	2	U	OR	5	w	NR	NR	MA	M	MOR	SURV	WO		20	73

ACTP = activity level; B = both; BIO = biochemical; BL = blood; d = days; BDWT = body weight changes; BEH = behavior; DR = Drinking water; F = female; FCNS = food consumption; FD = food; GE = gestation; GRO = growth; GLSN = gross lesions; GV = gavage; HE = heart; HMCT = hematocrit; HMGL = hemoglobin; JV = juvenile; LI = liver; MA = mature; M = male; M = measured; m = months; MOR = mortality, NMVM = number of movements; NR = Not reported; OR = other oral; PHY = physiology; PTH = pathology; PRFM = sexual performance; REP = reproduction; SM = sexually mature; SMIX = weight relative to body weight; SURV = survival; TE = testes; TEDG = testes degeneration; TEWT = testes weight; U = unmeasured; w = weeks; WO = whole organism

Figure 4.7 Example of a Toxicological Plot for the TRV Derivation Process (Cobalt)



Result number → **1) 10 - C** ← Test Species

Reference Number

Test Species Key

R = rat	Pg = pig
M = mouse	Gp = guinea pig
	Cw = cow

83 — Lowest Observed Adverse Effect Dose

Paired values from same study when joined by line

No Observed Adverse Effect Dose

4-4) and scored within a range of 0 to 100 (worst to best) for usefulness in establishing an oral TRV. Data with limited utility were defined as study endpoints receiving a Total Data Evaluation Score of 65 or less. These data points were excluded from the plots. The purpose of the exclusion was to ensure that the TRV derivation used the most suitable data.

TRV Selected. The general steps and conditional statements of the derivation process are outlined in Figure 4.8. These steps are an a priori framework for selection of the TRV value based on the results of the toxicological plots. The flow chart (Figure 4.8) is used with the toxicity data plots to derive the TRV according to the described steps. The TRV is equal to the geometric mean of the NOAEL values for growth (GRO) and reproductive (REP) effects. In cases where the geometric mean NOAEL is higher than the lowest bounded LOAEL (bounded refers to a LOAEL that has a paired NOAEL) for either, GRO, REP or mortality (MOR), the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL. An example is provided using the mammalian cobalt plot depicted as Figure 4.9.

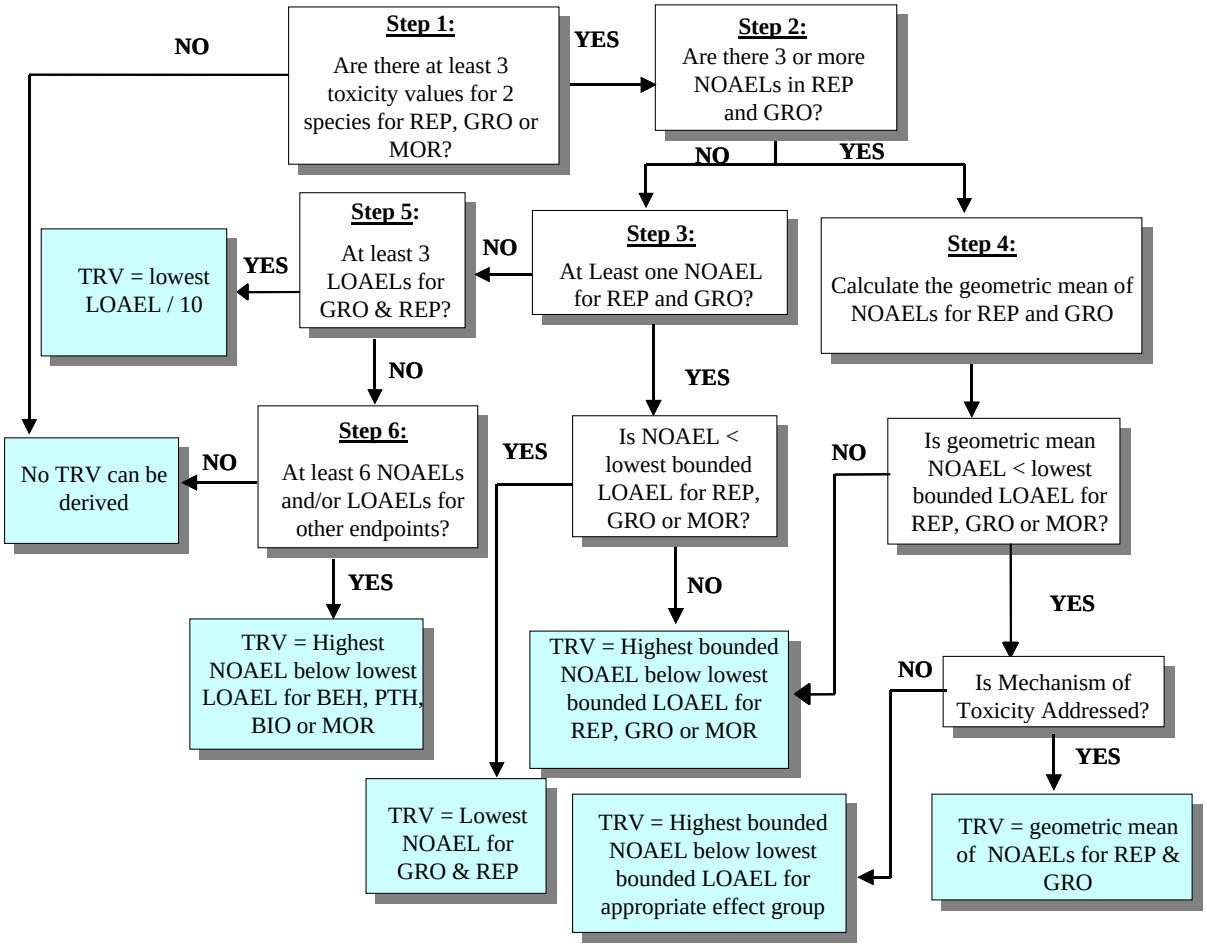
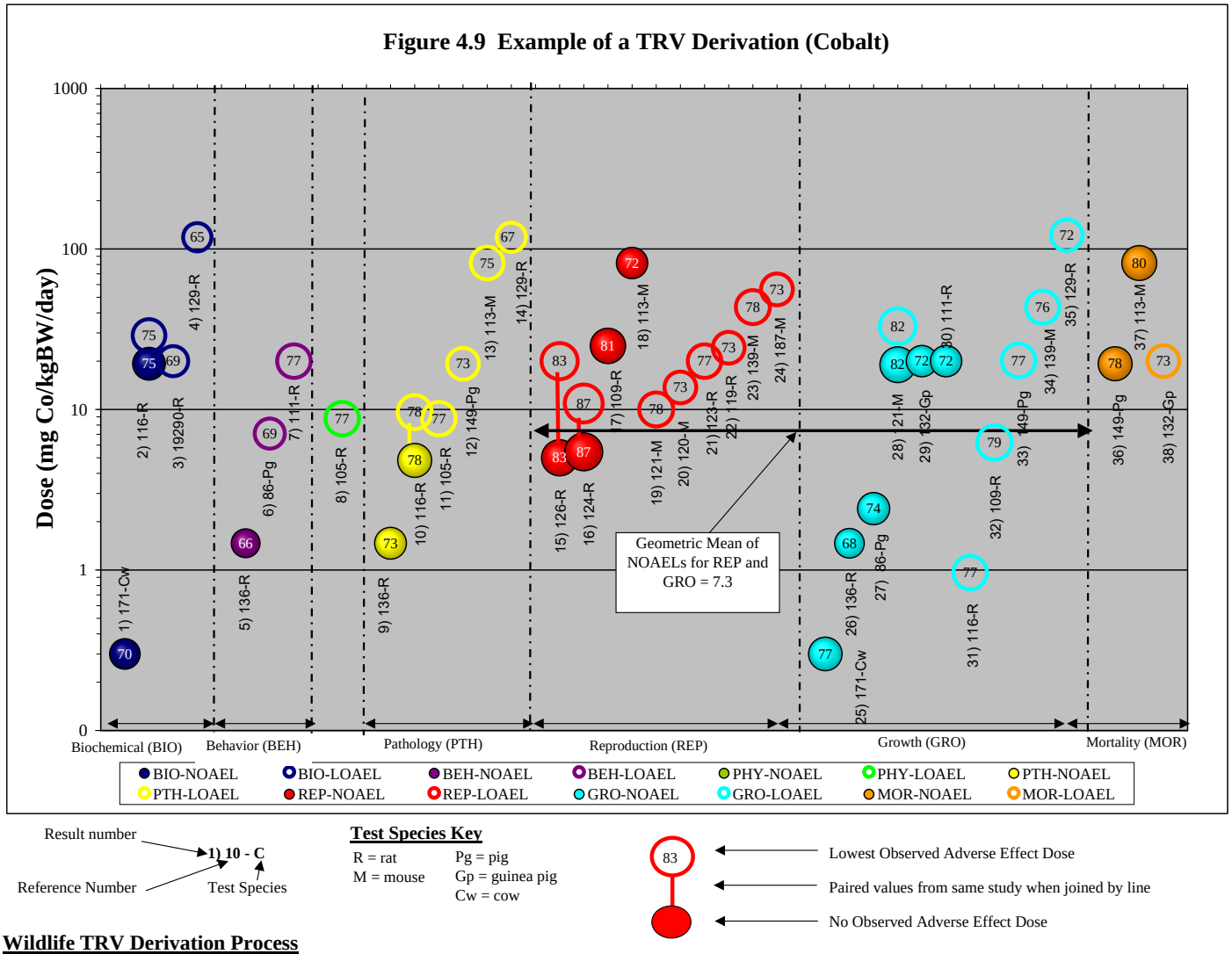


Figure 4.8 Procedure for Deriving the Wildlife Toxicity Reference Value (TRV)

Figure 4.9 Example of a TRV Derivation (Cobalt)



Result number → **1) 10 - C** ← Test Species

Reference Number

Test Species Key

R = rat	Pg = pig
M = mouse	Gp = guinea pig
	Cw = cow

83 — Lowest Observed Adverse Effect Dose; Paired values from same study when joined by line; No Observed Adverse Effect Dose

Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the GRO, REP and MOR effect groups. There is enough data to derive TRV.

2) There are are at least three NOAEL results available for calculation of a geometric mean.

3) The geometric mean of the NOAEL values for GRO and REP equals 7.3 mg Co/kg BW/day.

4) The geometric mean NOAEL value is less than the lowest bounded LOAEL for REP, GRO or MOR.

5) The mammalian wildlife TRV for cobalt is equal to 7.3 mg Co/kg BW/day.

4.5 Calculation of Wildlife Eco-SSLs

The Eco-SSL wildlife risk model (Equation 4-2) was expressed in two forms, depending on the method used to estimate contaminant concentrations in food items (B_i).

1) If a BAF was used to estimate the contaminant concentrations in food items leave, then the equation was:

where:

T_{ij} = soil-to-biota BAF (units- dry weight to dry weight) for contaminant (j) for food type (i)

$$HQ_j = \frac{\left([Soil_j * P_s * FIR] + [\sum_{i=1}^{N} (Soil_j * T_{ij}) * P_i * FIR]\right)}{TRV_j} \qquad \textit{(Equation 4-3)}$$

2) If regression models were used, then the equation was:

$$HQ_j = \frac{\left([Soil_j * P_s * FIR] + [\sum_{i=1}^{N} e^{B0_{ij} + ln(Soil_j) * B1_{ij}} * P_i * FIR]\right)}{TRV_j} \qquad \textit{(Equation 4-4)}$$

where:

e = Napierian constant (2.7182818),

$B0_{ij}$ = Intercept from log-linear bioaccumulation model for contaminant (j) for biota type (i), and

$B1_{ij}$ = slope from log-linear bioaccumulation model for contaminant (j) for biota type (i)

The general procedure for calculating the wildlife Eco-SSL involved inverting the BAF or log-linear forms of the exposure models (Equations 4-3 and 4-4, respectively) to determine the contaminant concentration in soil that was equivalent to an HQ = 1. The exposure models that employed BAFs were a simple linear function of the soil concentration and were inverted algebraically. However, when the exposure model incorporated the log-linear bioaccumulation models, numerical methods were required. The solution of the Eco-SSL exposure model when a simple BAF was used is outlined in the following steps. Equation 4-3 was rewritten as:

$$HQ_j = \frac{\left([P_s * FIR] + [\sum_{i=1}^{N} (T_{ij}) * P_i * FIR]\right) * Soil_j}{TRV_j} \qquad \textit{(Equation 4-5)}$$

Multiplication of both sides of Equation 4-5 by $\frac{1}{\text{Soil}_j}$ and $\frac{1}{\text{HQ}_j}$ produced:

$$\frac{1}{Soil_j} = \frac{\left([P_s * FIR] + [\sum_{i=1}^{N} (T_{ij}) * P_i * FIR]\right)}{TRV_j * HQ_j} \qquad \textit{(Equation 4-6)}$$

Inversion of Equation 4-6 produced:

$$Soil_j = \frac{TRV_j * HQ_j}{\left([P_s * FIR] + [\sum_{i=1}^{N} (T_{ij}) * P_i * FIR]\right)} \qquad \textit{(Equation 4-7)}$$

where:

Soil_j = the Eco-SSL for contaminant j for wildlife and TRV_j was equal to a no-effect level.

Solution of the log-linear form of the wildlife Eco-SSL model was more complex than the BAF-based model. Solution of the log-linear form of the model was accomplished by solving Equation 4-4 where the HQ = 1 using a computer spreadsheet program.

Wildlife Eco-SSLs. In order to calculate wildlife Eco-SSLs, Equation 4-7 was rearranged, with the removal of all parameters that were set to 1, resulting in the following simplified model:

$$Soil_j = \frac{TRV_j}{FIR*[P_s + T_{ij}]} \qquad \textit{(Equation 4-8)}$$

where:

Soil_j = Contaminant concentration for contaminant (j) in soil (mg/kg dry weight),
FIR = Food ingestion rate (kg food [dry weight]/ kg bw [wet weight] / d),
P_s = Soil ingestion as proportion of diet,
TRV_j = Toxicity reference value for contaminant (j) (mg [dry weight]/kg bw [wet weight] /d),
T_{ij} = Soil-to-biota BAF for contaminant (j) for biota type (i).

In some cases where soil-to-biota BAFs were not available it was necessary to use a string of BAFs (for example: (BAF for soil to earthworm + BAF for earthworm to shrew) in which case the equation was reduced to:

$$Eco-SSL_{pred} = \frac{TRV_j}{FIR*[P_s + (T_{ij} * T_{ver})]} \qquad \textit{(Equation 4-9)}$$

where:

T_{ver} = diet-to-biota BAF

Conservatism of Model Parameterization

The purpose of the Eco-SSLs is to identify concentrations of contaminants in soil that may present a risk, from those concentrations that clearly do not. As a screening tool, the Eco-SSLs should be conservative, but not so much so that no concentrations pass the screen. To this end, the wildlife Eco-SSL model was parameterized using a combination of conservatively skewed and non-conservatively skewed parameter values. The level of conservatism associated with the model parameter values is summarized in Table 4.5. Whereas the TRVs, food and soil ingestion rates, diet composition, area use, and bioavailability were all conservatively skewed, all bioaccumulation values were based on central tendency estimates.

Sensitivity Analysis of the Wildlife Eco-SSL Model

Parameterization of the final wildlife EcoSSL model was accomplished by selecting a combination of conservative and central tendency values from distributions for the different parameters. For example, whereas food and soil ingestion rates were defined as the 90th percentile from their respective distributions, bioaccumulation was defined by central tendency values (median values for T_{ij} and T_{ver}, least -squares regression output for log-linear bioaccumulation estimates). To evaluate the relative influence of parameter values to the final Eco-SSL value, nominal range sensitivity analyses (Cullen and Frey 1999) were performed. The results of the sensitivity analyses were included in Attachment 4-1.

Parameter	Value selected for use in calculation of Eco-SSL	Conservatism of Value	
Toxicity Reference Value (TRV)	highest bounded NOAEL below the lowest bounded LOAEL or the geometric mean of NOAELs for REP or GRO	moderate	Represents highest dose that did not cause any adverse effects in any test species
Food Ingestion Rate (FIR)	90th percentile	high	Conservatively-skewed value selected to represent majority of individuals within population without being over protective.
Soil Ingestion Rate (P_s)	90th percentile	high	Conservatively-skewed value selected to represent majority of individuals within population without being over protective.
Soil-Biota Bioaccumulation Factor (T_{ij})	median	neither conservative nor anti-conservative	Lowest uncertainty - not expected to over-predict concentrations
Diet-Biota Bioaccumulation Factor (T_{ver})	median	neither conservative nor anti-conservative	Lowest uncertainty - not expected to over-predict concentrations
log-linear regression models for bioaccumulation	Best-fit least-squares model	neither conservative nor anti-conservative	Lowest uncertainty - not expected to over-predict concentrations
Diet composition (P_i)	100% plant, small mammal, or soil invertebrate (depending on trophic group)	high	Maximum pathway-specific exposure to allow screening of risks by pathway. Consistent with Superfund Ecological Risk Assessment Guidance (EPA 1997)
Area Use Factor (AUF)	100%	high	Consistent with Superfund Ecological Risk Assessment Guidance (EPA 1997)
Bioavailability (Af_{ij}, AF_{sj})	Equivalent to that for the chemical form used to develop the TRV	high	Consistent with Superfund Ecological Risk Assessment Guidance (EPA 1997)

5.0 ECO-SSL DOCUMENTS

Presented in this chapter is a description of the format and content of the Eco-SSL documents which report the results of the Eco-SSL derivation procedures as described in the previous chapters. Each document is structured with the following standard sections. However, the structure is not followed for iron and aluminum where the documents specifically review the chemistry, bioavailability, and toxicity in soils instead of providing numeric screening levels. EPA is continuing to evaluate existing toxicity studies (primarily for birds and mammals) and intends to issue additional Eco-SSL documents in the future. These documents will be posted on the afore mentioned website as they become available. The following subsections describe the basic components of each of the documents.

Introduction

The introduction to each contaminant summary provides a brief review of the contaminant including environmental forms, sources, background concentrations, mechanisms of toxicity, and essential elemental status if applicable. These summaries are intended to provide the reader with a general introduction only and do not represent an exhaustive review of the environmental fate and effects of the contaminant. It is recommended that the user of the Eco-SSL values review site-specific data concerning contaminant sources and possible fate and transport processes to evaluate as necessary the site-specific properties of the contaminant in soils. The general introductory material is based on a review of literature obtained during the search process for plants and soil invertebrates and wildlife. Some review material is based on information available from the Hazardous Substances Databank (HSDB), a database of the National Library of Medicine's TOXNET system (http://toxnet.nlm.nih.gov). Some Eco-SSLs for metals are within the range of reported background concentrations that may occur at sites without any contaminant release due to hazardous waste management activities. As part of the Eco-SSL project, available data for the background concentrations of metals are summarized in Table 2.3 (see Chapter 2) and Attachment 1-4.

Summary Table

This subsection of each document contains a summary table of the Eco-SSL values calculated for each receptor group expressed as mg contaminant per kg dw soil. If an Eco-SSL could not be calculated for a receptor group then “NC” is noted for not calculated. In some cases, the Eco-SSL is pending further review of toxicity information. In these cases, “pending” is noted. The Eco-SSL values are rounded to two significant digits.

Eco-SSL for Plants

This subsection describes the results of the derivation of an Eco-SSL value for terrestrial plants completed according to the procedures describe in Chapter 3 and appropriate Attachments.

Eco-SSL for Soil Invertebrates

This subsection describes the results of the derivation of an Eco-SSL value for soil invertebrates completed according to the procedures described in Chapter 3 and Attachments.

Eco-SSL for Avian Wildlife

This subsection describes the results of the derivation of an Eco-SSL value for avian wildlife. The subsection provides only the data used to derive the Eco-SSL according to the procedures described in Chapter 4 and Attachments. The results are provided as two parts.

- Toxicity Reference Value
- Estimation of Dose and Calculation of the Eco-SSL

Eco-SSL for Mammalian Wildlife

This subsection describes the results of the derivation of an Eco-SSL value for mammalian wildlife. The subsection provides only the data used to derive the Eco-SSL according to the procedures described in Chapter 4 and Attachments. The results are provided as two parts.

- Toxicity Reference Value
- Estimation of Dose and Calculation of the Eco-SSL.

References

The references are provided as the last subsection of each document. The references are segregated by receptor with separate lists for plants and soil invertebrates and wildlife. The references for each receptor are further segregated into two lists. The first list provides the papers used to derive the Eco-SSL and the second list provides the papers that were rejected for use. For each of the papers rejected the reason for the rejection is listed.

Appendices

A complete tabulation of the toxicity data used to derive the wildlife toxicity reference values (TRVs) is provided as an appendix.

6.0 REFERENCES

Abou-Donia, M.B. and D. G. Graham. 1978. Delayed neurotoxicity from long term low-level topical administration of Leptophos to the comb of hens. *Toxicology and Applied Pharmacology.* 46: 199-213.

Alexander, M. 1995. How toxic are toxic chemicals in soil? *Environ. Sci. Technol.* 29: 2713-2717.

Allen, H., S. McGrath, M. McLaughlin, W. Peijnenburg, and S. Suave. 1999. *Bioavailability of Metals in Terrestrial Ecosystems.* Draft Document.

Anderson, W.C., R. C. Loehr, and B. P. Smith. 1999. *Environmental Availability of Chlorinated Organics, Explosives, and Heavy Metals in Soils.* American Academy of Environmental Engineers.

Anderson, M. B., Lepak, K., Farinas, V., and George, W. J. 1993. Protective action of zinc against cobalt-induced testicular damage inthe mouse. *Reprod. Toxicol*. 7(1): 49-54.

Anderson, M. B., Pedigo, N. G., Katz, R. P., and George, W. J. 1992. Histopathology of testes from mice chronically treated with cobalt. *Reprod. Toxicol*. 6(1): 41-50.

Barber, S.A. 1995. *Nutrient Bioavailability - A Mechanistic Approach.* John Wiley and Sons.

Barnhart, J. 1997. Chromium Chemistry and Implications for Environmental Fate and Toxicity. 1997. *Journal of Soil Contamination*. 6(6): 561-568.

Betchel-Jacobs. 1998. *Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants.* Oak Ridge National Laboratory BJC/OR-133. Bechtel Jacobs Company L.L.C.

Beyer, W. N., O. H. Pattee, L. Siteo, D. J. Hoffman, and B. M. Mulhern. 1985. Metal contamination in wildlife living near two zinc smelters. *Environ. Poll. Series A.* 38(1): 63-86.

Bohn, H., B. McNeal, and G. O'Connor. 1985. *Soil Chemistry.* 2nd ed. John Wiley and Sons.

Bourg, W. J., Nation, J. R., and Clark, D. E. 1985. The effects of chronic cobalt exposure on passive-avoidance performance in the adult rat. *Bull. Psychon. Soc.* 3(6): 527-530.

Canadian Council of Ministers of the Environment (CCME). 1997. *Recommended Canadian Soil Quality Guidelines.* March 1997.

Chetty, K. N., Subba, R. A. O. D SV, Drummond, L., and Desaiah, D. 1979. Cobalt-induced *changes in immune response and atpase activities in rats. J Environ. Sci. Health Part B*

Pestic. Food. Contam. Agric. Wastes. 14(5): 525-544.

Corrier, D. E., Mollenhauer, H. H., Clark, D. E., Hare, M. F., and Elissalde, M. H. 1985. Testicular degeneration and necrosis induced by dietary cobalt. *Vet Pathol*. 22(6): 610-6.

Cullen, A.C. and H.C. Frey. 1999. *Probabilistic Techniques in Exposure Assessment. A Handbook for Dealing with Variability and Uncertainty in Models and Inputs.* New York: Plenum Press.

Derr, R. F., Aaker, H., Alexander, C. S., and Nagasawa, H. T. 1970. Synergism between cobalt and ethanol on rat growth rate. *J. Nutr*. 100(5): 521-524.

Domingo, J. L., Paternain, J. L., Llobet, J. M., and Corbella, J. 1985. Effects of cobalt on postnatal development and late gestation in rats upon oral administration. *Rev Esp Fisiol.*

Driver, C.J., M. W. Ligotke, P. V. Van Voris, B. D. McVeety, and B. J. Greenspan. 1991. Routes of uptake and their relative contribution to the toxicologic response of northern bobwhite (*Colinus virginianus*) to an organophosphate pesticide. *Environ. Tox. and Chem.* 10: 21-33.

Efroymson, R. A., M. E. Will, and G. W. Suter II. 1997a. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil And Litter Invertebrates and Heterotrophic Process:* 1997 Revision. ES/ER/TM-126/R2. Prepared for the U.S. Department of Energy, Office of Environmental Management by Lockheed Martin Energy Systems, Inc. managing the activities at the Oak Ridge National Laboratory (ORNL).

Efroymson, R.A., M.E. Will, G. W. Suter II and A.C. Wooten. 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants:* 1997 Revision. ES/ER/TM-85/R3. Prepared for the U.S. Department of Energy, Office of Environmental Management by Lockheed Martin Energy Systems, Inc. managing the activities at the Oak Ridge National Laboratory (ORNL).

Gershbein, L. L., Gershbein, J. D., and French, R. 1983. Behavior of male rats fed low levels of metallic salts. *Res Commun Chem Pathol Pharmacol. 39(3):507-510.*

Gertsl, Z. 1990. Estimation of Organic Chemical Sorption by Soils. *Journal of Contaminant Hydrology.* 6: 357-375.

Haga, Y., Clyne, N., Hatroi, N., Hoffman-Bang, C., Pehrsson, S. K., and Ryden, L. 1996. Impaired myocardial function following chronic cobalt exposure in an isolated rat heart model. *Trace Elements and Electrolytes*. 13(2): 69-74.

Hansen, B.G., A. B. Paya-Perez,, M. Rahman, and B. R. Larsen. 1999. QSARs for Kow and Koc of PCB congeners: a critical examination of data, assumptions, and statistical approaches. *Chemosphere* 39: 2209-2228.

Henderson, J. D., J. T. Yamamoto, D.M. Fry, J. N. Seiber, and B. W. Wilson. 1994. Oral and dermal toxicity of organophosphate pesticides in the domestic pigeon (*Columba livia*). *Bulletin of Environ. Contam. Toxicol*. 52: 633-640.

Huck, D. W. and Clawson, A. J. 1976. Excess dietary cobalt in pigs. *J Anim Sci*. 43(6): 1231-1246.

James, B.R., J.C. Petura, R.J. Vitale, and G.R. Mussoline. 1997. Oxidation-Reduction Chemistry of Chromium: Relevance to the Regulation and Remediation of Chromate-Contaminated Soils. *Journal of Soil Contamination.* 6(6): 569-580.

Jones, D.S., G. W. Suter, and R. N. Hull. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota:* 1997 Revision. ES/ER/TM-95/R4. Prepared for the U.S. Department of Energy, Office of Environmental Management by Lockheed Martin Energy Systems, Inc. managing the activities at the Oak Ridge National Laboratory (ORNL).

Kuperman, R. G., Checkai, R. T., Phillips, C. T., and Simini, M. 2002. *Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Enchytraeid Reproduction Benchmark Values.* Rep.Doc.#ECBC-TR-XXX (Draft) , 81 p.

Lagrega, M. 1994. *Hazardous Waste Management.* McGraw-Hill, Inc.

Lee, L. S., P. S. C. Rao, P. Nkedi-Kizza, and J. J. Delfino. 1990. Influence of solvent and sorbent characteristics on distribution of pentachlorophenol in octanol-water and soil-water systems. *Environ. Sci. Tech.* 24: 654-661.

Lindsay, W. L. 1979. *Chemical Equilibria in Soils.* John Wiley & Sons, New York.

Linz, D. G. and D. V. Nakles. 1997. *Environmentally Acceptable Endpoints in Soil: Risk-Based Approach to Contaminated Site Management Based on Availability of Chemicals in Soil.* American Academy of Environmental Engineers. Annapolis, MD.

Loehr, R. C. and M. T. Webster. 1996. Effect of Treatment on Contaminant Availability, Mobility and Toxicity. Chapter 2. In: *Environmentally Acceptable Endpoints in Soils.* D. Linz, and D. Nakles (eds.), American Academy of Environmental Engineers. Annapolis, MD.

Lyman, W. J., W. F. Reehl, and D. H. Rosenblatt. 1990. *Handbook of Chemical Property Estimation Methods.* McGraw-Hill, New York.

McNab, B. K. 1963. Bioenergetics and the determination of home range size. *Am. Nat.* 97:133-140.

Maro, J. K., Kategile, J. A., and Hvidsten, H. 1980. Studies on copper and cobalt in dairy calves. *British Journal of Nutrition*. 44(1): 25-31.

Miller, R.W. and D. T. Gardiner. 1998. *Soil in Our Environment*, 8th edition, Prentice Hall, Upper Saddle River, NJ.

Mohiuddin, S. M., Taskar, P. K., Rheault, M., Roy, P. E., Chenard, J., and Morin, Y. 1970. Experimental cobalt cardiomyopathy. *Am Heart J.* 80(4): 532-543.

Mollenhauer, H. H., Corrier, D. E., Clark, D. E., Hare, M. F., and Elissalde, M. H. 1985. Effects of dietary cobalt on testicular structure *Virchow Arch* [Cell Pathol]. 49(3): 241-248.

Nagy, K. A., I. A. Girard, and T. K. Brown. 1999. Energetics of free-ranging mammals, reptiles, and birds. *Ann. Rev. Nutr.* 19: 247-277.

Nation, J. R., Bourgeois, A. E., Clark, D. E., and Hare, M. F. 1983. The effects of chronic cobalt exposure on behavior and metallothionein levels in the adult rat. *Neurobehav Toxicol Teratol*. 5(1): 9-15.

Paternain, J. L., Domingo, J. L., and Corbella, J. 1988. Developmental toxicity of cobalt in the rat. *J. Toxicol. Environm. Health*. 24(2):193-200.

Pedigo, N. G. and Vernon, M. W. 1993. Embryonic losses after 10-week administration of cobalt to male mice. *Reprod. Toxicol.* 7: 111-116.

Pedigo, N. G., George, W. J., and Anderson, M. B. 1988. Effects of acute and chronic exposure to cobalt on male reproduction in mice. *Reprod Toxicol* . 2(1): 45-53.

Pignatello, J. J. 2000. The measurement and interpretation of sorption and desorption rates for organic compounds in soil media. In: *Advances in Agronomy*, Vol. 69, Academic Press, San Diego, CA.

Phillips, C. T., Checkai, R. T., Kuperman, R. G., and Simini, M. 2002. *Toxicity Assessment of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (Eco-SSL) Using Folsomia Reproduction Benchmark Values.* Rep.Doc.#ECBC-TR-XXX (Draft) , 98 p.

Rijksinstituut Voor Volksgezondheid en Milieu (RIVM). 1997a. National Institute of Public Health and Environment. *Maximum Permissible Concentrations and Negligible Concentrations for Pesticides*. T. Crommentuijn, D.F. Kalf, M.D. Polder, R. Posthumus and E.J. van de Plassche. October, 1997.

Rijksinstituut Voor Volksgezondheid en Milieu (RIVM). 1997b National Institute of Public Health and Environment. *Maximum Permissible Concentrations and Negligible Concentrations for Metals.* T. Crommentuijn, D.F. Kalf, M.D. Polder, R. Posthumus and E.J. van de Plassche.

Sample, B. E., J. J. Beauchamp, R. Efroymson, and G. W. Suter, II. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. *Environmental Toxicology and Chemistry*. 18: 2110-2120.

Sample, B. E., D. M. Opresko, and G. W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision.* ES/ER/TM-86/R3. Prepared for the U.S. Department of Energy, Office of Environmental Management by Lockheed Martin Energy Systems, Inc. managing the activities at the Oak Ridge National Laboratory (ORNL).

Sample, B. E, J. J. Beauchamp, R. A. Efroymson, and G. W. Suter, II. 1998a. *Development and Validation of Bioaccumulation Models for Small Mammals.* Oak Ridge National Laboratory ES/ER/TM-219. Lockheed Martin Energy Systems Environmental Restoration Program.

Sample, B. E, J. J. Beauchamp, R. A. Efroymson, G. W. Suter, II and T.L. Ashwood. 1998b. *Development and Validation of Bioaccumulation Models for Earthworms.* Oak Ridge National Laboratory ES/ER/TM-220. Lockheed Martin Energy Systems Environmental Restoration Program.

Schwarzenbach, R. P., P.M. Gschwend, and D. M. Imboden. 1993. Environmental Organic Chemistry. In: *Methods of Soil Analysis, Part 2, Microbiological and Biochemical Properties,* 2nd Edition.. R. W. Weaver et al (eds.), Agronomy Monograph 9, Agronomy Science of America. Soil Science Society of America. Wiley-Interscience. Madison, WI. p. 63.

Seidenberg, J. M., Anderson, D. G., and Becker, R. A. 1986. Validation of an in vivo developmental toxicity screen in the mouse. *Teratog Carcinog Mutagen.* 6:361-374.

Sumner, M.E. (ed). 2000. *Handbook of Soil Science*. CRC Press, Boca, Raton. FL.

Syracuse Research Corp. (SRC). Physical Properties Database. http://esc.syrres.com/interkow /PhysProp.htm

United States Environmental Protection Agency (U.S. EPA). 2003. ECOTOX (ECOTOXicology) database http://www.epa.gov/ecotox/.

United States Environmental Protection Agency (U.S. EPA). 2002. *Role of Background in the CERCLA Cleanup Program.* U.S. EPA Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, April 26, 2002. OSWER 9285.6-07P.

United States Environmental Protection Agency (U.S. EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-28.P.

United States Environmental Protection Agency (U.S. EPA). 1998. *Guidelines for Ecological Risk Assessment.* Risk Assessment Forum. U.S. Environmental Protection Agency, Washington DC. EPA/630/R-95/002F. April. May 14, 1998 Federal Register 63(93): 26846-26924.

United States Environmental Protection Agency (U.S. EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. U.S. Environmental Protection Agency, Environmental Response Team (Edison, NJ). June 5, 1997.

United States Environmental Protection Agency (U.S. EPA). 1996. *Soil Screening Guidance: Technical Background Document.* Office of Emergency and Remedial Response, Washington, D.C., EPA/540/R-95/128. May.

United States Environmental Protection Agency (U.S. EPA). 1995. *Internal Report on Summary of Measured, Calculated, and Recommended Log K_{ow} Values.* U.S. Environmental Protection Agency, Office of Water, Washington, D.C. 38 pp.

United States Environmental Protection Agency (U.S. EPA). 1993. *Wildlife Exposure Factors Handbook, Volumes 1 and II.* U.S. Environmental Protection Agency. EPA/600/R-93/187a and b.

Van Vleet, J. F., Boon, G. D., and Ferrans, V. J. 1981. Induction of lesions of selenium-vitamin E deficiency in weanling swine fed silver, cobalt, tellurium, zinc, cadmium, and vanadium. Am. J. *Vet. Res.* 42(5): 789-799.

Verschueren, K. 1996. *Handbook of Environmental Data on Organic Chemicals.* 3rd ed. Van Nostrand Reinhold, New York, NY, USA.

Weissmahr, K.W., S.B. Haderlein, and R.P. Schwarzenbach. 1998. Complex formation of soil minerals with nitroaromatic explosives and other pi-acceptors. *Soil Science Society of America Journal.* 62: 369-378.

Weissmahr, K.W., M. Hildenbrand, R. P. Schwarzenbach, and S. B.Haderlein. 1999. Laboratory and Field Scale Evaluation of Geochemical Controls on Groundwater Transport of Nitroaromatic Ammunition Residues. *Environ. Sci. Technol.* 33 (15): 2593 –2600.

Witschi, H.R., and J.A. Last. 1996. Toxic responses of the respiratory system. In: *Casarett and Doull's Toxicology,* 5th Edition, pp 443-462. C.D. Klaassen (ed.), McGraw-Hill, New York.

SETAC PRESS

Environmental Toxicology and Chemistry
© 2012 SETAC
Printed in the USA
DOI: 10.1002/etc.2030

Environmental Toxicology

EFFECTS OF SILVER NANOPARTICLES AND SILVER NITRATE IN THE EARTHWORM REPRODUCTION TEST

KARSTEN SCHLICH,†‡ THORSTEN KLAWONN,† KONSTANTIN TERYTZE,‡ and KERSTIN HUND-RINKE*†
†Fraunhofer Institute for Molecular Biology and Applied Ecology, Schmallenberg, Germany
‡Institute of Geological Sciences, Berlin, Germany

(*Submitted* 13 *July* 2012; *Returned for Revision* 8 *August* 2012; *Accepted* 28 *August* 2012)

Abstract—The widespread use of silver nanoparticles (Ag-NPs), for example, in textiles and cleaning products, means that they are likely to reach the environment via biosolids or the effluent from wastewater treatment plants. The aim of the present study was to determine the ecotoxicity of Ag-NPs in the earthworm reproduction test using *Eisenia andrei*. In addition to the usual endpoints, the authors also investigated the uptake and accumulation of Ag by adult earthworms and the concentration of free Ag^+ in soil pore water. Silver nanoparticles and Ag nitrate showed similar toxicities in the earthworm reproduction test. The uptake of Ag from Ag-NPs in the earthworm was slightly higher than the uptake of Ag from Ag nitrate. Spiked soils showed a concentration-dependent effect on reproduction, but there was no concentration-dependent increase in the amount of Ag in earthworm tissues. The authors noted a concentration-dependent increase in the levels of free Ag^+ in the soil pore water regardless of the Ag source. The number of juveniles is a more suitable endpoint than biomass or mortality. The uptake of Ag does not appear to inhibit reproduction. Instead, inhibition seems to reflect Ag^+ released into the soil pore water, which affects cocoons and juveniles in the soil. Analysis of transformed Ag-NPs after purification in wastewater treatment plants would provide additional information. Environ. Toxicol. Chem.
© 2012 SETAC

Keywords—Silver nanoparticles Toxicity Accumulation *Eisenia andrei* Reproduction

INTRODUCTION

Silver nanoparticles (Ag-NPs) are advantageous in textiles, microelectronics, inks, medical imaging reagents, and cleaning products [1,2]. According to the Inventory of Nanotechnology-based Consumer Products (Project on Emerging Nanotechnologies), Ag nanotechnology is currently present in more than 313 commercial products. The predominant commercial application of Ag-NPs is in the health and fitness sector, which includes personal care products, clothing, cosmetics, sporting goods, filtration units, and sunscreens (Woodrow Wilson International Center for Scholars, 2011). The rising use of engineered NPs (especially Ag-NPs) increases the potential for environmental contamination and adverse effects.

Large numbers of studies concerning the effects of Ag-NPs in the aquatic environment are already available. Calculations of predicted environmental concentrations (PECs) based on probabilistic material flow analysis from a life-cycle perspective of different engineered NPs revealed that Ag-NP from sewage treatment effluents and surface waters may increase risks to aquatic organisms [3]. Studies with various aquatic organisms have demonstrated the hazard of Ag-NPs, which can induce respiratory stress in the Eurasian perch [4], phytotoxicity in *Lemna minor* [5], and hepatocyte damage in rainbow trout (*Oncorhynchus mykiss*) [6]. Many other studies have considered the fate and behavior of Ag-NPs released from textiles and from nanosilver-coated washing machines into wastewater treatment plants (WWTPs). Physical separation and ion-selective electrode (ISE) analysis suggest that both colloidal and ionic Ag leach from socks [7]. The amounts depend on the total Ag content in the products and the stability of the linkage between the silver particles and the product matrix [8]. Significant amounts of Ag are released into the environment from nanosilver-coated washing machines and finally reach the effluent of WWTPs [9]. A mass balance analysis of Ag in a WWTP indicated that more than 95% of the incoming Ag was sequestered into the wastewater biomass [10]. Transmission electron microscopy (TEM) analysis confirmed that nanoscale Ag particles were adsorbed to wastewater biosolids. X-ray absorption spectroscopy (XAS) measurements indicated that most Ag in sludge and effluent was present as Ag_2S when Ag-NPs were added to the nonaerated tank of a pilot plant. The addition of Ag-NPs to aerated mixed liquor increased the stability of Ag-NPs [11]. Silver from Ag-NPs is therefore likely to reach terrestrial ecosystems via activated sludge when it is applied as agricultural fertilizer.

Despite the large number of studies concerning the influence of Ag-NPs in the aquatic environment, few have considered their impact on terrestrial ecosystems. Engineered NPs may enter soil via biosolids originating from wastewater treatment or the effluent from manufacturing processes and can inhibit organisms in the terrestrial ecosystem [12]. There is a growing concern that restrictions on the use of biosolids as agricultural fertilizers may have to be implemented to account for the presence of Ag-NPs [7]. In terrestrial ecosystems, Ag-NPs may have adverse effects on soil microflora [13,14] and (in a limit test) on earthworms [15]. Further studies have demonstrated the effect of Ag-NP surface coatings on bioaccumulation and earthworm reproduction [16], and the role of particle size and soil type on the toxicity of Ag-NPs to the earthworm *Eisenia fetida* [17].

To gain more insight into the effects of Ag-NPs in the terrestrial environment, we used the earthworm reproduction test according to Organisation for Economic Co-operation and

* To whom correspondence may be addressed (kerstin.hund-rinke@ime.fraunhofer.de).
Published online 11 October 2012 in Wiley Online Library (wileyonlinelibrary.com).

Development (OECD) guideline 222 [18] and exposed the earthworms to Ag-NPs by spiking the soil. Several aspects were considered to develop a more comprehensive understanding of the ecotoxicity of Ag-NPs, specifically Ag-NP NM-300K from the OECD Sponsorship Program. Silver nitrate was used as a reference material in all tests, because this should indicate where the effects of Ag are caused by particles or ions released from particles.

The first objective was to provide information about the ecotoxicity of Ag-NPs in the earthworm reproduction test according to OECD guideline 222 [18] by addressing the following endpoints: mortality, biomass increase, and number of offspring. In addition to the usual endpoints in the standardized reproduction test, we also investigated the uptake and bioaccumulation of Ag in adult earthworms. According to the guideline, adult earthworms were removed after 28 d and used to determine the concentration of Ag after their gut had been purged. It was important to determine the toxic impact of the particles and of released silver ions (Ag^+) in comparison with a pure Ag^+ source (Ag nitrate), so the amount of Ag^+ in pore water was determined with diffusive gradients in thin films (DGT) in addition to the total Ag concentration.

MATERIALS AND METHODS

Test soil

The test and carrier soil for the application was RefeSol 01A, a loamy, medium-acidic, and lightly humic sand (pH 5.67; C_{org} 0.93%, sand 71%, silt 24%, clay 5%), which has been described in detail elsewhere [19]. RefeSol 01A matches the properties as stated in various OECD terrestrial ecotoxicological guidelines (e.g., tests with plants and soil microflora). The soils were sampled in the field and were stored and treated according to good agricultural practice. They were stored outdoors in stainless-steel containers, red clover was sown on the stored soils, and no pesticides were used. Appropriate amounts of soil were sampled from the outdoor boxes one to four weeks before the test. If the soil was too wet for sieving, it was dried at room temperature to 20 to 30% of the maximum water-holding capacity (WHC_{max}), with periodic turning to avoid surface drying. If the tests did not start immediately after sieving, the soil was stored in the dark at 4°C under aerobic conditions [20].

Materials and methods

We used the Ag-NP NM-300K from the OECD Sponsorship Program. This is from the same initial material batch of NM-300, which is one of the best-characterized nanomaterials from the official NM materials. It is a colloidal Ag dispersion with a nominal Ag content of 10% (w/w) and a particle size of approximately 15 nm, with a narrow size distribution (99%). A second particle size of 5 nm, which is much less abundant (1%), was identified by TEM. The NM-300K is a mixture of a stabilizing agent (NM-300K DIS) comprising 4% (w/w) each of polyoxyethylene glycerol trioleate and polyoxyethylene sorbitan monolaurate (Tween-20) and the Ag-NPs. The release of ions from NM-300K particles into the matrix under storage conditions was estimated to be less than 0.01% (w/w) [21]. The Ag nitrate was purchased from Merck KGaA.

Test organism

We used *Eisenia andrei*, which has been cultured in our laboratory for more than 15 years. The earthworms were bred under defined conditions (1:1 mixture of cow manure and sphagnum peat at 20 ± 2°C and a light:dark cycle of 16:8 h). Three days prior to the test, the earthworms were adapted to the test soil under experimental conditions ($WHC_{max} = 55\%$), with free access to food. In the test, we only used earthworms with a clitellum and a wet mass of 300 to 500 mg.

Application and test concentration

Silver nanoparticles were applied by mixing the test material and air-dried carrier soil with the same physicochemical properties as the test soil. Enough Ag-NPs were added to the carrier to achieve the final test concentration when 5% carrier soil and 95% test soil were mixed to homogeneity. The soil was mixed with a spoon instead of a pestle to avoid modifying the Ag-NPs. Uncontaminated soil (at 20–30% WHC_{max}) was spread on a plate, and the spiked carrier soil was evenly distributed over the test soil before mixing. The mixed soil was adjusted to 55% WHC_{max} using deionized water. This procedure was preformed for every test concentration.

All concentrations refer to the dry matter of soil. The first test was carried out using concentrations of 60, 120, and 200 mg Ag-NPs per kilogram dry matter soil, and the second test was carried out using concentrations of 15, 30, 60, 120, and 200 mg/kg soil. Silver nitrate was applied at concentrations of 15, 30, 60, 120, and 200 mg/kg soil in both tests. In all tests with NM-300 K, the stabilizing agent NM-300 K DIS was used as a dispersant control. The amount of dispersant corresponded to the highest test concentration with Ag-NPs.

Ecotoxicological test

All tests were carried out as described in OECD guideline 222, "Earthworm reproduction test with *Eisenia fetida*" [18], which allows the use of *E. fetida* and *E. andrei* as test organisms. We filled polypropylene containers (Bellaplast GmbH) to a depth of approximately 5 cm with 625 g dry mass of soil (55% WHC_{max}) and then spread 40 g wet mass of cow dung (air dried, ground, and moistened before application) onto the surface. The cows were kept in an ethical husbandry. The tests were performed in eight replicates for the negative control and four replicates for the dispersant control and each Ag-NP and Ag nitrate concentration. For chemical analysis with DGT devices, we prepared single analytical test replicates for each concentration to avoid exposing the earthworms to stress.

After overnight equilibration of the treated soils, 10 earthworms were added to each container and were incubated at 20 ± 2°C with a light:dark cycle of 16:8 h (~700 lux). Once per week, the water content was checked gravimetrically, the evaporated water was replaced, and 20 g wet mass (corresponding to 5 g dry mass) of uncontaminated food was spread onto the soil surface in each container. After 28 d, the adult earthworms were removed and weighed, and after 56 d, the number of juveniles in each test container was counted. Statistical calculations were performed with ToxRat Pro 2.10 software for ecotoxicity response analysis (ToxRat Solutions GmbH). For the median effective concentration (EC50) calculation, we use da probit analysis, assuming log-normal distribution of the values. For each concentration, we determined the percentage of mortality, the percentage of loss or gain in biomass of the adults, and the number of offspring produced in the test.

Silver content in earthworms and soil

Earthworms were incubated for 24 h on wet filter paper to purge their gut and then frozen at −20°C. Homogeneous material was prepared by freezing the earthworms in liquid N, followed by coarse and then fine grinding using mortar and

pestles of different grades under a laminar-flow hood, transferring the powder to cryoproof vials stored directly above liquid N (−150°C), and lyophilizing until the samples reached constant weights in a Christ Alpha 1–2 freeze dryer (Martin Christ GmbH). Approximately 200 mg homogenized and lyophilized powder was digested in a quartz vessel with 5 ml concentrated nitric acid, heated in a microwave for 25 min at 220°C, held at 220°C for 30 min, and allowed to cool to room temperature for 1 h. The initial pressure was 40 bar. After digestion, the vessels were filled to an exact volume of 20 ml with ultrapure water. This digestion procedure is in accordance with the guidelines for chemical analysis published by the German Federal Environment Agency (http://www.umweltprobenbank.de/en/documents/publications/15363).

The Ag content of the test soil was measured for representative 15 and 120 mg/kg soil samples. Six samples were obtained from the master batch after the application of Ag-NPs. The digestion procedure was carried out according to DIN ISO 11466 [22] and DIN EN 13346 [23]. Prior to digestion, the soil was dried at 105°C until the weight was constant for at least 12 h, and 3 g of the homogenized material was mixed with 28 g aqua regia and incubated at room temperature for 16 h without agitation. The mixture was then heated under reflux for 2 h, with glass chips and several drops of 1-octanole to prevent overboiling and foaming. The mixture was cooled to room temperature and then carefully made up to 100 ml and filtered prior to analysis (0.45-μm syringe filter, Supor membrane; Pall Corporation).

Silver concentrations in aqueous samples of digested soil and earthworms were measured by inductively coupled plasma–optical emission spectrometry (ICP–OES) using an IRIS Intrepid II ICP-OES (Thermo Electron) at wavelengths of 328.068 and 338.289 nm. The instrument was calibrated before each measurement using blank, 1.0, 2.5, 5.0, 10, 25, 50, 100, or 250 μg/L solutions depending on the concentration range in the samples. The calibration formula was calculated using the linear regression algorithm of the ICP–OES instrument software. Spectral interference was observed at 338.289 nm, so the 328.068-nm readings were used to calculate the concentrations. The correlation coefficient was at least 0.99995. For each sample, at least three measurements were taken, and the mean was determined by the instrument software.

Nitric acid was of Suprapur quality (supplied by Carl Roth). The water was purified using an ELGA Pure Lab Ultra water purification system (purified water resistivity $>18\,M\Omega \times cm$). A commercially available Ag ICP standard containing 1,000 mg/L Ag in 2 to 3% nitric acid was used to prepare appropriate stock and calibration solutions. All prepared standard solutions had a final HNO_3 concentration of 3%. The reference material NIST 2977 Mussel Tissue (info value of 4.58 mg Ag/kg; purchased from LGC Standards) was digested and analyzed along with the earthworm samples to verify the procedures. Furthermore, aqueous certified reference material TMDA-70 (Environment Canada; certified concentration 10.9 μg Ag/L) was analyzed along with all samples. The analytical method was also verified using a multielement Merck IV Standard, appropriately diluted to fit in the range of samples.

The bioaccumulation factors (BAFs) were determined as described in OECD guideline 317 [24]. Therefore, total Ag concentrations measured in the earthworms were divided by the nominal concentrations of Ag in the soil. Silver concentrations in the worms were compared using the Williams multiple sequential *t* test procedure ($\alpha = 0.05$).

Diffusive gradients in thin films

We used DGT devices (obtained from DGT Research Ltd.) comprising a layer of Chelex resin impregnated in a hydrogel, overlain with a diffusive layer of hydrogel and a filter. Ions must diffuse through the filter and diffusive layer to reach the resin layer, where they are collected for downstream analysis and quantitation. The resulting concentration gradient in the diffusive layer allows the quantitation of metal concentrations in solution without the need for calibration (www.dgtresearch.com). The DGT devices were prepared by equilibrating in 0.01 mol/L NaCl with argon purging for 1 h, then for 24 h in a sealed container under argon. Two DGT devices were carefully introduced into the analytical test replicates with the diffusive layer facing upward and covered with soil and were left in situ for 48 h. The DGT application to the soil began on days 0, 26, and 54. After removal, the devices were rinsed thoroughly with ultrapure water and wrapped in polyethylene bags for storage at 4°C for no longer than 4 d. The resin layer was then extracted and directly transferred into 1.5 ml 1 mol/L nitric acid for the elution of Ag^+ for at least 24 h. After adjustment to a precise volume with 1 mol/L nitric acid, the Ag content of the solution was determined by ICP-MS using an Agilent 7500ce ICP-MS instrument (Agilent Technologies). Silver was detected at the isotope 109. Calibrations were performed prior to measurement depending on the concentration range in the samples. The calibration formula was calculated using the linear regression algorithm of the ICP-MS instrument software.

The amount of Ag^+ in the DGTs was calculated following the manufacturer's recommendations (www.dgtresearch.com) and was expressed as the mass per liter of pore water. Before exposing the DGTs to soil, the dry matter content was determined (79.2–89.3% in all tests), which allowed the amount of soil per liter of pore water to be calculated. These calculations were combined, yielding the amount of Ag^+ per kilogram dry matter soil. The percentage from the nominal concentration was taken into consideration to determine whether increasing concentrations of Ag-NPs increase the concentration of free Ag^+.

RESULTS

Ecotoxicological test

The reproduction test results are presented in Table 1, whereas Table 2 shows the calculated ECx, lowest observed effect concentration (LOEC), and no observed effect concentration (NOEC) values. The Ag-NPs and silver nitrate were tested twice, and all tests fulfilled test guideline validity criteria, that is: (1) ≥30 juveniles must be produced in each of the replicate negative control vessels by the end of the test; (2) the reproductive coefficient of variation in the negative control vessels must be ≤30%; and (3) adult mortality in the negative control vessels over the initial four weeks of the test must be ≤10%.

At the beginning of the test, the earthworms tried to escape from the 120 and 200 mg/kg soil test vessels. However, after 24 h, all earthworms went back into the soil, although some tried to stay in the food that had been spread over the top of the soil. This avoidance behavior was observed throughout the tests with Ag-NPs and Ag nitrate, until the adults were removed. There was no significant mortality in either the Ag-NP or the Ag nitrate treatments.

In both Ag-NP tests, the increase in biomass of the adult earthworms was similar in the negative control and dispersant control (36–40%). In replicates with Ag-NPs, the increase in

Table 1. Results of the earthworm reproduction test with silver nanoparticles and silver nitrate

Concentration (mg/kg soil)[a]	Mortality (%)	Changes in biomass (%)[b]	Mean number of juveniles per test vessel ± SD	SD (%)	Inhibition (%) to negative control	Inhibition (%) to dispersant control
Test 1 (Ag-NP)						
0 (negative control)	0	36	347 ± 27	7.8	—	—
0 (dispersant)	0	39	329 ± 4	1.1	5.2	—
60	0	49*	186 ± 22	11.6	46.4***	43.5***
120	0	43*	147 ± 24	16.4	57.6***	55.3***
200	0	46*	86 ± 18	21.4	75.2***	73.8***
Test 2 (Ag-NP)						
0 (negative control)	0	40	341 ± 26	7.6	—	—
0 (dispersant)	0	36	268 ± 45	16.8	21.5**	—
15	0	62*	252 ± 31	12.3	26.3***	6.2
30	0	61*	209 ± 46	22.0	38.9***	22.1**
60	0	61*	220 ± 30	13.6	35.7***	18.1*
120	0	67*	158 ± 18	11.4	53.7***	41.0***
200	0	63*	97 ± 26	26.8	71.7***	64.0***
Test 3 (silver nitrate)						
0 (negative control)	0	36	347 ± 27	7.8	—	—
15	0	57*	261 ± 24	9.4	24.9*	—
30	0	55*	202 ± 17	8.2	41.8*	—
60	0	59*	158 ± 28	17.9	54.4*	—
120	0	56*	107 ± 16	15.2	69.1*	—
200	0	54*	64 ± 21	32.5	81.5*	—
Test 4 (silver nitrate)						
0 (negative control)	0	27	240 ± 14	5.7	—	—
15	0	52*	183 ± 17	9.5	23.9*	—
30	0	53*	121 ± 13	10.5	49.6*	—
60	7.5	43*	120 ± 7	5.4	49.9*	—
120	0	57*	69 ± 4	6.0	71.5*	—
200	15.0	35*	18 ± 5	25.3	92.5*	—

[a] Dry matter soil.
[b] Values indicate the increase in biomass.
* $0.05 \geq p \geq 0.01$.
** $0.01 \geq p \geq 0.001$.
*** $p \leq 0.001$).
SD = standard deviation.

biomass showed a statistically significant increase over the negative controls (43–49% in the first test and 61–67% in the second test). Similar results were obtained with Ag nitrate (Table 1).

Table 1 shows the number of offspring in the tests with Ag-NPs after 56 d. Reproduction was not inhibited by the dispersant in the first test. The replicates with Ag-NPs showed statistically significant differences from both controls and a concentration–effect relationship. In comparison with the negative control, the inhibition of reproduction ranged from 46.4% at the lowest concentration to 75.2% at the highest concentration, yielding an EC50 value of 74.3 mg/kg soil compared with the negative control and 83.0 mg/kg soil compared with the dispersant control (Table 2).

In the second test with Ag-NPs, the dispersant had an impact on reproduction; that is, fewer juveniles were found in the dispersant control (268) than in the negative control (341), representing a statistically significant 21.5% inhibition of reproduction. The standard deviation ranged from 7.6% in the negative control to 16.8% in the dispersant control (Table 1). Both control values were considered with respect to the effect of Ag-NPs, and inhibition was calculated in comparison with both the negative control and the dispersant control, even in the test in which no significant difference between the controls was seen (Test 1).

Even in the second test with Ag-NPs, we found a concentration–effect relationship and observed strong, statistically significant inhibition of earthworm reproduction. In comparison with the negative control, the inhibition of reproduction ranged from 26.3% at the lowest concentration to 71.7% at the highest concentration, yielding an EC50 of 80 mg/kg soil compared with the negative control, which is close to the EC50 value determined in the first test, and an EC50 of 146.0 mg/kg soil for the dispersant control, which is less pronounced than in the first test (Table 2).

Silver nitrate also caused concentration-dependent effects in both tests and was approximately twice as toxic to earthworms as Ag-NPs. For the first test, we observed a reduction in the number of juveniles compared with negative controls from the lowest concentration (261 juveniles, 24.9% inhibition) to the highest concentration (64 juveniles, 81.5% inhibition; Table 1), reflecting an EC50 value of 46.9 mg/kg soil. The second test showed a similar concentration-dependent effect, with a calculated EC50 value of 42.0 mg/kg soil (Table 2).

Table 2. Median effective concentration (EC50), lowest observed effect concentration (LOEC), and no observed effect concentration (NOEC; mg/kg soil) calculations for the reproduction of *Eisenia fetida* in all tests

	Test	LOEC	NOEC	EC50 (mg/kg soil)[c]
Silver nanoparticles	Test 1[a]	≤60	<60	74.3 (—)
	Test 1[b]	≤60	<60	83.0 (—)
	Test 2[a]	≤15	<15	80.0 (33.6–413.3)
	Test 2[b]	30	15	146.0 (85.7–741.4)
Silver nitrate	Test 3	≤15	<15	46.9 (40.7–53.6)
	Test 4	≤15	<15	42.0 (15.2–83.5)

[a] Calculation in comparison with the negative control.
[b] Calculation in comparison with the dispersant control.
[c] Dry matter soil.

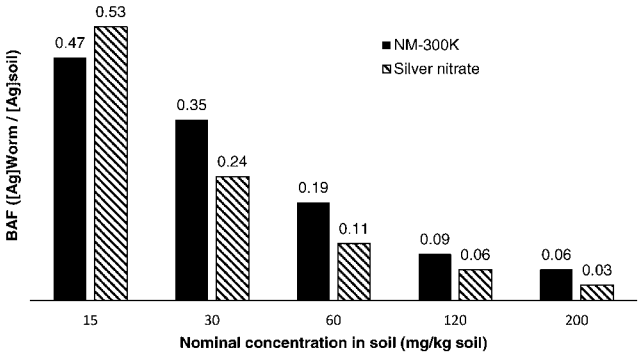


Fig. 1. Bioaccumulation factors (BAFs) for the earthworm *Eisenia fetida* exposed to silver nanoparticles (NM-300 K) and silver nitrate compared with the nominal concentrations.

Silver content in the soil and earthworms

We analyzed the spiked soil at the beginning of the test and achieved 90% recovery of Ag from both the 15 and the 120 mg/kg soil samples (standard deviation 14 and 4%, respectively, confirming that the Ag is distributed homogeneously at both low and high concentrations). All concentrations of Ag in the earthworms and in soil refer to the dry matter content of the sample.

We then determined the silver concentrations in earthworms (Table 3). No silver was detected in the negative control or dispersant control, but silver was detected in all the worms that had been exposed to Ag-NPs or Ag nitrate. The concentrations of Ag in earthworms exposed to NM-300 K ranged from 7.0 mg/kg worm at 15 mg/kg soil to 11.3 mg/kg worm at 120 mg/kg soil. There was a significant difference in the Ag content of adult worms when we compared the 15 mg/kg soil sample with all the higher concentrations. The concentration of Ag in earthworms exposed to Ag nitrate was 8.0 mg/kg worm at 15 mg/kg soil, and this value declined as the Ag content of the soil increased (Table 3). There was a significant difference in the earthworm Ag content when we compared the 15 mg/kg soil and 200 mg/kg soil samples. As shown in Figure 1, all calculated BAF values were below 1.0. There was a concentration-dependent reduction in the BAFs, and Ag-NPs yielded higher BAFs than Ag nitrate from concentrations of 30 mg/kg soil up to 200 mg/kg soil.

Diffusive gradients in thin films

The amount of free Ag^+ in the soil pore water represents the bioavailable part of Ag-NPs and Ag nitrate, which is likely to be predominantly responsible for any adverse effects on earthworms. The free Ag^+ was calculated for all negative control tests as well as tests carried out at concentrations of 60, 120, and 200 mg/kg soil, and the data are presented as nanograms Ag^+ per kilogram soil and as percentages of nominal concentrations in Table 4.

The results show that only approximately 0.0001% of the nominal concentration of Ag is available as free Ag^+ in the soil. Free Ag^+ was not present in the negative control, and there was little difference in the amount of free Ag^+ in soils spiked with Ag-NPs and Ag nitrate.

The amounts of Ag^+ at the first and second measurement points were comparable. At least for tests 1, 2, and 4, there was an increase in free Ag^+ levels with increasing total concentrations; for example, in test 1 (NM-300 K), the amount of free Ag^+ increased from 22.1 to 73.4 ng/kg soil and, in test 4 (Ag nitrate), it increased from 31.7 to 60.6 ng/kg soil (Table 4). The percentage of the nominal concentration did not increase proportionally but instead declined (tests 2 and 4) or remained the same (test 1). The concentration dependence was less pronounced in test 3. At the third measurement point in all four tests, the highest Ag^+ levels were detected at 120 mg/kg soil (151.8 ng/kg soil in test 2 with NM-300 K and 103.8 ng/kg soil in test 4 with Ag nitrate), and the percentage of nominal concentration also increased.

Table 3. Silver content in earthworm tissues

Concentration (mg/kg soil)[b]	Silver nanoparticles; mean Ag (mg/kg worm[c]) ± SD	Silver nitrate; mean Ag (mg/kg worm[c]) ± SD
15	7.0 ± <0.01	8.0 ± 0.9
30	10.5 ± 0.4[a]	7.3 ± 1.5
60	11.1 ± 0.2[a]	6.8 ± 0.4
120	11.3 ± 0.4[a]	6.7 ± 0.2
200	11.2 ± 0.1[a]	5.9 ± 0.1[a]

SD = standard deviation.
[a] Statistically significant difference shown from the lowest test concentration ($\alpha = 0.05$).
[b] Dry matter soil.
[c] Dry matter worm.

DISCUSSION

Ecotoxicological effects

We achieved a 90% recovery for both low and high concentrations of Ag, so there was no concern that the Ag concentration in the soil might be reduced by any means during the 56-d test period. According to the guidance document on aquatic ecotoxicology [25], the nominal concentration can be used to express toxicity if the measured concentration has a recovery >80%. Because equivalent guidelines are not available for terrestrial tests, the procedure described for aquatic tests was used.

Our objective was to provide insight into the ecotoxicity of Ag, using the earthworm reproduction test and addressing the following three endpoints: mortality, biomass increase, and number of offspring. Natural soil was used for our tests so that the results were relevant to environmental conditions. The results indicated that Ag-NPs and Ag nitrate do not induce statistically significant mortality in earthworm populations at Ag concentrations up to 200 mg/kg soil. However, we observed a statistically significant increase in the biomass of the adult worms exposed to Ag-NPs and Ag nitrate. The earthworms attempted to avoid the contaminated soil during the first 24 h of the test and then preferred to remain in the food layer spread on top of the soil, a behavior that persisted until the adult worms were removed. Our observations support earlier studies in which earthworms attempted to avoid soil contaminated with Ag-NPs and Ag nitrate at concentrations of 6.92 to 7.42 mg/kg soil, although the particles were larger and were coated with polyvinylpyrrolidone (PVP) [26]. No differences between the effects of Ag-NPs and Ag nitrate were observed, confirming that earthworms appear to sense the presence of Ag^+ in soil. The increase in biomass can therefore be explained by the tendency of the earthworms to favor the food layer, which leads to the ingestion of more food and an increase in biomass. The avoidance behavior and the resulting increase in biomass can be reduced by spreading the food in a thin layer on the soil surface.

Table 4. Concentration of silver ions measured by diffusive gradients in thin films in the soil pore water

	Test 1 (silver nanoparticles)		Test 2 (silver nanoparticles)		Test 3 (silver nitrate)		Test 4 (silver nitrate)	
Concentration (mg/kg soil[a])	Ag^+ (ng/kg soil[a])	Percentage from nominal concentration ($\times 10^{-4}$)	Ag^+ (ng/kg soil[a])	Percentage from nominal concentration ($\times 10^{-4}$)	Ag^+ (ng/kg soil[a])	Percentage from nominal concentration ($\times 10^{-4}$)	Ag^+ (ng/kg soil[a])	Percentage from nominal concentration ($\times 10^{-4}$)
Day 0								
Negative control	0.4	—	0.2	—	0.4	—	0.2	—
60	22.1	0.37	20.1	0.34	39.1	0.65	31.7	0.53
120	43.8	0.36	28.8	0.24	34.9	0.29	37.7	0.31
200	73.4	0.37	32.3	0.16	91.8	0.46	60.6	0.30
Day 26								
Negative control	0.7	—	0.6	—	0.7	—	0.4	—
60	25.3	0.42	27.3	0.46	8.4	0.14	40.6	0.68
120	34.9	0.29	45.1	0.38	24.6	0.20	56.8	0.47
200	59.3	0.30	45.6	0.23	18.3	0.09	58.3	0.29
Day 54								
Negative control	1.2	—	1.4	—	1.2	—	0.8	—
60	24.3	0.40	63.8	1.06	38.9	0.65	61.1	1.02
120	46.7	0.39	151.8	1.27	87.4	0.73	103.8	0.86
200	31.5	0.16	94.2	0.47	70.9	0.35	88.7	0.44

[a] Dry matter soil.

After 56 d, we observed significant differences in the number of offspring at an Ag-NP concentration of 30 mg/kg soil and at a Ag nitrate concentration of 15 mg/kg soil (the lowest concentration we tested). There was only a marginal difference between the toxicity of Ag-NPs and Ag nitrate, yielding EC50 values of 74 to 80 mg/kg in comparison with the negative control for NM-300 K and 42 to 47 mg/kg for Ag nitrate. In one test with Ag-NPs, the dispersant also inhibited reproduction. Several tests with earthworms and other organisms in the presence of the dispersant were carried out, with no evidence of toxic effects (data not shown). We are therefore unable to explain why the dispersant had an inhibitory effect in one of the tests but none of the others. The calculated EC50 value based on the negative control was similar in both tests with Ag-NPs, so we focus on the results compared with the negative control in the following discussion.

Few studies have considered the different issues that influence the toxicity of Ag-NPs to the earthworm *E. fetida*. A limit test using PVP-coated Ag-NPs and Ag nitrate at a concentration of 1,000 mg/kg soil in a natural soil resulted in 97.5% survival for earthworms exposed to Ag-NP and 2.5% survival for those exposed to Ag nitrate [15]. The number of cocoons was used as an indicator of reproduction, but the surviving earthworms produced no cocoons even in the Ag-NP test, in which most of the earthworms survived. Our data also show that reproduction is a sensitive endpoint and is strongly affected by both Ag-NPs and Ag nitrate.

Another study focusing on the influence of surface coatings on the bioaccumulation of Ag-NPs and reproduction toxicity in *E. fetida* was carried out with artificial soil [16]. Silver nanoparticles coated with PVP and oleic acid, with a nominal particle size of 30 to 50 nm, were tested at nominal concentrations of 10, 100, and 1,000 mg/kg against Ag nitrate at nominal concentrations of 10 and 100 mg/kg. In these tests, neither the Ag nitrate nor the Ag-NPs coated with PVP and oleic acid affected growth and mortality. However, there was a significant effect on earthworm reproduction at 773.3 mg/kg for PVP-coated Ag-NPs, 727.6 mg/kg for oleic acid-coated Ag-NPs, and 94.12 mg/kg for Ag nitrate. The coated Ag-NPs were approximately 10 times less toxic than our uncoated Ag-NPs with a primary particle size of 15 nm, whereas the results for Ag nitrate were in a comparable range. However, cocoon production was again used as the parameter to measure reproduction in the investigation discussed above, whereas in the present study the juveniles were counted, which limits direct comparisons. Nevertheless, it can be assumed that particle properties, for example, size and coating, play an important role in the toxicity of Ag-NPs to earthworms.

A further study focused on the role of particle size and soil type in the toxicity of Ag-NPs to earthworms [17]. Two types of soil were tested to determine the influence of soil composition, a sandy loam soil comparable to our test soil and an artificial soil. The study also included two types of Ag-NPs, one with a small particle size (10 nm) and another with particles of 30 to 50 nm, both coated with PVP. There were no differences in toxicity between the two types of particles. Growth and reproduction (expressed as "juveniles and worms") were significantly affected in the natural soil by 7.413 mg/kg Ag nitrate, but the Ag-NPs had no significant effect on any of the tested endpoints. However, only a nominal concentration of 10 mg/kg was tested in the natural soil. The higher toxicity observed in our study may reflect differences in the organic matter content of the soils (0.93% in our case but 1.77% in an earlier study [17]). The organic matter content affects the fate of Ag-NPs in soil, and all types of Ag are more mobile in mineral soils compared with soils rich in organic matter [27].

The studies discussed above indicate that the toxicity of Ag-NPs is strongly dependent on the properties of test medium (e.g., organic matter) and the coating. We also used smaller particles compared with previous investigations, which may also increase the toxicity of Ag-NPs.

Silver content of earthworms

In addition to the typical endpoints considered in the standardized reproduction test, we also investigated the uptake and accumulation of Ag in adult earthworms. As specified in OECD guideline 222 [18], adult earthworms were removed after 28 d. Worms were used to determine the concentration of Ag after the gut had been purged. A concentration-dependent effect on reproduction above the lowest test concentrations (15 mg/kg) was observed, but, although the lowest and highest test concentrations differed by a factor of 13, the Ag concentrations in

the earthworms were comparable (and were higher in earthworms exposed to Ag-NPs than in those exposed to Ag nitrate). We therefore assume that a steady state of Ag uptake is already achieved at 30 mg/kg soil. It is unclear whether the measured Ag is located in the tissues or whether residues remain in the gut because of incomplete purging. The comparable concentrations in earthworms exposed to soil concentrations greater than 30 mg/kg and the concentration-dependent inhibition of reproduction at concentrations of 30 to 200 mg/kg soil indicate that the Ag content in the worms is not responsible for the observed effects. It can be assumed that the fertility of adults is not affected, but the development of cocoons and the survival of juveniles in soil are sensitive life stages.

In a previous study [16], a concentration-dependent increase in the levels of Ag in earthworm tissues was observed, although none of the BAFs exceeded 1, suggesting that there was no bioaccumulation of Ag-NPs. The BAFs for Ag-NPs and Ag nitrate at 10 and 100 mg/kg soil in the study cited above were comparable to our results at 15 and 120 mg/kg soil.

As with earthworms, nematodes are also exposed to Ag via soil pore water, so studies considering the uptake of Ag-NPs in the nematode *Caenorhabditis elegans* are also relevant to this discussion. These studies have shown that Ag-NPs are taken up into cells from the gut lumen and that transgenerational Ag-NP transfer is possible [28]. Citrate-coated Ag-NPs with a particle size of 50.6 nm induced epidermal fissuring and serious epidermal burst effects in a concentration-dependent manner at concentrations of 10 and 100 mg/L [29]. However, both studies were carried out using aqueous media rather than soil and might not reliably predict the influence of Ag-NPs on earthworm guts and tissues or on juveniles or cocoons.

DGT approach

The concentration of Ag^+ in pore water was determined in addition to the total silver concentration using the DGT approach, which showed that only 0.0001% of the nominal Ag concentration exists as freely available Ag^+ in the soil pore water. There was no statistically significant difference between Ag-NPs and Ag nitrate in our tests.

In tests with *C. elegans* [29], the measurement of dissolved Ag^+ in K-medium after 24 h of incubation revealed a concentration equivalent to 0.001% of the nominal concentration, which may differ from our results because of the different incubation conditions. In aqueous K-medium, the equilibrium between bulk Ag and Ag^+ may differ from that in soil, resulting in the lower concentration of Ag^+ observed in this investigation. Other studies have focused on the interactions between Ag^+ and other environmentally relevant compounds. The release of Ag^+ may also be modified by interactions between Ag-NPs and sulfide ions or dissolved organic matter (DOM). A study with nitrifying bacteria in a wastewater treatment plant showed that sulfide reduces the toxicity of Ag-NPs by promoting the formation of Ag_xS_y complexes or precipitates [30]. Furthermore, if the concentration of DOM is higher than that of metal ions in water, then DOM binds to the dissolved metal ions, which may influence the Ag^+ content detectable by DGTs [31].

We observed a concentration-dependent increase of Ag^+ in the soil pore water at least at the first two measurement points. Furthermore, the comparable concentrations of Ag^+ detected via DGT in soil pore water from soils spiked with Ag-NPs and Ag nitrate match the similar effect of these substances on earthworm reproduction. Therefore, it can be assumed that Ag^+ is responsible for the inhibition of earthworm reproduction. Because the effect of Ag-NPs and Ag nitrate is in a similar range, we can conclude that the locally increased ion concentration on the surface of NPs compared with evenly distributed Ag nitrate is not relevant for earthworm toxicity. This may not be the case for single-cell organisms, which may be exposed to high ion concentrations in the vicinity of AgNPs. Yang et al. [32] note that Ag-NPs are more toxic than the equivalent mass of dissolved Ag or the generation of reactive oxygen species in studies with single-cell systems (e.g., nitrifying bacteria, human cells). In multicellular organisms (e.g., nematodes, fish), toxicity is caused predominantly by the dissolution of Ag-NPs.

CONCLUSION

Silver NPs and Ag nitrate display similar toxicity in the earthworm reproduction test, and we observed a concentration–effect relationship in all the tests that we carried out. The number of juveniles was a more suitable endpoint than biomass or mortality, and we recommend that at least this endpoint should be determined. Earthworms can sense low concentrations of uncoated Ag-NPs in the soil, so their food must be distributed in a thin surface layer to prevent avoidance behavior. In further tests, the number of juveniles and cocoons should be counted to achieve better comparability with previous investigations. Studies at the cellular level may help to elucidate the mode of action.

The uptake of Ag-NPs in the earthworm was slightly more efficient than that of Ag nitrate. Spiked soils with a concentration-dependent effect on reproduction did not cause a concentration-dependent increase in the amount of Ag in earthworm tissues. The uptake of Ag appears not to be the factor that inhibits reproduction.

Diffusive gradients in thin films measurements revealed no differences between the free Ag^+ content of soils spiked with Ag-NPs and Ag nitrate. We observed a concentration-dependent increase at least during the first two measurements points, suggesting that the released ions affect the cocoons and juveniles and are responsible for the inhibition of reproduction. The results strengthen the assumption that toxicity caused by Ag-NPs is closely related to the content of released Ag^+ measured in the soil pore water. Introducing the DGT method for measuring Ag^+ ions released from Ag-NPs in the soil pore water is potentially an inexpensive way to gain insight into the concentration of free ions.

We focused on pure Ag-NPs in this investigation, but transformation processes in WWTPs generate modified Ag compounds. Therefore, to increase the environmental relevance of the reported observations, it will be important to study the effects on terrestrial organisms of Ag-NP-containing sewage sludge derived from model or pilot WWTPs. This includes potential Ag transformation products generated during the purification process.

Acknowledgement—The data reported in the present study are from projects performed on behalf of the German Federal Ministry of Education and Research and the German Environment Agency, which were supported by federal funds. We thank T. Görtz, K. Mock, R. Nöker, R. Schlinkert, J. Tigges, and P. Schulte for counting thousands of juvenile worms; D. Hansknecht and J. Schörmann for their support with the digestion and chemical analysis; and H. Rüdel and B. Knopf for scientific discussion.

REFERENCES

1. Ahamed M, AlSalhi MS, Siddiqui MKJ. 2010. Silver nanoparticle applications and human health. *Clin Chim Acta* 411:1841–1848.

2. Fabrega J, Luoma SN, Tyler CR, Galloway TS, Lead JR. 2011. Silver nanoparticles: Behavior and effects in the aquatic environment. *Environ Int* 37:517–531.
3. Gottschalk F, Sonderer T, Scholz RW, Nowack B. 2010. Possibilities and limitations of modeling environmental exposure to engineered nanomaterials by probabilistic material flow analysis. *Environ Toxicol Chem* 29:1036–1048.
4. Bilberg K, Malte H, Wang T, Baatrup E. 2010. Silver nanoparticles and silver nitrate cause respiratory stress in Eurasian perch (*Perca fluviatilis*). *Aquat Toxicol* 96:159–165.
5. Gubbins EJ, Batty LC, Lead JR. 2011. Phytotoxicity of silver nanoparticles to *Lemna minor* L. *Environ Pollut* 159:1551–1559.
6. Farkas J, Christian P, Urrea JAG, Roos N, Hassellöv M, Tollefsen KE, Thomas KV. 2010. Effects of silver and gold nanoparticles on rainbow trout (*Oncorhynchus mykiss*) hepatocytes. *Aquat Toxicol* 96:44–52.
7. Benn TM, Westerhoff P. 2008. Nanoparticle silver released into water from commercially available sock fabrics. *Environ Sci Technol* 42: 4133–4139.
8. Geranio L, Heuberger M, Nowack B. 2009. The behavior of silver nanotextiles during washing. *Environ Sci Technol* 43:8113–8118.
9. Farkas J, Peter H, Christian P, Urrea JAG, Hassellöv M, Tuoriniemi J, Gustafsson S, Olsson E, Hylland K, Thomas KV. 2011. Characterization of the effluent from a nanosilver producing washing machine. *Environ Int* 37:1057–1062.
10. Shafer MM, Overdier JT, Armstrong DE. 1998. Removal, partitioning, and fate of silver and other metals in wastewater treatment plants and effluent-receiving streams. *Environ Toxicol Chem* 17:630–641.
11. Kaegi R, Voegelin A, Sinnet B, Zuleeg S, Hagendorfer H, Burkhardt M, Siegrist H. 2011. Behavior of metallic silver nanoparticles in a pilot wastewater treatment plant. *Environ Sci Technol* 45:3902–3908.
12. Ge Y, Schimel JP, Holden PA. 2011. Evidence of negative effects of TiO_2 and ZnO nanoparticles on soil bacterial communities. *Environ Sci Technol* 45:1659–1664.
13. Hänsch M, Emmerling C. 2010. Effects of silver nanoparticles on the microbiota and enzyme activity in soil. *J Plant Nutr Soil Sc* 173:554–558.
14. Choi O, Deng KK, Kim NJ, Ross L Jr, Surampalli RY, Hu Z. 2008. The inhibitory effects of silver nanoparticles, silver ions, and silver chloride colloids on microbial growth. *Water Res* 42:3066–3074.
15. Heckmann LH, Hovgaard MB, Sutherland DS, Autrup H, Besenbacher F, Scott-Fordsmand JJ. 2011. Limit-test toxicity screening of selected inorganic nanoparticles to the earthworm *Eisenia fetida*. *Ecotoxicology* 20:226–233.
16. Shoults-Wilson WA, Reinsch BC, Tsyusko OV, Bertsch PM, Lowry GV, Unrine JM. 2011. Effect of silver nanoparticle surface coating on bioaccumulation and reproductive toxicity in earthworms (*Eisenia fetida*). *Nanotoxicology* 5:432–444.
17. Shoults-Wilson WA, Reinsch BC, Tsyusko OV, Bertsch PM, Lowry GV, Unrine JM. 2011. Nanoparticles in the environment: Role of particle size and soil type in toxicity of silver nanoparticles to earthworms. *Soil Sci Soc Am J* 75:365–377.
18. Organization for Economic Co-operation and Development. 2004. Test 222 Earthworm Reproduction Test (*Eisenia fetida/Eisenia andrei*). Guideline for the Testing of Chemicals. 2004. Paris, France.
19. Schlich K, Terytze K, Hund-Rinke K. 2012. Effect of TiO_2 nanoparticles in the earthworm reproduction test. *Environ Sci Eur* 24:5.
20. International Organization for Standardization. 2007. Soil quality—Guidance on long and short-term storage of soil samples. ISO 18512. Geneva, Switzerland.
21. Klein CL, Comero S, Stahlmecke B, Romazanov J, Kuhlbusch TAJ, Van Doren E, De Temmerman PJ, Mast J, Wick P, Krug H, Locoro G, Hund-Rinke K, Kördel W, Friedrichs S, Maier G, Werner J, Linsinger T, Gawlik BM. 2011. NM-Series of Representative Manufactured Nanomaterials: NM-300 Silver Characterisation, Stability, Homogeneity. Publications Office of the European Union, Luxembourg.
22. Deutsches Institut für Normung. 1995. German version 1997. Soil quality—Extraction of trace elements soluble in aqua regia. DIN ISO 11466. Berlin, Germany.
23. Deutsches Institut für Normung. 2000. Characterization of sludges—Determination of trace elements and phosphorus—Aqua regia extraction methods. DIN EN 13346. Berlin, Germany.
24. Organisation for Economic Co-operation and Development. 2010. OECD Guideline for the Testing of Chemicals. Test 317, Bioaccumulation in Terrestrial Oligochaetes. Paris, France.
25. European Commission Health and Consumer Protection Directorate-General. 2002. Guidance document on aquatic ecotoxicology. Brussels, Belgium.
26. Shoults-Wilson WA, Zhurbich OI, McNear DH, Tsyusko OV, Bertsch PM, Unrine JM. 2011. Evidence for avoidance of Ag nanoparticles by earthworms (*Eisenia fetida*). *Ecotoxicology* 20:385–396.
27. Coutris C, Jautris E, Helen D. 2012. Aging and soil organic matter content affect the fate of silver nanoparticles in soil. *Sci Total Environ* 420:327–333.
28. Meyer JN, Lord CA, Yang XY, Turner EA, Badireddy AR, Marinakos SM, Chilkoti A, Wiesner MR, Auffan M. 2010. Intracellular uptake and associated toxicity of silver nanoparticles in *Caenorhabditis elegans*. *Aquat Toxicol* 100:140–150.
29. Kim SW, Nam SH, An YJ. 2012. Interaction of silver nanoparticles with biological surfaces of *Caenorhabditis elegans*. *Ecotoxicol Environ Safe* 77:64–70.
30. Choi O, Clevenger TE, Deng B, Surampalli RY, Ross L, Hu Z. 2009. Role of sulfide and ligand strength in controlling nanosilver toxicity. *Water Res* 43:1879–1886.
31. Aiken GR, Hsu-Kim H, Ryan JN. 2011. Influence of dissolved organic matter on the environmental fate of metal, nanoparticles and colloids. *Environ Sci Technol* 45:3196–3201.
32. Yang X, Gondikas AP, Marinakos SM, Auffan M, Liu J, Hsu-Kim H, Meyer JN. 2012. Mechanism of silver nanoparticle toxicity is dependent on dissolved silver and surface coating in *Caenorhabditis elegans*. *Environ Sci Technol* 46:1119–1127.

ES/ER/TM-126/R2

Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision

This document has been approved
by the East Tennessee Technology Park
Technical Information Office
for release to the public. Date: _____

ES/ER/TM-126/R2

Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision

R. A. Efroymson
M. E. Will
G. W. Suter II

Date Issued—November 1997

Prepared for the
U.S. Department of Energy
Office of Environmental Management
under budget and reporting code EW 20

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Oak Ridge Y-12 Plant Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-84OR21400
for the
U.S. DEPARTMENT OF ENERGY

PREFACE

This report presents a standard method for deriving benchmarks for the purpose of "contaminant screening," performed by comparing measured ambient concentrations of chemicals. The work was performed under Work Breakdown Structure 1.4.12.2.3.04.07.02 (Activity Data Sheet 8304). In addition, this report presents sets of data concerning the effects of chemicals in soil on invertebrates and soil microbial processes, benchmarks for chemicals potentially associated with United States Department of Energy sites, and literature describing the experiments from which data were drawn for benchmark derivation.

ACKNOWLEDGMENTS

The authors would like to thank Carla Gunderson and Art Stewart for their helpful reviews of the document. In addition, the authors would like to thank Christopher Evans and Alexander Wooten for conducting part of the literature review.

CONTENTS

PREFACE iii

ACKNOWLEDGMENTS v

TABLES ix

ABBREVIATIONS xi

EXECUTIVE SUMMARY xiii

1. SCREENING BENCHMARKS IN ECOLOGICAL RISK ASSESSMENT 1-1

2. METHODS 2-1
   2.1 DATA 2-1
   2.2 SELECTION OF LEVELS OF EFFECTS 2-2
   2.3 DERIVATION OF BENCHMARKS 2-2

3. EARTHWORMS 3-1
   3.1 INTRODUCTION 3-1
   3.2 EARTHWORM DATA SELECTION 3-1
   3.3 EARTHWORM TEST SPECIES 3-2
   3.4 EARTHWORM DATA AND BENCHMARK DERIVATION 3-3
      3.4.1 Inorganic Compounds 3-3
      3.4.2 Organic Compounds 3-10

4. MICROBIAL HETEROTROPHS AND PROCESSES 4-1
   4.1 INTRODUCTION 4-1
   4.2 MICROBE DATA SELECTION 4-1
   4.3 MICROBE DATA AND BENCHMARK DERIVATION 4-2
      4.3.1 Inorganic Chemicals 4-2
      4.3.2 Organic Chemicals 4-17

5. INVERTEBRATES OTHER THAN EARTHWORMS AND MICROBIAL HETEROTROPHS 5-1
   5.1 INTRODUCTION 5-1
   5.2 INVERTEBRATE DATA SELECTION 5-1
   5.3 INVERTEBRATE TEST SPECIES 5-2
   5.4 OTHER INVERTEBRATES LITERATURE REVIEW 5-3

6. RELATIONSHIP BETWEEN SOIL TOXICITY BENCHMARKS AND OTHER ECOTOXICOLOGICAL CRITERIA 6-1
   6.1 COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO CANADIAN ENVIRONMENTAL QUALITY CRITERIA FOR CONTAMINATED SITES 6-1

6.2 COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO RIVM (NETHERLANDS) ECOTOXICOLOGICAL INTERVENTION VALUES FOR CONTAMINANTS IN SOILS 6-1

7. COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO CONCENTRATIONS OF CHEMICALS IN UNPOLLUTED SOILS 7-1
7.1 COMPARISON TO USGS ELEMENT CONCENTRATIONS IN SOILS AND OTHER SURFICIAL MATERIALS OF THE EASTERN UNITED STATES 7-1
7.2 COMPARISON TO DOE OAK RIDGE RESERVATION BACKGROUND SOIL CHARACTERIZATION ELEMENT CONCENTRATIONS IN SOILS 7-1

8. RECOMMENDATIONS AND CONCLUSIONS 8-1

9. REFERENCES 9-1

APPENDIX A. TOXICITY DATA FOR EARTHWORMS A-1

APPENDIX B. TOXICITY DATA FOR MICROORGANISMS B-1

APPENDIX C. TOXICITY DATA FOR OTHER SOIL AND LITTER INVERTEBRATES C-1

TABLES

1 Screening benchmark concentrations for the toxicity of chemicals to earthworms 2-4
2 Screening benchmark concentrations for the toxicity of chemicals to soil microorganisms and microbial processes 2-5
3 Comparison of screening benchmark concentrations for the toxicity to earthworms and soil microbes of chemicals in soil to CCME remediation criteria (RC), RIVM ecotoxicological intervention values (EIV's), arithmetic means of elements in uncontaminated soils of the Oak Ridge Reservation (ORR), and geometric means of elements in soils and surficial materials of the eastern United States 6-3

ABBREVIATIONS

CCME	Canadian Council of Ministers of the Environment
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	United States Department of Energy
EIV	Ecotoxicological Intervention Value
EPA	United States Environmental Protection Agency
ER-L	Effects Range Low
HCl	Hydrochloric Acid
LCT	Lowest Concentration Tested
LOEC	Lowest Observed Effect Concentration
NOEC	No Observed Effect Concentration
OECD	Organization for Economic Cooperation and Development
ORR	Oak Ridge Reservation
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
RC	Remediation Criteria
RIVM	National Institute of Public Health and Environmental Protection
USGS	United States Geological Survey

EXECUTIVE SUMMARY

One of the initial stages in ecological risk assessments for hazardous waste sites is the screening of contaminants to determine which of them are worthy of further consideration as "contaminants of potential concern." This process is termed "contaminant screening." It is performed by comparing measured ambient concentrations of chemicals to benchmark concentrations. Currently, no standard benchmark concentrations exist for assessing contaminants in soil with respect to their toxicity to soil- and litter-dwelling invertebrates, including earthworms, other micro- and macroinvertebrates, or heterotrophic bacteria and fungi. This report presents a standard method for deriving benchmarks for this purpose, sets of data concerning effects of chemicals in soil on invertebrates and soil microbial processes, and benchmarks for chemicals potentially associated with United States Department of Energy sites. In addition, literature describing the experiments from which data were drawn for benchmark derivation. Chemicals that are found in soil at concentrations exceeding both the benchmarks and the background concentration for the soil type should be considered contaminants of potential concern.

1. SCREENING BENCHMARKS IN ECOLOGICAL RISK ASSESSMENT

An important step in ecological risk assessments is screening the chemicals occurring on a site for contaminants of potential concern. Screening may be accomplished by comparing reported ambient concentrations to a set of toxicological benchmarks. Multiple endpoints for assessing risks posed by soil-borne contaminants to organisms directly impacted by them have been established. Benchmarks for toxic effects of contaminants on terrestrial plants are presented in a companion manuscript (Efroymson et al. 1997). This report presents benchmarks for soil invertebrates and microbial processes and addresses only chemicals found at United States Department of Energy (DOE) sites. The benchmarks for microbial processes have not been updated since 1995. No benchmarks for pesticides are presented.

If a chemical's concentration or reported detection limit exceeds the screening benchmark, additional analysis may be needed to determine the hazards posed by that chemical (i.e., it is a contaminant of potential concern). However, if the chemical's concentration or detection limit falls below the proposed benchmark, the chemical may be ignored during further study unless public concern or ancillary evidence suggest that it should be retained.

Soil benchmarks are based on data provided by toxicity studies in the field or, more commonly, in laboratory settings. Most of the soil concentrations of metals reported from waste sites are from extractions with hydrochloric acid (HCl) or other mineral acids which are intended to provide estimates of total concentrations. Similarly, concentrations of organic contaminants in waste site soils are total concentrations derived from rigorous extractions by solvents. In some cases, toxicity tests report contaminant concentrations extracted from soils, but various extractants are used that may not yield total concentrations. More commonly, the concentrations reported are nominal concentrations of a soluble form (i.e., a highly bioavailable form) of the chemical added to soil. We have chosen to use nominal concentrations from the literature to compare to the "total" extracted quantities of a chemical reported for waste sites.

These benchmarks are appropriate for contaminant screening purposes only. An assessor must realize that soil and invertebrate characteristics play a large part in toxicity and incorporate these site-specific considerations in the evaluation of the potential hazards of a chemical. If chemical concentrations reported in soils supporting many earthworms exceed one or more of the benchmarks presented in this report, or if a benchmark is exceeded by background soil concentrations, it is generally safe to assume that the benchmark is a poor measure of risk to earthworms at that site.

After discussing methods, this report presents the results of the literature reviews and benchmark derivation for toxicity to earthworms (Sect. 3), heterotrophic microbes and their processes (Sect. 4), and other invertebrates (Sect. 5). The final sections compare the benchmarks to other criteria and background concentrations of chemicals and draw conclusions concerning the utility of the benchmarks.

2. METHODS

2.1 DATA

References on the toxicity of selected chemicals to soil and litter dwelling invertebrates, microbes, and microbial processes were obtained from searches of bibliographic data bases (BIOSIS, POL TOX I, current contents), review articles, and conventional literature searching. Reports of toxicity tests of individual chemicals in laboratory, greenhouse, or field settings were obtained. Data presented in this report were derived mainly from primary sources. More specific information on the types of effects data available for each group of organisms is given in the appropriate section of this report. The general criteria for inclusion of a study in the data set used to derive toxicity benchmarks follow.

1. Methodology was clearly stated (especially concentrations of applied chemicals) and followed in the experiment.

2. Results were quantified as measures of survivorship, growth, respiration, reproduction, substrate transformation, or enzyme activity.

3. Results were presented in numeric form, or graphical presentations of data were clearly interpretable.

4. An unambiguous reduction existed in the measured parameter within the range of applied concentrations of the chemical of interest.

The data selected for soil benchmarks using these criteria appear in Appendix A through Appendix C. Data were collected in the following categories for analysis:

1. Chemical—The effects of individual chemicals of interest were analyzed. In the case of metals, the metal is listed in the "Chemical" field. For organics, the compound is listed in the "Chemical" field.

2. Chemical Form—The form in which the chemical was added to the experimental medium (e.g., soluble salt, organic).

3. Growth Medium—Substrate in which organisms were kept during the experiment. The media included natural and artificial soil, manure, soil/litter microcosms, and other experimental substrates.

4. Cation exchange capacity is the sum of the exchangeable cations that a soil can adsorb, expressed as milliequivalents per 100 g of soil. Soil organic and inorganic constituents contain negatively charged sites that are the location of important interactions with positively charged ions in soil solution. These interactions affect the toxicity of many contaminants.

5. Organic matter—Soil organic matter is important in reactions of many contaminants in the soil. Percentage organic matter, if given, was converted to percentage organic carbon by the equation (Nelson and Sommers, 1982):

$$\%\text{organic matter} / 2 = \%\text{organic carbon}$$

6. Soil pH—The pH of the soil exerts control over chemical reactions that affect speciation and bioavailability of chemicals

7. Species—The species of earthworm, other invertebrate, or microorganism is necessary when provided. However, most microbiological experiments were conducted with an undefined, mixed native microflora.

8. Exposure duration—How long the organisms were exposed to the test chemical.

9. NOEC Applied—The no observed effect concentration (NOEC) is defined as the highest applied concentration of the chemical of interest causing a reduction of 20% or less in a measured response.

10. LOEC Applied—The lowest observed effect concentration (LOEC) is defined as the lowest applied concentration of the chemical of interest causing a greater than 20% reduction in a measured response. In some cases, the LOEC for the test was the lowest concentration tested (LCT) or the only concentration reported, as when the EC_{50} (or ED_{50}) was reported.

11. Growth parameter—Response varied with the type of organism and experiment.

12. Percent decrease—Percent decrease in measured parameter compared to control organism.

2.2 SELECTION OF LEVELS OF EFFECTS

Twenty percent reduction in growth, reproduction, or activity was used as the threshold for significant effects to be consistent with other screening benchmarks for ecological risk assessment and with current regulatory practice (Suter et al. 1995). In brief, most regulatory criteria are based on concentrations in toxicity tests that cause effects which are statistically significantly different from controls. On average, these concentrations correspond to greater than a 20% difference in effects. In addition, regulatory actions may be based on comparisons of biological parameters measured on contaminated sites to those from reference sites. Differences between parameters at sites generally must be greater than 20% to be reliably detected in such studies. Therefore, the 20% effects level is treated as a conservative approximation of the threshold for regulatory concern.

2.3 DERIVATION OF BENCHMARKS

Because of the diversity of soils, species, chemical forms, and test procedures, it is impossible to estimate concentrations that would constitute thresholds for toxic effects on the invertebrate communities at particular sites from published toxicity data. This situation is analogous to the problem of deriving benchmarks for sediments. In this report, the method used for deriving soil benchmarks is based on the National Oceanographic and Atmospheric Administration's method for deriving the Effects Range Low (ER-L) (Long and Morgan, 1990), which has been recommended as a sediment screening benchmark by the U.S. Environmental Protection Agency (EPA) Region IV. The ER-L is the tenth percentile of the distribution of various toxic effects thresholds for various organisms in sediments.

This approach can be justified by assuming that the toxicity of a chemical in soil is a random variate, the toxicity of contaminated soil at a particular site is drawn from the same distribution, and the assessor should be 90% certain of protecting organisms growing in the site soil. Any bias in the data set would mitigate against that assumption. In this implementation of the approach, the bias most likely to

be significant is the use of soluble salts of metals in the toxicity tests. These salts are likely to be more toxic than the mixture of forms encountered in field soils. That bias would result in conservative benchmark values. Other possible sources of bias include the exclusion of synergistic and antagonistic effects resulting from interactions between chemicals, use of a limited number of test species that may not be representative of those in the field, use of artificial soils that may not be representative of soils in general, and other laboratory test conditions that may not be representative of field conditions. The direction and magnitude of these potential biases is unknown.

The toxicity benchmarks were derived by rank-ordering the LOEC values and then picking a number that approximated the 10th percentile. As with the ER-Ls, statistical fitting was not used because there were seldom sufficient data and because these benchmarks are to be used as screening values and do not require the consistency and precision of regulatory criteria. If there were 10 or fewer values for a chemical, the lowest LOEC was used. If there were more than 10 values, the 10th percentile LOEC value was used. If the 10th percentile fell between LOEC values, a value was chosen by interpolation. Since these benchmarks are intended to be thresholds for significant effects on growth and production, test endpoints that indicate a high frequency of lethality are not appropriate. Therefore, when a benchmark is based on an LC_{50} or on some other endpoint that includes a 50% or greater reduction in survivorship, the value is divided by a factor of 5; this factor is based on the authors' expert judgment. Although no data exist for comparison of lethal and sublethal effects concentrations in tests conducted with the same species and soils, it is assumed that a factor of 5 can be used to approximate the ratio LC_{50}/EC_{20}.

In all cases, benchmark values were rounded down to one significant figure. This rounding was done for two reasons. First, it is not appropriate to ascribe greater precision to a number than it actually possesses; these benchmarks are very imprecise. Second, the rounding serves to emphasize the fact that the benchmarks are conceptually distinct from the test endpoint values from which they were derived. That is, an LOEC may be a precise estimate of the lowest toxic concentration for a particular plant variety in a particular test system, but when an LOEC is used as a benchmark for all plants in field soils, it is a qualitatively different and much more poorly defined value.

Benchmarks were derived in the previously described manner for earthworms and microbial heterotrophs. Insufficient information was available for establishing benchmarks for other invertebrates, as discussed in the appropriate section of this report. Proposed screening benchmarks for toxic effects of contaminants in soils are presented in Table 1 (earthworms) and Table 2 (microbial populations).

Table 1. Screening benchmark concentrations for the toxicity of chemicals to earthworms

Chemical	Soil (mg/kg)
Arsenic	60
Cadmium	20
Chromium	0.4
Copper	50
Lead	500
Mercury	0.1
Nickel	200
Selenium	70
Zinc	200
Chloroacetamide	2
3-chloroaniline	30
2,4-dichloroaniline	100
3,4-dichloroaniline	20
2,4,5-trichloroaniline	20
2,3,5,6-tetrachloroaniline	20
Pentachloroaniline	100
1,2-dichloropropane	700
Dimethylphthalate	200
Fluorene	30
N-nitrosodiphenylamine	20
Phenol	30
4-nitrophenol	7
3-chlorophenol	10
3,4-dichlorophenol	20
2,4,5-trichlorophenol	9
2,4,6-trichlorophenol	10
2,3,4,5-tetrachlorophenol	20
Pentachlorophenol	6
Chlorobenzene	40
1,4-dichlorobenzene	20
1,2,3-trichlorobenzene	20
1,2,4-trichlorobenzene	20
1,2,3,4-tetrachlorobenzene	10
Pentachlorobenzene	20
Nitrobenzene	40

Table 2. Screening benchmark concentrations for the toxicity of chemicals to soil microorganisms and microbial processes

Chemical	Soil (mg/kg)
Aluminum	600
Arsenic	100
Barium	3000
Boron	20
Cadmium	20
Chromium	10
Cobalt	1000
Copper	100
Fluorine	30
Iron	200
Lanthanum	50
Lead	900
Lithium	10
Manganese	100
Mercury	30
Molybdenum	200
Nickel	90
Selenium	100
Silver	50
Tin	2000
Titanium	1000
Tungsten	400
Vanadium	20
Zinc	100
Acrylonitrile	1000
Carbon tetrachloride	1000
Cis-1,4-dichloro-2-butene	1000
Hexachlorobenzene	1000
Nitrobenzene	1000
Phenol	100
Pentachlorophenol	400
Trans-1,4-dichloro-2-butene	1000

This method of deriving screening benchmarks for soil organisms may appear as insufficiently conservative. This impression might result from the fact that the derivation of the benchmark (like the derivation of the ER-L values) implies a significant effect on approximately 10% of the species. However, the method probably is sufficiently conservative for the following reasons. First, the benchmarks were derived for a community-level assessment endpoint. Given the water, nutrient, or physical limitations of most soil- and litter-dwelling communities, a reduction in survival, growth, or reproduction of 10% of earthworm species or reduction of the rates of 10% of microbial processes is likely to be acceptable. Second, the benchmarks derived by these methods have proved to be conservative in practice. In some cases, the benchmarks are lower than background concentrations (Sect. 7). The benchmarks are based on toxicity tests that dose growth substrates with soluble salts of metals which are more available than most naturally occurring metals and even metals at many, if not most, waste sites.

The authors have attempted to assign levels of confidence to the benchmarks; these are presented with the appropriate chemicals in Sect. 3. The criteria best reflecting that confidence are as follows:

1. Low Confidence—Benchmarks based on fewer than 10 literature values.

2. Moderate Confidence—Benchmarks based on 10 to 20 literature values.

3. High Confidence—Benchmarks based on more than 20 literature values.

High confidence in a benchmark based on more than 20 reported toxic concentrations may be reduced to moderate if the range of plant, earthworm, or microbial species tested is narrow (i.e., only one species of earthworms was tested). Moderate or high confidence benchmarks were in some instances demoted one level if the value approximating the 10th percentile was the lowest concentration tested and caused a greater than 30% reduction in the measured growth parameter. These criteria may seem arbitrary, but the result is a confidence classification that fairly reflects the authors' professional judgment.

Any scheme for deriving a set of standard ecotoxicological benchmarks is based on assumptions that may be questioned by readers. The procedure used herein is consistent with current regulatory practice and contains a minimum of assumptions or factors. Readers who care to make other assumptions or add safety factors may make use of the data presented herein to calculate their own benchmarks.

3. EARTHWORMS

3.1 INTRODUCTION

Earthworms are probably the most important soil invertebrate in promoting soil fertility (Edwards, 1992). Their feeding and burrowing activities break down organic matter and release nutrients and improve aeration, drainage, and aggregation of soil. Earthworms are also important components of the diets of many higher animals.

Earthworms are known to take up many inorganic and organic soil contaminants. Availability of contaminants for uptake from the soil is controlled by soil characteristics. van Gestel (1992) concludes that, with the exception of extremes in pH, it is not possible to predict metal availability on the basis of soil variables. Availability of contaminants from plant litter in varying degrees of decomposition is also complex and poorly understood. The feeding and burrowing habits of earthworms determine their exposure to chemicals in soil and litter. Geophagus organisms (those taking in large amounts of soil during feeding on well-decomposed organic material) and those living on or near the soil surface may have greater exposure to organic chemicals than worms feeding on litter pulled down into burrows in the subsoil (Curl et al., 1987). Organic contaminants may undergo oxidation by the cytochrome P-450 and other enzyme systems within the earthworm. Earthworms also may bind xenobiotics and their metabolites in unextractable forms (Stenersen, 1992). Physiological response mechanisms to metals are species specific (Tomlin, 1992). Much of the ingested lead, cadmium, and zinc (the three most studied inorganic contaminants) is accumulated in chloragogenous tissue (intestinal wall) of the posterior alimentary canal (Morgan et al., 1993). Little is known about mechanisms of toxicity of chemicals in earthworms.

3.2 EARTHWORM DATA SELECTION

Information suitable for calculating screening benchmarks was available for a limited number of metals and a larger number of organic compounds. Toxic effects information on polychlorinated biphenyls (PCBs) is not available and information is limited for polycyclic aromatic hydrocarbons (PAHs). The toxicity of many agricultural pesticides has been tested, but as stated previously, it is not presented herein. Data on which the benchmarks are based are given in Appendix A; benchmarks are given in Table 1.

Only experiments in which earthworms were exposed to soil (natural or artificial mixture of natural components), soil/litter microcosms, or manure were considered for determining benchmark levels of contaminants in soils. The main alternative method is the contact filter paper test in which the organisms are placed on filter paper containing the chemical to be tested for toxicity. Results are presented as mg chemical per cm^2 filter paper and are therefore not comparable to results given as concentrations (mg per kg substrate). The test gives information about skin contact toxicity but not oral ingestion toxicity (Reinecke, 1992). Although uptake through the cuticle is considered an important uptake route for some organic chemicals (Stenersen, 1992), oral ingestion is an important uptake route for metals and organic compounds found in soil and litter. Heimbach (1988) reports that there is little correlation between contact paper test and OECD artificial soil test results. Good correlation between the OECD artificial soil test and field tests are reported for several pesticides (Heimbach, 1992).

Acute and chronic toxicity are tested in experiments evaluating the effects of chemicals on earthworms. Mortality is the main endpoint in acute toxicity tests with results reported as the

concentration causing death in 50% of the test population (LC_{50}). In the case of organic compounds, most of the literature reports LC_{50} values.

Change of individual body weight, which may indicate sublethal effects, can also be measured during acute toxicity tests. Endpoints that indicate effects important to population dynamics include cocoon production, cocoon hatching rates, and juvenile survival (Kokta, 1992). It should be noted that several researchers have found a negative correlation between adult body weight and reproduction (Kokta, 1992), and the conclusion is that these characteristics should be investigated together.

3.3 EARTHWORM TEST SPECIES

Experiments on the toxicity of chemicals to earthworms have been performed with representatives of three families (*Megascolecidae*, *Eudrilidae*, and *Lumbricidae*) and 12 species representing earthworms from Europe and North America, Africa, India, and Asia.

The most commonly used earthworm, *Eisenia fetida*, is a nonburrowing organism found in compost piles and other organic-rich environments (Lee, 1985). It belongs to the epigeic ecological category of Bouche (1992). *Eisenia fetida* may be the most prolific of worms with a shorter lifespan than others of the *Lumbricidae* family. Its natural habitat may be under the bark of fallen trees, and protozoa may be an essential part of its diet (Lee, 1985). *Eisenia andrei* is considered a sibling species of *E. fetida* by most researchers (Bouche, 1992); however, it has been treated as a subspecies of *E. fetida* by others in the past (van Gestel and Ma, 1988). These earthworms are considered ideal for toxicity testing because of the ease with which populations are maintained in the laboratory. The short generation time of *E. fetida* allows investigation of effects of chemicals on reproduction and second generation survival.

Lumbricus rubellus is a shallow-burrowing lumbricid active in the surface and litter horizons of pastures and grasslands (Lee, 1985). It may forage for food, such as dead roots, in the subsurface horizon and dig deep burrows in which to rest during periods of environmental stress. In the litter layer, *L. rubellus* feeds on slightly decomposed plant remains, dung, and bacteria.

The genus *Allolobophora* is represented in the toxicity literature by three species. *Allolobophora chlorotica* is a shallow-burrowing lumbricid worm found in permanent pasture and other grasslands (Lee, 1985). It spends most of its life in the topsoil feeding on well-decomposed plant remains (humus). It is considered to be geophagus because it ingests a large quantity of soil during feeding. *Allolobophora caliginosa* and *Apporectodea caliginosa* are classified by Dindal (1990) as the same organism. It is similar to *A. chlorotica* in its burrowing and feeding habits and is common in alkaline soils of Egypt (Lee, 1985). No life history information was available on the species *A. tuberculata*.

Octolasium cyaneum is a burrowing lumbricid species that lives in the soil and feeds on dead roots (Lee, 1985). It is common in pasture lands where it creates deep horizontal burrows.

Dendrobaena rubida is an ubiquitous forest litter inhabiting lumbricid (Lee, 1985). It feeds on slightly decomposed leaf litter and does not burrow into the soil.

The *Eudrilidae* family is represented by *Eudrilus eugeniae*. This tropical species from west Africa is now widespread throughout tropical and temperate regions (Neuhauser et al., 1979). It is a common inhabitant of topsoils and prefers habitats with high concentrations of organic matter.

The *Megascolecidae* family is represented by three organisms for which little information is available. *Perionyx excavatus* is the Indian subcontinent equivalent of *Eisenia fetida*, preferring compost heaps and other accumulations of organic material (Lee, 1985). It is known to feed on animal dung. *Pheretima posthuma* is originally from east and southeast Asia. No life history information was found on *Octochaetus pattoni*; however, other members of the genus occur in New Zealand (Lee, 1985).

3.4 EARTHWORM DATA AND BENCHMARK DERIVATION

3.4.1 Inorganic Compounds

Arsenic. Fischer and Koszorus (1992) tested the effects of 68 ppm of arsenic (as potassium arsenate) on growth and reproduction of *Eisenia fetida* (average initial age of 5 weeks) when added to a combination of peaty marshland soil and horse manure (1:1). The number of survivors and their live mass and the number of cocoons produced were measured. The number of cocoons produced per worm showed the highest sensitivity to arsenic with a 56% reduction at the test concentration.

The benchmark of 60 ppm arsenic is based on this study only. Because of the lack of data, confidence in this benchmark is low.

Cadmium. van Gestel and his colleagues in the Netherlands have established a fairly standard procedure for testing the toxicity of chemicals to earthworms in an artificial soil mixture made up of (by dry weight) 10% sphagnum peat, 20% kaolin clay, and 69% fine sand and $CaCO_3$ to adjust the pH to approximately 6 (OECD soil) (van Gestel et al., 1992). The work in this citation evaluated the effects of Cd, added to the soil as $CdCl_2$, on growth and reproduction (cocoons/worm/week, percent fertility of cocoons, juveniles/fertile cocoon, juveniles/worm/week) of *Eisenia andrei* after 21 days. The Cd was added in aqueous form and the resultant substrate added to 1 L glass jars. Approximately 5 g finely ground cow dung was added to a shallow hole in the middle of the substrate to serve as a food source for the 10 worms. A concentration of 18 ppm Cd was required to reduce the number of cocoons produced/week and the number of juveniles/worm (23 and 22%). Growth and reproduction were not affected at 10 ppm Cd. In other experiments by van Gestel et al. (1991a) using the same system but comparing the results from putting the food source in a hole with those from mixing it in with substrate, growth was reduced 44% by 100 ppm (32 ppm had no effect) in the former case and 40% by 32 ppm (10 ppm had no effect), in the latter. The EC_{50} for clitella development (indicating sexual maturity) was 108 ppm Cd for dung placed in a center hole in the substrate, and 27 ppm for dung mixed in with substrate.

Khalil et al. (1996) measured the mortality and cocoon production of *Aporrectodea caliginosa* when exposed to various concentrations of cadmium, copper and zinc sulfate in an Egyptian soil. After eight weeks of exposure to 10 mg/kg of cadmium, the lowest concentration tested, cocoon production was reduced 25%. Toxicity tests with mixtures of the contaminants were also conducted, and it was concluded that the three metals act antagonistically at the concentrations tested.

Spurgeon and Hopkin (1995) investigated the effect of cadmium (as nitrate) on survival, growth, cocoon production, and cocoon viability of *Eisenia fetida* in an OECD artificial soil. The lowest EC50, 215 ppm, was for growth. The investigators also studied the toxicity of metal-contaminated field soils and an artificial soil contaminated with multiple metals.

Spurgeon et al. (1994) kept adult *E. fetida* in contaminated OECD artificial soil (pH 6.3) for 8 weeks to test the effects of Cd [as $Cd(NO_3)_2$] on survival and growth of the earthworms. Results were

reported as LC_{50}s for mortality and EC_{50}s for effects on cocoon production. After 56 days, the calculated LC_{50} was greater than 300 ppm Cd. The EC_{50} for cocoon production was 46.3 ppm.

The effects of Cd added to horse manure (as Cd acetate) on *E. fetida* (initially less than 2 weeks old) was investigated by Malecki et al. (1982). Two growth periods were used, 8 and 20 weeks, and survival, weight gain, and cocoon production were measured. The most sensitive parameter was cocoon production. In the 8-week test, the lowest concentration tested, 25 ppm Cd, caused a 52% decrease in cocoon production. In the 20-week test, the lowest concentration tested, 50 ppm Cd, caused a 24% decrease in cocoon production.

The previously described system (horse manure) was used by Neuhauser et al. (1984) to look at the effects of Cd added as various soluble salts on growth and reproduction of *E. fetida*. The authors report their results with pooled data from all forms of a metal. After 6 weeks, both growth (weight) and cocoon production were decreased (25 and 100%) by 100 ppm Cd, the lowest concentration tested.

Bengtsson et al. (1986) report the effects of Cd on reproduction in the earthworm *Dendrobaena rubida* when grown in substrate at varying acidity. The metal was added to a 1:2 (volume) combination of sandy soil and well-decomposed cattle dung with a resulting organic carbon of about 6%. After 4 months at pH 4.5, the number of cocoons produced per worm was reduced 62% by 100 ppm Cd, while 10 ppm had no effect. The percent hatched cocoons, hatchlings/cocoon, and total number of hatchlings were not affected. At pH 5.5, the number of cocoons produced per worm, hatchlings/cocoon, and total number of hatchlings were reduced 78, 71, and 74%, respectively, by 100 ppm Cd, while 10 ppm had no effect. The percent hatched cocoons was not affected. At pH 6.5, the percent hatched cocoons, hatchlings/cocoon, and total number of hatchlings were reduced 47, 38, and 30%, respectively, by 100 ppm Cd, while 10 ppm had no effect. The number of cocoons/worm was not affected.

van Gestel and van Dis (1988) conducted a series of experiments in a sandy soil (1.7% organic matter, CEC 5.5 meq/100 g soil) to investigate the effects of acidity on acute toxicity of Cd ($CdCl_2$) to adult *E. andrei*. The LC_{50} was between 320 and 560 ppm Cd after 14 days at pH 4.1 and >1000 (no effect) at pH 7. The LC50 concentration in OECD soil, with 10% organic matter at pH 7, was also >1000 (no effect).

Neuhauser et al. (1985) used OECD artificial soil (pH 6) to determine LC_{50} of Cd (added as Cd nitrate) for adult *E. fetida*. After 14 days, the LC_{50} was calculated to be 1843 ppm Cd.

In a study examining the effects of soil factors on Cd toxicity and uptake, Ma (1982) used a sandy loam soil (pH 7.3, 8% organic matter) spiked with $CdCl_2$ to determine the effects of Cd on survival of adult *Lumbricus rubellus*. After 12 weeks, 1000 ppm Cd caused an 82% decrease in survival while 150 ppm had no effect.

A benchmark of 20 ppm has been computed for Cd on the basis of the 18 available concentrations causing toxicity. Confidence in this benchmark is moderate.

Chromium. Abbasi and Soni (1983) worked with a system in which the earthworm *Octochaetus pattoni* was kept in concrete tanks containing a mixture of soil and animal dung for 60 days to assess the effect of Cr(VI), added as $K_2Cr_2O_7$, on survival and reproduction. Survival was the most sensitive measure with a 75% decrease resulting from 2 ppm Cr, the lowest concentration tested. The number of cocoons produced was not diminished until the concentration reached 20 ppm Cr (highest concentration tested); the number of juveniles produced was not affected.

These same researchers (Soni and Abbasi, 1981) found no survival of *Pheretima posthuma* after 61 days in a paddy soil to which 10 ppm Cr(VI) (lowest concentration tested) was added.

van Gestel et al. (1992), in the system described previously for Cd, also found growth of *E. andrei* to be more sensitive to Cr than reproduction. In this case, Cr(III) was added as chromic nitrate to OECD soil. A concentration of 32 ppm Cr reduced growth by 30% while cocoons/worm/week, percent fertile cocoons, and juveniles/worm/week were reduced 28, 22, and 51%, respectively, by 100 ppm Cr.

Molnar et al. (1989) examined the effects of Cr(III) and Cr(VI) on growth and reproduction of *Eisenia fetida* in an undefined substrate. Chromium (VI) was added as $K_2Cr_2O_7$ and Cr(III) as $KCr(SO_4)_2$. Reproduction after 8 weeks was the measure most sensitive to Cr(III) with a 55% decrease in the number of cocoons and hatchlings at 625 ppm Cr(III). The authors indicate that reproduction was also sensitive to Cr(VI) but no data were given. After 2 weeks, mass gain of juveniles was decreased 34% by 2,500 ppm Cr(III) (625 ppm had no effect) and 43% by 625 ppm Cr(VI) (lowest concentration tested). After 4 weeks, mass gain of juveniles was decreased 39% by 2,500 ppm Cr(III) (625 ppm had no effect), and Cr(VI) had no effect. Chromium(VI) at 1,250 ppm was ineffective when worms were introduced after the soil had equilibrated for 2 weeks, regardless of the length of exposure.

It is difficult to set a benchmark concentration for toxicity of Cr to earthworms. Survival may be more sensitive than reproduction to the metal when it is added to the earthworm substrate as a soluble salt. The relative toxicity of Cr(III) and Cr(VI) is not clear from these studies. Cr(VI) ions can pass through cell membranes with much greater ease than Cr(III) ions. However, it is thought that Cr(VI) is reduced to Cr(III) inside the cell (Molnar et al., 1989); this latter may be the final active form. Without a better understanding of Cr transformations in the soil, transport across earthworm cell membranes, and reactions within the cell, it is difficult to separate the effects of the two different forms.

The 0.4 ppm benchmark for Cr is based on the work of Abbasi and Soni (1983). A safety factor of 5 was applied to the 2 ppm LOEC because it caused a 75% reduction in earthworm survival.

Confidence in this benchmark is low because it is based on only five reported concentrations causing toxicity to earthworms.

Copper. Neuhauser et al. (1984) evaluated the effects of soluble forms of copper on growth and reproduction *E. fetida* as described for Cd. The authors report their results with pooled data from all forms of a metal. After 6 weeks, both growth (weight) and cocoon production were decreased (75 and 85%) by 2000 ppm Cu, while 1000 ppm had no effect.

Khalil et al. (1996) measured the mortality and cocoon production of *Aporrectodea caliginosa* when exposed to various concentrations of cadmium, copper and zinc sulfate in an Egyptian soil. Eight weeks of exposure to 100 ppm of copper led to a 36% decrease in cocoon production (NOEC = 50 ppm). Toxicity tests with mixtures of the contaminants were also conducted, and it was concluded that the three metals act antagonistically at the concentrations tested.

Spurgeon and Hopkin (1995) investigated the effect of copper (as nitrate) on survival, growth, cocoon production, and cocoon viability of *Eisenia fetida* in an OECD artificial soil. The lowest EC50, 601 ppm, was for growth. The investigators also studied the toxicity of metal-contaminated field soils and an artificial soil contaminated with multiple metals.

Neuhauser et al. (1985) used the OECD artificial soil (pH 6) to estimate LC_{50} of Cu (added as Cu nitrate) for adult *E. fetida*. After 14 days, the LC_{50} was 643 ppm Cu.

Spurgeon et al. (1994) kept adult *E. fetida* in contaminated OECD artificial soil (pH 6.3) for 8 weeks to test the effects of Cu (as $Cu(NO_3)_2$) on survival and growth of the earthworms, as described for Cd. After 56 days, the calculated LC_{50} was 555 ppm, and the EC_{50} for cocoon production was 53.3 ppm.

The effects of Cu added to horse manure (as copper acetate) on *E. fetida* (initially less than 2 weeks old) was investigated by Malecki et al. (1982). Two growth periods were used, 8 and 20 weeks, and survival, weight gain, and cocoon production were measured. The most sensitive parameter was cocoon production. In the 8-week test, 500 ppm Cu caused a 24% decrease in cocoon production, while 300 ppm had no effect. In the 20-week test, 1000 ppm Cu caused a 24% decrease in cocoon production, while 500 ppm had no effect.

Bengtsson et al. (1986) looked at the effects of copper on *Dendrobaena rubida* at different acidities in the same type of experiments described for Cd. After 4 months at pH 4.5, the number of cocoons produced per worm, hatchlings/cocoon, and total number of hatchlings were reduced 70, 64, and 74%, respectively, by 100 ppm Cu, the lowest concentration tested. The percent hatched cocoons was not affected. At pH 5.5, the number of cocoons produced per worm, hatchlings/cocoon, and percent hatched cocoons were reduced 96, 100, and 100%, respectively, by 500 ppm Cu, while 100 ppm had no effect. The total number of hatchlings was not affected. At pH 6.5, the number of cocoons produced per worm, hatchlings/cocoon, and percent hatched cocoons were reduced 90, 100, and 100%, respectively, by 500 ppm Cu, while 100 ppm had no effect. The total number of hatchlings was not affected.

In experiments by van Gestel et al. (1991b) using the same system described previously but with Cu ($CuCl_2$) mixed homogeneously with the OECD substrate, growth of *E. fetida* was reduced 32% by 100 ppm (32 ppm had no effect). The EC_{50} for clitella development (sexual development) was >100 ppm Cu.

In a study examining the effects of soil factors on Cu toxicity and uptake, Ma (1982) used a sandy loam soil (pH 7.3, 8% organic matter) spiked with $CuCl_2$ to determine the effects of Cu on survival of adult *Lumbricus rubellus*. After 12 weeks, 1000 ppm Cu caused an 82% decrease in survival while 150 ppm had no effect.

The effect of soil organic carbon on toxicity of Cu ($CuSO_4$) to the earthworm *Octolasium cyaneum* was evaluated by Streit and Jaggy (1983). They determined the 14-day LC_{50} in a Brown soil, a Rendzina soil, and a peat soil containing 3.2, 14, and 43% organic carbon, respectively. LC_{50} concentrations were 180, 850, and 2500 ppm, respectively.

van Rhee (1975) tested the effects of a single concentration of Cu added to a polder soil on body weight, number of cocoons produced per week, mortality and sexual development of *Allolobophora caliginosa*. After 60 days, number of cocoons produced was the only measure affected; it decreased by 27% in the presence of 110 ppm Cu.

Using the OECD artificial soil (pH 6) and 21-day test procedure, van Gestel et al. (1989) looked at the effects of Cu (as $CuCl_2$) on reproductive parameters of adult *E. andrei*. After 21 days, cocoon production was decreased 36% by the addition of 180 ppm Cu to the substrate, while 120 ppm had no effect. Cocoon hatchability and number of juveniles per cocoon were not affected.

The sublethal effects of Cu on *L. rubellus* were investigated with respect to mortality, growth, cocoon production, and litter breakdown activity (Ma, 1984). Loamy sand field soil (5.7% organic matter, pH 4.8), with Cu added as $CuCl_2$, was placed in bags with leaf litter added to the top. In an

experiment lasting 6 weeks, the number of cocoons produced was decreased 42% by 131 ppm (HNO_3:H_2SO_4 extractable), while 54 ppm had no effect. In another study using this soil with the pH adjusted to between 4.8 and 7.1, Ma investigated at the effect of acidity on toxicity of Cu ($CuSO_4$) to *L. rubellus* growth and reproduction. At pH 4.8, 148 ppm Cu resulted in a 26% decrease in production (83 ppm had no effect). At pH 6, a 33% reduction in cocoon production resulted from 278 ppm Cu, while 148 ppm had no effect. In a 6-week experiment using a calcareous sandy loam soil (pH 7.3, organic matter 3.4%), the number of cocoons produced was diminished 41% in cultures to which 63 ppm Cu were added as $CuCl_2$ (13 ppm had no effect).

The relative sensitivity of several lumbricid earthworms to Cu ($CuCl_2$) added to a sandy soil (pH 5, organic matter 5%) was investigated by Ma (1988). EC_{50}s for cocoon production of *L. rubellus*, *Aporrectodea caliginosa*, and *Allolobophora chlorotica* were 122, 68, and 51 ppm Cu.

The work of Streit and Jaggy (1983) and others shows that the organic carbon content of the soil is a strong determinant of the bioavailability and toxicity of copper. From the studies cited, it appears that low pH has a compounding effect, with an increase in Cu availability resulting from more acid conditions. Overall, reproduction is more sensitive than mortality, and there is no consistent evidence that one genus of earthworms is any less tolerant to Cu under a given set of conditions than another genus.

The benchmark for Cu was established at 60 ppm. Confidence in this benchmark is moderate.

Lead. Bengtsson et al. (1986) examined the effects of lead on *Dendrobaena rubida* at different acidities in the same type of experiments as those described for Cd. After 4 months at pH 4.5, the number of cocoons produced per worm, hatchlings/cocoon, and percent hatched cocoons were reduced 75, 100, and 100%, respectively, by 500 ppm Pb, while 100 ppm had no effect. At pH 5.5 and 6.5, Pb had no effect at any level on any of the measures.

Spurgeon and Hopkin (1995) investigated the effect of lead (as nitrate) on survival, growth, cocoon production, and cocoon viability of *Eisenia fetida* in an OECD artificial soil. The lowest EC50, 1629 ppm, was that for cocoon production. The investigators also studied the toxicity of metal-contaminated field soils and an artificial soil contaminated with multiple metals.

Spurgeon et al. (1994) kept adult *E. fetida* in contaminated OECD artificial soil (pH 6.3) for 8 weeks to examine the effects of Pb (as $Pb(NO_3)_2$) on survival and growth of the earthworms as described for Cd. After 56 days, the calculated LC_{50} was 3760 ppm, and the EC_{50} for cocoon production was 1940 ppm.

The effects of Pb added to horse manure (as lead acetate) on *E. fetida* was investigated by Malecki et al. (1982), as described above for Cd. The most sensitive parameter was cocoon production. In the 8-week test, 4000 ppm Pb caused a 50% decrease in cocoon production, while 2000 ppm had no effect. In the 20-week test, 5000 ppm Pb caused a 28% decrease in cocoon production, while 1000 ppm had no effect.

Neuhauser et al. (1985) used the OECD artificial soil (pH 6) to determine LC_{50} of Pb [added as Pb (NO_3)] for adult *E. fetida*. After 14 days, the LC_{50} was calculated to be 5941 ppm Pb.

Neuhauser et al. (1984) evaluated the effects of soluble forms of lead on growth and reproduction of *E. fetida* as described for Cd. The authors report their results with pooled data from all forms of a

metal. After 6 weeks, cocoon production was decreased 80% by 5000 ppm Pb, the lowest concentration tested. Growth was not affected until 40,000 ppm was added to the substrate.

A benchmark of 500 ppm has been established for Pb based on the work of Bengtsson et al. (1986) which showed inhibition of reproduction at this concentration. Confidence in this benchmark is low because of the limited amount of data.

Mercury. Abbasi and Soni (1983) worked with *Octochaetus pattoni* in a system described previously for Cd. They assessed the effect of Hg(II), added as $HgCl_2$, on survival and reproduction. Survival and cocoon production were reduced 65 and 40% at 0.5 ppm Hg, the lowest concentration tested. The number of juveniles produced was not affected.

The effect of methyl mercury on survival and segment regeneration of *E. fetida* was investigated by Beyer et al. (1985). Methyl mercury chloride was added to an undefined potting soil in which the earthworms were cultured for 84 days. A concentration of 12.5 ppm Hg reduced survival by 21%, and the ability to regenerate excised segments was reduced by 69%. Methyl mercury at 2.5 ppm had no effect.

It is not possible to evaluate the relative toxicity of forms of Hg based on these two studies which used different systems and evaluated two different families of earthworms.

A benchmark of 0.1 ppm was established for Hg based on the work of Abbasi and Soni (1983). A safety factor of 5 was applied to the 0.5 ppm LOEC because it caused a 65% reduction in earthworm survival. Confidence in this benchmark is low because of the limited amount of data.

Nickel. The effects of Ni (added to horse manure as Ni acetate) on *E. fetida* were investigated by Malecki et al. (1982), as described for Cd. The most sensitive parameter was cocoon production. In the 8-week test, 300 ppm Ni caused a 41% decrease in cocoon production, while 200 ppm had no effect. In the 20-week test, 200 ppm Ni caused a 23% decrease in cocoon production, while 100 ppm had no effect.

Neuhauser et al. (1985) used the OECD artificial soil (pH 6) to determine LC_{50} of Ni (added as Ni nitrate) for adult *E. fetida*. After 14 days, the LC_{50} was calculated to be 757 ppm Ni.

Neuhauser et al. (1984) evaluated the effects of soluble forms of nickel on growth and reproduction *E. fetida* as described for Cd. The authors report their results with pooled data from all forms of a metal. After 6 weeks, cocoon production was decreased 33% by 250 ppm Ni, the lowest concentration tested. Growth was not affected until 500 ppm was added to the substrate.

In a study examining the effects of soil factors on Ni toxicity and uptake, Ma (1982) used a sandy loam soil (pH 7.3, 8% organic matter) spiked with $NiCl_2$ to determine the effects of Ni on survival of adult *Lumbricus rubellus*. After 12 weeks, 1000 ppm Cd caused a 31% decrease in survival while 150 ppm had no effect.

A benchmark of 200 ppm has been established for Ni based on the work of Malecki et al. (1982) which showed inhibition of reproduction at this concentration. Confidence in this benchmark is low because of the limited amount of data.

Selenium. Fischer and Koszorus (1992) tested the effects of 77 ppm of selenium (as sodium arsenite) on growth and reproduction of *Eisenia fetida* when added to a combination of peaty marshland

soil and horse manure (1:1). Number of survivors and their live mass and number of cocoons produced were measured. The number of cocoons produced per worm showed the highest sensitivity to selenium with a 69% reduction at the test concentration.

The benchmark of 70 ppm is based on this study. Confidence in this benchmark is low.

Zinc. van Gestel et al. (1993) evaluated the effect of zinc added as $ZnCl_2$ to OECD artificial soil (pH 6.2), on the growth and reproduction of *E. andrei*. The numbers of cocoons and juveniles produced were reduced 31 and 42% by 560 ppm, while 320 ppm had no effect. The percent fertile cocoons and number of juveniles per fertile cocoon were not affected until Zn was added to a concentration of 1000 ppm Zn, and percent growth of individuals increased with increasing Zn concentration.

Khalil et al. (1996) measured the mortality and cocoon production of *Aporrectodea caliginosa* when exposed to various concentrations of cadmium, copper and zinc sulfate in an Egyptian soil. Exposure to 300 ppm of zinc, the lowest concentration tested, led to a 20% reduction in cocoon production. Toxicity tests with mixtures of the contaminants were also conducted, and it was concluded that the three metals act antagonistically at the concentrations tested.

Spurgeon and Hopkin (1995) investigated the effect of zinc (as nitrate) on survival, growth, cocoon production, and cocoon viability of *Eisenia fetida* in an OECD artificial soil. The lowest EC50, 1078 ppm, was for mortality. For the derivation of the benchmark, the LC50 was divided by 5 to give a concentration of 216 ppm. The EC50 for a growth effect was greater than 400 ppm. The investigators also studied the toxicity of metal-contaminated field soils and an artificial soil contaminated with multiple metals.

Spurgeon and Hopkin (1996a) conducted toxicity tests with zinc (as nitrate) and three earthworm species to determine whether the earthworm population distribution near a smelter could be related to species sensitivity to metals. Tests were conducted in OECD artificial soil. The growth rates of *Eisenia fetida* and *Aporrectodea rosea* were reduced by 69% and 48%, respectively, following exposure to 190 ppm for 21 days, the lowest concentration tested. The same concentration led to a 32% decrease in the rate of cocoon production by *Lumbricus rubellus*. Effects on other endpoints tested, such as survival, percentage of fertile cocoons, and rate of production of juveniles, occurred at higher concentrations.

Spurgeon and Hopkin (1996b) used a range of artificial soils with differing organic matter content and soil pH for tests of the toxicity of zinc to *Eisenia fetida*. The EC50 concentrations for cocoon production in soils with of pH 6.0 and 5%, 10% and 15% organic matter were 136, 462, and 592 ppm, respectively. The EC50 concentrations for cocoon production in soils of pH 6.0 and 5%, 10% and 15% organic matter were 199, 343, and 548 ppm, respectively. The EC50 concentrations for cocoon production in soils of pH 6.0 and 5%, 10% and 15% organic matter were 142, 189, and 230 ppm, respectively. Mortality was observed at higher concentrations. In the range of pH and organic matter in the soils tested, a decrease in pH and/or organic matter content of soils led to a lower toxic concentration of zinc.

Spurgeon et al. (1994) kept adult *E. fetida* in contaminated OECD artificial soil (pH 6.3) for 8 weeks to test the effects of Zn (as $Zn(NO_3)_2$) on survival and growth of the earthworms as described for Cd. After 56 days, the calculated LC_{50} was 745 ppm, and the EC_{50} for cocoon production was 276 ppm.

Neuhauser et al. (1985) used the OECD artificial soil (pH 6) to determine LC_{50} of Zn [added as Zn (NO_3)] for adult *E. fetida*. After 14 days, the LC_{50} was calculated to be 662 ppm Zn. To derive the benchmark, a concentration of 132 ppm (662/5) was used.

van Rhee (1975) tested the effects of one concentration of Zn (1100 ppm) added to a polder soil on body weight, number of cocoons produced per week, mortality and sexual development of *Allolobophora caliginosa*. After 60 days, there was a 53% loss of body weight and a 22% increase in mortality; clitellum development and cocoon production were completely inhibited.

Neuhauser et al. (1984) evaluated the effects of soluble forms of zinc on growth and reproduction *E. fetida* as described for Cd. The authors report their results with data pooled from all forms of a metal. After 6 weeks, cocoon production was decreased 50% by 2500 ppm Zn, while 1000 ppm had no effect. Growth was not affected until 5000 ppm was added to the substrate.

The effects of Zn added to horse manure (as zinc acetate) on *E. fetida was* investigated by Malecki et al. (1982), as described for Cd. The most sensitive parameter was cocoon production. In the 8-week test, 2000 ppm Zn caused a 36% decrease in cocoon production, while 1000 ppm had no effect. In the 20-week test, 5000 ppm Zn caused a 53% decrease in cocoon production, while 2500 ppm had no effect.

A benchmark of 100 ppm is established for zinc. The benchmark is somewhat lower than concentrations at which effects have been observed. The low concentrations include: measures of cocoon production of *Eisenia fetida* in two artificial soils (136 ppm, 142 ppm) (Spurgeon and Hopkin 1996b) and 132 ppm, which is the LC50 for *Eisenia fetida* divided by 5 (Neuhauser et al. 1985). The authors have moderate confidence in this benchmark.

3.4.2 Organic Compounds

A small number of research groups have been conducting experiments on the toxicity of organic compounds and pesticides to earthworms. As a result, there are a limited number of experimental designs in use, and data are mainly in the form of LC_{50}s. The following review describes the experimental designs of the various groups; the reader is directed to Appendix A for complete data.

Chloroacetamide. van Gestel and van Dis (1988) evaluated the effects of soil pH and organic matter content on toxicity of chloroacetamide to survival of adult *E. andrei*. The LC_{50} (14 d) in a sandy soil (1.7% organic matter) at pH 4.1 and 7 was determined. Clearly, pH had an effect in this soil with higher LC_{50} values at pH 7. In the OECD artificial soil (7.7% organic matter) at pH 7, the LC_{50} was similar to that in the sandy soil at the same pH. It appears that differences in the organic matter content in this range were not determining the toxicity of this compound.

Heimbach (1984) also used the OECD artificial soil (pH 7) to evaluate the effects of this compound on the survival of *E. fetida* after 28 days. He found an LC_{50} of 24 ppm.

The effect of chloroacetamide on growth and reproduction of *E. fetida* after 56 days of growth in horse manure was assessed by Neuhauser and Callahan (1990). A concentration of 500 ppm had no effect on the earthworms, but 1000 ppm caused 100% mortality.

The LC_{50} value between 10 and 18 (van Gestel and van Dis, 1988) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to the lower bound on the LC_{50} to obtain the benchmark of 2 ppm chloroacetamide. Confidence in this benchmark is low because of the limited amount of data.

3-Chloroaniline. van Gestel and Ma (1993) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*. In a sandy soil with pH 4.8 and 3.7% organic matter, LC_{50} values were lower for both earthworm species than it was in the OECD artificial soil with pH 5.9 and 8.1% organic matter. The authors conclude that, with this narrow a range of pH values, it is likely that the difference in organic matter is responsible for the results.

The LC_{50} value of 195 (van Gestel and Ma, 1993) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 30 ppm 3-chloroaniline. Confidence in this benchmark is low.

2,4-Dichloroaniline. van Gestel et al. (1989) used the OECD artificial soil (pH 6) to determine the effects of this compound on growth and reproduction of *E. andrei*. After 21 days, cocoon production was reduced 23% by 100 ppm, while 56 ppm had no effect. Cocoon fertility and number of juveniles per cocoon were not affected by concentrations up to 180 ppm, the highest concentration tested.

van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*. Two sandy soils had similar pH values (5.3 and 5.6) but different organic matter levels (3.7 and 6.1%). The OECD artificial soil had a pH of 5.9 and 8.1% organic matter. A peaty soil also used had a pH of 4 and organic matter content of 15.6%. The LC_{50} values for 2-4-dichloroaniline ranged from 145 to 824 ppm, with organic matter being the more important determinant of bioavailability of this compound within the narrow pH range of soils used.

The 100 ppm benchmark is based on the work of van Gestel et al. (1989) which showed inhibition of reproduction at this concentration. This test endpoint is chosen as more appropriate than lethality (LC_{50}). Confidence in the benchmark is low because of the few data available.

3,4-Dichloroaniline. van Gestel and van Dis (1988) investigated the effects of soil pH and organic matter content on the toxicity of this compound to *E. fetida*. A sandy soil (1.7% organic matter) was tested at pH 4.1 and 7. The OECD artificial soil had a pH of 7 and 7.7% organic matter. The LC_{50} values ranged from 140 to 250 ppm increased with increasing organic matter content. No difference related to pH was seen in the sandy soil.

The LC_{50} value of 140 (van Gestel and van Dis, 1988) was the lowest toxic concentration of the three reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 3,4-dichloroaniline. Confidence in this benchmark is low.

2,4,5-Trichloroaniline. van Gestel and Ma (1993) evaluated the effects of this compound on the earthworms *E. andrei* and *L. rubellus* as described for 3-chloroaniline. As was the case for that compound, it is likely that the difference in organic matter is responsible for the results.

The lowest LC_{50} value of 134 derives from this work. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 2,4,5-trichloroaniline. Confidence in this benchmark is low.

2,3,5,6-Tetrachloroaniline. van Gestel and Ma (1993) evaluated the effects of this compound on the earthworms *E. andrei* and *L. rubellus* as described for 3-chloroaniline. There is not much difference in the results under different pH and organic matter conditions, and it is not clear that organic matter affecting the bioavailability as in the case of 3-chloroaniline and 2,4,5-trichloroaniline.

The lowest LC_{50} value of 116 ppm derives from this work. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 2,3,5,6-tetrachloroaniline. Confidence in this benchmark is low.

Pentachloroaniline. van Gestel and Ma (1993) evaluated the effects of this compound on the earthworms *E. andrei* and *L. rubellus* as described previously. There is considerable difference in the LC_{50}s but no discernible pattern was evident based on soil characteristics or species of earthworm tested.

The lowest LC_{50} value of 825 derives from this work. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 100 ppm pentachloroaniline. Confidence in this benchmark is low.

1,2-Dichloropropane. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms, *Perionyx excavatus*, *Eudrilus eugeniae, Eisenia fetida,* and *Allolobophora tuberculata*. They determined the LC_{50} after 14 days and found less than two-fold difference in sensitivity among the worms; sensitivity decreased in the order *P. excavatus>E. fetida>A. tuberculata>E. eugeniae*.

Neuhauser and Callahan (1990) investigated the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 80,800 ppm had no effect on the earthworms, but 92,300 ppm caused 100% mortality.

The LC_{50} value of 3880 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 700 ppm 1,2-dichloropropane. Confidence in this benchmark is low.

Dimethylphthalate. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four species of earthworms, as described previously. The LC_{50}s after 14 days showed a three-fold difference in sensitivity among the worms; sensitivity decreased in the order *P. excavatus>E. eugeniae>E. fetida>A. tuberculata*.

Neuhauser and Callahan (1990) evaluated the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 47,200 ppm had no effect on the earthworms, but 70,800 ppm caused a 62% reduction in cocoon production.

The LC_{50} value of 1064 (Neuhauser et al., 1986) was the lowest toxic concentration of the three reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 200 ppm dimethylphthalate. Confidence in this benchmark is low.

Fluorene. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *P. excavatus>E. fetida>E. eugeniae>A. tuberculata*.

Neuhauser and Callahan (1990) investigated the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 500 ppm had no effect on the earthworms, but 750 ppm caused a 49% reduction in cocoon production.

The LC_{50} value of 170 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 30 ppm fluorene. Confidence in this benchmark is low.

N-nitrosodiphenylamine. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *E. eugeniae*>*P. excavatus*>*E. fetida*>*A. tuberculata*.

Neuhauser and Callahan (1990) looked at the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 1400 ppm (lowest concentration tested) caused a 37% reduction in cocoon production.

The LC_{50} value of 109 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm N-nitrosodiphenylamine. Confidence in this benchmark is low.

Phenol. Neuhauser et al. (1986) used OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four species of earthworms, as described previously. The LC_{50}s after 14 days showed a less than three-fold difference in sensitivity among the worms; sensitivity decreased in the order *E. eugeniae*>*P. excavatus*>*E. fetida*>*A. tuberculata*.

Neuhauser and Callahan (1990) assessed the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 3900 ppm had no effect on the earthworms, but 4900 ppm caused a 26% reduction in cocoon production.

The LC_{50} value of 188 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 30 ppm phenol. Confidence in this benchmark is low.

4-Nitrophenol. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four species of earthworms, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *E. fetida*>*E. eugeniae*>*P. excavatus*>*A. tuberculata*.

Neuhauser and Callahan (1990) looked at the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 600 ppm (the lowest concentration tested) caused a 39% reduction in cocoon production.

The LC_{50} value of 38 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 7 ppm 4-nitrophenol. Confidence in this benchmark is low.

3-Chlorophenol. van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*. Two sandy soils had similar pH values (5.3 and 5.6) but different organic matter levels (3.7 and 6.1%). The OECD artificial soil had a pH of 5.9 and 8.1% organic matter. A peaty soil also used had a pH of 4 and organic matter content of 15.6%. The LC_{50} values ranged from 75 to 633 ppm, with organic matter being the more important determinant of bioavailability of this compound within the narrow pH range of soils used.

van Gestel and Ma (1988) looked at the effects of this compound on survival of *L. rubellus* and *E. andrei* in two humic sand soils of differing organic matter content (3.7 and 6.1%) but similar pH (5 and

5.6). These investigators found a three-fold difference between the highest and lowest values with no strong trend in relation to earthworm species or soil factors.

The benchmark for this compound has been established at 10 ppm. The LC_{50} of 75 from the work of van Gestel and Ma (1990) approximates the 10th percentile. A safety factor of 5 was applied to this value to obtain the benchmark. Confidence in this benchmark is low because all 12 values of the data set are LC_{50}s.

3,4-Dichlorophenol. van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*, as described previously. The LC_{50} values ranged from 134 to 680 ppm, with a trend of organic matter being more important than pH as a determinant of bioavailability for this compound.

van Gestel and Ma (1988) assessed at the effects of this compound on survival of *L. rubellus* and *E. andrei* in two humic sand soils of differing organic matter content but similar with respect to pH, as described previously. There was about a three-fold difference between the highest and lowest values with no strong trend in relation to earthworm species or soil factors.

The benchmark for this compound was established at 20 ppm. The LC_{50} of 134 from the work of van Gestel and Ma (1990) approximates the 10th percentile. A safety factor of 5 was applied to this value to obtain the benchmark. Confidence in this benchmark is low because all 12 values of the data set are LC_{50}s.

2,4,5-Trichlorophenol. van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworm species, *E. andrei* and *L. rubellus*, as described previously. The LC_{50} values ranged from 46 to 875 ppm, with a trend of organic matter being more important than pH as a determinant of bioavailability within earthworm type. *E. andrei* appears to be more sensitive than *L. rubellus* to this compound.

van Gestel and Ma (1988) assessed the effects of this compound on survival of *L. rubellus* and *E. andrei* in two humic sand soils of differing organic matter content but similar pH, as described previously. The LC_{50} values ranged from 52 to 290 ppm, with a trend of organic matter being the more important determinant of bioavailability within earthworm type. *E. andrei* again appears to be more sensitive to this compound than *L. rubellus*.

The benchmark for this compound was established at 9 ppm. The LC_{50} of 46 from the work of van Gestel and Ma (1990) approximates the 10th percentile. A safety factor of 5 was applied to this value to obtain the benchmark. Confidence in this benchmark is low because all 12 values of the data set are LC_{50}s.

2,4,6-Trichlorophenol. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *E. fetida>P. excavatus>E. eugeniae>A. tuberculata*.

Neuhauser and Callahan (1990) assessed the effect of this compound on growth and reproduction of *E. fetida* after 56 days of growth in horse manure. A concentration of 100 ppm (lowest concentration tested) caused a 28% reduction in cocoon production.

The LC_{50} value of 58 (Neuhauser et al., 1986) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 10 ppm for 2,4,6-trichlorophenol. Confidence in this benchmark is low.

2,3,4,5-Tetrachlorophenol. van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*, as described previously. The LC_{50} values ranged from 117 to 875 ppm, with a trend of organic matter being more important that pH as a determinant of bioavailability within earthworm species. *E. andrei* appears to be more sensitive than *L. rubellus* to this compound.

van Gestel and Ma (1988) looked at the effects of this compound on survival of *L. rubellus* and *E. andrei* in two humic sand soils of differing organic matter content but similar pH, as described previously. The LC_{50} values ranged from 116 to 828 ppm, with a trend of organic matter being the more important determinant of bioavailability within earthworm type. *E. andrei* again appears to be more sensitive to this compound than *L. rubellus*.

The LC_{50} value of 116 (van Gestel and Ma, 1990) was the lowest toxic concentration of the eight reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 2,3,4,5-tetrachlorophenol. Confidence in this benchmark is low.

Pentachlorophenol. van Gestel and van Dis (1988) investigated the effects of soil pH and organic matter content on the toxicity of this compound to *E. fetida*. A sandy soil (1.7% organic matter) was tested at pH 4.1 and 7. The OECD artificial soil had a pH of 7 and 7.7% organic matter. There was no strong trend related to organic matter, but the highest LC_{50} occurred in the more acid soil.

Fitzgerald et al. (1996) investigated the role of species, temperature, and soil type on toxicity of pentachlorophenol to earthworms. The researchers estimated incipient lethal levels (ILLs), which they defined as a time-independent LC50, i. e., an LC50 that does not change if the test is run for a longer period of time. The ILLs for *Eisenia fetida* grown for 14 days in an artificial soil at 24°C or 15°C were 37 ppm and 27 ppm, respectively. The ILL for *Eisenia fetida* grown for 14 days in a clay soil at 24°C was 72 ppm. The ILL for *Eisenia eugeniae* at 24°C was 168 ppm. *Lumbricus terrestris* grown at 15°C had an ILL of 191 ppm.

van Gestel et al. (1989) used the OECD artificial soil (pH 6) to determine the effects of this compound on the growth and reproduction of *E. andrei*. After 21 days, percent cocoon hatching success was reduced 50% by 32 ppm, while 10 ppm had no effect. Cocoon production and number of juveniles per cocoon were not affected until 100 ppm was added.

Heimbach (1984) used the OECD artificial soil (pH 7) to evaluate the effects of this compound on survival of *E. fetida* after 28 days. He found an LC_{50} of 87 ppm.

van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms, *E. andrei* and *L. rubellus*, as described previously. The LC_{50} values ranged from 83 to 2298 ppm, with the highest value occurring in soil with the highest organic matter content for each earthworm species. *E. andrei* appears to be more sensitive than *L. rubellus* to this compound.

van Gestel and Ma (1988) investigated the effects of this compound on survival of *L. rubellus* and *E. andrei* in two humic sand soils of differing organic matter content but similar pH, as described

previously. The LC_{50} values ranged from 94 to 1094 ppm, with no strong trend related to organic matter. *E. andrei* again appears to be more sensitive to this compound than *L. rubellus*.

The 10th percentile of the data is about 30 ppm. A safety factor of 5 is applied to the value to obtain the benchmark of 6 ppm pentachlorophenol. Confidence in this benchmark is low because all but one of the 22 values in the data set are LC_{50}s.

Chlorobenzene. van Gestel et al. (1991b) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms species, *E. andrei* and *L. rubellus*. In a sandy soil with pH 4.8 and 3.7% organic matter and OECD artificial soil (pH 5.9 and 8.1% organic matter), LC_{50} values were lower for *E. fetida* than for *L. rubellus*. Values ranged from 240 to 1107 ppm.

The LC_{50} value of 240 (van Gestel et al., 1991b) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 40 ppm chlorobenzene. Confidence in this benchmark is low.

1,4-Dichlorobenzene. van Gestel et al. (1991b) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms species, *E. andrei* and *L. rubellus*. In a sandy soil with pH 4.8 and 3.7% organic matter and the OECD artificial soil (pH 5.9 and 8.1% organic matter), LC_{50} values were lower in the soil with a lower percentage of organic matter. LC_{50} values ranged from 128 to 615 ppm.

The LC_{50} value of 128 (van Gestel et al., 1991b) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 1,4-dichlorobenzene. Confidence in this benchmark is low.

1,2,3-Trichlorobenzene. van Gestel and Ma (1990) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms species, *E. andrei* and *L. rubellus*, as described previously. The LC_{50} values ranged from 115 to 563 ppm, with the highest LC_{50} occurring in soil with the highest organic matter content. No trend in sensitivity of earthworm species was evident.

The LC_{50} value of 115 (van Gestel and Ma, 1990) was the lowest toxic concentration of the eight reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 1,2,3-trichlorobenzene. Confidence in this benchmark is low because of the limited amount of data.

1,2,4-Trichlorobenzene. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms species, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *E. eugeniae*>*P. excavatus*>*E. fetida*>*A. tuberculata*.

The LC_{50} value of 127 ppm (Neuhauser et al., 1986) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm 1,2,4-trichlorobenzene. Confidence in this benchmark is low.

1,2,3,4-Tetrachlorobenzene. van Gestel et al. (1991b) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms species, *E. andrei* and *L. rubellus*. In a sandy soil with pH 4.8 and 3.7% organic matter and the OECD artificial soil (pH 5.9 and 8.1% organic matter), LC_{50} values were lower in the soil with less organic matter. The LC_{50} values ranged from 75 to 223 ppm.

The LC_{50} value of 75 (van Gestel et al., 1991b) was the lowest toxic concentration of the five reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 10 ppm 1,2,3,4-tetrachlorobenzene. Confidence in this benchmark is low.

Pentachlorobenzene. van Gestel et al. (1991a) investigated the effects of soil pH and organic matter content on the toxicity of this compound to two earthworms species, *E. andrei* and *L. rubellus*, as described previously. In a sandy soil and the OECD artificial soil, LC_{50} values were lower in the soil with a lower percentage of organic matter. LC_{50} values ranged from 72 to 223 ppm.

The LC_{50} value of 115 (van Gestel et al., 1991b) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 20 ppm pentachlorobenzene. Confidence in this benchmark is low.

Nitrobenzene. Neuhauser et al. (1986) used the OECD artificial soil (pH 6) to assess the effects of this compound on survival of adults of four earthworms species, as described previously. The LC_{50}s after 14 days showed little difference in sensitivity among the worms; sensitivity decreased in the order *E. eugeniae>E. fetida>P. excavatus>A. tuberculata*.

The LC_{50} value of 226 (Neuhauser et al., 1986) was the lowest toxic concentration of the four reported. A safety factor of 5 was applied to this LC_{50} to obtain the benchmark of 40 ppm nitrobenzene. Confidence in this benchmark is low.

4. MICROBIAL HETEROTROPHS AND PROCESSES

4.1 INTRODUCTION

Soil microorganisms play a critical role in nutrient cycling. As primary consumers of soil organic matter, soil microbes convert nutrients to plant-available forms and serve as a food source for higher trophic levels. The soil microbiota is a heterogeneous collection of highly adaptable organisms exploiting the many micro-niches in the soil. The effect of contaminants may be to change the microbial community structure without overall changes in the functional ability of the community. The authors' assessment endpoint, however, is microflora community functioning. This is measured as effects on C mineralization, N transformation, and enzyme activities.

Little information is available on the mechanisms of toxicity of contaminants to soil microorganisms. Some metal ions may inhibit enzyme reactions by complexing with enzyme substrates, combining with the protein active group of the enzyme, or reacting with the enzyme-substrate complex (Juma and Tabatabai, 1977).

As with the others benchmarks, much of the variance is due to the variance in soil characteristics that influence toxicity. These characteristics control bioavailability to all soil-dwelling organisms, with pH and organic matter content being among those that are very important.

4.2 MICROBE DATA SELECTION

Toxic response data were collected for inorganic elements and organic compounds. Measures of effects of soil-borne chemicals on microorganisms include growth, respiration, nitrogen transformation reactions (denitrification, mineralization, and nitrification), C mineralization, P mineralization, cellulolytic activity, oxidation of hydrogen gas, alpha-glucosidase synthesis, and other enzyme activities.

Many enzymes that are produced by plants and microbes can exist and function extracellularly in the soil for varying periods of time, depending on soil micro-environmental factors (Tabatabai, 1982). For this reason, it may not be appropriate to interpret measured effects of chemicals on soil enzyme activities as representing effects on soil microbial populations. Soil enzymes do, however, give valuable information about the functioning of the soil in organic matter degradation. These enzymes include urease which catalyzes the hydrolysis of urea to CO_2 and NH_3; phosphatases which catalyze the hydrolysis of phospho esters and anhydrides; arylsulfatase which catalyzes the hydrolysis of the arylsulfate ion; amidase, which catalyzes the hydrolysis of acid amides with the release of NH_3; amylases, enzymes which catalyze the hydrolysis of starch and glycogen; and dehydrogenases, a group of enzymes which catalyze the dehydrogenation of many organic compounds. Dehydrogenase activity is considered by some to provide an overall estimate of microbial activity. None of these activities is accepted as adequate for characterizing the response of the soil microbial community to toxic stress because of the many soil and microbial factors affecting them at the micro-environment level. However, it is often the case that benchmarks are based on the effects of a chemical on a single activity (e.g., reduction of phosphatase activity) because of lack of other data.

Most of the research used to establish benchmarks was conducted in the laboratory with native soil microflora in small samples of soil or soil/litter microcosms. Exposure durations ranged from one and one-half hours to one and one-half years. The chemicals tested were mixed into the soil in the form of

salts. Bacteria, actinomycetes, and fungi are included and evaluated together. Tests conducted in culture media are not included because they are not directly relevant to the soil environment.

4.3 MICROBE DATA AND BENCHMARK DERIVATION

A short review of the available literature is discussed in the following text. Data are summarized in Appendix B, and benchmarks are given in Table 2.

4.3.1 Inorganic Chemicals

Aluminum. The effects of soil characteristics on effects of Al (as $AlCl_3$) on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979). Soils were chosen with a range in pH, organic matter, and clay contents (6.2 to 7.6; 5.4 to 10.6%; 26 to 34%). Air-dried, sieved soil samples were placed in flasks with the test chemical added in solution. The samples were incubated for 90 minutes before microbial activity was stopped and arylsulfatase activity measured. In all soils, a concentration of 675 ppm Al reduced the enzyme activity between 24 and 43%. The least inhibition occurred in the soil with the highest contents of organic matter and clay.

Juma and Tabatabai (1977) used essentially the same system and three of the same soils to evaluate the effects of several metals on soil acid and alkaline phosphatase activities. Three soils were used to test effects and acid phosphatase activity with pH, organic matter, and clay ranging from 5.8 to 7.8, 5.2 to 11%, and 23 to 30%. Alkaline phosphatase activity was not tested in the most acid soil. For Al in a loam soil (pH 5.8; percent organic matter 5.2) acid phosphatase activity was reduced, and alkaline phosphatase activity was reduced in another loam soil (pH 7.4, percent organic matter 11) by a concentration of 675 ppm Al. Aluminum had no effect on the activity of either enzyme in an alkaline soil (pH 7.8, percent organic matter 7.4).

The benchmark of 600 ppm of Al was derived from the previously described studies. Confidence in the benchmark is low because of the limited amount and type of data available.

Arsenic. Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of two forms of As on soil acid and alkaline phosphatase activities. Arsenic (III) had no effect on acid phosphatase activity in any of the three soils. At a concentration of 1875 ppm As (lowest concentration tested), acid phosphatase activity was reduced in a loam soil (pH 7.8; percent organic matter 7.4). Arsenic (V) was more toxic than As(III) to both enzyme complexes. Alkaline and acid phosphatase activities were reduced by as little as 187.5 ppm As(V) (lowest concentration tested) in soils of pH 5.8 to 7.4 and percent organic matter 5.2 to 11.

Frankenberger and Tabatabai (1981) investigated the effect of As(III) on amidase activity in three soils in shaker flask assays as described previously. After 2 1/2 hrs, amidase activity was reduced in all three soils. Activity was almost totally inhibited in the soil with the soils tested with a lowest concentration of 1873 ppm.

The effective concentration of 187 ppm (Frankenberger and Tabatabai, 1981) is the lowest of the eight reported. Confidence in the benchmark of 100 ppm is low because of the limited amount and type of data available.

Barium. The influence of soil characteristics on effects of Ba on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) using methods described for Al. A reduction in activity

was measured in only one of the four soils, having the lowest pH and organic matter content. A 22% reduction in activity was caused by 3433 ppm Ba (only concentration tested).

The benchmark of 3000 ppm is based on this study. Confidence in the benchmark is low because of the limited amount of data available.

Boron. The influence of soil characteristics on effects of B on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) using methods described for Al. Approximately the same degree of reduction in activity was measured in all soils at 270 ppm, and at 27 ppm in a loam (pH 6.5, percent organic matter 5.8) There was no clear relationship between magnitude of reduction in activity and soil pH and organic matter.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of B on soil acid and alkaline phosphatase activities. Acid phosphatase activity was not affected in the soil with the highest pH. It was reduced in the other two soils at a concentration of 270 ppm. Alkaline phosphatase activity was not affected by B in the soils tested.

The effective concentration of 27 ppm (Al-Khafaji and Tabatabai, 1979) is the lowest of the six reported. Confidence in the benchmark of 20 ppm is low because of the limited amount and type of data available.

Cadmium. The influence of soil characteristics on effects of Cd on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) using methods described for Al. A reduction in activity was measured in all four soils (23 to 55%) at 2810 ppm Cd, with the greatest reduction in the soil with the lowest clay content.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of Cd on soil acid and alkaline phosphatase activities. Acid phosphatase activity was reduced in all three of the soils (44 to 51%) at 2810 ppm. Alkaline phosphatase activity was reduced 27% in the loam soil at a concentration of 281 ppm and 78% at 2810 ppm in a clay loam soil in which this was the only concentration tested.

Haanstra and Doelman (1991) investigated short- and long-term effects of metals on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) by native soil microflora in five soils (sand, sandy loam, silt loam, clay, and sandy peat) of varying characteristics. Soil pH ranged from 7.7 to 4, organic matter content from 1.6 to 12.8%, and clay from 2 to 60%. Metals were added as salts to the sieved soils in flasks, and enzyme activity was measured after a 6-week or 18-month study. Results were reported as EC_{50}. In the 6-week incubation study on the effects of Cd, data from the sandy loam soil were not available. Data for the effects on phosphatase activity were also not available for sandy peat. For all three enzyme systems, the highest EC_{50}s were found in the soil with the highest clay content (9520, 9779, and 4460 ppm for arylsulfatase, phosphatase, and urease activities, respectively). The lowest EC_{50}s were 1888 ppm for arylsulfatase, and 840 and 340 ppm in the sand for phosphatase and urease activities. In the 18-month study, data from the sandy peat soil were not available for arylsulfatase and phosphatase. The highest EC_{50}s were 230 ppm in the soil with the highest pH for phosphatase, 30 ppm Cd in the sandy loam soil for urease, and 121 ppm in the sand (lowest pH, organic matter, and clay) for arylsulfatase.

The effects of several elements on dehydrogenase activity of the native soil microflora in a composite soil sample from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985). Soil was amended with glucose and alfalfa, with the metal salts added in solution. After 6 days, a

concentration of 30 ppm Cd (lowest concentration tested), added as cadmium nitrate, reduced dehydrogenase activity by 47%.

Lighthart and Bond (1976) investigated the effects of Cd (as $CdCl_2$) added to a small (600 ml) soil and litter microcosm. Soil was homogenized and sieved and the overlying plant litter layer was sieved. The Cd (0.006 or 6.1 ppm Cd) was introduced into the microcosm by injecting an aqueous solution into the soil and litter with a syringe. After 24 days, the native soil and litter microflora exhibited a 43% reduction in respiration (O_2 uptake) in microcosms inoculated with 6.1 ppm Cd.

Threshold levels of Cd (as cadmium acetate) for soil respiration of native microflora in three soils were determined by Reber (1989). The soils ranged in pH from 5.6 to 7, percent organic matter 1.7 to 2.6, and percent clay 3.2 to 21.3. There was no clear relationship between these soil characteristics and the magnitude of reduction in soil respiration at the concentrations tested. The highest LOEC concentration (56.3 ppm) for Cd was associated with the soil containing the lowest percentage of organic matter and the lowest pH.

Liang and Tabatabai (1977) investigated the effects of various metals on N mineralization by native soil microflora in four soils varying in pH from 6 to 7.8, clay from 23 to 34%, and organic matter content from 6 to 11%. Only one concentration of each metal was tested and was added to the soil as a salt solution. Cadmium reduced N mineralization in two soils at 562 ppm but no relationship between soil characteristics and effects of Cd could be discerned.

Bollag and Barabasz (1979) evaluated the effects of several metals on denitrification in autoclaved soil by three species of soil-dwelling *Pseudomonas* species of bacteria andon denitrification in soil by native soil microflora. The silt loam soil was autoclaved to kill the majority of its microflora, inoculated with individual metals and bacterial populations, and incubated 4 days under anaerobic conditions. The same soil was used to determine the effects of metals on denitrification by the native soil microflora after 21-day incubation under anaerobic conditions. In the autoclaved soil, two of the three *Pseudomonas* species had reductions in activity at 50 ppm Cd, while the third was more sensitive to the toxic effects of this metal (and Cu and Zn) on denitrification. The native soil population in unautoclaved soil was more tolerant of the Cd, with reductions in activity at 100 ppm Cd. It is not clear whether this difference is due to changes in the chemical and physical nature of the soil during autoclaving or to other organisms in the natural soil being more tolerant to Cd.

Khan and Frankland (1984) used a dyed cellophane film technique to evaluate the effects of Cd on cellulolytic activity of native soil microflora in a Brown earth soil (pH 4.6). The film was encased in nylon mesh, buried in the potted soils containing Cd added as $CdCl_2$, and allowed to equilibrate for 15 days. After a further 30 days past the equilibrium period, the film was retrieved and analyzed for dye release. A 35% reduction in percent cellulose decomposition was measured in pots containing 100 ppm Cd, while 50 ppm had no effect.

Lighthart et al. (1977) evaluated the effects of a number of metals at single concentrations on respiration of native soil microflora in small coniferous forest soil/litter microcosms. Metals in solution form were mixed into the soil and litter which were then layered in the microcosm. Cadmium at 920 ppm reduced respiration 61%.

In a study on the effects of Cd on N mineralization and nitrification by native soil microflora in a moderately acid soil, Bewley and Stotzky (1983) found N mineralization to be unaffected by Cd levels up to 1000 ppm, the highest concentration tested. Nitrification was reduced 62% by 1000 ppm.

The effects of Cd as $CdCl_2$ on carbon and nitrogen mineralization and nitrogen transformations in alfalfa-amended sieved soil were determined by Suter and Sharples (1984). The silt loam soil had a pH of 4.7. At 3 days, respiration was reduced by 20% at 500 ppm, but at later dates no significant reduction occurred. Ammonia levels were increased (by as much as a factor of 12) on days 22 to 53 at 50 ppm Cd and higher. Nitrate levels were reduced by >21% on days 25, 32, and 39 at 50 ppm Cd and higher, but on days 46 and 53 significant effects occurred at only 100 ppm and higher. These results suggest that nitrification is highly sensitive to Cd relative to C mineralization and may be chronically reduced at 50 ppm.

A benchmark of 20 ppm Cd was established as the 10th percentile of the 47 reported effective values. Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional measures.

Chromium. Liang and Tabatabai (1977) investigated the effects of various metals on N mineralization by native soil microflora in four soils, as described for Cd. Chromium(III) at 260 ppm reduced N mineralization in the soil containing the highest organic matter content. This same soil showed an effect of added Cu.

The effects of Cr(III) on dehydrogenase activity of the native soil microflora in soil from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985) as described previously for Cd. After 6 days, a concentration of 30 ppm Cr (the lowest concentration tested) reduced dehydrogenase activity by 54%.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Cr on soil acid and alkaline phosphatase activities. Acid and alkaline phosphatase activities were affected at 1635 ppm in all three soils to about the same degree, but greater inhibition of alkaline phosphatase activity occurred in the soil with the greatest content of organic matter and clay.

Ross et al. (1981) evaluated the relative toxicities of forms of Cr to respiration of native soil microflora in a loam and a sandy loam soil. After 22 days, Cr (III), tested at only 100 ppm, caused reductions in both soils of 41 and 48%. A concentration of 10 ppm (the lowest concentration tested) Cr (VI) caused reductions in both soils (27 and 33%). In this experiment, Cr(VI) was more toxic than Cr(III) to soil respiration.

Premi and Cornfield (1969, 1969/1970) investigated the effects of Cr added to a sandy loam soil on nitrogen transformations by native soil microflora. In a 21-day experiment (1969), nitrification was severely inhibited at 1000 ppm Cr (added as sulfate salt), but was unaffected at 100 ppm. In an 8-week experiment (1969/1970) with sucrose and ammonium nitrate added to the soil, nitrification was not affected by 10,000 ppm Cr, the highest concentration tested. Possible reasons for the differences in results for the two sets of experiments are differences in exposure duration and effects of amendments.

Bhuiya and Cornfield (1976) investigated the effects of several metals on N mineralization and nitrification by native soil microflora in a sandy soil at different pH levels. Metals were added to the soil as oxides to achieve a concentration of 1000 ppm, and the pH was adjusted to 7 (or left at the natural pH 6) before a 2-month equilibration period. After an additional 6 or 12 weeks past the equilibrium period, N transformation measures were made. After 6 weeks, both mineralization and nitrification were reduced by 1000 ppm Cr at pH 7, but not at pH 6. After 12 weeks, neither mineralization nor nitrification was affected by Cr at either pH.

The effects of soil characteristics on toxicity of Cr to arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) using methods described for Al. Activity was reduced in all soils at 1300 ppm Cr. Magnitude of reduction was inversely related to soil organic C content.

Haanstra and Doelman (1991) investigated short- and long-term effects of Cr on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) by native soil microflora in five soils, as described for Cd. In the 6-week incubation study on the effects of Cr, data from the silt loam soil were not available for arylsulfatase activity and not available from the sandy loam soil for urease. The highest EC_{50}s were 3203, 5512, and 4470 ppm, respectively, for arylsulfatase, phosphatase, and urease activities found in different soils. The lowest was 17 ppm in the sand for arylsulfatase and 1170 and 490 ppm in the clay for phosphatase and urease. In an 18-month study, the highest EC_{50}s were 1798, 20020, and 1110 ppm Cr, respectively, for arylsulfatase, phosphatase, and urease activities found in different soils. The lowest were 12 and <1 ppm in the clay for arylsulfatase and urease activities and 2692 ppm in the sandy loam for phosphatase activity.

The benchmark for Cr was established at 10 ppm because the 10th percentile lies between the EC_{50} values of 12 and 15 ppm from the work of Haanstra and Doelman (1991). Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional measures.

Cobalt. Lighthart et al. (1977) evaluated the effects of Co at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. Co at 1362 ppm reduced respiration 23%.

The benchmark of 1000 ppm comes from this study. Confidence in the benchmark is low because of the limited amount of data available.

Copper. Liang and Tabatabai (1977) investigated the effects of various metals on N mineralization by native soil microflora in four soils, as described for Cd. Copper at 320 ppm severely reduced N mineralization in one soil. This same soil showed an effect of added Cr(III).

The effects of Cu on dehydrogenase activity of the native soil microflora in soil from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985) using methods described for Cd. A concentration of 30 ppm Cu (the lowest concentration tested) Cu reduced dehydrogenase activity by 28%.

Bollag and Barabasz (1979) evaluated the effects of Cu on denitrification by three species of soil-dwelling *Pseudomonas* species of bacteria in autoclaved soil and by native soil microflora, as described for Cd. In the autoclaved soil, there was a range of sensitivities of the *Pseudomonas* species to Cu. LOECs ranged from 10 (lowest concentration tested) to 250 ppm (highest concentration tested). The organism most sensitive to the effects of Cd and Zn was also more sensitive to the toxic effects of Cu on denitrification. Denitrification by the native soil population was reduced 44% by 250 ppm Cu.

The effects of adding Cu, as $CuSO_4$, to a sandy loam adjusted to three pH levels on N mineralization during a 21-day incubation was assessed by Quraishi and Cornfield (1973). Mineralization was decreased by 1000 ppm Cu at all three pH levels (5.1, 5.9, and 7.3) with inhibitory effect increasing with decreasing pH from 39% to 100%.

Premi and Cornfield (1969, 1969/1970) investigated the effects of several metals added to a sandy loam soil on nitrogen transformations by native soil microflora. In a 21-day experiment (1969),

nitrification was severely inhibited at 10,000 ppm Cu, added as $CuSO_4$, but unaffected at 1000 ppm. Copper added in carbonate form was ineffective at 10,000 ppm (highest concentration tested), probably because of the increase in soil pH caused by addition of this form. In an 8-week experiment (1969/1970) with sucrose and ammonium nitrate added to the soil, nitrification was decreased at 1000 ppm Cu but unaffected at 100 ppm. Possible reasons for the differences in results between the two experiments are differences in exposure duration and effects of amendments.

Bhuiya and Cornfield (1972) assessed the effects of several metals on C mineralization by native microflora in a sandy soil, with or without added organic matter. Metals were added to the soil as oxides to achieve a concentration of 1000 ppm and a small amount of ground oat straw was added to part of the soil before a 2-month equilibration period. After a further 12 weeks, soil respiration was reduced in the Cu-treated soil with amendment but not in the unamended soil.

The influence of soil characteristics on effects of Cu on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) using methods described previously for Al. In the soil with the highest pH (7.6), Cu had no effect. Arylsulfatase activity in the other three soils was reduced by Cu at a concentration of 1590 ppm. Reductions were the least severe in the soil having the highest organic carbon and clay content.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of two forms of Cu on soil acid and alkaline phosphatase activities. Acid phosphatase activity was affected by Cu(I) and Cu(II) in all three soils about equally at a concentration of 1590 Cu (lowest concentration tested). The greatest reduction occurred in the soil with the lowest pH and the lowest contents of organic matter and clay. Alkaline phosphatase activity was more sensitive to Cu(I) than Cu(II).

Haanstra and Doelman (1991) investigated short- and long-term effects of Cu on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) for native soil microflora in five soils, as described for Cd. In the 6-week study, data were not available for phosphatase activity in the sandy loam or for urease activity in the silt loam. The highest EC_{50}s for arylsulfatase and phosphatase activities (14,946 and 6424 ppm) was found in the soil with the highest pH (silt loam). The highest EC_{50} for urease activity (4200 ppm) was found in the soil with the greatest content of organic matter and the lowest pH (sandy peat). The lowest EC_{50}s, all found in the sand, were 390, 140, and 260 ppm for arylsulfatase, phosphatase, and urease. In the 18-month incubation study, the highest EC_{50}s were 6996 and 4200 ppm Cu in the soil with the greatest percentage organic matter for arylsulfatase and urease activities and 2773 ppm for phosphatase in the clay soil. Lowest EC_{50}s were 203, 170, and 680 ppm in the sand for arylsulfatase, phosphatase, and urease activities, respectively.

The effects of Cu (as $CuCl_2$) on carbon and nitrogen mineralization and nitrogen transformations in alfalfa-amended sieved soil were determined by Suter and Sharples (1984). The silt loam soil had a pH of 4.7. At 10 days, respiration was reduced by 24% at 100 ppm, but significant reductions occurred at 500 ppm on days 3 and 14 and at 1000 ppm on all dates. Ammonia concentration was decreased significantly by 58% on days 4 and 11 at 10 ppm, but there was no increase of effects with concentration on those dates, and ammonia concentrations were unchanged or increased at those concentrations on later dates. Ammonia concentrations were significantly increased at 500 and 1000 ppm from day 18 to 53, and after day 18 there were regular patterns of increasing ammonia at increasing Cu levels. Nitrate levels were reduced by 21% on day 4 at a concentration of 10 ppm, but not on later dates. On day 11, nitrate concentrations were significantly reduced to 50–1000 ppm (but increased at 10 ppm), and on days 18 to 53, they were significantly reduced only at 500 and 1000 ppm Cu. These results suggest that

nitrification is highly sensitive to Cu, relative to C and N mineralization. If the chronic response is used as the basis for the benchmark, the threshold for significant effects in this test is 500 ppm Cu.

The benchmark for Cu has been established at 100 ppm. Confidence in this benchmark is high.

Fluoride. The effects of fluoride, added as potassium fluoride to poplar litter, on nitrogen and phosphorus mineralization by native microflora was investigated by van Wensem and Adema (1991). The newly fallen (2 months old) litter was air-dried, cut into small pieces, and rewetted with KF solutions of varying concentrations. After 9 weeks, K mineralization was reduced 22% in litter treated with 32.3 ppm F, the lowest concentration tested. Nitrogen mineralization was reduced 26% by 100.7 ppm, while 32.3 ppm had no effect.

The effects of F on dehydrogenase activity of the native soil microflora in soil from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985) as described previously for Cd. A concentration of 5000 ppm F reduced dehydrogenase activity by 30% (3000 ppm had no effect).

The toxic concentration of 32 ppm (van Wensem and Adema, 1991) is the lowest of the two reported. Confidence in the benchmark of 30 ppm is low because of the limited amount and type of data available.

Iron. Liang and Tabatabai (1977) investigated the effects of Fe on N mineralization by native soil microflora in four soils, as described for Cd. Iron(III) reduced N mineralization in one soil at 280 ppm. This same soil showed an effect of added Cd.

The influence of soil characteristics on effects of Fe(III) on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In the soil with the highest pH (7.6), Fe(III) had no effect. Activity was reduced in all other soils at 1398 ppm Fe. The magnitude of reduction generally was inversely related to soil pH.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of Fe(II) and Fe(III) on soil acid and alkaline phosphatase activities. Iron(II) reduced acid phosphatase activity at 1398 ppm in only the soil with the lowest pH and organic matter and clay contents. Iron(III) reduced activity to a greater degree in this soil and also in the soil with the second lowest pH (but highest organic matter and clay contents). Iron(II) inhibited alkaline phosphatase activity in one of the soils tested and Fe(III) in the soil in which both forms of Fe inhibited acid phosphatase activity.

The effective concentration of 280 ppm (Liang and Tabatabai, 1977) is the lowest of the nine reported. Confidence in the benchmark of 200 ppm is low because of the limited amount and type of data available.

Lanthanum. Lighthart et al. (1977) evaluated the effects of La (as $LaCl_2$) at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. After 23 days, lanthanum at 57 ppm reduced respiration by 22%.

The benchmark of 50 ppm (Al-Khafaji and Tabatabai, 1979) is based on this work. Confidence in the benchmark is low because of the limited amount of data available.

Lead. Khan and Frankland (1984) used a dyed cellophane film technique to evaluate the effects of Pb on cellulolytic activity of native soil microflora in a Brown earth soil (pH 4.6), as described

previously for Cd. A 23% reduction in percent cellulose decomposition was measured in pots containing 1000 ppm Pb, while 500 ppm had no effect.

The mediating influence of clay on effects of lead on soil respiration was assessed by Debosz et al. (1985). The sandy loam soil (9% clay) was amended with glucose and Pb acetate in solution. After 15 days, respiration was reduced 29% by 10,000 ppm Pb (1000 ppm had no effect). In the same soil amended with either 9% by weight kaolinite or montmorillonite, Pb up to 10,000 ppm had no effect.

Cole (1977) assessed the effects of various carbohydrate additions and Pb compounds on amylase synthesis and activity by native soil microflora in a silt loam soil. Carbohydrates were added to the soil in solution and Pb in dry salt form. With the addition of glucose and lead acetate, amylase activity was more sensitive than synthesis, with a 74% reduction at the lowest concentration tested (2000 ppm). With the addition of starch, amylase activity was reduced less by $PbCl_2$ than with lead acetate and lead sulfate. With the addition of lead acetate, amylase activity was more sensitive with the addition of starch than with glucose. Cole also investigated the effect of Pb acetate on alpha-glucosidase synthesis and bacterial population size. Both were reduced by the addition of 2000 ppm Pb (lowest concentration tested).

Liang and Tabatabai (1977) investigated the effects of Pb on N mineralization by native soil microflora in four soils, as described for Cd. Lead reduced N mineralization in one soil at 1035 ppm. This same soil showed an effect of added Cd.

Bhuiya and Cornfield (1972) assessed the toxic effects of Pb on C mineralization by native microflora in a sandy soil, with or without added organic matter, as described for Cu. After 12 weeks, soil respiration was reduced in the Pb-treated soil without oat straw, but not in the straw-amended soil.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effects of two forms of Pb (acetate and nitrate) to soil acid and alkaline phosphatase activities. The two forms had equal effect on acid phosphatase activity at 5175 ppm and that only in the soil with the lowest pH and organic matter and clay contents. They had equal effects on alkaline phosphatase activity at this concentration in one of the soils tested, and only Pb acetate was inhibitory in the soil with the highest organic matter and clay contents.

Haanstra and Doelman (1991) investigated short- and long-term effects of Pb on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) by native soil microflora in five soils, as described for Cd. In the 6-week study on the effects of Pb, data from the sandy loam, clay, and sandy peat soils were not available for arylsulfatase, the sand, sandy loam and peat for phosphatase, and the sand for urease. The highest EC_{50}s for arylsulfatase and phosphatase activities (9138 and 1168 ppm) were found in the clay soil. The highest EC_{50} for urease activity (7190 ppm) was found in the silt loam (highest pH). The lowest were 8288, 8184, and 50 60 ppm Pb for arylsulfatase, phosphatase, and urease activities. In the 18-month study, data from the sandy peat soil were not available for arylsulfatase and phosphatase and from the clay and sandy loam for phosphatase. The highest EC_{50}s were 12,411 ppm in the soil with the highest clay for arylsulfatase, 78,943 ppm for phosphatase in the sand, and 8130 in the silt loam for urease. The lowest EC_{50}s were 3004, 7604, and 1340 ppm, in different soils.

Doelman and Haanstra (1979) evaluated the effects of Pb on soil respiration and dehydrogenase activity in several soils. After 24 hours, respiration in a sand (pH 5.7, percent organic matter 3) was reduced by 750 ppm Pb, the lowest concentration tested. Dehydrogenase activity was not affected at this concentration. After 40 months, respiration in this soil was reduced to approximately the same degree at 1500 ppm, the lowest concentration tested. Dehydrogenase activity was not evaluated. In another

sandy soil, (pH 5.4, percent organic matter 6.7), dehydrogenase activity was severely inhibited by 1500 ppm, but not at 750 ppm Pb after 24 hours. Respiration was not affected at this concentration. In a clay soil, dehydrogenase activity was inhibited by 375 ppm, the lowest concentration tested. Respiration was not evaluated.

The benchmark of 900 ppm Pb is the 10th percentile of the 36 reported effective values. Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional measures.

Lithium. Lighthart et al. (1977) evaluated the effects of Li at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. Lithium at 17 ppm reduced respiration 43%.

The effective concentration of 10 ppm was derived from this study. Confidence in the benchmark is low because of the limited amount of data available.

Manganese. Liang and Tabatabai (1977) investigated the effects of Mn on N mineralization by native soil microflora in four soils, as described for Cd. Manganese at 275 ppm reduced N mineralization in one soil. This same soil showed an effect of added Cd.

Premi and Cornfield (1969) investigated the effects of Mn added to a sandy loam soil on nitrogen transformations by native soil microflora. In a 21-day experiment, nitrification was severely inhibited at 100 ppm, added as sulfate salt, the lowest concentration tested.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Mn on soil acid and alkaline phosphatase activities. Acid phosphatase activity was affected at 1375 ppm only in the soil with the lowest pH and organic matter and clay contents. Alkaline phosphatase activity was reduced in one of the soils tested by this same concentration.

The effective concentration of 100 ppm (Premi and Cornfield, 1969) the lowest of the four reported. Confidence in the benchmark of 100 ppm is low because of the limited amount and type of data available.

Mercury. van Fanssen (1973) investigated the effects of an inorganic and an organic mercury compound on N mineralization and nitrification by native soil microflora in two alkaline soils: a dune sand with 2% organic matter and a mix of two clay soils with 6% organic matter. Little information was provided concerning the experimental design. In the clay soil, both $HgCl_2$ and phenylmercury acetate reduced nitrification at 100 ppm Hg (10 ppm had no effect), but the organic form was more inhibitory than the inorganic form. Mineralization was not affected by the inorganic form but was decreased by phenylmercury acetate. In the dune sand, $HgCl_2$ severely reduced nitrification at 100 ppm (10 ppm had no effect) and phenylmercury acetate reduced nitrification at 10 ppm Hg (lowest concentration tested). Mineralization was not affected by the organic form but was decreased by $HgCl_2$ at 100 ppm Hg. This work indicates that the relative toxicity of various forms of Hg can be influenced by soil characteristics.

Landa and Fang (1978) investigated the effects of mercuric chloride (up to 100 ppm Hg) on carbon mineralization by native soil microflora in five agricultural topsoils varying in pH and organic matter content. The magnitude of effects varied greatly among the soils and were not related to those two soil characteristics. Effects ranged from an 87% reduction at 0.1 ppm (the lowest concentration tested) in one of the soils to no effect at 100 ppm in another soil.

Bremner and Douglas (1971) evaluated the effects of several metals on urease activity in two soils with similar pH, organic matter, and clay content characteristics. Metals were added individually in solution at a concentration of 50 ppm, and urease activity was determined after 5 hours. Mercury, added either as the chloride or sulfate salt, decreased urease activity by 36 to 42% in both soils.

Liang and Tabatabai (1977) investigated the effects of Hg on N mineralization by native soil microflora in four soils, as described for Cd. Mercury reduced N mineralization in all soils at 1003 ppm. The greatest magnitude of the toxic effect was seen in the soil having the lowest pH and organic matter and clay contents.

The influence of soil characteristics on effects of Hg on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In two soils tested with a lowest concentration of 502 ppm, arylsulfatase activity was greatly reduced. In the two soils tested with a lowest concentration of 5015 ppm, arylsulfatase activity was inhibited almost totally. No clear differences between the soils with regard to effects on toxicity of Hg could be discerned.

Frankenberger and Tabatabai (1981) investigated the effect of Hg on amidase activity in three soils in shaker flask assays as described previously. After 2 1/2 hours, amidase activity was reduced in all three soils at 5015 ppm. The greatest reduction occurred in the soil with the lowest pH and organic matter and clay contents.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Hg on soil acid and alkaline phosphatase activities. Acid and alkaline phosphatase activities were affected at 5015 ppm in all three soils to about the same degree.

The benchmark of 30 ppm Hg is the 10th percentile of the 27 reported effective values. Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional measures.

Molybdenum. Liang and Tabatabai (1977) investigated the effects of Mo on N mineralization by native soil microflora in four soils, as described for Cd. Molybdenum reduced N mineralization in three of the soils at 480 ppm. No toxic effect was seen in the soil having the lowest pH and organic matter and clay contents. No clear relationship between soil characteristics and magnitude of effects of Mo could be discerned.

The influence of soil characteristics on effects of Mo on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In the soil with the highest clay and organic matter contents, Mo had no effect. Activity was severely reduced at 2398 ppm (lowest concentration tested) in the soil with the lowest pH and organic matter content. It is possible that activity in this soil would have been inhibited to a somewhat lesser degree by 240 ppm Mo, as it was in the two remaining soils.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Mo on soil acid and alkaline phosphatase activities. Acid phosphatase activity in all three soils was reduced at 2398 ppm. In the soil with the lowest pH, and organic matter and clay contents, it was also inhibited at 240 ppm Mo. Alkaline phosphatase activity in both soils tested was reduced about the same degree at this concentration.

The benchmark for Mo was established at 200 ppm based on the work of Al-Khafaji and Tabatabai (1979). Confidence in this benchmark is moderate.

Nickel. The effects of Ni, as nickel sulfate, on dehydrogenase activity of the native soil microflora in soil from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985) as described previously for Cd. After 6 days, a concentration of 30 ppm (lowest concentration tested) Ni reduced dehydrogenase activity by 39%.

Babich and Stotzky (1982) evaluated the effects of two forms of Ni on mycelial growth rate of a number of soil-dwelling fungi inoculated individually into autoclaved sandy loam soil. The concentrations at which growth was reduced ranged from 50 to 750 ppm for Ni (added in chloride or sulfate form).

Giashuddin and Cornfield assessed the effect of Ni added in oxide (1979) and sulfate (1978) forms on N and C mineralization by native soil microflora in a sandy soil. The metal salts were mixed into the soil in dry form. After 42 days incubation, soil respiration (C mineralization) was reduced in soil containing 10 ppm Ni from Ni sulfate (lowest concentration tested), and N mineralization was affected at 100 ppm. Soil respiration was reduced in soil containing 50 ppm Ni from Ni oxide (lowest concentration tested), and N mineralization was affected at 1000 ppm. Because of the test concentrations used, it is difficult to assess the relative toxicity of these two forms of Ni to C mineralization. When the soil pH was raised to 6.9 (from its normal 5.9), soil respiration was reduced in soil containing 250 ppm Ni from Ni oxide (lowest concentration tested), and N mineralization was affected at 1000 ppm. The effect of Ni from Ni sulfate was not tested at the higher pH. Raising the pH appeared to affect soil respiration but not N mineralization.

Bhuiya and Cornfield (1974) assessed the effects of Ni on C mineralization by native microflora in a sandy soil, with or without added organic matter, as described for Cu. After 12 weeks, soil respiration was reduced in the Ni-treated soil with or without oat straw, but to a greater degree in the straw-amended soil.

The influence of soil characteristics on effects of Ni on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In only one soil was the highest concentration tested, 1468 ppm, found to reduce arylsulfatase activity. This soil had the lowest pH and organic matter content of the four soils tested.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Ni on soil acid and alkaline phosphatase activities. Acid phosphatase activity was not affected at 1468 ppm only in the soil with the highest pH. Alkaline phosphatase activity was reduced in one of the soils tested by this same concentration.

Haanstra and Doelman (1991) investigated short- and long-term effects of Ni on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) by native soil microflora in five soils, as described for Cd. In the 6-week study on the effects of Ni, data from the sandy peat soil were not available for arylsulfatase and phosphatase activities. The highest EC_{50}s (5659, 6516, and 3380 ppm for arylsulfatase, phosphatase, and urease activities) were found in the soil with the highest clay content. The lowest were 2119, 1109, and 100 ppm, for arylsulfatase, phosphatase, and urease activities found in the sand. In the 18-month study, data from the sandy loam soil were not available for arylsulfatase activity nor from clay and sandy peat for phosphatase activities. The highest EC_{50}s were 8101, 8042, and 2790 ppm Ni for arylsulfatase, phosphatase, and urease activities in different soils. The lowest LC_{50}s, 92, 769, and 370 ppm, were found in the sand.

A benchmark of 90 ppm Ni was established based on the 56 reported effective values. Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional measures.

Selenium. Lighthart et al. (1977) evaluated the effects of using methods at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. Selenium at 484 ppm reduced respiration 43%.

The influence of soil characteristics on effects of Se on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In the soil with the lowest clay content, activity was reduced by 198 ppm. In the other soils, arylsulfatase activity was reduced by 1975 ppm with the greatest reduction in the soil with the lowest pH and organic matter content.

Frankenberger and Tabatabai (1981) investigated the effect of Se on amidase activity in three soils in shaker-flask assays as described previously. After 2 1/2 hours, amidase activity was reduced in only one soil at 1975 ppm. This soil had the lowest pH and organic matter and clay contents of the soils tested.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Se(IV) to soil acid and alkaline phosphatase activities. Acid phosphatase activity in all three soils was reduced at 1975 ppm. Alkaline phosphatase activity in both soils tested was reduced about the same degree at this concentration.

The effective concentration of 198 ppm (Al-Khafaji and Tabatabai, 1979) is the lowest of the 10 reported. Confidence in the benchmark of 100 ppm is moderate.

Silver. Bremner and Douglas (1971) evaluated the effects of Ag on urease activity in two soils, as described for Hg. After 5 hours, silver, added as either nitrate or sulfate salt, decreased urease activity by 60 to 65% in both soils.

Liang and Tabatabai (1977) investigated the effects of Ag on N mineralization by native soil microflora in four soils, as described for Cd. Silver at 540 ppm reduced N mineralization in all soils. The greatest magnitude of the inhibitory effect was seen in the soil having the lowest pH and organic matter and clay contents.

The influence of soil characteristics on effect of Ag on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In two soils tested with a lowest concentration of 270 ppm, arylsulfatase activity was greatly reduced. In the two soils tested with a lowest concentration of 2698 ppm, arylsulfatase activity was almost totally inhibited.

Frankenberger and Tabatabai (1981) investigated the effect of Ag on amidase activity in three soils in shaker-flask assays as described previously. After 2 1/2 hours, amidase activity was severely reduced in all three soils at 2698 ppm. The greatest reduction occurred in the soil with the lowest pH and organic matter and clay contents.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of silver on soil acid and alkaline phosphatase activities. Acid phosphatase activity was affected at 2698 ppm only in the soil with the highest pH (7.8). Alkaline phosphatase activity was reduced 28% in the loam soil at an Ag concentration of 270 ppm and 93% at 2698 ppm in a clay loam soil.

A benchmark of 50 ppm Ag was established based on the 17 reported effective values. Confidence in this benchmark is moderate.

Tin. The influence of soil characteristics on effect of Sn on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In the soil with the highest pH (7.6), Sn had no effect. Arylsulfatase activity in the other three soils was reduced by 2968 ppm Sn. The reductions were the least severe in the soil having the highest organic C and clay content.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of Sn on soil acid and alkaline phosphatase activities. Acid phosphatase activity was affected at 2968 ppm only in the soil with the lowest pH and organic matter and clay contents. Alkaline phosphatase activity was reduced in both soils tested by this same concentration.

The effective concentration of 2968 ppm (Al-Khafaji and Tabatabai, 1979) is the lowest of the seven reported. Confidence in the benchmark of 2000 ppm is low because of the limited amount and type of data available.

Titanium. The influence of soil characteristics on effect of Ti (as $TiSO_4$) to arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In two soils tested with a lowest concentration, arylsulfatase activity was reduced by 1198 ppm. These two soils had the lowest pH and organic matter and clay contents of the four tested.

The effective concentration of 1198 ppm (Al-Khafaji and Tabatabai, 1979) is the lowest of the two reported. Confidence in the benchmark of 1000 ppm is low because of the limited amount and type of data available.

Tungsten. The influence of soil characteristics on effects of tungsten (W) (Na_2WO_4) on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In the soil with the highest clay and organic matter contents, W had no effect. Activity was reduced in all other soils at 4598 ppm, with the greatest reduction in the soil with the lowest clay content.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of tungsten on soil acid and alkaline phosphatase activities. Acid phosphatase activity in all three soils was reduced at 4598 ppm. In the soil with the lowest pH and organic matter and clay content, it was also inhibited at 460 ppm W. Alkaline phosphatase activity in both soils tested was reduced about the same amount at this concentration.

The effective concentration of 460 ppm (Juma and Tabatabai, 1977) is the lowest of the seven reported. Confidence in the benchmark of 400 ppm is low because of the limited amount and type of data available.

Vanadium. Tyler (1976) evaluated the effect of V, added in a solution of sodium vanadate to fresh needles from a white pine stand, on acid phosphatase activity of the native microflora. After 3 hours of exposure, activity was reduced 40% by 50 ppm V, while 30 ppm had no effect.

The influence of soil characteristics on effect of V on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. In two soils tested with a lowest concentration of 127 ppm, arylsulfatase activity was reduced with the greatest reduction in the soil with the lowest clay content. In the two soils tested with a lowest concentration of 1273 ppm, arylsulfatase activity was severely inhibited.

Juma and Tabatabai (1977) used the system described for Al to evaluate the effect of V on soil acid and alkaline phosphatase activities. Acid phosphatase activity in all three soils was reduced about the same degree at 1273 ppm. In the soil with the lowest pH and organic matter and clay contents, it was also inhibited at 127.3 ppm V. Alkaline phosphatase activity in both soils tested was reduced about the same degree at 1273 ppm. In the soil with the highest organic matter and clay contents, it was also inhibited at 127.3 ppm V.

Lighthart et al. (1977) evaluated the effects of V at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. Vanadium at 23 ppm reduced respiration 21%.

The effective concentration of 23 ppm (Lighthart et al., 1977) is the lowest of the 10 reported. Confidence in the benchmark of 20 ppm is moderate.

Zinc. Wilson (1977) evaluated the effect of Zn, as zinc sulfate solution, on nitrification by native soil microflora in three soils. The soils ranged in pH from 5.1 to 6.2, percent organic matter from 1.1 to 2.4, and percent clay from 2 to 28. After 49 days, nitrification was severely inhibited in all three soils (98 to 100%) by 1000 ppm Zn, while Zn at 100 ppm had no effect.

Haanstra and Doelman (1991) investigated short- and long-term effects of Zn on arylsulfatase activity, urease activity (Doelman and Haanstra, 1986), and total phosphatase activity (Doelman and Haanstra, 1989) by native soil microflora in five soils, described for Cd. In the 6-week study on the effects of Zn, data from the sandy peat soil were not available for any of the enzymes. The highest EC_{50}s were 5559, 3623, and 1780 ppm for arylsulfatase, phosphatase, and urease activities, all in the soil with the greatest content of clay. The lowest EC_{50}s of 909, 220, and 420 ppm Zn were all found in the sand. In the 18-month study, data were not available from the sandy peat for phosphatase or the silt loam for urease. The highest EC_{50}s were 9679, 4872, and 290 ppm Zn in different soils. The lowest EC_{50}s were 375, 170, and 70 ppm in different soils.

Juma and Tabatabai (1977) used the system described for Al to evaluate the toxicity of Zn to soil acid and alkaline phosphatase activities. Acid and alkaline phosphatase activities were affected at 1635 ppm in all three soils to about the same degree, except increased inhibition of alkaline phosphatase activity in the soil with the highest pH.

The influence of soil characteristics on effects of Zn on arylsulfatase activity was evaluated by Al-Khafaji and Tabatabai (1979) as described previously for Al. A reduction in activity was measured in two soils tested at a concentration of 1635 ppm. No clear differences between the soils with regard to influence on effects of Zn could be discerned.

Bhuiya and Cornfield (1974) investigated the effects of Zn on N mineralization and nitrification by native soil microflora in a sandy soil at different pH levels, as described for Cr. After 12 weeks, both mineralization and nitrification were reduced by 1000 ppm Zn at pH 7, but not at pH 6. After 6 weeks, neither mineralization nor nitrification was affected by Zn at either pH.

Bhuiya and Cornfield (1974) investigated the effects of 1000 ppm Zn added as Zn oxide to a sandy soil at three pH levels on nitrogen mineralization by native soil microflora. After 42 days, N mineralization was reduced in the pH 7.7 soil but not in soils at pH 6 and 7.

The effects of Zn on dehydrogenase activity of the native soil microflora in soil from the Rocky Mountain Arsenal was assessed by Rogers and Li (1985) as described previously for Cd. A concentration of 300 ppm Zn reduced dehydrogenase activity by 30%; Zn at 150 ppm had no effect.

Laskowski et al. (1994) looked at the effects of several metals at low to moderate levels on the respiration rate of acid-mixed forest litter. The fresh litter was treated with solutions of $CdCl_2$ (up to 250 ppm Cd), $Pb(NO_3)_2$ (up to 2500 ppm Pb), or $ZnCl_2$. Only zinc had an effect at the concentrations tested. A concentration of 1000 ppm Zn reduced respiration by 26%; Zn at 200 ppm had no effect.

The effect of Cd and Zn on respiration of soil microflora in field-collected black oak forest soil/litter microcosms was evaluated by Chaney et al. (1978). The metals, in solutions of chloride salts, were sprinkled over the litter layer of the chamber. After 23 days, Cd at a concentration up to 6 ppm had no effect. Respiration was decreased 21% by Zn at 479 ppm; Zn at 47 ppm had no effect.

Bollag and Barabasz (1979) evaluated the effects of Zn on denitrification by three soil-dwelling *Pseudomonas* (bacteria) in autoclaved soil and by native soil microflora, as described for Cd. In the autoclaved soil, two of the three species had reductions in activity at 250 ppm Cd, while the organism most sensitive to the effects of Cd and Cu was also more sensitive to the toxic effects of Zn on denitrification. Denitrification by the native soil population was reduced 31% by 250 ppm Zn.

Lighthart et al. (1977) evaluated the effects of Zn at a single concentration on respiration of native soil microflora in soil/litter microcosms, as described for Cd. Zinc at 3600 ppm reduced respiration 66%.

Premi and Cornfield (1969, 1969/1970) investigated the effects of Zn added to a sandy loam soil on nitrogen transformations by native soil microflora. In a 21-day experiment (1969), nitrification was severely inhibited at 100 ppm Zn, added as sulfate salt, the lowest concentration tested. Zinc added in carbonate form was ineffective at 10,000 ppm (highest concentration tested), probably because of the increase in soil pH caused by addition of this form. In the 8-week experiment (1969/1970) with sucrose and ammonium nitrate added to the soil, nitrification was decreased only slightly less at 100 ppm Zn than it was in the 21-day study.

The benchmark of 100 ppm Zn is the 10th percentile of the 46 reported effective values. Confidence in this benchmark is high because of the relatively large amount of data available for a variety of functional response factors.

4.3.2 Organic Chemicals

Acrylonitrile. The effects of several organic compounds on respiration of native soil microflora in a sandy loam and a silt loam soil were evaluated by Walton et al. (1989). Both soils were acid (pH 4.9 and 5.3) and low in organic matter (1.4 and 3%) but differed with respect to amounts of clay (5% vs and 30%). Respiration was measured after 6-day exposure to 1000 ppm of each chemical. Chemicals tested at 1000 ppm had no effect and include methyl ethyl ketone, benzene, toluene, p-xylene, chlorobenzene, chloroform, and other chlorinated benzenes. Acrylonitrile reduced respiration by 59% in the sandy loam soil and 41% in the silt loam. Clay appeared to have an ameliorating influence on the effects of acrylonitrile.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Carbon tetrachloride. The effects of 1000 ppm carbon tetrachloride on respiration of native soil microflora in a sandy loam and a silt loam soil was evaluated by Walton et al. (1989) as described for acrylonitrile. Carbon tetrachloride reduced respiration by 21% in the sandy loam but did not lower respiration in the silt loam soil. Clay may have had an ameliorating influence on the effects of this compound.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Cis-1,4-dichloro-2-butene. The effects of cis-1,4-dichloro-2-butene on respiration of native soil microflora in a sandy loam and a silt loam soil was evaluated by Walton et al. (1989) as described for acrylonitrile. Cis-1,4-dichloro-2-butene reduced respiration by 48% in the sandy loam soil and 44% in the silt loam by 1000 ppm. Clay did not appear not to have an ameliorating influence on the effects of this compound.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Hexachlorobenzene. The effects of 1000 ppm hexachlorobenzene on respiration of native soil microflora in a sandy loam and a silt loam soil was evaluated by Walton et al. (1989) as described for acrylonitrile. Hexachlorobenzene reduced respiration by 37% in the silt loam but did not lower respiration in the sandy loam soil. Clay did not appear to have an ameliorating effect on the toxicity of this compound.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Nitrobenzene. The effects of 1000 ppm nitrobenzene on respiration of native soil microflora in a sandy loam and a silt loam soil was evaluated by Walton et al. (1989) as described for acrylonitrile. Nitrobenzene reduced respiration by 61% in the sandy loam soil and by 22% in the silt loam. Clay appears to have an ameliorating influence on the effect of nitrobenzene.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Pentachlorophenol. van Beelen and Fleuren-Kemila (1993) evaluated the effect of pentachlorophenol (PCP) on mineralization of added acetate by native soil microflora in an acid agricultural soil and an acid dune sand. After 1.8 days, CO_2 evolved was reduced 50% (EC_{50}) by 460 ppm in the agricultural soil (percent organic matter, 10.4; percent clay, 5) and by 1500 ppm in the dune sand (percent organic matter, 1.2; percent clay, 0.4).

The benchmark of 400 ppm for PCP is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Phenol. Effects of phenol on carbon and nitrogen mineralization and nitrogen transformations in alfalfa-amended, sieved soil were determined by Suter and Sharples (1984). The silt loam soil had a pH of 4.7. Carbon dioxide production was increased at 10 ppm and 100 ppm on days 1 and 7 but not on later dates or at higher concentrations. CO_2 production was decreased at 1000 ppm phenol on day 1, but not thereafter, and at 5000 ppm phenol on days 1 through 55. On all dates (days 7 through 42), ammonia concentrations were significantly increased and nitrate significantly decreased by 1000 and 5000 ppm

phenol. At 10 and 100 ppm on day 7 and at 100 ppm on day 42, but not on intermediate dates, ammonia was significantly increased and nitrate decreased. If the lowest chronic response is used as the basis for the benchmark, the threshold for significant effects in this test is 100 ppm phenol.

The benchmark of 100 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

Trans-1,4-dichloro-2-butene. The effects of 1000 ppm trans-1,4-dichloro-2-butene on respiration of native soil microflora in a sandy loam and a silt loam soil was evaluated by Walton et al. (1989) as described for acrylonitrile. Trans-1,4-dichloro-2-butene reduced respiration by 44% in the sandy loam soil and 58% in the silt loam. Clay did not appear not to have an ameliorating influence on the effect of this compound.

The benchmark of 1000 ppm is based on this work. Confidence in the benchmark is low because of the limited amount and type of data available.

5. INVERTEBRATES OTHER THAN EARTHWORMS AND MICROBIAL HETEROTROPHS

5.1 INTRODUCTION

Interest in the toxic effects of soil pollutants on soil and litter dwelling invertebrates other than earthworms and microorganisms stems from concern for negative effects on nutrient cycling and availability and quality of food for animals feeding on soil and litter dwelling invertebrates. In general, the most important route for assimilation of metals by soil invertebrates is through the digestive tract (Beeby, 1991). Assimilation of toxic metals depends on diet and the animal's essential metal demand. In general, invertebrates with a high calcium demand tend to accumulate higher concentrations of toxic metals. The metals are often bound in intracellular granules, structural tissues, and membrane-bound vesicles. There is no clear relationship between the bioconcentration potential of a species and its susceptibility to metal intoxication (van Straalen, 1991).

Toxic effects of metals on invertebrates result in part from their interactions with nutritionally significant metals. van Straalen et al. (1989) suggest that the negative impact of cadmium on mite (*Platynothrus peltifer*) egg production results from disruption of the role of zinc in reproductive metabolism. Cadmium also blocks the calcium current of *Helix* neurons (Akaike et al., 1978), possibly leading to tissue damage and reduced reproduction (Russell et al., 1981). The interrelationships between metals, both essential and nonessential, appear to be quite complex and variable among species of invertebrates. Other effects may result from the binding of metals to proteins and enzymes with consequent functional disruption.

5.2 INVERTEBRATE DATA SELECTION

The experimental approaches are too diverse and the data too meager to allow for the establishment of benchmarks for the toxicity of contaminants in soil to soil-dwelling invertebrates other than earthworms. Most experiments evaluating the effects on nematodes are conducted in solution because these organisms inhabit the water films around soil particles and roots. The experiments using Collembola and mites are often conducted by feeding the organisms on algae that were reared on contaminated media. Perhaps the most common method for other organisms is to surface apply a solution, or soluble powder, of the chemical to the organic substrate on which it is to feed during the experiment. At most contaminated sites, concentrations of chemicals in soil are measured while concentrations in soil algae, litter, and pore water are not. Surface-applied chemicals are only appropriate when evaluating sites where deposition of air-borne contaminants onto vegetation and litter is the only route by which these food sources become contaminated. The bioavailability of chemicals introduced to food by these methods is not directly comparable to that of chemicals bound in organic form inside plant material or microflora. Furthermore, it would be difficult to assess the food preferences of these diverse and opportunistic organisms in any specific field situation (Hopkin, 1989) to allow appropriate sampling and analysis.

For the previously described reasons, no benchmarks have been established for these organisms. The information in this part of the document is provided as reference and support material. Experimental data are given in Appendix C.

5.3 INVERTEBRATE TEST SPECIES

The literature on toxicity of chemicals to soil and litter-dwelling invertebrates presents experimental results using microarthropods, macroarthropods, nematodes, and terrestrial gastropods and crustaceans. These organisms represent diverse morphological, physiological, and behavioral groups. The following general information is derived mainly from works edited by Dindal (1990) and Dickinson and Pugh (1974).

Collembola (springtails) are small, wingless microarthropods that live mainly in the soil litter layer. With the mites, springtails make up the majority of the soil litter arthropod fauna. Most soil forms live on partially decomposed vegetation or microflora, especially fungi. The importance of Collembola to soil organic matter breakdown and nutrient cycling results from the comminution of organic matter fragments, feeding on humus and feces in the litter, and on decaying roots. Collembola commonly used as test species are *Folsomia candida*, *Onychiurus armatus*, and *Orchesella cincta*. *Folsomia candida* is considered well-suited for the study of effects of contaminants on population parameters because it is easy to culture and has a relatively short generation time. This allows the study of individual and population parameters in the same experiment (Crommentuijn et al., 1993).

The Acarina (mites) are a diverse group of arthropods in the suborders *Prostigmata*, *Mesostigmata*, *Astigmata*, and *Oribatida*. Each suborder contains representatives living in a wide range of habitats. In the soil and litter, mites may be detritivores eating dead plant material, predatory, or fungivores/algivores. Oribatid mites are found in large numbers in organic horizons of soils. They are represented in toxicity tests by *Platynothrus peltifer*. Like the springtails, mites act to increase the rate of organic matter decomposition by reducing the size of organic matter fragments and feeding on microflora involved in decomposition. Mites, especially oribatids, are considered suitable for the study of effects of contaminants on population parameters because they are easy to culture and have a relatively short generation time (1 per year), although it is longer than that of the Collembola (2 per year).

Terrestrial crustaceans are represented in the toxicity literature by woodlice, also known as pill bugs (Isopoda, *Porcellio scaber* and *Oniscus asellus*). They are common in deciduous woodland, living in the litter layer and on decaying wood. Woodlice are omnivorous, feeding mainly on dead and decaying plants. They increase organic matter decomposition by comminuting the fragments and feeding on microflora involved in primary decomposition. As leaf litter feeders, isopods are considered good candidates for standard organisms in ecotoxicological testing (van Wensem, 1989). *Porcellio scaber* is common in many countries and is easy to maintain in the laboratory.

The snail *Helix aspersa* and the slug *Arion ater* represent terrestrial gastropods. They are generalized feeders (living and dead plant materials) inhabiting the soil surface, the litter layer, and standing vegetation. Their use in ecotoxicological testing stems from their potential importance for accumulation of contaminants in the food chain (Russell et al., 1981).

Nematodes (roundworms) are significantly different from other soil and litter-dwelling organisms discussed herein because they require a continuous water film for survival. They feed on a wide variety of foods although some are specialized parasites. The effects of chemicals on fungivores, bactivores, herbivores, and omnivores/predators have been evaluated. *Caenorhabditis elegans* used in experiments is a widespread free-living, soil-dwelling nematode. Nematodes have been used in ecotoxicological work for a number of reasons. They are abundant, easily retrieved from soil, and reared in the laboratory. Nematodes live in the interstitial water of the soil so experiments can be conducted in water. They may be exposed to higher concentrations of contaminants by this route than earthworms and other

invertebrates not constantly in contact with the soil solution. Uptake of chemicals is mainly through the cuticle, and differences in cuticle permeability are thought to be the primary source of variability in response of various nematodes to toxic chemicals (Kammenga et al., 1994).

5.4 OTHER INVERTEBRATES LITERATURE REVIEW

Cadmium. Kammenga et al. (1994) compared the acute toxicity of Cd ($CdCl_2$) to seven terrestrial nematode species belonging to different taxonomic and ecological groups. The nematodes were extracted from the surface horizon of an arable soil and a forest floor and identified and selected on the basis of different trophic levels: *Rhabditis* species and *Diplogasteritus* species; *Cephalobus persegnis*, *Acrobeloides buetschlii*, and *Caenorhabditis elegans*, bacteria feeders; *Aphelenchus avenae*, fungus feeder; and *Tylenchus elegans*, plant feeder. Solutions were mixed to mimic the mineral concentrations of soil solution in a sandy forest surface soil plus Cd at different concentrations. LC_{50} values were determined after 72 hours. The nematodes *T. elegans* and *A. avenae* had LC_{50} values of greater than 90 ppm after 96 hours (termination of experiment); that is, they were essentially unaffected by the experimental treatment. Among the bacterial feeders the LC_{50} ranged from approximately 3 to 60 ppm Cd after 72 hours.

The nematode *C. elegans* was used by van Kessel et al. (1989) to test the effects of Cd (as $CdCl_2$) on growth (length) and reproduction (number of juveniles per adult) of this soil-dwelling group. Juvenile (J-1) nematodes were cultured for 168 hours in microtiter plates containing solutions with different levels of Cd. Reproduction, the more sensitive parameter, was reduced 36% by 3.6 ppm.

The influence of Cd (as $CdCl_2$) on life-history characteristics of the collembolan *Folsomia candida* was investigated by Crommentuijn et al. (1993). One-week old animals were placed on OECD artificial soil (containing, in percent dry weight, 10 sphagnum peat, 20 kaolin clay, 70 quartz sand; pH 6) containing a series of concentrations of Cd and fed baker's yeast. Number and weight of adults and number of offspring were determined. A soil concentration ($HCl+HNO_3$ extractable) of 326 ppm Cd reduced the number of offspring produced by 21% after 42 days. Weight of the individual animals was not affected at this concentration.

Representatives of Collembola and mites were used by van Straalen et al. (1989) to assess the effect of Cd in diets of soil microarthropods on population growth rates. Three-day old *Orchesella cincta* (Collembola) were fed green algae containing Cd ($CdSO_4$). A concentration of 15 ppm Cd caused an approximate 56% reduction in calculated population growth rate after 61 days, while 4.7 ppm had no effect. Adult mites (*P. peltifer*) fed the same diet for 84 days experienced a 23% reduction in population growth rate at a concentration of 9 ppm Cd, while 3 ppm had no effect.

Hopkin and Hames (1994) investigated the effects of Cd (as $CdNO_3$) in food on survival and reproduction of the terrestrial isopod *Porcellio scaber*. Leaves of field maple (*Acer campestre*) were sprayed with solutions containing Cd and placed in plastic containers with juvenile woodlice. After 360 days, the number of surviving isopods and the number of juveniles were determined. The number of juveniles produced was decreased 47% by 10 ppm Cd (lowest concentration tested) while 50 ppm was required to reduce total survival.

The effects of Cd on individual weight, new shell growth, and reproductive behavior of the snail *Helix aspersa* was evaluated by Russell et al. (1981). The diet fed to the sub-adult (4-month- old) snails for 30 days was ground Purina Lab Chow (for rats, mice, and hamsters) with Cd (as $CdCl_2$) added. Snails were raised in plastic containers with sand bottoms. Reproductive activity, as measured by the number

of individuals mating or with spermatophores in place, was reduced 28% by 25 ppm Cd while 10 ppm had no effect. New shell growth and weight were not affected at this concentration.

The experimental approaches described in the previous paragraphs are too diverse to allow comparison of results, as discussed in the Introduction. There is agreement between the two studies on the effects of Cd on nematodes in that approximately 3 ppm in solution is detrimental to the organisms. This number may be useful when soil solution concentration values for Cd are available.

The one study conducted in soil yielded a toxic concentration of 326 ppm, which is higher than the earthworm and microbe benchmarks for soil (Tables 1 and 2).

Copper. The acute toxicity of Cu to the nematode *C. elegans* in four soils and in solution was evaluated by Donkin and Dusenbery (1993). The soils included two silt loams, a loam, and a clay loam. Adult nematodes were placed in the soil with Cu added as $CuCl_2$ and native soil organic matter as food. After 24 hours, surviving animals were counted, and an LC_{50} concentration calculated. Toxicity was also tested in solutions containing Cu. A concentration of 105 ppm Cu in solution caused 50% mortality while at least 400 ppm (sandy loam soil) was required in soil. The highest LC_{50} (1061 ppm) was associated with the highest percentage organic matter in the loam soil.

Parmalee et al. (1993) used a soil microcosm to test the effects of Cu on survival of nematodes and microarthropods feeding on native soil organic matter. Cu was added as $CuSO_4$ to the A horizon of an acid sandy forest soil where native soil nematode and microarthropod populations were exposed for 7 days. There was an average reduction of approximately 70% in number of individuals of most categories of nematodes (fungivores, bactivores, herbivores, hatchlings) at 400 ppm total Cu, while 185 ppm had no effect. The number of individuals of the omnivores/predators category was reduced 85% by the lowest concentration of Cu tested, 72 ppm. Total microarthropod numbers were reduced about 50% by 400 ppm. The oribatid and Mesostigmata mites appeared to be more sensitive, and the Collembola population was too small to evaluate.

Streit (1984) exposed microarthropod communities for six weeks to copper sulfate in 27-L microcosms containing a loess-derived brown earth soil with local gley horizons from a forest site in northern Switzerland. From 40 to 150 ppm Cu, no significant effects on the mite community were observed. At 200 ppm, a reduction in juvenile mites was observed. The effect was primarily due to a decrease in the species *Platynothrus peltifer*. The authors concluded that 200 ppm did not conclusively cause adverse effects at the community level, since only one of seven species was affected. The mites were less sensitive than earthworms to the copper concentrations in soil.

Korthals et al. (1996) investigated the effects of copper on the nematode community in an agroecosystem in the Netherlands after 10 years of exposure. The mean total number of nematodes was reduced at least 20% in soil containing 100 ppm of Cu (pH adjusted to 4.0), 104 ppm of Cu (pH adjusted to 4.7), and 160 ppm of Cu (pH adjusted to 5.4). The abundance of different species and trophic groups was more sensitive a parameter than the total number of nematodes. Copper was extracted from the top 10 cm of soil with 0.43 M nitric acid; thus, total concentrations of the metal may be higher than those reported.

Hopkin and Hames (1994) investigated the effects of Cu (as $CuNO_3$) in food on survival and reproduction of the terrestrial isopod *Porcellio scaber*. The experimental design used by the authors is described in the discussion of the effects of Cd on this animal. After 360 days, the number of surviving isopods and the number of juveniles were determined. The number of juveniles produced was decreased 53% by 50 ppm Cu while 100 ppm of Cu was required to reduce total survival.

The slug, *Arion ater*, was used as the test organism by Marigomez et al. (1986) to determine the effects of several pollutants on terrestrial mollusks. Slugs collected from the field were reared in plastic boxes and fed a diet of a pulverized mixture of lettuce, apple, carrot, and pumpkin mixed with $CuSO_4$. After 27 days on this diet, the animals experienced a 55% decrease in growth at 1000 ppm Cu, while 300 ppm had no effect.

The studies of Donkin and Dusenbery (1993) and Parmalee et al. (1993) taken together show a higher concentration in soil than in solution is required to affect the survival of nematodes. Differences among groups of nematodes in sensitivity to Cu is shown by Parmalee et al. (1993). The application of soluble form of Cu to food material by Hopkin and Hames (1994) and Marigomez et al. (1986) show very distinct sensitivities of woodlice and slugs to Cu.

The lowest toxic concentration reported in these two studies (72 ppm Cu) is higher than the benchmarks for earthworms (50 ppm) and microbes (30 ppm).

Iron. The effect of iron on the Collembola *Orchesella cincta* was investigated by Nottrot et al. (1987). The springtails were grown in plastic dishes and fed green algae (*Pleurococcus* spp.) containing various concentrations of Fe for 21 days. Percent growth, feeding activity, and molting were determined. Growth of the springtails was reduced 42% by a diet of 7533 ppm, while 3515 ppm had no effect.

Lead. Bengtsson et al. (1983) evaluated the effects of lead, in the fungus *Verticillium bulbillosum*, on growth rate of a fungus-feeding collembolan, *O. armatus*. Adult springtails were fed the fungus for 125 days and their lengths were recorded for calculation of growth rate. Lead at 3089 ppm in the fungus caused a 25% reduction in *O. armatus* growth rate. fungus.

Hopkin and Hames (1994) investigated the effects of Pb (as $PbNO_3$) in food on survival and reproduction of the terrestrial isopod *Porcellio scaber*. The experimental design used by the authors is described in the discussion of the effects of Cd on this animal. After 360 days, the number of surviving isopods and the number of juveniles were determined. Survival and the number of juveniles produced were decreased 100% by 2000 ppm Pb while 1000 ppm had no effect.

Beyer and Anderson (1985) also used *Porcellio scaber* in experiments to determine the effect of Pb, added as PbO to ground deciduous leaf litter, on several population parameters. The woodlice were reared in plastic containers and fed this diet for 448 days. During this time, the following were measured: lifespan of generation 1, maximum number of individuals in generation 2, and survival of generation 2. These parameters were decreased 27, 68, and 84%, respectively, by 12,800 ppm Pb in the diet, while 6400 ppm had no effect.

The slug, *Arion ater*, was used as the test organism by Marigomez et al. (1986) to determine the effect of lead on terrestrial mollusks. Field collected slugs were reared in plastic boxes and fed a diet of a pulverized mixture of lettuce, apple, carrot, and pumpkin mixed with $PbNO_3$. After 27 days on this diet, the animals experienced a 51% decrease in growth at 1000 ppm Pb, while 300 ppm had no effect.

The studies indicate a high tolerance to Pb in the diets of the tested woodlouse, springtail, and slug species. The discrepancy between the Hopkin and Hames (1994) and Beyer and Anderson (1985) levels of Pb required to affect the woodlouse may be due to differences in bioavailability of the added Pb compounds.

Mercury. The slug, *Arion ater*, was used as the test organism by Marigomez et al. (1986) to determine the effect of mercury (as $HgCl_2$) on terrestrial mollusks, as described for Pb. After 27 days

on this diet, the animals experienced a 26% decrease in growth at 1000 ppm Hg, while Hg at 300 ppm had no effect.

Zinc. Hopkin and Hames (1994) investigated the effects of Zn (as $ZnNO_3$) in food on survival and reproduction of the terrestrial isopod *Porcellio scaber*. The experimental design used by the authors is described in the discussion of the effects of Cd on this animal. After 360 days, the number of surviving isopods and number of juveniles were determined. Survival and number of juveniles produced were decreased 100% by 1000 ppm Zn while 500 ppm had no effect.

Smit and van Gestel (1996) investigated the toxicity of zinc chloride to the springtail *Folsomia candida* in two soils and compared the results to results from contaminated soils near a zinc smelter. EC50s for the effect of zinc on the population size of springtails were 185 and 348 ppm for the two soils after 4 weeks of exposure and 210 and 363 ppm for the soils after 6 weeks of exposure. The EC50 for growth in one of the soils (pH corrected from 3.46 to 6.0 with $CaCO_3$, 3% organic matter, 1.38% clay) was 462 ppm, and an EC50 for growth could not be calculated for the other soil. In the field soil, no relationship was observed between zinc concentrations and either growth or reproduction.

Zinc (as ZnO) was added to litter from the O2 layer under woodlands to evaluate the effects of that metal on *Porcellio scaber* (Beyer et al. 1984). Adult animals kept in plastic boxes were fed this diet for 56 days before survival was determined. The only concentration tested, 5000 ppm, caused a 26% decrease in survival.

Beyer and Anderson (1985) also used *Porcellio scaber* in experiments to determine the effect of Zn, added ZnO to ground deciduous leaf litter, on several population parameters. The woodlice were reared in plastic containers and fed this diet for 448 days. During this time the following were measured: lifespan of generation 1, maximum number of individuals in generation 2, and survival of generation 2. The maximum number of individuals in generation 2 and the survival rate for generation 2 were decreased 22 and 27% by 1600 ppm Zn in the diet, while 800 ppm had no effect.

The slug, *Arion ater*, was used as the test organism by Marigomez et al. (1986) to determine the effect of Zn (as $ZnCl_2$) on terrestrial mollusks, as described previously. After 27 days on this diet the animals experienced a 38% decrease in growth at 10 ppm Zn, the lowest concentration tested.

The experiments evaluating the toxicity of Zn to the woodlouse *Porcellio scaber* show a high tolerance to the metal when it is added to the food in soluble form. The work with *Arion ater* (Marigomez et al., 1986) indicates that this organism is more sensitive than *P. scaber* to Zn. On the other hand, growth of individual woodlice was not evaluated and may be more sensitive than survival and reproduction.

Benzo(a)pyrene (BaP). The woodlouse *P. scaber* was chosen by van Straalen and Verweij (1991) to determine the effects of this PAH on the soil invertebrate community. Polynuclear aromatic hydrocarbons are strongly sorbed onto soil organic matter which serves as the main food for many of these organisms. Adult woodlice were reared in plastic boxes for 28 days and fed ground poplar leaf litter mixed with benzo(a)pyrene. Growth efficiency was determined as dry weight increase divided by net food consumption (consumption minus defecation). Respiration, food consumption, and food assimilation were also measured. Growth efficiency of the males of the group was reduced 82% by 125 ppm BaP in the food, while 25 ppm had no effect. Growth efficiency of the females, respiration, food consumption, and food assimilation were not affected.

Two isopods, *Porcellio scaber* and *Oniscus asellus*, were used by van Brummelen and Stuijfzand (1993) to determine the effects of BaP on litter layer-dwelling soil invertebrates. Weight and length changes and energy reserves were measured in individuals reared in plastic boxes and fed a combination of ground poplar leaves and ground dog food spiked with BaP for 63 days. Dry weight of *P. scaber* was reduced 30% with a diet containing 100 ppm BaP, while 32 ppm had no effect. Length and energy reserves (lipids+glycogen+protein) were not affected. Dry weight and length of *O. asellus* were reduced 58 and 48% with a diet containing 316 ppm BaP, while 100 ppm had no effect. Energy reserves were not affected.

These experiments with woodlice indicate that growth may be affected by BaP at concentrations of about 100 ppm applied to food.

p-nitrophenol (PNP). Parmalee et al. (1993) tested the effects of PNP on survival of nematodes and microarthropods in soil microcosms, as described for Cu. There was an average reduction of approximately 55% in number of individuals of most categories of nematodes (fungivores, herbivores, herbivores/predators, and hatchlings) at 40 ppm total PNP, while 20 ppm had no effect. The number of individuals of the bacterivore category was reduced 40% by the lowest concentration of PNP tested, 20 ppm. Total microarthropod numbers were reduced about 35% by 176 ppm, mainly as the result of reductions in oribatids. P-nitrophenol up to 176 ppm had no effect on numbers of Mesostigmata or unclassified microarthropods, and there were no Collembola were present.

Pentachlorophenol. Kammenga et al. (1994) compared the acute toxicity of PCP in solution culture to seven terrestrial nematode species belonging to different taxonomic and ecological groups. The nematodes and experimental design are the same as described previously for Cd. *Aphelenchus avenae*, *Caenorhabditis elegans*, and *Acrobeloides beutschlii* had LC_{50} values greater than 9 ppm after 96 hours (that is, experimental concentrations killed fewer than half of the nematodes). LC_{50} values for the remaining nematodes ranged from approximately 1 to 7 ppm PCP.

Trinitrotoluene (TNT). Parmalee et al. (1993) used a soil microcosm to test the effects of TNT on survival of nematodes and microarthropods in soil microcosms, as described previously for Cu. Trinitrotoluene additions up to 200 ppm had no effect on numbers of nematodes. Total microarthropod numbers were reduced about 58% by 200 ppm, while 100 ppm had no effect. Trinitrotoluene up to 200 ppm had no effect on numbers of Mesostigmata, Collembola, or unclassified microarthropods.

6. RELATIONSHIP BETWEEN SOIL TOXICITY BENCHMARKS AND OTHER ECOTOXICOLOGICAL CRITERIA

6.1 COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO CANADIAN ENVIRONMENTAL QUALITY CRITERIA FOR CONTAMINATED SITES

The Canadian Council of Ministers of the Environment has developed Environmental Quality Criteria for contaminated sites. These are "numerical limits for contaminants in soil and water intended to maintain, improve, or protect environmental quality and human health at contaminated sites in general" (CCME, 1991). Remediation criteria are presented for comparison to the toxicity benchmarks presented herein because they represent levels considered generally protective of human health and the environment for specified uses of soil (in this case the most conservative use—which is agriculture—has been chosen) without taking into account site-specific conditions. If contaminant concentrations exceed the remediation criteria for a current or future land use, further investigation or remediation is needed. These criteria have an interim status, and final criteria will be included in future revisions of this document. They have been adopted from several Canadian jurisdictions and many lack supporting rationale (CCME, 1991). The remediation criteria are not strictly comparable to the toxicity benchmarks developed herein because they also take into account human health and, presumably, plants and the entire food web dependent upon the soil. A comparison of the toxicity benchmarks presented in this report with the CCME Remediation Criteria is given in Table 3.

For 7 of 18 chemicals, one or both of the soil toxicity benchmarks derived by the method used in this report is lower than the CCME criterion. There is no indication in the source publication as to the level of protection being afforded by the CCME Remediation Criteria. However, because human health is considered in the conservative agriculture land-use scenario, one would expect it to be high. This level of protection is seen in the organic chemicals which are known to be toxic to mammals at relatively low levels.

6.2 COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO RIVM (NETHERLANDS) ECOTOXICOLOGICAL INTERVENTION VALUES FOR CONTAMINANTS IN SOILS

The Dutch National Institute of Public Health and Environmental Protection (RIVM) developed Ecotoxicological Intervention Values (EIVs) that represent concentrations of contaminants in soil causing 50% of the species potentially present in an ecosystem to experience adverse effects (van den Berg et al., 1993). The EIVs take into account plants, soil fauna, and microorganisms. The method for deriving the EIVs is described by Denneman and van Gestel in several RIVM publications in Dutch. To take the influence of soil characteristics on the bioavailability of compounds, data were adjusted for organic matter and clay content as described by van den Berg et al. (1993). Risks resulting from biomagnification were included.

Although these EIVs are based on purely "ecological" endpoints, they take into account many more types of organisms than the authors' earthworm and microbe toxicity benchmarks. For metals, benchmarks presented herein are more conservative than the RIVM EIVs in about half of the cases. For organic chemicals, most of benchmarks presented herein for earthworms are in fairly good agreement with the RIVM values. Differences here may stem from the RIVM report of values for undefined compounds of particular classes rather than for particular compounds.

Table 3. Comparison of screening benchmark concentrations for the toxicity to earthworms and soil microbes of chemicals in soil to CCME remediation criteria (RC), RIVM ecotoxicological intervention values (EIV's), arithmetic means of elements in uncontaminated soils of the Oak Ridge Reservation (ORR), and geometric means of elements in soils and surficial materials of the eastern United States

Chemical	Earthworm benchmark (mg/kg)	Microbial benchmark (mg/kg)	CCME RC[a] (mg/kg)	RIVM EIVs (mg/kg)	ORR (mg/kg)	Eastern United States (mg/kg)
Aluminum	---	600	---	---	15700	33000
Arsenic	60	100	20	40	9.7	4.8
Barium	---	3000	750	625	87.9	290
Boron	---	20	2[b]	---	10.4	---
Cadmium	20	20	3	12	0.22	---
Chromium	0.4	10	750[c]	230	24	33
Cobalt	---	1000	40	240	15.6	5.9
Copper	60	100	150	190	11.2	13
Fluorine	---	30	200	---	---	130
Iron	---	200	---	---	22650	14000
Lanthanum	---	50	---	---	---	29
Lead	500	900	375	290	26.8	14
Lithium	---	10	---	---	9.4	17
Manganese	---	100	---	---	1318	260
Mercury	0.1[d]	30	0.8[e]	10[e]	0.20[e]	0.08[e]
Molybdenum	---	200	5	<480	3.9	0.32
Nickel	200	90	150	210	15.1	11
Selenium	70	100	2	---	0.73	0.3
Silver	---	50	20	---	1.22	---
Tin	---	2000	2	---	---	0.86
Titanium	---	1000	---	---	---	2800

Table 3. (continued)

Chemical	Earthworm benchmark (mg/kg)	Microbial benchmark (mg/kg)	CCME RC[a] (mg/kg)	RIVM EIVs (mg/kg)	ORR (mg/kg)	Eastern United States (mg/kg)
Vanadium	---	20	200	---	32.3	43
Zinc	100	100	600	720	46.2	40
Phenol	30	100	0.01[f]	40	---	---
4-nitrophenol	7	---	0.01[f]	---	---	---
3-chlorophenol	10	---	0.05[g]	10[i]	---	---
3,4-dichlorophenol	20	---	0.05[g]	10[i]	---	---
2,4,5-trichlorophenol	9	---	0.05[g]	10[i]	---	---
2,4,6-trichlorophenol	10	---	0.05[g]	10[i]	---	---
2,3,4,5-tetrachlorophenol	20	---	0.05[g]	10[i]	---	---
Pentachlorophenol	6	400	0.05[g]	5	---	---
Chlorobenzene	40	---	0.1	30	---	---
1,4,-dichlorobenzene	20	---	0.1	30[j]	---	---
1,2,3-trichlorobenzene	20	---	0.05[h]	30[j]	---	---
1,2,4-trichlorobenzene	20	---	0.05[h]	30[j]	---	---
1,2,3,4-tetrachlorobenzene	10	---	0.05[h]	30[j]	---	---
Pentachlorobenzene	20	---	0.05[h]	30	---	---
Hexachlorobenzene	---	1000	0.05	30	---	---

[a] Agricultural land-use context
[b] Hot water soluble B
[c] Total Cr. Criterion for Cr (VI) is 8 ppm
[d] Combined inorganic and organic forms of Hg
[e] Does not indicate form (organic or inorganic)
[f] Each unspecified non-chlorinated phenolic compound is not to exceed 0.1 ppm
[g] Each unspecified chlorinated phenolic compound is not to exceed 0.05 ppm
[h] Each unspecified tri-, tetra-, and pentachlorinated benzene is not to exceed 0.05 ppm
[i] Unspecified chlorinated phenols
[j] Unspecified chlorinated benzenes

7. COMPARISON OF TOXICITY BENCHMARKS FOR CONTAMINANTS IN SOIL TO CONCENTRATIONS OF CHEMICALS IN UNPOLLUTED SOILS

7.1 COMPARISON TO USGS ELEMENT CONCENTRATIONS IN SOILS AND OTHER SURFICIAL MATERIALS OF THE EASTERN UNITED STATES

To place the four sets of critical values into a broader perspective, soil chemical concentrations are presented herein as reported by the United States Geological Survey (USGS) in a survey of soils of the eastern United States (Shacklette and Boerngen, 1984) (Table 3). These samples were collected and analyzed by the USGS to represent, as closely as possible, soils that supported native plants and which were altered very little from their natural condition.

It is interesting to compare the levels of elements cited in the literature as toxic against concentrations of the same elements found in natural (i.e., not known to be polluted) soils. This comparison is reasonable in most cases because benchmarks generally were based on nominal soil concentrations (i.e., those added to the soil by the experimenter) as opposed to a measure of either total concentration or of the bioavailable quantity of the element in the soil. Seldom was the background level of the "contaminant" element in the soil measured, the assumption being that very little of the element existed naturally in the soil compared to treatment levels added. This is often, but not always, a reasonable assumption. The USGS compilation contains concentrations of elements derived mainly from strong-acid extractions, although in the case of uranium, neutron activation was used to measure a true total concentration. Values for the eastern United States were used because surficial deposits of the western United States, especially in arid and mountainous regions, may contain unusually high concentrations of naturally-occurring trace elements.

For several of the metals, our toxicity benchmarks were below (Al, Cr, F, Fe, Mn, Ti, and V) or about equal to (Li) the geometric mean for the element in soils and surficial deposits in the eastern United States. The large difference between the USGS soil Fe and Al values and the low microbial benchmark based on a quantity of Fe or Al added to soil is likely due to the strong extractant used in the USGS study. The form of the element added or some other aspect of the experimental design may account for other low benchmark concentrations as compared to mean levels in soils.

7.2 COMPARISON TO DOE OAK RIDGE RESERVATION BACKGROUND SOIL CHARACTERIZATION ELEMENT CONCENTRATIONS IN SOILS

The Background Soil Characterization Project (BSCP) at the ORR was established to determine the background concentrations of organics, metals, and radionuclides in natural soils that are important to environmental restoration projects (Watkins et al., 1993). Soils were sampled, field classified, and analyzed for chemicals using several methods. The data presented in Table 3 show the arithmetic means of elements from 46 sampling sites. The elements were extracted from the soil samples using nitric acid and hydrogen peroxide (EPA, 1986). This standard EPA acid digestion for sediments, sludges, and soils is not explicitly meant to extract total elements from a sample. A comparison with total soil concentrations of elements measured by neutron activation analysis (NAA) shows that for many elements (e.g., Sb, As, Cr, Co, Mn, Si, V, Zn) the HNO_3-H_2O_2 extraction method was adequate for most of the elements in question (Watkins et al., 1993). Unfortunately, not all elements are amenable to measurement by NAA.

A large discrepancy was found between the BSCP soil Fe and Al values and the low soil toxicity benchmarks, based on a quantity of Fe or Al added to soil. At least one of our benchmarks is lower than background soil concentrations in the case of Cr, Mn, and V, and about equal for Li and Hg. The form of the element added or some other aspect of the experimental design may account for these differences.

8. RECOMMENDATIONS AND CONCLUSIONS

The values presented in Tables 1 and 2 are intended for use in contaminant screening during the hazard identification (problem formulation) phase of ecological risk assessments. Chemicals with soil concentrations that exceed both the toxicity benchmarks for soil and the background soil concentration for the soil type are contaminants of potential concern. Background soil concentrations have been derived for the ORR and should be generated for other Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites as well.

For baseline ecological risk assessments, and other assessments that may lead to regulatory actions, assessors should consult the primary sources of toxicity data and then determine the applicability of the data to their specific sites. In addition, assessments should not rely on laboratory toxicity data only. Where toxicity to soil invertebrates is suspected, toxicity tests should be performed with the contaminated soil. In addition, the abundance of earthworms in the soil of a particular site, determined during collection of earthworms for chemical analysis, may provide a rough indication of the likelihood of soil toxicity.

9. REFERENCES

Abbasi, S.A., and R. Soni. 1983. "Stress-induced enhancement of reproduction in earthworm *Octochaetus pattoni* exposed to chromium (VI) and mercury (II) - Implications in environmental management." *Intern. J. Environ. Stud.* 22:43-47.

Akaike, N., K.S. Lee, and A.M. Brown. 1978. "The calcium current of *Helix* neuron." *J. Gen. Physiol.* 71:509-531.

Al-Khafaji, A.A., and M.A. Tabatabai. 1979. "Effects of trace elements on arylsulfatase activity in soils." *Soil Sci.* 127(3):129-133.

Babich, H., and G. Stotzky. 1982. "Toxicity of nickel to microorganisms in soil: Influence of some physicochemical characteristics." *Environ. Pollut.* 29A:303-315.

Beeby, A. 1991. "Toxic metal uptake and essential metal regulation in terrestrial invertebrates: A review." In *Metal Ecotoxicology, Concepts & Applications*. M.C. Newman and A.W. McIntosh (eds). Lewis Publishers, Boca Raton. pp. 65-89.

Bengtsson, G., T. Gunnarsson, and S. Rundgren. 1983. "Growth changes caused by metal uptake in a population of *Onychiurus armatus* (Collembola) feeding on metal polluted fungi." *OIKOS* 40:216-225.

Bengtsson, G., T. Gunnarsson, and S. Rundgren. 1986. "Effects of metal pollution on the earthworm *Dendrobaena rubida* (Sav.) in acidified soils." *Water Soil Air Pollut.* 28:361-383.

Bewley, R.J.F., and G. Stotzky. 1983. "Effects of cadmium and simulated acid rain on ammonification and nitrification in soil." *Arch. Environ. Contam. Toxicol.* 12:285-291.

Beyer, W.N., and A. Anderson. 1985. "Toxicity to woodlice of zinc and lead oxides added to soil litter." *Ambio* 14(3):173-174.

Beyer, W.N., E. Cromartie, and G.B. Moment. 1985. "Accumulation of methylmercury in the earthworm *Eisenia foetida*, and its effect on regeneration." *Bull. Environ. Contam. Toxicol.* 35:157-162.

Beyer, W.N., G.W. Miller, and E.J. Cromartie. 1984. "Contamination of the O2 soil horizon by zinc smelting and its effect on woodlouse survival." *J. Environ. Qual.* 13(2):247-251.

Bhuiya, M.R.H., and A.H. Cornfield. 1976. "Effect of addition of Cu, Cr, Pb and Zn on nitrogen mineralisation and nitrification during incubation of sandy soils." *Bangladesh J. Biol. Sci.* 5(1):18-20.

Bhuiya, M.R.H., and A.H. Cornfield. 1974. "Incubation study on effect of pH on nitrogen mineralisation and nitrification in soils treated with 1000 ppm lead and zinc, as oxides." *Environ. Pollut.* 7:161-164.

Bhuiya, M.R.H., and A.H. Cornfield. 1972. "Effects of addition of 1000 ppm Cu, Ni, Pb and Zn on carbon dioxide release during incubation of soil alone and after treatment with straw." *Environ. Pollut.* 3:173-177.

Bollag, J.-M., and W.Barabasz. 1979. "Effect of heavy metals on the denitrification process in soil." *J. Environ. Qual*. 8(2):196-201.

Bouche, M.B. 1992. "Earthworm species and ecotoxicological studies." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 20-35.

Bremner, J.M., and L.A. Douglas. 1971. "Inhibition of urease activity in soils." *Soil Biol. Biochem.* 3:297-307.

Canadian Council of Ministers of the Environment (CCME). 1991. *Interim Canadian Environmental Quality Criteria for Contaminated Sites*. CCME EPC-CS34. Winnipeg, Manitoba.

Chaney, W.R., J.M. Kelly, and R.C. Strickland. 1978. "Influence of cadmium and zinc *on carbon dioxide evolution from litter and soil from a Black Oak forest."* J. Environ. Qual. 7(1):115-119.

Cole, M.A. 1977. "Lead inhibition of enzyme synthesis in soil." *Appl. Environ. Microbiol.* 33(2):262-268.

Crommentuijr, T., J. Brils, and N.M. van Straaler. 1993. "Influence of cadmium on life-history characteristics of *Folsomia candida* (Willem) in an artificial soil substrate." *Ecotoxicol. Environ. Sat.* 26:216-227.

Curl, E.A., P.J. Edwards, C. Elliott, and J.P. Leahey. 1987. "The conjugation and accumulation of metabolites of cypermethrin by earthworms." *Pesticide Sci.* 20:207-222.

Debosz, K., H. Babich, and G. Stotzky. 1985. "Toxicity of lead to soil respiration: Mediation by clay minerals, humic acids, and compost." *Bull. Environ. Contam. Toxicol.* 35:517-524.

Dickinson, C.H., and G.J.F. Pugh. (ed). 1974. *Biology of Plant Litter Decomposition. Vols 1 & 2*. Academic Press, New York.

Dindal, D.L. 1990. *Soil Biology Guide.* John Wiley and Sons, New York.

Doelman, P., and L. Haanstra. 1989. "Short- and long-term effects of heavy metals on phosphatase activity in soils: An ecological dose-response model approach." *Biol. Fertil. Soils* 8:235-241.

Doelman, P., and L. Haanstra. 1986. "Short- and long-term effects of heavy metals on urease activity." *Biol. Fertil. Soils* 2:213-218.

Doelman, P., and L. Haanstra. 1979. "Effect of lead on soil respiration and dehydrogenase activity." *Soil Biol. Biochem*. 11:475-479.

Donkin, S.G., and D.B. Dusenbery. 1993. "A soil toxicity test using the nematode *Caenorhabditis elegans* and an effective method of recovery." *Arch. Environ. Contam. Toxicol.* 25:145-151.

Edwards, C.A. 1992. "Testing the effects of chemicals on earthworms: The advantages and limitations of field tests." In *Ecotoxicology of Earthworms.* P.W. Greig-Smith et al. (eds). Intercept Ltd. pp. 75-84.

Efroymson, R. A., M. E. Will, and G. W. Suter II. 1997. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants*. ES/ER/TM-85/R3, Oak Ridge National Laboratory, Environmental Sciences Division.

Environmental Protection Agency (EPA). 1986. *Test Methods for Evaluating Solid Waste. Vol. 1: Laboratory Manual Physical/Chemical Methods*. SW 846. Office of Solid Waste and Emergency Response. Washington, D.C.

Fischer, E., and L. Koszorus. 1992. "Sublethal effects, accumulation capacities and elimination rates of As, Hg and Se in the manure worm, *Eisenia fetida* (Oligochaeta, Lumbricidae)." *Pedobiologia* 36:172-178.

Fitzgerald, D. G., K. A. Warner, R. P. Lanno, and D. G. Dixon. 1996. Assessing the effects of modifying factors on pentachlorophenol toxicity to earthworms: applications of body residues. *Environ. Toxicol. Chem.* 15:2299-2304.

Frankenberger, W.T., and M.A. Tabatabai. 1981. "Amidase activity in soils: IV. Effects of trace elements and pesticides." *Soil Sci. Soc. Am. J.* 45:1120-1125.

Giashuddin, M., and A.H. Cornfield. 1979. "Effects of adding nickel (as oxide) to soil on nitrogen and carbon mineralisation at different pH values." *Environ. Pollut.* 19:67-70.

Giashuddin, M., and A.H. Cornfield. 1978. "ncubation study on effects of adding varying levels of nickel (as sulphate) on nitrogen mineralisation in soil." *Environ. Pollut.* 15:231-234.

Haanstra, L., and P. Doelman. 1991. "An ecological dose-response model approach to short- and long-term effects of heavy metals on arylsulfatse activity." *Biol. Fertil. Soils* 11:18-23.

Heimbach, F. 1992. "Effects of pesticides on earthworm populations: Comparison of results from laboratory and field tests." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 100-106.

Heimbach, F. 1988. "A comparison of laboratory methods for toxicity testing with earthworms." In *Earthworms in Waste and Environmental Management*. C.A. Edwards and E.F. Neuhauser (eds). SPB Academic Pub., Netherlands. pp. 329-335.

Heimbach, F. 1984. "Correlations between three methods for determining the toxicity of chemicals to earthworms." *Pestic Sci*. 15:605-611.

Hopkin, S.P. 1989. *Ecophysiology of Metals in Terrestrial Invertebrates*. Elsevier Applied Science, New York.

Hopkin, S.P. and C.A.C. Hames. 1994. "Zinc, among a `cocktail' of metal pollutants, is responsible for the absence of the terrestrial isopod *Porcellia scaber* from the vicinity of a primary smelting works." *Ecotox.* 2:68-78.

Juma, N.G., and M.A. Tabatabai. 1977. "Effects of trace elements on phosphatase activity in soils." *Soil Sci. Soc. Am. J.* 41:343-346.

Kammenga, J.E., C.A.M. van Gestel, and J. Bakker. 1994. "Patterns of Sensitivity to Cadmium and Pentachlorophenol (among nematode species from different taxonomic and ecological groups." *Arch. Environ. Contam. Toxicol.* 27:88-94.

Khalil, M. A., H. M. Abdel-Lateif, B. M. Bayoumi, N. M. van Straalen, and C. A. M. van Gestel. 1996. Effects of metals and metal mixtures on survival and cocoon production of the earthworm *Aporrectodea caliginosa*. *Pedobiologia* 40:548-556.

Khan, D.H., and B. Frankland. 1984. "Cellulolytic activity and root biomass production in some metal-contaminated soils." *Environ. Pollut.* 33A:63-74.

Kokta, C. 1992. "Measuring effects of chemicals in the laboratory: Effect criteria and endpoints." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 55-62.

Korthals, G. W., A. D. Alexiev, T. M. Lexmond, J. E. Kammenga, and T. Bongers. 1996. Long-term effects of copper and pH on the nematode community in an agroecosystem. *Environ. Toxicol. Chem.* 15:979–985.

Landa, E.R., and S.C. Fang. 1978. "Effect of mercuric chloride on carbon mineralization in soils." *Plant Soil* 49:179-183.

Laskowski, R., M. Maryanski, and M. Niklinska. 1994. "Effect of heavy metals and mineral nutrients on forest litter respiration rate." *Environ. Pollut*. 84:97-102.

Lee, K.E. 1985. *Earthworms, Their Ecology and Relationships with Soils and Land Use.* Academic Press, New York.

Liang, C.N., and M.A. Tabatabai. 1977. "Effects of trace elements on nitrogen mineralisation in soils." *Environ. Pollut*. 12:141-147.

Lighthart, B., and H. Bond. 1976. "Design and preliminary results from soil/litter microcosms." *Intern. J. Environ. Stud*. 10:51-58.

Lighthart, B., H. Bond, and M. Ricard. 1977. *Trace Elements Research Using Coniferous Forest Soil/Litter Microcosms.* USEPA-600/3-77-091.

Long, R. E. and L. G. Morgan. 1990. *The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program*. NOAA Technical Memorandum NOS OMA 52.

Ma, W.-C. 1982. "The influence of soil properties and worm-related factors on the concentration of heavy metals in earthworms." *Pedobiologia* 24:109-119.

Ma, W.-C. 1984. "Sublethal toxic effects of copper on growth, reproduction and litter breakdown activity in the earthworm *Lumbricus rubellus*, with observations on the influence of temperature and soil pH." *Environ. Pollut. Ser. A* 33:207-219.

Ma, W.-C. 1988. "Toxicity of copper to lumbricid earthworms in sandy agricultural soils amended with Cu-enriched organic waste materials." *Ecol. Bull*. 39:53-56.

Malecki, M.R., E.F. Neuhauser, and R.C. Loehr. 1982. "The effect of metals on the growth and reproduction of *Eisenia foetida* (Oligochaeta, Lumbricidae)." *Pedobiologia* 24:129-137.

Marigomez, J.A., E. Angulo, and V. Saez. 1986. "Feeding and growth responses to copper, zinc, mercury, and lead in the terrestrial gastropod *Arion ater* (Linne)." *J. Moll. Stud.* 52:68-78.

Molnar, L., E. Fischer, and M. Kallay. 1989. "Laboratory studies on the effect, uptake and distribution of chromium in *Eisenia foetida* (Annelida, Oligochaeta)." *Zool. Anz*. 223(1/2):57-66.

Morgan, A.J., J.E. Morgan, M. Turner, C. Winters, and A. Yarwood. 1993. "Metal relationships of earthworms." In *Ecotoxicology of Metals in Invertebrates*. R. Dallinger and P.S. Rainbow (eds). Lewis Publishers, Boca Raton. pp. 333-358.

Nelson, D. W., and L. E. Sommers. 1982. "Total carbon, organic carbon, and organic matter." In *Methods of Soil Analysis, Part 2.* p. 574. ASA/SSSA. Madison, WI.

Newhauser, E.F. and C.A. Callahan. 1990. "Growth and Reproduction of the earthworm *Eisenia fetida* exposed to sublethal concentrations of organic chemicals." *Soil Biol. Biochem.* 22(2):175-179.

Neuhauser, F., D.L. Kaplan, and R. Hartenstein. 1979. "Life history of the earthworm *Eudrilus eugeniae*." *Rev. Ecol. Biol. Sol.* 16:525-534.

Neuhauser, E.F., M.R. Malecki, and R.C. Loehr. 1984. "Growth and reproduction of the earthworm *Eisenia fetida* after exposure to sublethal concentrations of metals." *Pedobiologia* 27:89-97.

Neuhauser, E.F., R.C. Loehr, D.L. Milligan, and M.R. Malecki. 1985. "Toxicity of metals to the earthworm *Eisenia fetida*. *Biol. Fertil. Soils* 1:149-152.

Neuhauser, E.F., P.R. Durkin, M.R. Malecki, and M. Anatra. 1986. "Comparative toxicity of ten organic chemicals to four earthworm species." *Comp. Biochem. Physiol.* 83C(1):197-200.

Nottrot, F., E.N.G. Joosse, and N.M. van Straalen. 1987. "Sublethal effects of iron and manganese soil pollution on *Orchesella cincta* (Collembola)." *Pedobiologia* 30:45-53.

Parmalee, R.W., R.S. Wentsel, C.T. Phillips, M. Simini, and R.T. Checkai. 1993. "Soil microcosm for testing the effects of chemical pollutants on soil fauna communities and trophic structure." *Environ. Toxicol. Chem.* 12:1477-1486.

Premi, P.R., and A.H. Cornfield. 1969. "Effects of addition of copper, manganese, zinc and chromium compounds on ammonification and nitrification during incubation of soil." *Plant Soil* 31(2):345-352.

Premi, P.R., and A.H. Cornfield. 1969/1970. "Effects of copper, zinc and chromium on immobilization and subsequent re-mobilization of nitrogen during incubation of soil treated with sucrose.: *Geoderma* 3:233-237.

Quraishi, M.S.I., and A.H. Cornfield. 1973. "Incubation study of nitrogen mineralisation and nitrification in relation to soil pH and level of copper addition." *Environ. Pollut*. 4:159-163.

Reber, H.H. 1989. "Threshold levels of cadmium for soil respiration and growth of spring wheat (Triticum aestivum L.) and difficulties with their determination." *Biol. Fertil. Soils* 7:152-157.

Reinecke, A.J. 1992. "A review of ecotoxicological test methods using earthworms." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 7-19.

Rogers, J.E., and S.W. Li. 1985. "Effect of metals and other inorganic ions on soil microbial activity: Soil dehydrogenase assay as a simple toxicity test." *Bull. Environ. Contam. Toxicol*. 34:858-865.

Ross, D.S., R.E. Sjogren, and R.J. Bartlett. 1981. "Behavior of chromium in soils: IV. Toxicity to microorganisms." *J. Environ. Qual.* 10(2):145-148.

Russell, L.K., J.I. De Haven, and R.P. Botts. 1981. "Toxic effects of cadmium on the garden snail (*Helix aspersa*)." *Bull. Environ. Contam. Toxico.l* 26:634-640.

Shacklette, H.T., and J.G. Boerngen. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Coterminous United States.* USGS Prof. Paper 1270. US Govt Printing Office, Washington.

Smit, C. E., and C. A. M. van Gestel. 1996. Comparison of the toxicity of zinc for the springtail *Folsomia candida* in artificially contaminated and polluted field soils. *Appl. Soil Ecol.* 3:127-136.

Soni, R., and S.A. Abbasi. 1981. "Mortality and reproduction in earthworms *Pheretima posthuma* exposed to chromium (VI)." *Intern.J Environ. Stud*. 17:147-149.

Spurgeon, D. J., and S. P. Hopkin. 1995. Extrapolation of the laboratory-based OECD earthworm toxicity test to metal-contaminated field sites. *Ecotoxicology* 4:190-205.

Spurgeon, D. J., and S. P. Hopkin. 1996a. The effects of metal contamination on earthworm populations around a smelting works: quantifying species effects. *Appl. Soil Ecol.* 4:147-160.

Spurgeon, D. J., and S. P. Hopkin. 1996b. Effects of variations in organic matter content and pH of soils on the availability and toxicity of zinc to the earthworm *Eisenia fetida*. *Pedobiologia* 40:80-96.

Spurgeon, D.J., S.P. Hopkin, and D.T. Jones. 1994. "Effects of Cadmium, Copper, Lead, and Zinc on Growth, Reproduction, and Survival of the Earthworm *Eisenia fetida* (Savigny): Assessing the Environmental Impact of Point-source Metal Contamination in Terrestrial Ecosystems." *Environ. Pollut.* 84:123-130.

Stenersen, J. 1992. "Uptake and metabolism of xenobiotics by earthworms." In *Ecotoxicology of Earthworms.* P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 129-138.

Streit, B. 1984. Effects of high copper concentrations on soil invertebrates (earthworms and oribatid mites): Experimental results and a model. *Oecologia* 64:381-388.

Streit, B, and A. Jaggy. 1983. "Effect of soil type on copper toxicity and copper uptake in *Octolasium cyaneum* (Lumbricidae)." In *New Trends in Soil Biology*. Ph. Lebrun et al. (eds). pp. 569-575. Ottignies-Louvain-la-Neuve.

Suter, G. W., II, and F.E. Sharples. 1984. "Examination of a proposed test for effects of toxicants on soil microbial processe"s. In *Toxicity Screening Procedures Using Bacterial Systems*. Marcel Dekker, Inc., New York. pp. 327-344.

Suter, G. W., II, B. E. Sample, D. S. Jones, T. L. Ashwood, and J. M. Loar. 1995. *Approach and Strategy for Performing Ecological Risk Assessments for the U. S. Department of Energy's Oak Ridge Reservation: 1995 Revision.* ES/ER/TM-33/R2. Oak Ridge National Laboratory, Environmental Sciences Division.

Tabatabai, M.A. 1982. "Soil enzymes." In *Methods of Soil Analysis, Part 2. Chemical and Microbiological Properties*. pp. 903-948. ASA/SSSA, Madison, WI.

Tomlin, A.D. 1992. "Behavior as a source of earthworm susceptibility to ecotoxicants." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 116-125.

Tyler, G. 1976. "Influence of vanadium on soil phosphatase activity." *J. Environ. Qual.* 5(2):216-217.

van Beelen, P., and A.K. Fleuren-Kemila. 1993. "Toxic effects of pentachlorophenol and other pollutants on the mineralization of acetate in several soils." *Ecotoxicol. Environ. Saf.* 26:10-17.

van Brummelen, T.C., and S.C. Stuijfzand. 1993. "Effects of benzo(a)pyrene on survival, growth and energy reserves in terrestrial isopods *Oniscus asellus* and *Porcellio scaber." Sci. Total. Environ. Suppl*:921-930.

van den Berg, R., C.A.J. Denneman, and J.M. Roels. 1993. "Risk assessment of contaminated soil: Proposal for adjusted, toxicologically based Dutch soil clean-up criteria." In F.Arendt, G.J. Annokkee, R. Bosman, and W.J. van den Brink (eds) *Contaminated Soil '93.* Kluwer Academic Pub., Netherlands.

van Faassen, H.G. 1973. "Effects of mercury compounds on soil microbes." *Plant Soil* 38:485-487.

van Gestel, C.A.M. 1992. "The influence of soil characteristics on the toxicity of chemicals for earthworms: A review." In *Ecotoxicology of Earthworms*. P.W. Greig-Smith et al. (eds). Intercept Ltd., U.K. pp. 44-54.

van Gestel, C.A.M. and W.-C. Ma. 1993. "Development of QSAR's in soil ecotoxicology: Earthworm toxicity and soil sorption of chlorophenols, chlorobenzenes and dichloroaniline." *Water Air Soil Pollut.* 69:265-276.

van Gestel, C.A.M. and W.-C. Ma. 1988. "Toxicity and bioaccumulation of chlorophenols in earthworms, in relation to bioavailability in soil." *Ecotoxicol. Environ. Saf.* 15:289-297.

van Gestel, C.A.M. and W.-C. Ma. 1990. "An approach to quantitative structure-activity relationships (QSARs) in earthworm toxicity." *Chemosphere* 21(8):1023-1033.

van Gestel, C.A.M., and W.A. van Dis. 1988. "The influence of soil characteristics on the toxicity of four chemicals to the earthworm *Eisenia fetida andrei* (Oligochaeta)." *Biol. Fertil. Soils* 6:262-265.

van Gestel, C.A.M., W.A. van Dis, E.M. van Breemen, and P.M. Sparenburg. 1989. "Development of a standardized reproduction toxicity test with the earthworm species *Eisenia fetida andrei* using copper, pentachlorophenol, and 2,4-dichloroaniline." *Ecotoxicol. Environ. Saf.* 18:305-312.

van Gestel, C.A.M., W.A. van Dis, E.M. Dirven-van Breemen, P.M. Sparenburg, and R. Baerselman. 1991a. "Influence of cadmium, copper, and pentachlorophenol on growth and sexual development of *Eisenia andrei* (Oligochaeta; Annelida)." *Biol. Fertil. Soils* 12:117-121.

van Gestel, C.A.M., W.-C. Ma, and C.E. Smit. 1991b. "Development of QSAR's in terrestrial ecotoxicology: Earthworm toxicity and soil sorption of chlorophenols, chlorobenzenes and dichloroaniline." Sci. Total. Environ. 109/110:589-604.

van Gestel, C.A.M., E.M. Dirven-van Breemen, and R. Baerselman. 1993. "Accumulation and elimination of cadmium, chromium and zinc and effects on growth and reproduction in *Eisenia andrei* (Oligochaeta; Annelida)." *Sci. Total Environ. Suppl.*:585-597.

van Gestel, C.A.M., E.M. Dirven-van Breemen, R. Baerselman, H.J.B. Emans, J.A.M. Janssen, R. Postuma, and P.J.M. van Vliet. 1992. "Comparison of sublethal and lethal criteria for nine different chemicals in standardized toxicity tests using the earthworm *Eisenia andrei*." *Ecotoxicol. Environ. Saf.* 23:206-220.

van Kessel, W.H.M., R.W.B. Zaalberg, and W. Seinen. 1989. "Testing environmental pollutants on soil organisms: A simple assay to investigate the toxicity of environmental pollutants on soil organisms, using $CdCl_2$ and nematodes." *Ecotoxicol. Environ. Sat.* 18:181-190.

van Rhee, J.A. 1975. "Copper contamination effects on earthworms by disposal of pig waste in pastures." *Progress in Soil Zoology* 1975:451-457.

van Straalen, N.M. 1991. "Soil and sediment quality criteria derived from invertebrate toxicity data." In *Metal Ecotoxicology, Concepts & Applications.* M.C. Newman and A.W. McIntosh (eds). Lewis Publishers, Boca Raton. pp. 427-440.

van Straalen, N.M., and R.A. Verweij. 1991. "Effects of benzo(a)pyrene on food assimilation and growth efficiency in *Porcellio scaber* (Isopoda)." *Bull. Environ. Contam. Toxicol*. 46:134-140.

van Straalen, N.M., J.H.M. Schobben, and R.G.M. de Goede. 1989. "Population consequences of cadmium toxicity in soil microarthropods." *Ecotoxicol. Environ. Saf.* 17:190-204.

van Wensem, J. 1989. "A terrestrial micro-ecosystem for measuring effects of pollutants on isopod-mediated litter decomposition." *Hydrobiologia* 188/189:507-516.

van Wensem, J., and T. Adema. 1991. "Effects of fluoride on soil fauna mediated litter decomposition." *Environ. Pollut.* 72:239-251.

Walton, B.T., T.A. Anderson, M.S. Hendricks, and S.S. Talmage. 1989. Physiochemical properties as predictors of organic chemical effects on soil microbial respiration. Environ Toxicol Chem 8:53-63.

Watkins, D.R., J.T. Ammons, J.L. Branson, B.B. Burgoa, et al. 1993. *Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge Tennessee, Vols. 1 and 2.* EE/ER/TM-84. Oak Ridge National Laboratory, Environmental Restoration Division.

Wilson, D.O. 1977. "Nitrification in three soils amended with zinc sulfate." *Soil Biol. Biochem.* 9:277-280.

APPENDIX A

TOXICITY DATA FOR EARTHWORMS

Table A.1. Toxicity data for earthworms

Chemical concentrations are mg of element/kg of growth medium

%OC - % organic carbon

% Dec - % decrease in measured parameter at LOEC as compared to controls.

OECD soil (% dry weight): sphagnum peat, 10; kaolin clay, 20; fine sand, 69; $CaCO_3$, 1; pH 6.0

Chemical / Form		Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
As	KH_2AsO_4	Eisenia fetida	soil & manure			56	cocoons/worm		68LCT	56	Fischer & Koszorus. 1992.
Cd	$CdSO_4$	Aporrectodea caliginosa	Egyptian	7.05	10.8	56	cocoon production		10	25	Khalil et al. 1996
Cd	$CdCl_2$	Eisenia andrei	OECD soil	6	5	21	cocoons/worm;juveniles/worm	10	18	23,22	van Gestel, et al. 1992.
Cd	$C_4H_6CdO_4$	Eisenia fetida	horse manure			56	cocoon production		25LCT	52	Malecki et al. 1982.
Cd	$CdCl_2$	Eisenia andrei	OECD soil	6	5	84	sexual development EC50		27	50	van Gestel et al. 1991a.
Cd	$CdCl_2$	Eisenia andrei	OECD soil	6	5	84	growth	10	32	40	van Gestel et al. 1991a.
Cd	$Cd(NO_3)_2$	Eisenia fetida	OECD soil	6		56	cocoon production EC50		46.3	50	Spurgeon et al. 1994.

Table A.1 (continued)

Chemical	/ Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Cd	C4H6CdO4	Eisenia fetida	horse manure			140	cocoon production		50LCT	24	Malecki et al. 1982.
Cd	Soluble forms	Eisenia fetida	horse manure			42	growth;cocoon production		100LCT	25,100	Neuhauser et al. 1984.
Cd	CdCl2	Eisenia andrei	OECD soil	6	5	84	growth	32	100	44	van Gestel et al. 1991a.
Cd		Dendrobaena rubida	soil & dung	5	5.7	120	cocoons/worm	10	100	62	Bengtsson et al. 1986.
Cd		Dendrobaena rubida	soil & dung	6	5.7	120	cocoons/worm;hatchlings/ cocoon	10	100	78,71	Bengtsson et al. 1986.
							total hatchlings			74	
Cd		Dendrobaena rubida	soil & dung	7	5.7	120	% cocoon hatching success;	10	100	47	Bengtsson et al. 1986.
							hatchlings/coc; total hatchlings			38,30	Bengtsson et al. 1986.
Cd	CdCl2	Eisenia andrei	OECD soil	6	5	84	sexual development EC50		108	50	van Gestel et al. 1991a.
Cd	$Cd(NO_3)_2$	Eisenia fetida	OECD soil	6.1		21	growth		215	50	Spurgeon and Hopkin 1995

Table A.1 (continued)

Chemical	/ Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Cd	CdCl2	Eisenia fetida	sandy soil	4	0.9	14	survival LC50		440	50	van Gestel & van Dis.1988
Cd	CdCl2	Lumbricus rubellas	sandy loam	7	4	84	survival	150	1000	82	Ma. 1982.
Cd	CdNO3	Eisenia fetida	OECD soil	6	5	14	survival LC50		1843	50	Neuhauser et al. 1985
Cr	K2Cr2O7	Octochaetus pattoni	soil & dung			60	survival		2LCT	75	Abbasi & Soni. 1983.
Cr	K2Cr2O7	Pheretima posthuma	paddy soil			61	survival		10LCT	100	Soni & Abbasi. 1981.
Cr	Cr(NO3)3	Eisenia andrei	OECD soil	6	5	21	growth	10	32	30	van Gestel et al. 1992.
Cr	KCr(SO4)2	Eisenia fetida	soil & manure			56	number cocoons and hatchlings		625LCT	55	Molnar et al. 1989.
Cr	K2Cr2O7	Eisenia fetida	soil & manure			14	weight gain of juveniles		625LCT	43	Molnar et al. 1989.
Cu	CuCl2	Allolobophora chlorotica	sandy loam	5	2.5		cocoon production		51	50	Ma. 1988.
Cu	Cu(NO3)2	Eisenia fetida	OECD soil	6		56	cocoon production EC50		53.3	50	Spurgeon et al. 1994.
Cu	CuCl2	Lumbricus rubellus	sandy loam	7	1.7	42	cocoon production	13	63	41	Ma. 1984.

Table A.1 (continued)

Chemical	/ Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Cu	CuCl2	Apporectodea caliginosa	sandy loam	5	2.5		cocoon production		68	50	Ma. 1988.
Cu		Dendrobaena rubida	soil & dung	5	5.7	120	cocoons/worm;hatchlings/ cocoon		100LCT	70,64	Bengtsson et al. 1986.
Cu	CuCl2	Eisenia andrei	OECD soil	6	5	84	growth	32	100	32	van Gestel et al. 1991a.
Cu	Cu-sulfate	Aporrectodea caliginosa	Egyptian	7.05	10.8	56	cocoon production	50	100	36	Khalil et al. 1996
Cu		Allolobophora caliginosa	polder soil			60	cocoon production		110LCT	27	van Rhee. 1975.
							total hatchlings			74	
Cu	CuCl2	Lumbricus rubellus	sandy loam	5	2.5		cocoon production		122	50	Ma. 1988.
Cu	CuCl2	Lumbricus rubellus	loamy sand	5	2.9	42	cocoon production	54	131	42	Ma. 1984.
Cu	CuSO4	Lumbricus rubellus	loamy sand	5	2.9	18	cocoon production	83	148	26	Ma. 1984.
Cu	CuSO4	Octolasium cyaneum	Brown soil		3	14	survival LC50		180	50	Streit & Jaggy. 1983.
Cu	CuCl2	Eisenia fetida	OECD soil	6	5	21	cocoon production	120	180	36	van Gestel et al. 1989.
Cu	CuSO4	Lumbricus rubellus	loamy sand	6	2.9	18	cocoon production	148	278	33	Ma. 1984.
Cu		Dendrobaena rubida	soil & dung	6	5.7	120	cocoons/worm;hatchlings/ cocoon	100	500	96,100	Bengtsson et al. 1986.

Table A.1 (continued)

Chemical / Form		Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
							% hatching success			100	
Cu		Dendrobaena rubida	soil & dung	7	5.7	120	cocoons/worm;hatchlings/ cocoon	100	500	90,100	Bengtsson et al. 1986.
							% hatching success			100	
Cu	C4H6CuO4	Eisenia fetida	horse manure			56	cocoon production	300	500	24	Malecki et al. 1982
Cu	Cu-nitrate	Eisenia fetida	OECD soil	6.1		21	growth		601	50	Spurgeon and Hopkin 1995
Cu	CuNO3	Eisenia fetida	OECD soil	6	5	14	survival LC50		643	50	Neuhauser et al. 1985.
Cu	CuSO4	Octolasium cyaneum	Rendzina soil		14	14	survival LC50		850	50	Streit & Jaggy. 1983.
Cu	C4H6CuO4	Eisenia fetida	horse manure			140	cocoon production	500	1000	24	Malecki et al. 1982.
Cu	CuCl2	Lumbricus rubellus	sandy loam	7	4	84	survival	150	1000	82	Ma. 1982.
Cu	Soluble forms	Eisenia fetida	horse manure			42	growth;cocoon production	1000	2000	27,85	Neuhauser et al. 1984.
Cu	CuSO4	Octolasium cyaneum	Peat soil		43	14	survival LC50		2500	50	Streit & Jaggy. 1983.

Table A.1 (continued)

Chemical / Form		Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Pb		Dendrobaena rubida	soil & dung	5	5.7	120	cocoons/worm;hatchlings/ cocoon	100	500	75,100	Bengtsson et al. 1986.
Pb	Pb-nitrate	Eisenia fetida	OECD soil	6.1		21	growth		1629	50	Spurgeon and Hopkin 1995
Pb	Pb(NO3)2	Eisenia fetida	OECD soil	6		56	cocoon production EC50		1940	50	Spurgeon et al. 1994.
Pb	C4H6O4Pb	Eisenia fetida	horse manure			56	cocoon production	2000	4000	50	Malecki et al. 1982.
Pb	C4H6O4Pb	Eisenia fetida	horse manure			140	cocoon production	1000	5000	28	Malecki et al. 1982.
Pb	PbNO3	Eisenia fetida	OECD soil	6	5	14	survival LC50		5941	50	Neuhauser et al. 1985.
Pb	Sol forms	Eisenia fetida	horse manure			42	cocoon production		5000LCT	80	Neuhauser et al. 1984.
Hg	HgCl2	Octochaetus pattoni	soil & dung			60	survival;cocoon production		0.5LCT	65,40	Abbasi & Soni. 1983.
Hg	CH3HgCl	Eisenia fetida	potting soil			84	survival;segment regeneration	2.5	12.5	21,69	Beyer et al. 1985.

Table A.1 (continued)

Chemical / Form		Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Ni	C4H6NiO4	Eisenia fetida	horse manure			140	cocoon production	100	200	23	Malecki et al. 1982.
Ni	Soluble forms	Eisenia fetida	horse manure			42	cocoon production		250LCT	33	Neuhauser et al. 1984.
Ni	C4H6NiO4	Eisenia fetida	horse manure			56	cocoon production	200	300	41	Malecki et al. 1982.
Ni	NiNO3	Eisenia fetida	OECD soil	6	5	14	survival LC50		757	50	Neuhauser et al. 1985.
Ni	NiCl2	Lumbricus rubellus	sandy loam	7	4	84	survival	150	1000	31	Ma. 1982.
Se	Na2SeO3	Eisenia fetida	soil & manure			56	cocoons/worm		77LCT	69	Fischer & Koszorus. 1992.
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	6.0	2.5	21	cocoon production	ca. 97	136	50	Spurgeon and Hopkin 1996b
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	4.0	2.5	21	cocoon production	ca. 115	142	50	Spurgeon and Hopkin 1996b
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	4.0	5	21	cocoon production	ca. 161	189	50	Spurgeon and Hopkin 1996b

Table A.1 (continued)

Chemical	/ Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Zn	$Zn(NO_3)_2$	Eisenia fetida	OECD soil	6		21	growth rate		190	69	Spurgeon and Hopkin 1996a
Zn	$Zn(NO_3)_2$	Aporrectodea rosea	OECD soil	6		21	growth rate		190	48	Spurgeon and Hopkin 1996a
Zn	$Zn(NO_3)_2$	Lumbricus rubellus	OECD soil	6		21	cocoon production		190	69	Spurgeon and Hopkin 1996a
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	5.0	2.5	21	cocoon production	ca. 85	199	50	Spurgeon and Hopkin 1996b
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	4.0	7.5	21	cocoon production	ca. 223	230	50	Spurgeon and Hopkin 1996b
Zn	Zn(NO3)2	Eisenia fetida	OECD soil	6		56	cocoon production EC50		276	50	Spurgeon et al. 1994.
Zn	Zn-sulfate	Aporrectodea caliginosa	Egyptian	7.05	10.8	56	cocoon production		300	20	Khalil et al. 1996
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	5.0	5	21	cocoon production	ca. 183	343	50	Spurgeon and Hopkin 1996b

Table A.1 (continued)

Chemical	/ Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	6.0	5	21	cocoon production		462	50	Spurgeon and Hopkin 1996b
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	5.0	7.5	21	cocoon production	ca. 414	548	50	Spurgeon and Hopkin 1996b
Zn	ZnCl2	Eisenia andrei	OECD soil	6	5	21	cocoons/worm; juveniles/worm	320	560	31,42	van Gestel et al. 1993.
Zn	$Zn(NO_3)_2$	Eisenia fetida	artificial soil	6.0	7.5	21	cocoon production	ca. 484	592	50	Spurgeon and Hopkin 1996b
Zn	ZnNO3	Eisenia fetida	OECD soil			14	survival LC50		662	50	Neuhauser et al. 1985.
Zn	$Zn(NO_3)_2$	Eisenia fetida	OECD soil	6.1		21	growth		1078	50	Spurgeon and Hopkin 1995a
Zn		Allolobophora caliginosa	polder soil				body weight; cocoon production; mortality; sexual development		1100LCT	53,100, 22, 100	van Rhee. 1975.
Zn	C4H6O4Zn	Eisenia fetida	horse manure			56	cocoon production	1000	2000	36	Malecki et al. 1982.

Table A.1 (continued)

Chemical / Form		Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Zn	Soluble forms	Eisenia fetida	horse manure			42	cocoon production	1000	2500	50	Neuhauser et al. 1984.
Zn	C4H6O4Zn	Eisenia fetida	horse manure			140	cocoon production	2500	5000	53	Malecki et al. 1982.
Chloroacetamide		Eisenia andrei	sandy soil	4	0.9	14	survival LC50		>10<18	50	van Gestel & van Dis. 1988
Chloroacetamide		Eisenia fetida	artificial soil	7		28	survival LC50		24	50	Heimbach 1984.
Chloroacetamide		Eisenia andrei	sandy soil	7	0.9	14	survival LC50		>32<56	50	van Gestel & van Dis. 1988
Chloroacetamide		Eisenia andrei	OECD soil	7	3.9	14	survival LC50		40	50	van Gestel & van Dis. 1988
Chloroacetamide		Eisenia fetida	horse manure			56	growth	500	1000	100	Neuhauser & Callahan. 1990
3-chloroaniline		Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		195	50	van Gestel & Ma. 1993.
3-chloroaniline		Eisenia andrei	sandy soil	5	1.9	14	survival LC50		220	50	van Gestel & Ma. 1993.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
3-chloroaniline	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		332	50	van Gestel & Ma. 1993.
3-chloroaniline	Eisenia andrei	OECD soil	6	4	14	survival LC50		448	50	van Gestel & Ma. 1993.
2,4-dichloroaniline	Eisenia andrei	OECD soil	6	5	21	cocoon production	56	100	23	van Gestel et al. 1989.
2,4-dichloroaniline	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		142	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		190	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		201	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Eisenia andrei	sandy soil	6	3	14	survival LC50		285	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		304	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Eisenia andrei	OECD soil	6	4	14	survival LC50		319	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
2,4-dichloroaniline	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		580	50	van Gestel & Ma. 1990.
2,4-dichloroaniline	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		824	50	van Gestel & Ma. 1990.
3,4-dichloroaniline	Eisenia andrei	sandy soil	7	0.9	6	survival LC50		140	50	van Gestel & van Dis. 1988
3,4-dichloroaniline	Eisenia andrei	sandy soil	4	0.9	6	survival LC50		140	50	van Gestel & van Dis. 1988
3,4-dichloroaniline	Eisenia andrei	OECD soil	7	3.9	11	survival LC50		250	50	van Gestel & van Dis. 1988
2,4,5-trichloroaniline	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		134	50	van Gestel & Ma. 1993.
2,4,5-trichloroaniline	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		174	50	van Gestel & Ma. 1993.
2,4,5-trichloroaniline	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		213	50	van Gestel & Ma. 1993.
2,4,5-trichloroaniline	Eisenia andrei	OECD soil	6	4	14	survival LC50		233	50	van Gestel & Ma. 1993.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
2,3,5,6-tetrachloroaniline	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		116	50	van Gestel & Ma. 1993.
2,3,5,6-tetrachloroaniline	Eisenia andrei	OECD soil	6	4	14	survival LC50		133	50	van Gestel & Ma. 1993.
2,3,5,6-tetrachloroaniline	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		159	50	van Gestel & Ma. 1993.
2,3,5,6-tetrachloroaniline	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		179	50	van Gestel & Ma. 1993.
Pentachloroaniline	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		825	50	van Gestel & Ma. 1993.
Pentachloroaniline	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		825	50	van Gestel & Ma. 1993.
Pentachloroaniline	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		1014	50	van Gestel & Ma. 1993.
Pentachloroaniline	Eisenia andrei	OECD soil	6	4	14	survival LC50		>3200	50	van Gestel & Ma. 1993.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
1,2-dichloropropane	Perionyx excavatus	OECD soil	6	5	14	survival LC50		3880	50	Neuhauser et al. 1986.
1,2-dichloropropane	Eisenia fetida	OECD soil	6	5	14	survival LC50		4240	50	Neuhauser et al. 1986.
1,2-dichloropropane	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		4272	50	Neuhauser et al. 1986.
1,2-dichloropropane	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		5300	50	Neuhauser et al. 1986.
1,2-dichloropropane	Eisenia fetida	horse manure			56	growth	80800	92300	death	Neuhauser & Callahan. 1990
Dimethylphthalate	Perionyx excavatus	OECD soil	6	5	14	survival LC50		1064	50	Neuhauser et al. 1986.
Dimethylphthalate	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		2000	50	Neuhauser et al. 1986.
Dimethylphthalate	Eisenia fetida	OECD soil	6	5	14	survival LC50		3160	50	Neuhauser et al. 1986.
Dimethylphthalate	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		3335	50	Neuhauser et al. 1986.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Dimethylphthalate	Eisenia fetida	horse manure			56	cocoon production	4720	70800	62	Neuhauser & Callahan. 1990
Fluorene	Perionyx excavatus	OECD soil	6	5	14	survival LC50		170	50	Neuhauser et al. 1986.
Fluorene	Eisenia fetida	OECD soil	6	5	14	survival LC50		173	50	Neuhauser et al. 1986.
Fluorene	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		197	50	Neuhauser et al. 1986.
Fluorene	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		206	50	Neuhauser et al. 1986.
Fluorene	Eisenia fetida	horse manure			56	cocoon production	500	750	49	Neuhauser & Callahan. 1990
N-nitrosodiphenylamine	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		109	50	Neuhauser et al. 1986.
N-nitrosodiphenylamine	Perionyx excavatus	OECD soil	6	5	14	survival LC50		128	50	Neuhauser et al. 1986.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
N-nitrosodiphenylamine	Eisenia fetida	OECD soil	6	5	14	survival LC50		151	50	Neuhauser et al. 1986.
N-nitrosodiphenylamine	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		155	50	Neuhauser et al. 1986.
N-nitrosodiphenylamine	Eisenia fetida	horse manure			56	cocoon production		1400 LCT	37	Neuhauser & Callahan. 1990
Phenol	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		188	50	Neuhauser et al. 1986.
Phenol	Perionyx excavatus	OECD soil	6	5	14	survival LC50		258	50	Neuhauser et al. 1986.
Phenol	Eisenia fetida	OECD soil	6	5	14	survival LC50		401	50	Neuhauser et al. 1986.
Phenol	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		450	50	Neuhauser et al. 1986.
Phenol	Eisenia fetida	horse manure			56	cocoon production	3900	4900	26	Neuhauser & Callahan. 1990

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
4-nitrophenol	Eisenia fetida	OECD soil	6	5	14	survival LC50		38	50	Neuhauser et al. 1986.
4-nitrophenol	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		40	50	Neuhauser et al. 1986.
4-nitrophenol	Perionyx excavatus	OECD soil	6	5	14	survival LC50		44	50	Neuhauser et al. 1986.
4-nitrophenol	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		56	50	Neuhauser et al. 1986.
4-nitrophenol	Eisenia fetida	horse manure			56	cocoon production		600 LCT	39	Neuhauser & Callahan. 1990
3-chlorophenol	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		75	50	van Gestel & Ma. 1990.
3-chlorophenol	Eisenia andrei	humic sand	5	1.9	14	survival LC50		78	50	van Gestel & Ma. 1988.
3-chlorophenol	Eisenia andrei	OECD soil	6	4	14	survival LC50		130	50	van Gestel & Ma. 1990.
3-chlorophenol	Eisenia andrei	sandy soil	6	3	14	survival LC50		134	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
3-chlorophenol	Eisenia andrei	humic sand	6	3	14	survival LC50		140	50	van Gestel & Ma. 1988.
3-chlorophenol	Lumbricus rubellus	humic sand	5	1.9	14	survival LC50		150	50	van Gestel & Ma. 1988.
3-chlorophenol	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		150	50	van Gestel & Ma. 1990.
3-chlorophenol	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		247	50	van Gestel & Ma. 1990.
3-chlorophenol	Lumbricus rubellus	humic sand	6	3	14	survival LC50		296	50	van Gestel & Ma. 1988.
3-chlorophenol	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		342	50	van Gestel & Ma. 1990.
3-chlorophenol	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		423	50	van Gestel & Ma. 1990.
3-chlorophenol	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		633	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		134	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
3,4-dichlorophenol	Eisenia andrei	humic sand	5	1.9	14	survival LC50		140	50	van Gestel & Ma. 1988.
3,4-dichlorophenol	Eisenia andrei	OECD soil	6	4	14	survival LC50		172	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Eisenia andrei	sandy soil	6	3	14	survival LC50		240	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Eisenia andrei	humic sand	6	3	14	survival LC50		250	50	van Gestel & Ma. 1988.
3,4-dichlorophenol	Lumbricus rubellus	humic sand	5	1.9	14	survival LC50		303	50	van Gestel & Ma. 1988.
3,4-dichlorophenol	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		322	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		352	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		423	50	van Gestel & Ma. 1990.
3,4-dichlorophenol	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		486	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
3,4-dichlorophenol	Lumbricus rubellus	humic sand	6	3	14	survival LC50		486	50	van Gestel & Ma. 1988.
3,4-dichlorophenol	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		680	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		46	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Eisenia andrei	humic sand	5	1.9	14	survival LC50		52	50	van Gestel & Ma. 1988.
2,4,5-trichlorophenol	Eisenia andrei	OECD soil	6	4	14	survival LC50		63	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Eisenia andrei	sandy soil	6	3	14	survival LC50		76	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Eisenia andrei	humic sand	6	3	14	survival LC50		90	50	van Gestel & Ma. 1988.
2,4,5-trichlorophenol	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		164	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Lumbricus rubellus	humic sand	5	1.9	14	survival LC50		201	50	van Gestel & Ma. 1988.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
2,4,5-trichlorophenol	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		235	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Lumbricus rubellus	humic sand	6	3	14	survival LC50		290	50	van Gestel & Ma. 1988.
2,4,5-trichlorophenol	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		316	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		362	50	van Gestel & Ma. 1990.
2,4,5-trichlorophenol	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		875	50	van Gestel & Ma. 1990.
2,4,6-trichlorophenol	Eisenia fetida	OECD soil	6	5	14	survival LC50		58	50	Neuhauser et al. 1986.
2,4,6-trichlorophenol	Perionyx excavatus	OECD soil	6	5	14	survival LC50		78	50	Neuhauser et al. 1986.
2,4,6-trichlorophenol	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		85	50	Neuhauser et al. 1986.
2,4,6-trichlorophenol	Eisenia fetida	horse manure			56	cocoon production		100 LCT	28	Neuhauser & Callahan. 1990

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
2,4,6-trichlorophenol	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		108	50	Neuhauser et al. 1986.
2,3,4,5-tetrachlorophenol	Eisenia andrei	humic sand	5	1.9	14	survival LC50		116	50	van Gestel & Ma. 1988.
2,3,4,5-tetrachlorophenol	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		117	50	van Gestel & Ma. 1990.
2,3,4,5-tetrachlorophenol	Eisenia andrei	sandy soil	6	3	14	survival LC50		166	50	van Gestel & Ma. 1990.
2,3,4,5-tetrachlorophenol	Eisenia andrei	humic sand	6	3	14	survival LC50		176	50	van Gestel & Ma. 1988.
2,3,4,5-tetrachlorophenol	Lumbricus rubellus	humic sand	5	1.9	14	survival LC50		514	50	van Gestel & Ma. 1988.
2,3,4,5-tetrachlorophenol	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		515	50	van Gestel & Ma. 1990.
2,3,4,5-tetrachlorophenol	Lumbricus rubellus	humic sand	6	3	14	survival LC50		828	50	van Gestel & Ma. 1988.
2,3,4,5-tetrachlorophenol	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		875	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Pentachlorophenol	Eisenia andrei	sandy soil	7	0.9	14	survival LC50		16	50	van Gestel & van Dis. 1988
Pentachlorophenol	Eisenia fetida	artificial	7.5		14	mortality		27	50	Fitzgerald et al. 1996
Pentachlorophenol	Eisenia andrei	OECD soil	7	3.9	14	survival LC50		29	50	van Gestel & van Dis. 1988
Pentachlorophenol	Eisenia andrei	OECD soil	6	5	21	% cocoon hatch success	10	32	50	van Gestel et al. 1989.
Pentachlorophenol	Eisenia fetida	artificial	7.5		14	mortality		37	50	Fitzgerald et al. 1996
Pentachlorophenol	Eisenia andrei	sandy soil	4	0.9	14	survival LC50		52	50	van Gestel & van Dis. 1988
Pentachlorophenol	Eisenia fetida	clay	6.1		14	mortality		72	50	Fitzgerald et al. 1996
Pentachlorophenol	Eisenia andrei	OECD soil	6	4	14	survival LC50		83	50	van Gestel & Ma. 1990.
Pentachlorophenol	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		84	50	van Gestel & Ma. 1990.
Pentachlorophenol	Eisenia fetida	artificial soil	7		28	survival LC50		87	50	Heimbach 1984.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Pentachlorophenol	Eisenia andrei	humic sand	5	1.9	14	survival LC50		94	50	van Gestel & Ma. 1988.
Pentachlorophenol	Eisenia andrei	sandy soil	6	3	14	survival LC50		142	50	van Gestel & Ma. 1990.
Pentachlorophenol	Eisenia andrei	humic sand	6	3	14	survival LC50		143	50	van Gestel & Ma. 1988.
Pentachlorophenol	Eisenia eugeniae	artificial	7.5		14	mortality		168	50	Fitzgerald et al. 1996
Pentachlorophenol	Lumbricus terrestris	artificial	7.5		14	mortality		191	50	Fitzgerald et al. 1996
Pentachlorophenol	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		502	50	van Gestel & Ma. 1990.
Pentachlorophenol	Lumbricus rubellus	humic sand	6	3	14	survival LC50		883	50	van Gestel & Ma. 1988.
Pentachlorophenol	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		1013	50	van Gestel & Ma. 1990.
Pentachlorophenol	Lumbricus rubellus	humic sand	5	1.9	14	survival LC50		1094	50	van Gestel & Ma. 1988.
Pentachlorophenol	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		1206	50	van Gestel & Ma. 1990.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Pentachlorophenol	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		2298	50	van Gestel & Ma. 1990.
Chlorobenzene	Eisenia fetida	sandy soil	5	1.8	14	survival LC50		240	50	van Gestel et al. 1991b.
Chlorobenzene	Eisenia fetida	OECD soil	6	4	14	survival LC50		446	50	van Gestel et al. 1991b.
Chlorobenzene	Lumbricus rubellus	sandy soil	5	1.8	14	survival LC50		547	50	van Gestel et al. 1991b.
Chlorobenzene	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		1107	50	van Gestel et al. 1991b.
1,4-dichlorobenzene	Eisenia fetida	sandy soil	5	1.8	14	survival LC50		128	50	van Gestel et al. 1991b.
1,4-dichlorobenzene	Lumbricus rubellus	sandy soil	5	1.8	14	survival LC50		184	50	van Gestel et al. 1991b.
1,4-dichlorobenzene	Eisenia fetida	OECD soil	6	4	14	survival LC50		229	50	van Gestel et al. 1991b.
1,4-dichlorobenzene	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		615	50	van Gestel et al. 1991b.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
1,2,3-trichlorobenzene	Lumbricus rubellus	sandy soil	5	1.9	14	survival LC50		115	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Eisenia andrei	OECD soil	6	4	14	survival LC50		133	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Eisenia andrei	sandy soil	5	1.9	14	survival LC50		134	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		195	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Lumbricus rubellus	sandy soil	6	3	14	survival LC50		200	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Eisenia andrei	sandy soil	6	3	14	survival LC50		240	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Eisenia andrei	peaty soil	4	7.8	14	survival LC50		547	50	van Gestel & Ma. 1990.
1,2,3-trichlorobenzene	Lumbricus rubellus	peaty soil	4	7.8	14	survival LC50		563	50	van Gestel & Ma. 1990.
1,2,4-trichlorobenzene	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		127	50	Neuhauser et al. 1986.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
1,2,4-trichlorobenzene	Perionyx excavatus	OECD soil	6	5	14	survival LC50		180	50	Neuhauser et al. 1986.
1,2,4-trichlorobenzene	Eisenia fetida	OECD soil	6	5	14	survival LC50		197	50	Neuhauser et al. 1986.
1,2,4-trichlorobenzene	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		251	50	Neuhauser et al. 1986.
1,2,3,4-tetrachlorobenzene	Eisenia fetida	sandy soil	5	1.8	14	survival LC50		75	50	van Gestel et al. 1991b.
1,2,3,4-tetrachlorobenzene	Lumbricus rubellus	sandy soil	5	1.8	14	survival LC50		112	50	van Gestel et al. 1991b.
1,2,3,4-tetrachlorobenzene	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		201	50	van Gestel et al. 1991b.
1,2,3,4-tetrachlorobenzene	Eisenia fetida	OECD soil	6	4	14	survival LC50		223	50	van Gestel et al. 1991b.
Pentachlorobenzene	Lumbricus rubellus	sandy soil	5	1.8	14	survival LC50		115	50	van Gestel et al. 1991b.
Pentachlorobenzene	Eisenia fetida	sandy soil	5	1.8	14	survival LC50		134	50	van Gestel et al. 1991b.

Table A.1 (continued)

Chemical / Form	Earthworm Species	Growth Medium	pH	%OC	Exp (D)	Response Parameter	NOEC APPL	LOEC APPL	% Dec	Reference
Pentachlorobenzene	Lumbricus rubellus	OECD soil	6	4	14	survival LC50		201	50	van Gestel et al. 1991b.
Pentachlorobenzene	Eisenia fetida	OECD soil	6	4	14	survival LC50		238	50	van Gestel et al. 1991b.
Nitrobenzene	Eudrilus eugeniae	OECD soil	6	5	14	survival LC50		226	50	Neuhauser et al. 1986.
Nitrobenzene	Eisenia fetida	OECD soil	6	5	14	survival LC50		319	50	Neuhauser et al. 1986.
Nitrobenzene	Perionyx excavatus	OECD soil	6	5	14	survival LC50		343	50	Neuhauser et al. 1986.
Nitrobenzene	Allolobophora tuberculata	OECD soil	6	5	14	survival LC50		362	50	Neuhauser et al. 1986.

APPENDIX B

TOXICITY DATA FOR MICROORGANISMS

Table B.1. Toxicity Data for Microorganisms

Chemical concentrations are mg of element/kg of growth medium

% Dec - % decrease in measured parameter at LOEC as compared to controls.

Exp Dur (d) - exposure duration in days

Growth Medium: Montmorill = mont = montmorillonite clay; Kaol = kaolinite clay

%OC - % organic carbon in growth medium

CEC = cation exchange capacity of growth medium (milliequivalents/100 g)

* denotes phenylmercury acetate

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Aluminum	AlCl3	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		675 LCT	43	Al-Khafaji & Tabatabai. 1979.
Aluminum	AlCl3	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		675 LCT	24	Al-Khafaji & Tabatabai. 1979.
Aluminum	AlCl3	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	67.5	675	34	Al-Khafaji & Tabatabai. 1979.
Aluminum	AlCl3	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	67.5	675	42	Al-Khafaji & Tabatabai. 1979.
Aluminum	AlCl3	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	67.5	675	34	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Aluminum	AlCl3	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	67.5	675	25	Juma & Tabatabai. 1977.
Arsenic	NaAsO2	native soil microflora	surface soil	6	2.6	0.1	Amidase activity		187.3 LCT	32	Frankenberger &Tabatabai. 1981
Arsenic	Na2HAsO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity		187.3 LCT	33	Juma & Tabatabai. 1977.
Arsenic	Na2HAsO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity		187.3 LCT	32	Juma & Tabatabai. 1977.
Arsenic	NaAsO2	native soil microflora	clay loam	8	3.2	0.1	Amidase activity		1873 LCT	98	Frankenberger &Tabatabai. 1981
Arsenic	NaAsO2	native soil microflora	loam	7	4.7	0.1	Amidase activity		1873 LCT	97	Frankenberger &Tabatabai. 1981
Arsenic	NaAsO2	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		1875 LCT	35	Juma & Tabatabai. 1977.
Arsenic	Na2HAsO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1875 LCT	75,39	Juma & Tabatabai. 1977.
Arsenic	Na2HAsO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1875 LCT	62	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Barium	BaCl2	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		3433 LCT	24	Al-Khafaji & Tabatabai. 1979.
Boron	Na2B4O7	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		27 LCT	31	Al-Khafaji & Tabatabai. 1979.
Boron	Na2B4O7	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		270 LCT	22	Juma & Tabatabai. 1977.
Boron	Na2B4O7	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		270 LCT	70	Al-Khafaji & Tabatabai. 1979.
Boron	Na2B4O7	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		270 LCT	60	Al-Khafaji & Tabatabai. 1979.
Boron	Na2B4O7	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	27	270	65	Al-Khafaji & Tabatabai. 1979.
Boron	Na2B4O7	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	27	270	33	Juma & Tabatabai. 1977.
Cadmium	CdCl2	native soil microflora	soil/litter microcosm			24	Respiration	.006	6.1	43	Lighthart & Bond. 1976.
Cadmium	Cd(NO3)2	Pseudomonas sp.	silt loam	7	2	4	Denitrification		10 LCT	23	Bollag & Barabasz. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Cadmium	C4H6CdO4	native soil microflora	phaeosem	7	1	84	Respiration	7	14	22	Reber. 1989.
Cadmium	C4H6CdO4	native soil microflora	sandy hortisol	7	1.5	84	Respiration	7	14	23	Reber. 1989.
Cadmium	CdCl2	native soil microflora	sandy loam	6	3	548	Urease activity		30 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdNO4	native soil microflora	surface soil		1.3	1	Dehydrogenase activity		30 LCT	47	Rogers & Li. 1985.
Cadmium	Cd(NO3)2	Pseudomonas denitrificans	silt loam	7	2	4	Denitrification	10	50	22	Bollag & Barabasz. 1979.
Cadmium	Cd(NO3)2	Pseudomonas aeruginosa	silt loam	7	2	4	Denitrification	10	50	25	Bollag & Barabasz. 1979.
Cadmium	CdCl2	native soil microflora	silt loam	5			Nitrification		50	>20	Suter and Sharples. 1984.
Cadmium	C4H6CdO4	native soil microflora	acid cambisol	6	1	84	Respiration	28	56	23	Reber. 1989.
Cadmium	CdCl2	native soil microflora	brown earth	5		30	Cellulolytic activity	50	100	35	Khan & Frankland. 1984.
Cadmium	Cd(NO3)2	native soil microflora	silt loam	7	2	21	Denitrification	50	100	27	Bollag & Barabasz. 1979.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	548	Urease activity		120 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	548	Arylsulfatase activity		121 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Cadmium	CdCl2	native soil microflora	silty loam	8	1	548	Arylsulfatase activity		137 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	native soil microflora	silty loam	8	1	548	Phosphatase activity		230 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdSO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity		281 LCT	27	Juma & Tabatabai. 1977.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	548	Phosphatase activity		330 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	42	Urease activity		340 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	native soil microflora	sandy peat	4	6.5	548	Urease activity		490 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	native soil microflora	silty loam	8	1	548	Urease activity		520 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	native soil microflora	clay	8	1.5	548	Urease activity		520 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdSO4	Native soil microflora	silty clay	7	3	20	N mineralization		562 LCT	27	Liang & Tabatabai. 1977.
Cadmium	CdSO4	native soil microflora	clay loam	8	4	20	N mineralization		562 LCT	39	Liang & Tabatabai. 1977.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	42	Phosphatase activity		840 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdCl2	native soil microflora	soil/litter microcosm				Respiration		920 LCT	61	Lighthart et al. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Cadmium	CdCl2	native soil microflora	silty loam	8	1	42	Urease activity		970 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdSO4	native soil microflora	surface soil	6	2.9	35	Nitrification	500	1000	62	Bewley & Stotzky. 1983.
Cadmium	CdCl2	native soil microflora	clay	8	1.5	548	Arylsulfatase activity		1016 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	native soil microflora	sandy loam	6	3	548	Arylsulfatase activity		1798 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	native soil microflora	silt loam	8	1	42	Arylsulfatase activity		1888 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	native soil microflora	sandy soil	7	1	42	Arylsulfatase activity		2214 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdSO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		2810 LCT	78,51	Juma & Tabatabai. 1977.
Cadmium	CdSO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		2810 LCT	48	Juma & Tabatabai. 1977.
Cadmium	CdSO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		2810 LCT	27	Al-Khafaji & Tabatabai. 1979.
Cadmium	CdSO4	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		2810 LCT	42	Al-Khafaji & Tabatabai. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Cadmium	CdSO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	281	2810	44	Juma & Tabatabai. 1977.
Cadmium	CdSO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	281	2810	55	Al-Khafaji & Tabatabai. 1979.
Cadmium	CdSO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	281	2810	23	Al-Khafaji & Tabatabai. 1979.
Cadmium	CdCl2	native soil microflora	sandy peat	4	6.5	42	Arylsulfatase activity		3192 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	native soil microflora	sandy peat	4	6.5	42	Urease activity		3260 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	native soil microflora	clay	8	1.5	42	Urease activity		4460 ED50	50	Doelman & Haanstra. 1986.
Cadmium	CdCl2	Native soil microflora	clay	8	1.5	548	Phosphatase activity		5305 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdCl2	Native soil microflora	Silty loam	8	1	42	Phosphatase activity		5485 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdCl2	native soil microflora	clay	8	1.5	42	Arylsulfatase activity		9520 ED50	50	Haanstra & Doelman. 1991.
Cadmium	CdCl2	Native soil microflora	clay	8	1.5	42	Phosphatase activity		9779 ED50	50	Doelman & Haanstra. 1989.
Cadmium	CdCl2	native soil microflora	sandy loam	6	3	548	Phosphatase activity		9869 ED50	50	Doelman & Haanstra. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Chromium	CrCl3	native soil microflora	sandy loam	6	3	548	Urease activity		<1 ED50	50	Doelman & Haanstra. 1986.
Chromium	K2Cr2O7	native soil microflora	sandy loam	6		22	Respiration		10 LCT	33	Ross et al. 1981.
Chromium	K2Cr2O7	native soil microflora	loam	6		22	Respiration		10 LCT	27	Ross et al. 1981.
Chromium	CrCl3	native soil microflora	sandy loam	6	3	548	Arylsulfatase activity		12 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	42	Arylsulfatase activity		17 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrSO4	native soil microflora	surface soil		1.3	1	Dehydrogenase activity		30 LCT	54	Rogers & Li. 1985.
Chromium	CrCl3	native soil microflora	sandy loam	6		22	Respiration		100 LCT	48	Ross et al. 1981.
Chromium	CrCl3	native soil microflora	loam	6		22	Respiration		100 LCT	41	Ross et al. 1981.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	548	Arylsulfatase activity		203 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	loam	6	3	20	N mineralization		260 LCT	20	Liang & Tabatabai. 1977.
Chromium	CrCl3	native soil microflora	silty clay loam	7	6	20	N mineralization		260 LCT	24	Liang & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Chromium	CrCl3	native soil microflora	clay	8	1.5	42	Arylsulfatase activity		281 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	sandy loam	6	3	42	Arylsulfatase activity		309 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	silty loam	8	1	548	Arylsulfatase activity		411 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	clay	8	1.5	548	Urease activity		420 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	clay	8	1.5	42	Urease activity		490 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	clay	8	1.5	548	Arylsulfatase activity		575 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	548	Urease activity		630 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrO	native soil microflora	sandy soil	7		42	N mineralization & nitrification		1000 LCT	22,24	Bhuiya & Cornfield. 1976.
Chromium	CuSO4	native soil microflora	sandy loam	7	2	21	Nitrification	100	1000	67	Premi & Cornfield. 1969.
Chromium	CrCl3	native soil microflora	silty loam	8	1	548	Urease activity		1110 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	clay	8	1.5	42	Phosphatase activity		1170 ED50	50	Doelman & Haanstra. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Chromium	CrCl3	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1300 LCT	54	Al-Khafaji & Tabatabai. 1979.
Chromium	CrCl3	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		1300 LCT	32	Al-Khafaji & Tabatabai. 1979.
Chromium	CrCl3	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1300 LCT	27,25	Juma & Tabatabai. 1977.
Chromium	CrCl3	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1300 LCT	27	Juma & Tabatabai. 1977.
Chromium	CrCl3	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	130	1300	43	Al-Khafaji & Tabatabai. 1979.
Chromium	CrCl3	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	130	1300	35	Al-Khafaji & Tabatabai. 1979.
Chromium	CrCl3	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	130	1300	30	Juma & Tabatabai. 1977.
Chromium	CrCl3	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	130	1300	39	Juma & Tabatabai. 1977.
Chromium	CrCl3	native soil microflora	sandy peat	4	6.5	42	Urease activity		1360 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	clay	8	1.5	548	Phosphatase activity		2652 ED50	50	Doelman & Haanstra. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Chromium	CrCl3	native soil microflora	sandy loam	6	3	548	Phosphatase activity		2792 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	sandy peat	4	6.5	548	Arylsulfatase activity		3203 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	42	Phosphatase activity		3208 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	sandy peat	4	6.5	42	Phosphatase activity		3208 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	silty loam	8	1	42	Phosphatase activity		3728 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	42	Urease activity		3970 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	silty loam	8	1	548	Phosphatase activity		4139 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	silty loam	8	1	42	Urease activity		4470 ED50	50	Doelman & Haanstra. 1986.
Chromium	CrCl3	native soil microflora	sandy loam	6	3	42	Phosphatase activity		5512 ED50	50	Doelman & Haanstra. 1989.
Chromium	CrCl3	native soil microflora	sandy peat	4	6.5	42	Arylsulfatase activity		5928 ED50	50	Haanstra & Doelman. 1991.
Chromium	CrCl3	native soil microflora	sandy soil	7	1	548	Phosphatase activity		20020 ED50	50	Doelman & Haanstra. 1989.
Cobalt	CoCl2	native soil microflora	soil/litter microcosm				Respiration		1362 LCT	23	Lighthart et al. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Copper	Cu(NO3)2	Pseudomonas sp.	silt loam	7	2	4	Denitrification		10 LCT	53	Bollag & Barabasz. 1979.
Copper	CuSO4	native soil microflora	surface soil		1.3	1	Dehydrogenase activity		30 LCT	28	Rogers & Li. 1985.
Copper	Cu(NO3)2	Pseudomonas aeruginosa	silt loam	7	2	4	Denitrification	10	50	43	Bollag & Barabasz. 1979.
Copper	CuSO4	native soil microflora	sandy loam	5	2	21	N mineralization		100 LCT	20	Quraishi & Cornfield. 1973.
Copper	CuCl2	native soil microflora	sandy soil	7	1	42	Phosphatase activity		140 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	sandy soil	7	1	548	Phosphatase activity		170 ED50	50	Doelman & Haanstra. 1989.
Copper	Cu(NO3)2	native soil microflora	silt loam	7	2	21	Denitrification	100	250	44	Bollag & Barabasz. 1979.
Copper	Cu(NO3)2	Pseudomonas denitrificans	silt loam	7	2	4	Denitrification	100	250	22	Bollag & Barabasz. 1979.
Copper	CuCl2	native soil microflora	sandy soil	7	1	42	Urease activity		260 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	sandy soil	7	1	548	Arylsulfatase activity		287 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Copper	CuSO4	native soil microflora	silty clay loam	7	6	20	N mineralization		320 LCT	82	Liang & Tabatabai. 1977.
Copper	CuCl2	native soil microflora	sandy soil	7	1	42	Arylsulfatase activity		391 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	silt loam	5			Nitrification		500	>2	Suter and Sharples. 1984.
Copper	CuCl2	native soil microflora	sandy loam	6	3	548	Arylsulfatase activity		548 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	sandy loam	6	3	42	Urease activity		570 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	sandy soil	7	1	548	Urease activity		680 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	silty loam	8	1	548	Phosphatase activity		744 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	silty loam	8	1	548	Arylsulfatase activity		763 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	sandy loam	6	3	42	Arylsulfatase activity		967 ED50	50	Haanstra & Doelman. 1991.
Copper	CuO	native soil microflora	sandy soil	6	2	84	C mineralization		1000 LCT	33	Bhuiya & Cornfield. 1972.
Copper	CuSO4	native soil microflora	sandy loam	8	2	56	Nitrification	100	1000	38	Premi & Cornfield. 1969/1970.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Copper	CuSO4	native soil microflora	sandy loam	6	2	21	N mineralization	100	1000	75	Quraishi & Cornfield. 1973.
Copper	CuSO4	native soil microflora	sandy loam	5	2	21	N mineralization	100	1000	100	Quraishi & Cornfield. 1973.
Copper	CuSO4	native soil microflora	sandy loam	7	2	21	N mineralization	100	1000	39	Quraishi & Cornfield. 1973.
Copper	CuCl2	native soil microflora	clay	8	1.5	548	Urease activity		1080 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	clay	8	1.5	42	Urease activity		1370 ED50	50	Doelman & Haanstra. 1986.
Copper	CuSO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1590 LCT	22	Al-Khafaji & Tabatabai. 1979.
Copper	CuCl2	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1590 LCT	43	Juma & Tabatabai. 1977.
Copper	CuSO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1590 LCT	36	Juma & Tabatabai. 1977.
Copper	CuCl2	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1590 LCT	30,28	Juma & Tabatabai. 1977.
Copper	CuSO4	native soil microflora	clay loam	8	3.7	0.1	Acid phosphatase activity		1590 LCT	26	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Copper	CuSO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	159	1590	26	Al-Khafaji & Tabatabai. 1979.
Copper	CuSO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	159	1590	32	Al-Khafaji & Tabatabai. 1979.
Copper	CuCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	159	1590	51	Juma & Tabatabai. 1977.
Copper	CuSO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	159	1590	44	Juma & Tabatabai. 1977.
Copper	CuCl2	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	159	1590	32	Juma & Tabatabai. 1977.
Copper	CuSO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	159	1590	23	Juma & Tabatabai. 1977.
Copper	CuCl2	native soil microflora	sandy loam	6	3	548	Phosphatase activity		1895 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	548	Urease activity		1970 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	silty loam	8	1	548	Urease activity		1990 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	548	Phosphatase activity		2442 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	42	Phosphatase activity		2639 ED50	50	Doelman & Haanstra. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Copper	CuCl2	native soil microflora	clay	8	1.5	42	Phosphatase activity		2722 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	clay	8	1.5	42	Arylsulfatase activity		2722 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	clay	8	1.5	548	Phosphatase activity		2754 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	42	Urease activity		4200 ED50	50	Doelman & Haanstra. 1986.
Copper	CuCl2	native soil microflora	clay	8	1.5	548	Arylsulfatase activity		4853 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	silty loam	8	1	42	Phosphatase activity		6424 ED50	50	Doelman & Haanstra. 1989.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	548	Arylsulfatase activity		6996 ED50	50	Haanstra & Doelman. 1991.
Copper	CuCl2	native soil microflora	sandy peat	4	6.5	42	Arylsulfatase activity		8904 ED50	50	Haanstra & Doelman. 1991.
Copper	CuSO4	native soil microflora	sandy loam	7	2	21	Nitrification	1000	10000	75	Premi & Cornfield. 1969.
Copper	CuCl2	native soil microflora	silty loam	8	1	42	Arylsulfatase activity		14946 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Fluoride	KF	native soil microflora	leaf litter			63	P mineralization		32 LCT	22	van Wensem & Adema. 1991.
Fluoride	NaF	native soil microflora	surface soil		1.3	1	Dehydrogenase activity	3000	5000	30	Rogers & Li. 1985.
Iron	FeCl3	native soil microflora	clay loam	8	4	20	N mineralization		280 LCT	22	Liang & Tabatabai. 1977.
Iron	FeCl3	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1398 LCT	59	Al-Khafaji & Tabatabai. 1979.
Iron	FeCl3	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		1398 LCT	23	Al-Khafaji & Tabatabai. 1979.
Iron	FeSO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		1398 LCT	22	Juma & Tabatabai. 1977.
Iron	FeCl2	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1398 LCT	26	Juma & Tabatabai. 1977.
Iron	FeCl3	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	139.8	1398	45	Al-Khafaji & Tabatabai. 1979.
Iron	FeSO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	139.8	1398	27	Juma & Tabatabai. 1977.
Iron	FeCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	139.8	1398	40	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Iron	FeCl2	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	139.8	1398	32	Juma & Tabatabai. 1977.
Lanthanum	LaCl3	native soil microflora	soil/litter microcosm				Respiration		57 LCT	22	Lighthart et al. 1977.
Lead	PbCl2	native soil microflora	clay	8	1.5	1	Dehydrogenase activity		375 LCT	29	Doelman & Haanstra. 1979.
Lead	PbCl2	native soil microflora	sandy soil	6	1.5	1	Respiration	375	750	35	Doelman & Haanstra. 1979.
Lead	PbC4H6O4	native soil microflora	silt loam			2	Amylase activity	450	900	31	Cole. 1977.
Lead	PbCl2	native soil microflora	silt loam			2	Amylase activity	450	900	21	Cole. 1977.
Lead	PbO	native soil microflora	sandy soil	6	2	84	C mineralization		1000 LCT	22	Bhuiya & Cornfield. 1972.
Lead	PbCl2	native soil microflora	brown earth	5		30	Cellulolytic activity	500	1000	23	Khan & Frankland. 1984.
Lead	PbC4H6O4	native soil microflora	clay loam	8	4	20	N mineralization		1035 LCT	28	Liang & Tabatabai. 1977.
Lead	PbCl2	native soil microflora	clay	8	1.5	548	Urease activity		1340 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	sandy soil	6	1.5	1217	Respiration		1500 LCT	30	Doelman & Haanstra. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Lead	PbCl2	native soil microflora	sandy soil	5	3	1	Dehydrogenase activity	750	1500	78	Doelman & Haanstra. 1979.
Lead	PbCl2	native soil microflora	sandy soil	7	1	548	Urease activity		1590 ED50	50	Doelman & Haanstra. 1986.
Lead	PbS	native soil microflora	silt loam			2	Amylase activity	900	1800	58	Cole. 1977.
Lead	PbC4H6O4	native soil microflora	silt loam			4	alpha-glucosidase synthesis		2000 LCT	38	Cole. 1977.
Lead	PbC4H6O4	native soil microflora	silt loam			2	Amylase activity		2000 LCT	74	Cole. 1977.
Lead	PbC4H6O4	native soil microflora	silt loam			5	Bacterial population size		2000 LCT	37	Cole. 1977.
Lead	PbCl2	native soil microflora	sandy loam	6	3	548	Urease activity		2870 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	sandy loam	6	3	548	Arylsulfatase activity		3004 ED50	50	Haanstra & Doelman. 1991.
Lead	PbCl2	native soil microflora	silty loam	8	1	548	Arylsulfatase activity		4538 ED50	50	Haanstra & Doelman. 1991.
Lead	PbCl2	native soil microflora	sandy loam	6	3	42	Urease activity		5060 ED50	50	Doelman & Haanstra. 1986.
Lead	PbC4H6O4	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		5175 LCT	33	Juma & Tabatabai. 1977.
Lead	PbNO3	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		5175 LCT	38	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Lead	PbNO3	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	517.5	5175	26	Juma & Tabatabai. 1977.
Lead	PbC4H6O4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	517.5	5175	24	Juma & Tabatabai. 1977.
Lead	PbC4H6O4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	517.5	5175	21	Juma & Tabatabai. 1977.
Lead	PbCl2	native soil microflora	clay	8	1.5	42	Urease activity		5730 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	sandy peat	4	6.5	42	Urease activity		6230 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	sandy peat	4	6.5	548	Urease activity		7050 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	silty loam	8	1	548	Phosphatase activity		7604 ED50	50	Doelman & Haanstra. 1989.
Lead	PbCl2	native soil microflora	silty loam	8	1	42	Urease activity		7190 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	silty loam	8	1	548	Urease activity		8130 ED50	50	Doelman & Haanstra. 1986.
Lead	PbCl2	native soil microflora	sandy soil	7	1	42	Arylsulfatase activity		8288 ED50	50	Haanstra & Doelman. 1991.
Lead	PbCl2	native soil microflora	sandy soil	7	1	548	Arylsulfatase activity		8785 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Lead	PbCl2	native soil microflora	silty loam	8	1	42	Arylsulfatase activity		9138 ED50	50	Haanstra & Doelman. 1991.
Lead	Pb(NO3)2	native soil microflora	sandy loam	5		15	Respiration	1000	10000	29	Debosz et al. 1985.
Lead	PbCl2	native soil microflora	clay	8	1.5	42	Phosphatase activity		11168 ED50	50	Doelman & Haanstra. 1989.
Lead	PbCl2	native soil microflora	clay	8	1.5	548	Arylsulfatase activity		12411 ED50	50	Haanstra & Doelman. 1991.
Lead	PbCl2	native soil microflora	sandy soil	7	1	548	Phosphatase activity		78943 ED50	50	Doelman & Haanstra. 1989.
Lithium	LiCl	native soil microflora	soil/litter microcosm				Respiration		17 LCT	43	Lighthart et al. 1977.
Manganese	MnSO4	native soil microflora	sandy loam	7	2	21	Nitrification		100 LCT	67	Premi & Cornfield. 1969.
Manganese	MnCl2	native soil microflora	clay loam	8	4	20	N mineralization		275 LCT	26	Liang & Tabatabai. 1977.
Manganese	MnCl2	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		1375 LCT	25	Juma & Tabatabai. 1977.
Manganese	MnCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	137.5	1375	62	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Mercury	HgCl2	native soil microflora	clay loam	8	2	28	C mineralization		0.1 LCT	87	Landa & Fang. 1978.
Mercury	PMA*	native soil microflora	dune sand	8	1		Nitrification		10 LCT	57	van Faassen. 1973.
Mercury	HgCl2	native soil microflora	clay loam	7	3	0.2	urease activity		50 LCT	38	Bremner & Douglas. 1971.
Mercury	HgSO4	native soil microflora	clay loam	7	3	0.2	urease activity		50 LCT	36	Bremner & Douglas. 1971.
Mercury	HgCl2	native soil microflora	silty clay loam	7	2.2	0.2	urease activity		50 LCT	42	Bremner & Douglas. 1971.
Mercury	HgSO4	native soil microflora	silty clay loam	7	2.2	0.2	urease activity		50 LCT	46	Bremner & Douglas. 1971.
Mercury	HgCl2	native soil microflora	clay loam	8	2	28	C mineralization	10	100	45	Landa & Fang. 1978.
Mercury	HgCl2	native soil microflora	silty clay	7	7	28	C mineralization	10	100	28	Landa & Fang. 1978.
Mercury	HgCl2	native soil microflora	clay	8	3		Nitrification	10	100	40	van Faassen. 1973.
Mercury	PMA*	native soil microflora	clay	8	3		Nitrification & ammonification	10	100	94,42	van Faassen. 1973.
Mercury	HgCl2	native soil microflora	dune sand	8	1		Nitrification & ammonification	10	100	95,34	van Faassen. 1973.
Mercury	HgCl2	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		501.5 LCT	39	Al-Khafaji & Tabatabai. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Mercury	HgCl2	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity		501.5 LCT	34	Al-Khafaji & Tabatabai. 1979.
Mercury	HgCl2	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity		501.5 LCT	34	Al-Khafaji & Tabatabai. 1979.
Mercury	HgCl2	native soil microflora	loam	6	3	20	N mineralization		1003 LCT	73	Liang & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	silty clay	7	3	20	N mineralization		1003 LCT	39	Liang & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	clay loam	8	4	20	N mineralization		1003 LCT	35	Liang & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	silty clay loam	7	6	20	N mineralization		1003 LCT	32	Liang & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	clay loam	8	3.2	0.1	Amidase activity		5015 LCT	30	Frankenberger &Tabatabai. 1981
Mercury	HgCl2	native soil microflora	loam	7	4.7	0.1	Amidase activity		5015 LCT	27	Frankenberger &Tabatabai. 1981
Mercury	HgCl2	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		5015 LCT	96	Al-Khafaji & Tabatabai. 1979.
Mercury	HgCl2	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		5015 LCT	86	Al-Khafaji & Tabatabai. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Mercury	HgCl2	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		5015 LCT	53,52	Juma & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		5015 LCT	53	Juma & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	surface soil	6	2.6	0.1	Amidase activity	501.5	5015	46	Frankenberger &Tabatabai. 1981
Mercury	HgCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	501.5	5015	63	Juma & Tabatabai. 1977.
Mercury	HgCl2	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	501.5	5015	41	Juma & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		239.8 LCT	40	Al-Khafaji & Tabatabai. 1979.
Molybdenum	H2MoO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity		239.8 LCT	26	Al-Khafaji & Tabatabai. 1979.
Molybdenum	H2MoO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity		239.8 LCT	69	Juma & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	silty clay	7	2	20	N mineralization		480 LCT	22	Liang & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Molybdenum	H2MoO4	native soil microflora	clay loam	8	4	20	N mineralization		480 LCT	22	Liang & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	silty clay loam	7	6	20	N mineralization		480 LCT	54	Liang & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		2398 LCT	63	Al-Khafaji & Tabatabai. 1979.
Molybdenum	H2MoO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		2398 LCT	25,41	Juma & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		2398 LCT	68	Juma & Tabatabai. 1977.
Molybdenum	H2MoO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	239.8	2398	22	Juma & Tabatabai. 1977.
Nickel	NiSO4	native soil microflora	sand	6	2	42	Respiration		10 LCT	22	Giashuddin & Cornfield. 1979.
Nickel	NiSO4	native soil microflora	surface soil		1.3	1	Dehydrogenase activity		30 LCT	39	Rogers & Li. 1985.
Nickel	NiO	native soil microflora	sand	6	2	42	Respiration		50 LCT	22	Giashuddin & Cornfield. 1979.
Nickel	NiCl2	Aspergillus clavatus	sandy loam	5	3	7	Growth rate	10	50	36	Babich & Stotzky. 1982.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Nickel	NiCl2	native soil microflora	silt loam	8	1.2	548	Arylsulfatase activity		92 ED50	50	Haanstra & Doelman. 1991.
Nickel	NiCl2	native soil microflora	sand	7	0.8	548	Arylsulfatase activity		99 ED50	50	Haanstra & Doelman. 1991.
Nickel	NiSO4	Agrobacteerium radiobacter	sandy loam	5	3	7	Growth		250 LCT	98	Babich & Stotzky. 1982.
Nickel	NiSO4	Proteus vulgaris	sandy loam	5	3	7	Growth		250 LCT	54	Babich & Stotzky. 1982.
Nickel	NiSO4	Bacillus megaterium	sandy loam	5	3	7	Growth		250 LCT	100	Babich & Stotzky. 1982.
Nickel	NiSO4	Cryptococcus terreus	sandy loam	5	3	7	Growth		250 LCT	73	Babich & Stotzky. 1982.
Nickel	NiSO4	Torulopsis glabrata	sandy loam	5	3	7	Growth		250 LCT	84	Babich & Stotzky. 1982.
Nickel	NiO	native soil microflora	sand	7	2	42	Respiration	50	250	33	Giashuddin & Cornfield. 1979.
Nickel	NiCl2	Aspergillus flavus	sandy loam	5	3	7	Growth rate	100	250	30	Babich & Stotzky. 1982.
Nickel	NiCl2	Penicillium vermiculatum	sandy loam	5	3	7	Growth rate	100	250	41	Babich & Stotzky. 1982.
Nickel	NiCl2	Aspergillus flavipes	sandy loam	5	3	7	Growth rate	250	500	98	Babich & Stotzky. 1982.
Nickel	NiCl2	Aspergillus niger	sandy loam	5	3	7	Growth rate	250	500	42	Babich & Stotzky. 1982.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Nickel	NiCl2	Rhizopus stolonifer	sandy loam	5	3	7	Growth rate	250	500	84	Babich & Stotzky. 1982.
Nickel	NiCl2	Gliocladium sp.	sandy loam	5	3	7	Growth rate	250	500	23	Babich & Stotzky. 1982.
Nickel	NiSO4	Serratia marcescens	sandy loam	5	3	7	Growth	250	500	87	Babich & Stotzky. 1982.
Nickel	NiSO4	Nocardia rhodochrous	sandy loam	5	3	7	Growth	250	500	25	Babich & Stotzky. 1982.
Nickel	NiSO4	Aspergillus flavipes	sandy loam+montmorill	6	2.5	7	Growth		750 LCT	44	Babich & Stotzky. 1982.
Nickel	NiSO4	Aspergillus clavatus	sandy loam+mont	6	2.5	7	Growth		750 LCT	31	Babich & Stotzky. 1982.
Nickel	NiSO4	Penicillium vermiculatum	sandy loam+mont	6	2.5	7	Growth		750 LCT	27	Babich & Stotzky. 1982.
Nickel	NiSO4	Trichoderma viride	sandy loam+mont	6	2.5	7	Growth		750 LCT	40	Babich & Stotzky. 1982.
Nickel	NiSO4	Aspergillus flavipes	sandy loam+kaol	6	2.5	7	Growth		750 LCT	64	Babich & Stotzky. 1982.
Nickel	NiSO4	Aspergillus clavatus	sandy loam+kaol	6	2.5	7	Growth		750 LCT	64	Babich & Stotzky. 1982.
Nickel	NiSO4	Rhizopus stolonifer	sandy loam+kaol	6	2.5	7	Growth		750 LCT	54	Babich & Stotzky. 1982.
Nickel	NiSO4	Penicillium vermiculatum	sandy loam+kaol	6	2.5	7	Growth		750 LCT	89	Babich & Stotzky. 1982.
Nickel	NiSO4	Trichoderma viride	sandy loam+kaol	6	2.5	7	Growth		750 LCT	73	Babich & Stotzky. 1982.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Nickel	NiSO4	Aspergillus flavipes	sandy loam	5	3	7	Growth rate		750 LCT	93	Babich & Stotzky. 1982.
Nickel	NiSO4	Aspergillus clavatus	sandy loam	5	3	7	Growth rate		750 LCT	84	Babich & Stotzky. 1982.
Nickel	NiSO4	Rhizopus stolonifer	sandy loam	5	3	7	Growth rate		750 LCT	78	Babich & Stotzky. 1982.
Nickel	NiSO4	Penicillium vermiculatum	sandy loam	5	3	7	Growth rate		750 LCT	82	Babich & Stotzky. 1982.
Nickel	NiSO4	Trichoderma viride	sandy loam	5	3	7	Growth rate		750 LCT	85	Babich & Stotzky. 1982.
Nickel	NiSO4	Gliocladium sp.	sandy loam	5	3	7	Growth rate		750 LCT	52	Babich & Stotzky. 1982.
Nickel	NiSO4	Bacillus cereus	sandy loam	5	3	7	Growth	500	750	32	Babich & Stotzky. 1982.
Nickel	NiSO4	Rhodotorula rubra	sandy loam	5	3	7	Growth	500	750	29	Babich & Stotzky. 1982.
Nickel	NiCl2	Trichoderma viride	sandy loam	5	3	7	Growth rate	500	750	85	Babich & Stotzky. 1982.
Nickel	NiCl2	native soil microflora	sand	7	0.8	548	Phosphatase activity		769 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiSO4	Bacillus megaterium	sandy loam	8	1		Growth	750	1000	22	Babich & Stotzky. 1982.
Nickel	NiSO4	Cryptococcus terreus	sandy loam	8	1		Growth	750	1000	21	Babich & Stotzky. 1982.
Nickel	NiCl2	native soil microflora	sand	7	0.8	42	Phosphatase activity		1109 ED50	50	Doelman & Haanstra. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Nickel	NiCl2	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1468 LCT	26	Al-Khafaji & Tabatabai. 1979.
Nickel	NiCl2	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		1468 LCT	22	Juma & Tabatabai. 1977.
Nickel	NiCl2	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1468 LCT	21	Juma & Tabatabai. 1977.
Nickel	NiCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	146.8	1468	23	Juma & Tabatabai. 1977.
Nickel	NiCl2	native soil microflora	sand	7	0.8	42	Arylsulfatase activity		2119 ED50	50	Haanstra & Doelman. 1991.
Nickel	NiCl2	native soil microflora	silt loam	8	1.2	548	Phosphatase activity		2131 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiCl2	native soil microflora	sandy loam	6	2.8	42	Arylsulfatase activity		2348 ED50	50	Haanstra & Doelman. 1991.
Nickel	NiCl2	native soil microflora	clay	8	1.6	548	Arylsulfatase activity		2436 ED50	50	Haanstra & Doelman. 1991.
Nickel	NiCl2	native soil microflora	silt loam	8	1.2	42	Phosphatase activity		4232 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiCl2	native soil microflora	silt loam	8	1.2	42	Arylsulfatase activity		5400 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Nickel	NiCl2	native soil microflora	sandy loam	6	2.8	42	Phosphatase activity		5688 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiCl2	native soil microflora	clay	8	1.6	42	Phosphatase activity		6516 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiCl2	native soil microflora	sandy loam	6	2.8	548	Phosphatase activity		8042 ED50	50	Doelman & Haanstra. 1989.
Nickel	NiCl2	native soil microflora	sandy peat	4	6.4	548	Arylsulfatase activity		8101 ED50	50	Haanstra & Doelman. 1991.
Selenium	H2SeO3	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		197.5 LCT	21	Al-Khafaji & Tabatabai. 1979.
Selenium	SeO2	native soil microflora	soil/litter microcosm				Respiration		484 LCT	43	Lighthart et al. 1977.
Selenium	H2SeO3	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1975 LCT	32	Al-Khafaji & Tabatabai. 1979.
Selenium	H2SeO3	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		1975 LCT	26	Al-Khafaji & Tabatabai. 1979.
Selenium	H2SeO3	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1975 LCT	30,39	Juma & Tabatabai. 1977.
Selenium	H2SeO3	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1975 LCT	34	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Selenium	H2SeO3	native soil microflora	surface soil	6	2.6	0.1	Amidase activity	197.5	1975	27	Frankenberger &Tabatabai. 1981
Selenium	H2SeO3	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	197.5	1975	26	Al-Khafaji & Tabatabai. 1979.
Selenium	H2SeO3	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	197.5	1975	24	Juma & Tabatabai. 1977.
Selenium	H2SeO3	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	197.5	1975	35	Juma & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	clay loam	7	3	0.2	urease activity		50 LCT	61	Bremner & Douglas. 1971.
Silver	AgNO3	native soil microflora	silty clay loam	7	2.2	0.2	urease activity		50 LCT	65	Bremner & Douglas. 1971.
Silver	AgSO4	native soil microflora		7	2.2	0.2	urease activity		50 LCT	63	Bremner & Douglas. 1971.
Silver	AgNO3	native soil microflora	clay loam	7	3	0.2	urease activity		50 LCT	60	Bremner & Douglas. 1971.
Silver	AgSO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		269.8 LCT	53	Al-Khafaji & Tabatabai. 1979.
Silver	AgSO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity		269.8 LCT	80	Al-Khafaji & Tabatabai. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Silver	AgSO4	native soil microflora	loam	6	3	20	N mineralization		540 LCT	73	Liang & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	silty clay	7	3	20	N mineralization		540 LCT	41	Liang & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	clay loam	8	4	20	N mineralization		540 LCT	59	Liang & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	silty clay loam	7	6	20	N mineralization		540 LCT	52	Liang & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	loam	7	4.7	0.1	Amidase activity		2698 LCT	50	Frankenberger &Tabatabai. 1981
Silver	AgSO4	native soil microflora	clay loam	8	3.2	0.1	Amidase activity		2698 LCT	53	Frankenberger &Tabatabai. 1981
Silver	AgSO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		2698 LCT	94	Al-Khafaji & Tabatabai. 1979.
Silver	AgSO4	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		2698 LCT	95	Al-Khafaji & Tabatabai. 1979.
Silver	AgSO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		2698 LCT	93,38	Juma & Tabatabai. 1977.
Silver	AgSO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity		2698 LCT	28	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Silver	AgSO4	native soil microflora	surface soil	6	2.6	0.1	Amidase activity	269.8	2698	62	Frankenberger &Tabatabai. 1981
Tin	SnCl2	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		2968 LCT	60	Al-Khafaji & Tabatabai. 1979.
Tin	SnCl2	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		2968 LCT	32	Al-Khafaji & Tabatabai. 1979.
Tin	SnCl2	native soil microflora	clay loam	8	3.7	0.1	Alkaline phosphatase activity		2968 LCT	25	Juma & Tabatabai. 1977.
Tin	SnCl2	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		2968 LCT	21	Juma & Tabatabai. 1977.
Tin	SnCl2	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	296.8	2968	45	Al-Khafaji & Tabatabai. 1979.
Tin	SnCl2	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	296.8	2968	41	Juma & Tabatabai. 1977.
Tin	SnCl2	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	296.8	2968	38	Juma & Tabatabai. 1977.
Titanium	TiSO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1198 LCT	33	Al-Khafaji & Tabatabai. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Titanium	TiSO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	119.8	1198	31	Al-Khafaji & Tabatabai. 1979.
Tungsten	Na2WO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity		459.8 LCT	75	Juma & Tabatabai. 1977.
Tungsten	Na2WO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		4598 LCT	23	Al-Khafaji & Tabatabai. 1979.
Tungsten	Na2WO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		4598 LCT	29,45	Juma & Tabatabai. 1977.
Tungsten	Na2WO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		4598 LCT	69	Juma & Tabatabai. 1977.
Tungsten	Na2WO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	459.8	4598	38	Al-Khafaji & Tabatabai. 1979.
Tungsten	Na2WO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	459.8	4598	25	Al-Khafaji & Tabatabai. 1979.
Tungsten	Na2WO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	459.8	4598	32	Juma & Tabatabai. 1977.
Vanadium	V2O5	native soil microflora	soil/litter microcosm				Respiration		23 LCT	21	Lighthart et al. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Vanadium	NaVO3	native soil microflora	Forest mor (litter)		46	0.1	Acid phosphatase activity	30	50	40	Tyler. 1976.
Vanadium	VSO4	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity		127.3 LCT	76	Al-Khafaji & Tabatabai. 1979.
Vanadium	VSO4	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity		127.3 LCT	32	Al-Khafaji & Tabatabai. 1979.
Vanadium	VSO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity		127.3 LCT	30	Juma & Tabatabai. 1977.
Vanadium	VSO4	native soil microflora	clay loam	6	2.7	0.1	Arylsulfatase activity		1273 LCT	87	Al-Khafaji & Tabatabai. 1979.
Vanadium	VSO4	native soil microflora	loam	7	5.3	0.1	Arylsulfatase activity		1273 LCT	85	Al-Khafaji & Tabatabai. 1979.
Vanadium	VSO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1273 LCT	61,45	Juma & Tabatabai. 1977.
Vanadium	VSO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1273 LCT	55	Juma & Tabatabai. 1977.
Vanadium	VSO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	127.3	1273	60	Juma & Tabatabai. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Zinc	Zn(NO3)2	Pseudomonas sp.	silt loam	7		4	Denitrification	10	50	29	Bollag & Barabasz. 1979.
Zinc	ZnCl2	native soil microflora	sandy peat	4	6.5	548	Urease activity		70 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	548	Urease activity		90 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnSO4	native soil microflora	sandy loam	7	2	21	Nitrification		100 LCT	57	Premi & Cornfield. 1969.
Zinc	ZnSO4	native soil microflora	sandy loam	8	2	56	Nitrification		100 LCT	43	Premi & Cornfield. 1969/1970.
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	548	Urease activity		110 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	548	Phosphatase activity		170 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	42	Phosphatase activity		220 ED50	50	Doelman & Haanstra. 1989.
Zinc	Zn(NO3)2	native soil microflora	silt loam	7		21	Denitrification	100	250	31	Bollag & Barabasz. 1979.
Zinc	Zn(NO3)2	Pseudomonas denitrificans	silt loam	7		4	Denitrification	100	250	22	Bollag & Barabasz. 1979.
Zinc	Zn(NO3)2	Pseudomonas aeruginosa	silt loam	7		4	Denitrification	100	250	35	Bollag & Barabasz. 1979.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	548	Urease activity		290 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnSO4	native soil microflora	surface soil		1.3	1	Dehydrogenase activity	150	300	30	Rogers & Li. 1985.
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	548	Arylsulfatase activity		375 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	42	Urease activity		420 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnCl2	native soil microflora	soil/litter microcosm			23	Respiration	47	479	21	Chaney et al. 1978.
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	42	Urease activity		480 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnCl2	native soil microflora	sandy soil	7	1	42	Arylsulfatase activity		909 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	548	Arylsulfatase activity		948 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnO	native soil microflora	sandy soil	7		84	N mineralization & nitrification		1000 LCT	28,31	Bhuiya & Cornfield. 1976.
Zinc	ZnO	native soil microflora	sandy soil	8		42	N mineralization		1000 LCT	32	Bhuiya & Cornfield. 1974.
Zinc	ZnCl2	native soil microflora	Forest mor (litter)	4		30	Respiration	200	1000	26	Laskowski et al. 1994.
Zinc	ZnSO4	native soil microflora	clay loam	6	1.2	49	Nitrification	100	1000	99	Wilson. 1977.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Zinc	ZnSO4	native soil microflora	sandy loam	6	0.8	49	Nitrification	100	1000	98	Wilson. 1977.
Zinc	ZnSO4	native soil microflora	loamy sand	5	0.6	49	Nitrification	100	1000	100	Wilson. 1977.
Zinc	ZnCl2	native soil microflora	silty loam	8	1	42	Urease activity		1030 ED50	50	Doelman & Haanstra. 1986.
Zinc	ZnCl2	native soil microflora	silty loam	8	1	42	Arylsulfatase activity		1295 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnSO4	native soil microflora	clay loam	8	3.7	0.1	Alkaline & acid phosphatase activity		1635 LCT	59,32	Juma & Tabatabai. 1977.
Zinc	ZnSO4	native soil microflora	loam	7	5.5	0.1	Acid phosphatase activity		1635 LCT	33	Juma & Tabatabai. 1977.
Zinc	ZnCl2	native soil microflora	loam	7	2.9	0.1	Arylsulfatase activity	163.5	1635	33	Al-Khafaji & Tabatabai. 1979.
Zinc	ZnCl2	native soil microflora	clay loam	8	3.2	0.1	Arylsulfatase activity	163.5	1635	36	Al-Khafaji & Tabatabai. 1979.
Zinc	ZnSO4	native soil microflora	loam	6	2.6	0.1	Acid phosphatase activity	163.6	1635	30	Juma & Tabatabai. 1977.
Zinc	ZnSO4	native soil microflora	loam	7	5.5	0.1	Alkaline phosphatase activity	163.5	1635	28	Juma & Tabatabai. 1977.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	42	Urease activity		1780 ED50	50	Doelman & Haanstra. 1986.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	42	Arylsulfatase activity		2184 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	548	Arylsulfatase activity		2838 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	548	Phosphatase activity		2845 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	silty loam	8	1	42	Phosphatase activity		2963 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	548	Phosphatase activity		2969 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	sandy loam	6	3	42	Phosphatase activity		3342 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	soil/litter microcosm				Respiration		3600 LCT	66	Lighthart et al. 1977.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	42	Phosphatase activity		3623 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	silty loam	8	1	548	Arylsulfatase activity		4349 ED50	50	Haanstra & Doelman. 1991.
Zinc	ZnCl2	native soil microflora	silty loam	8	1	548	Phosphatase activity		4872 ED50	50	Doelman & Haanstra. 1989.
Zinc	ZnCl2	native soil microflora	clay	8	1.5	42	Arylsulfatase activity		5559 ED50	50	Haanstra & Doelman. 1991.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
Zinc	ZnCl2	native soil microflora	sandy peat	4	6.5	548	Arylsulfatase activity		9679 ED50	50	Haanstra & Doelman. 1991.
acrylonitrile		native soil microflora	silt loam	5	1.5	4	Respiration		1000 LCT	41	Walton et al. 1989.
acrylonitrile		native soil microflora	sandy loam	5	0.7	4	Respiration		1000 LCT	59	Walton et al. 1989.
carbon tetrachloride		native soil microflora	sandy loam	5	0.7	4	Respiration		1000 LCT	21	Walton et al. 1989.
cis-1,4-dichloro-2-butene		native soil microflora	silt loam	5	1.5	4	Respiration		1000 LCT	44	Walton et al. 1989.
cis-1,4-dichloro-2-butene		native soil microflora	sandy loam	5	0.7	4	Respiration		1000 LCT	48	Walton et al. 1989.
hexachlorobenzene		native soil microflora	silt loam	5	1.5	4	Respiration		1000 LCT	37	Walton et al. 1989.
nitrobenzene		native soil microflora	silt loam	5	1.5	4	Respiration		1000 LCT	22	Walton et al. 1989.

Table B.1 (continued)

Chemical	Chemical Form	Organisms	Growth Medium	pH	%OC	Exp (d)	Response Parameter	NOEC	LOEC	% Dec	Reference
nitrobenzene		native soil microflora	sandy loam	5	0.7	4	Respiration		1000 LCT	61	Walton et al. 1989.
pentachlorophenol		native soil microflora	surface soil	5	5.2	1.8	Respiration		460 EC50	50	vanBeelen&Fleurin-Kemila.1993
pentachlorophenol		native soil microflora	dune sand	4	0.6	3	Respiration		800 EC50	50	vanBeelen&Fleurin-Kemila.1993
									1500 EC10	10	
phenol		native soil microflora	silt loam	5			Nitrification		100	>20	Suter and Sharples. 1984.
trans-1,4-dichloro-2-butene		native soil microflora	silt loam	5	1.5	4	Respiration		1000 LCT	58	Walton et al. 1989.
trans-1,4-dichloro-2-butene		native soil microflora	sandy loam	5	0.7	4	Respiration		1000 LCT	44	Walton et al. 1989.

APPENDIX C

TOXICITY DATA FOR OTHER SOIL AND LITTER INVERTEBRATES

Table C.1. Toxicity Data for Other Soil and Litter Invertebrates

Chemical concentrations are mg of element/kg of food or substrate

Exp (d) - exposure duration in days

LCT - lowest concentration tested

LC50 - concentration causing 50%mortality

% Dec - % decrease in measured parameter at LOEC as compared to controls.

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
Cadmium	CdCl2	Diplogasteritus spp.	solution	3	survival LC50		3.3	50	Kammenga et al. 1994.
Cadmium	CdCl2	Caenorhabditis elegans	solution	7	reproduction	1.1	3.6	36	van Kessel et al. 1989.
Cadmium	CdCl2	Cephalobus persegnis	solution	3	survival LC50		9.3	50	Kammenga et al. 1994.
Cadmium	CdCl2	Rhabditis species	solution	3	survival LC50		14.1	50	Kammenga et al. 1994.
Cadmium	CdCl2	Caenorhabditis elegans	solution	3	survival LC50		14.7	50	Kammenga et al. 1994.
Cadmium	CdCl2	Acrobeloides buetschlii	solution	3	survival LC50		59.3	50	Kammenga et al. 1994.
Cadmium	CdNO3	Porcellio scaber-juv.	maple leaves	360	number of offspring		10LCT	47	Hopkin and Hames. 1994.
Cadmium	CdSO4	Orchesella cincta	green algae	61	population growth rate	4.7	15	56	van Straalen et al. 1989.
Cadmium	CdCl2	Folsomia candida	Baker's yeast	42	number of offspring	148	326	21	Crommentuijn et al. 1993.
Cadmium	CdSO4	Platynothrus peltifer	green algae	61	population growth rate	3	9	23	van Straalen et al. 1989.

Table C.1 (continued)

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
Cadmium	CdCl2	Helix aspersa	Lab Chow	30	reproductive behavior	10	25	28	Russell et al. 1981.
Copper	CuSO4	nema-omnivore/predator	soil OM	7	survival		72 LCT	85	Parmalee et al. 1993.
Copper	$CuSO_4$	nematodes		3650	number of organisms	100		$\geq$ 20	Korthals et al. (1996)
Copper	$CuSO_4$	nematodes		3650	number of organisms	104		$\geq$ 20	Korthals et al. (1996)
Copper	CuCl2	Caenorhabditis elegans	solution	1	survival LC50		105	50	Donkin and Dusenbery. 1993.
Copper	$CuSO_4$	nematodes		3650	number of organisms	160		$\geq$ 20	Korthals et al. (1996)
Copper	$CuSO_4$	Platynothrus peltifer		42	population	150	200		Streit 1984
Copper	CuSO4	nematode-bacterivores	soil OM	7	survival	185	400	80	Parmalee et al. 1993.
Copper	CuSO4	nematode-herbivores	soil OM	7	survival	185	400	57	Parmalee et al. 1993.
Copper	CuSO4	nematode-hatchlings	soil OM	7	survival	185	400	75	Parmalee et al. 1993.
Copper	CuCl2	Caenorhabditis elegans	soil OM	1	survival LC50		413	50	Donkin and Dusenbery. 1993.
Copper	CuCl2	Caenorhabditis elegans	soil OM	1	survival LC50		534	50	Donkin and Dusenbery. 1993.
Copper	CuCl2	Caenorhabditis elegans	soil OM	1	survival LC50		629	50	Donkin and Dusenbery. 1993.
Copper	CuCl2	Caenorhabditis elegans	soil OM	1	survival LC50		1061	50	Donkin and Dusenbery. 1993.

Table C.1 (continued)

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
Copper	CuNO3	Porcellio scaber-juv.	maple leaves	360	number of offspring	20	50	53	Hopkin and Hames. 1994.
Copper	CuSO4	Mesostigmata	soil OM	7	survival		72 LCT		Parmalee et al. 1993.
Copper	CuSO4	Oribatida	soil OM	7	survival		72 LCT	48	Parmalee et al. 1993.
Copper	CuSO4	Prostigmata	soil OM	7	survival	185	400	37	Parmalee et al. 1993.
Copper	CuSO4	other microarthropods	soil OM	7	survival	185	400	60	Parmalee et al. 1993.
Copper	CuSO4	Arion ater	fruit & veg	27	percent growth	300	1000	55	Marigomez et al. 1986.
Iron	FeSO4	Orchesella cincta	green algae	21	percent growth	3515	7533	42	Nottrot et al. 1987.
Lead	PbO	Porcellio scaber	O1+O2 litter	448	gen 1 survival & repro; gen 2 survival	6400	12800	27,6884	Beyer and Anderson. 1985.
Lead	PbNO3	Porcellio scaber-juv.	maple leaves	360	survival; number of offspring	1000	2000	100, 100	Hopkin and Hames. 1994.
Lead		Onychiurus armatus	fungus	125	growth rate		3089 LCT	25	Bengtsson et al. 1983.
Lead	PbNO3	Arion ater	fruit & veg	27	percent growth	300	1000	51	Marigomez et al. 1986.

Table C.1 (continued)

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
Mercury	HgCl2	Arion ater	fruit & veg	27	percent growth	300	1000	26	Marigomez et al. 1986.
Zinc	$ZnCl_2$	Folsomia candida		28	number of organisms		185	50	Smit and van Gestel (1996)
Zinc	$ZnCl_2$	Folsomia candida		28	number of organisms		348	50	Smit and van Gestel (1996)
Zinc	ZnO	Porcellio scaber	O1+O2 litter	448	gen 2 population size; generation 2 survival	800	1600	22,27	Beyer and Anderson. 1985.
Zinc	ZnO	Porcellio scaber	O2 litter	56	survival		5000 LCT	26	Beyer et al. 1984.
Zinc	ZnCl2	Arion ater	fruit & veg	27	percent growth		10 LCT	38	Marigomez et al. 1986.
benzo[a]pyrene		Porcellio scaber	leaf&dog food	63	change in dry weight	31.6	100	30	van Brummelen&Stuijfzand. 1993
benzo[a]pyrene		Porcellio scaber	poplar leaves	28	% growth efficiency	25	125	82	van Straalen and Verweij. 1991
benzo[a]pyrene		Oniscus asellus	leaf&dog food	63	change in dry weight and length	100	316	58,48	van Brummelen&Stuijfzand. 1993

Table C.1 (continued)

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
p-nitrophenol		nematode-bacterivores	soil OM	7	survival		20LCT	40	Parmalee et al. 1993.
p-nitrophenol		nematode-fungivores	soil OM	7	survival	20	40	55	Parmalee et al. 1993.
p-nitrophenol		nematode-herbivores	soil OM	7	survival	20	40	51	Parmalee et al. 1993.
p-nitrophenol		nema-omnivore/predator	soil OM	7	survival	20	40		Parmalee et al. 1993.
p-nitrophenol		nematode-hatchlings	soil OM	7	survival	20	40	61	Parmalee et al. 1993.
p-nitrophenol		nematode-total	soil OM	7	survival	20	40	56	Parmalee et al. 1993.
p-nitrophenol		Prostigmata	soil OM	7	survival	40	80	24	Parmalee et al. 1993.
p-nitrophenol		Oribatida	soil OM	7	survival	80	160	26	Parmalee et al. 1993.
p-nitrophenol		total microarthropods	soil OM	7	survival	80	160	35	Parmalee et al. 1993.
pentachlorophenol		Tylenchus elegans	solution	3	survival LC50		1.2	50	Kammenga et al. 1994.
pentachlorophenol		Rhabditis species	solution	3	survival LC50		2.4	50	Kammenga et al. 1994.
pentachlorophenol		Cephalobus persegnis	solution	3	survival LC50		2.6	50	Kammenga et al. 1994.
pentachlorophenol		Diplogasteritus spp.	solution	3	survival LC50		6.8	50	Kammenga et al. 1994.
trinitrotoluene		Prostigmata	soil OM	7	survival	100	200	71	Parmalee et al. 1993.

Table C.1 (continued)

Chemical	Form	Species	Food	Exp (d)	Response	NOEC Applied	LOEC Applied	% Dec	Reference
trinitrotoluene		Oribatida	soil OM	7	survival	100	200	58	Parmalee et al. 1993.
trinitrotoluene		total	soil OM	7	survival	100	200	58	Parmalee et al. 1993.

Attachment B
Wildlife Calculations

Cleanup Levels for Potential TEE Receptors
AvalonBay Communities, Inc.
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway Southeast, Newcastle, WA
ARSENIC

Cleanup Level for Avian Predator (Robin)
Equation in Table 749-4

$$\text{Soil CUL} = \frac{\text{T robin}}{(\text{FIR robin X Psb robin X BAF worm}) + (\text{SIR robin X RGAF robin})}$$

CUL	Units
60	**mg/kg**

Variable	Unit	Value
Psb robin	Unitless	0.52
FIR robin	kg dry food / kg body weight - day	0.207
SIR robin	kg dry soil / kg body weight - day	0.0215
RGAF robin	Unitless (Table 749-5)	1
T robin	mg/kg - day (Eco SSL - EPA March 2005)	2.24
Home Range	Acres	0.6
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.15

Notes:

Psb	Proportion of contaminated food in diet
FIR	Food ingestion rate
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
T	Toxicity Reference Value from Ecological Screening Levels for Arsenic, US EPA, March 2005
BAF	Site Specific Bioaccumulation Factor

Cleanup Level for Mammalian Predator (Shrew)
Equation in Table 749-4

$$\text{Soil CUL} = \frac{\text{T shrew}}{(\text{FIR shrew X Psb shrew X BAF worm}) + (\text{SIR shrew X RGAF shrew})}$$

CUL	Units
49	**mg/kg**

Variable	Unit	Value
T shrew	mg/kg - day (Table 749-5)	1.89
FIR shrew	kg dry food / kg body weight - day	0.45
Psb shrew	unitless	0.5
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.15
SIR shrew	kg dry soil / kg body weight - day	0.0045
RGAF shrew	Unitless (chemical specific-As)	1

Notes:

T	Toxicity Reference Value
FIR	Food ingestion rate
P	Proportion of contaminated food in diet
BAF	Bioaccumulation factor
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
BAF	Site Specific Bioaccumulation Factor

TEE Site-Specific CUL Protective of Plants
(from bioassay analyses)

CUL	Units
16	**mg/kg**

TEE Site-Specific CUL Protective of Soil Biota
(Table 749-3)

CUL	Units
60	**mg/kg**

Cleanup Levels for Potential TEE Receptors
AvalonBay Communities, Inc.
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway Southeast, Newcastle, WA
LEAD

Cleanup Level for Avian Predator (Robin)
Equation in Table 749-4

$$\text{Soil CUL} = \frac{\text{T robin}}{(\text{FIR robin X Psb robin X BAF worm}) + (\text{SIR robin X RGAF robin})}$$

CUL	Units
508	**mg/kg**

Variable	Unit	Value
Psb robin	Unitless	0.52
FIR robin	kg dry food / kg body weight - day	0.207
SIR robin	kg dry soil / kg body weight - day	0.0215
RGAF robin	Unitless (Table 749-5)	1
T robin	mg/kg - day (Table 749-5 footnote a)	11.3
Home Range	Acres	0.6
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.007

Notes:

Psb	Proportion of contaminated food in diet
FIR	Food ingestion rate
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
T	Toxicity Reference Value from Ecological Screening Levels for Arsenic, US EPA, March 2005
BAF	Site Specific Bioaccumulation Factor

Cleanup Level for Mammalian Predator (Shrew)
Equation in Table 749-4

$$\text{Soil CUL} = \frac{\text{T shrew}}{(\text{FIR shrew X Psb shrew X BAF worm}) + (\text{SIR shrew X RGAF shrew})}$$

CUL	Units
3292	**mg/kg**

Variable	Unit	Value
T shrew	mg/kg - day	20
FIR shrew	kg dry food / kg body weight - day	0.45
Psb shrew	unitless	0.5
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.007
SIR shrew	kg dry soil / kg body weight - day	0.0045
RGAF shrew	Unitless (chemical specific-As)	1

Notes:

T	Toxicity Reference Value
FIR	Food ingestion rate
P	Proportion of contaminated food in diet
BAF	Bioaccumulation factor
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
BAF	Site Specific Bioaccumulation Factor

TEE Site-Specific CUL Protective of Plants
(Table 749-3)

CUL	Units
50	**mg/kg**

TEE Site-Specific CUL Protective of Soil Biota
(Table 749-3)

CUL	Units
500	**mg/kg**

Cleanup Levels for Potential TEE Receptors
AvalonBay Communities, Inc.
Former Mutual Materials Brick Plant
6620 Coal Creek Parkway Southeast, Newcastle, WA
ANTIMONY

Cleanup Level for Avian Predator (Robin)
Equation in Table 749-4

Soil CUL = $\frac{\text{T robin}}{\text{(FIR robin X Psb robin X BAF worm) + (SIR robin X RGAF robin)}}$

CUL	Units
#VALUE!	**mg/kg**

Variable	Unit	Value
Psb robin	Unitless	0.52
FIR robin	kg dry food / kg body weight - day	0.207
SIR robin	kg dry soil / kg body weight - day	0.0215
RGAF robin	Unitless (Table 749-5)	1
T robin	mg/kg - day (Table 749-5 footnote a)	**No Value Available**
Home Range	Acres	0.6
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.005

Notes:

Psb	Proportion of contaminated food in diet
FIR	Food ingestion rate
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
T	Toxicity Reference Value
BAF	Site Specific Bioaccumulation Factor

Cleanup Level for Mammalian Predator (Shrew)
Equation in Table 749-4

Soil CUL = $\frac{\text{T shrew}}{\text{(FIR shrew X Psb shrew X BAF worm) + (SIR shrew X RGAF shrew)}}$

CUL	Units
5	**mg/kg**

Variable	Unit	Value
T shrew	mg/kg - day	0.059
FIR shrew	kg dry food / kg body weight - day	0.45
Psb shrew	unitless	0.5
BAF worm	mg/kg worm / mg/kg soil (Table 749-5 footnote a)	0.033
SIR shrew	kg dry soil / kg body weight - day	0.0045
RGAF shrew	Unitless (chemical specific-As)	1

Notes:

T	Toxicity Reference Value
FIR	Food ingestion rate
P	Proportion of contaminated food in diet
BAF	Bioaccumulation factor
SIR	Soil ingestion rate
RGAF	Gut Absorbsion Factor
BAF	Site Specific Bioaccumulation Factor

TEE CUL Protective of Plants
(Table 749-3)

CUL	Units
5.0	**mg/kg**

TEE CUL Protective of Soil Biota
(Ecological Soil Screening Levels for Antimony, EPA OSWER Directive 9285.7-61, February 2005)

CUL	Units
78	**mg/kg**

Attachment C
Laboratory Analytical Data Sheets

Analysis For Total Metals By EPA Method 200.8

Client ID:	TP-47A-1	Client:	Environmental Partners
Date Received:	09/25/13	Project:	38814.1, F&BI 309432
Date Extracted:	09/25/13	Lab ID:	309432-01
Date Analyzed:	09/25/13	Data File:	309432-01.013
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	AP

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	96	60	125

Analyte:	Concentration mg/kg (ppm) Dry Weight
Arsenic	43.1

Analysis For Total Metals By EPA Method 200.8

Client ID:	TP-47B	Client:	Environmental Partners
Date Received:	09/26/13	Project:	38814.1, F&BI 309455
Date Extracted:	09/26/13	Lab ID:	309455-04
Date Analyzed:	09/26/13	Data File:	309455-04.022
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	AP

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	91	60	125

Analyte:	Concentration mg/kg (ppm) Dry Weight
Arsenic	31.7

Analysis For Total Metals By EPA Method 200.8

Client ID:	TP-47C	Client:	Environmental Partners
Date Received:	09/26/13	Project:	38814.1, F&BI 309455
Date Extracted:	09/26/13	Lab ID:	309455-05
Date Analyzed:	09/26/13	Data File:	309455-05.023
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	AP

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	90	60	125

Analyte:	Concentration mg/kg (ppm) Dry Weight
Arsenic	30.8

Analysis For Total Metals By EPA Method 200.8

Client ID:	TP-47D	Client:	Environmental Partners
Date Received:	09/26/13	Project:	38814.1, F&BI 309455
Date Extracted:	09/26/13	Lab ID:	309455-06
Date Analyzed:	09/26/13	Data File:	309455-06.024
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	AP

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	89	60	125

Analyte:	Concentration mg/kg (ppm) Dry Weight
Arsenic	37.7

Analysis For Total Metals By EPA Method 200.8

Client ID:	TP-47E	Client:	Environmental Partners
Date Received:	09/26/13	Project:	38814.1, F&BI 309455
Date Extracted:	09/26/13	Lab ID:	309455-07
Date Analyzed:	09/26/13	Data File:	309455-07.015
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm) Dry Weight	Operator:	AP

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	92	60	125

Analyte:	Concentration mg/kg (ppm) Dry Weight
Arsenic	32.8

Analysis For Total Metals By EPA Method 200.8

Client ID:	HSA-1A	Client:	Environmental Partners
Date Received:	09/05/13	Project:	Avalon Bay-Newcastle 38814, F&BI 309061
Date Extracted:	09/11/13	Lab ID:	309061-06
Date Analyzed:	09/11/13	Data File:	309061-06.036
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm)	Operator:	JS

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	75	60	125
Holmium	83	60	125

Analyte:	Concentration mg/kg (ppm)
Arsenic	143
Antimony	39.2
Lead	80.5

Analysis For Total Metals By EPA Method 200.8

Client ID:	HSA-1B	Client:	Environmental Partners
Date Received:	09/05/13	Project:	Avalon Bay-Newcastle 38814, F&BI 309061
Date Extracted:	09/11/13	Lab ID:	309061-07
Date Analyzed:	09/11/13	Data File:	309061-07.037
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm)	Operator:	JS

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	73	60	125
Holmium	81	60	125

Analyte:	Concentration mg/kg (ppm)
Arsenic	116
Antimony	34.4
Lead	106

Analysis For Total Metals By EPA Method 200.8

Client ID:	HSA-1C	Client:	Environmental Partners
Date Received:	09/05/13	Project:	Avalon Bay-Newcastle 38814, F&BI 309061
Date Extracted:	09/11/13	Lab ID:	309061-08
Date Analyzed:	09/11/13	Data File:	309061-08.038
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm)	Operator:	JS

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	75	60	125
Holmium	82	60	125

Analyte:	Concentration mg/kg (ppm)
Arsenic	44.5
Antimony	27.1
Lead	25.0

Analysis For Total Metals By EPA Method 200.8

Client ID:	HSA-1D	Client:	Environmental Partners
Date Received:	09/05/13	Project:	Avalon Bay-Newcastle 38814, F&BI 309061
Date Extracted:	09/11/13	Lab ID:	309061-09
Date Analyzed:	09/11/13	Data File:	309061-09.039
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm)	Operator:	JS

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Indium	73	60	125
Holmium	80	60	125

Analyte:	Concentration mg/kg (ppm)
Arsenic	50.2
Antimony	25.3
Lead	26.2

Analysis For Total Metals By EPA Method 200.8

Client ID:	HSA-1E	Client:	Environmental Partners
Date Received:	09/05/13	Project:	Avalon Bay-Newcastle 38814, F&BI 309061
Date Extracted:	09/11/13	Lab ID:	309061-10
Date Analyzed:	09/11/13	Data File:	309061-10.041
Matrix:	Soil	Instrument:	ICPMS1
Units:	mg/kg (ppm)	Operator:	JS

Internal Standard:	% Recovery:	Lower Limit:	Upper Limit:
Holmium	79	60	125

Analyte:	Concentration mg/kg (ppm)
Arsenic	91.3
Antimony	24.0
Lead	83.7

309432

SAMPLE CHAIN OF CUSTODY

ME 09/25/13 AI

Page # 1 of 1

Send Report To Eric Koltes

Company Environmental Partners Inc

Address 295 NE Gilman Blvd Ste 201

City, State, ZIP Issaquah WA 98027

Phone # 425-395-0010 Fax # 425-395-0011

SAMPLERS (signature) Kristin L. Addis

PROJECT NAME/NO. AvalonBay - Newcastle

PO# 38814.1

REMARKS

TURNAROUND TIME
- ☐ Standard (2 Weeks)
- ☒ RUSH
- Rush charges authorized by

SAMPLE DISPOSAL
- ☒ Dispose after 30 days
- ☐ Return samples
- ☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by8260	SVOCs by 8270	HFS	Arsenic	Lead	Mercury				Notes
TP-47A-1	01	9/24/13	1157	Soil	1							X	X	X				
TP-47A-2	02	↓	1158	↓	1							X	X	X				
TP-47A-3	03	↓	1159	↓	1							X	X	X				
																		Samples received at 5 °C

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Kristin L. Addis	Kristin L. Addis	EPI	9/25/13	0800
Received by:		Michael Erdahl	FB	↓	↓
Relinquished by:					
Received by:					

FORMS\COC\COC.DOC

309455

SAMPLE CHAIN OF CUSTODY

ME 09/26/13 BT3

Page # 1 of 1

Send Report To Eric Koltes
Company Environmental Partners, Inc
Address 295 NE Gilman Blvd Ste 201
City, State, ZIP Issaquah WA 98027
Phone # 425-358-0001 Fax # 425-395-0011

SAMPLERS (signature) Kristin L. Addis
PROJECT NAME/NO. AvalonBay - Newcastle
PO# 38814.1
REMARKS

TURNAROUND TIME
☐ Standard (2 Weeks)
☒ RUSH
Rush charges authorized by

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Return samples
☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by8260	SVOCs by 8270	HFS	Lead	Mercury	Arsenic				Notes
TP-37A-1	01	9/25/13	0910	Soil	1							X	X					
TP-37A-2	02	↓	0917	↓	1							X	X					
TP-37A-3	03	↓	0922	↓	1							X	X					
TP-47B	04	↓	1530	↓	1									X				
TP-47C	05	↓	1531	↓	1									X				
TP-47D	06	↓	1533	↓	1									X				
TP-47E	07	↓	1535	↓	1									X				

ANALYSES REQUESTED

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

FORMS\COC\COC.DOC

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Kristin L Addis	Kristin L Addis	EPI	9/26/13	0835
Received by:	Strava Alliance	Postal Express 9/26/		Samples received at 3.3 °C
Relinquished by:				
Received by: Nhan Phan	Nhan Phan	FedEx	9/26/13	10:10
				Samples received at 14 °C

309061

SAMPLE CHAIN OF CUSTODY

ME 09-05-13 BI 4

Page # 1 of 2

Send Report To Eric Koltes
Company Environmental Partners
Address 295 NE Gilman Blvd ste201
City, State, ZIP Issaquah WA 98027
Phone # 425-358-0001 Fax # 425-395-0011

SAMPLERS (signature) Kristin L Addis
PROJECT NAME/NO. AvalonBay - Newcastle
PO# 38814
REMARKS

TURNAROUND TIME
☒ Standard (2 Weeks)
☐ RUSH
Rush charges authorized by

SAMPLE DISPOSAL
☒ Dispose after 30 days
☐ Return samples
☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	ANALYSES REQUESTED: TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by8260	SVOCs by 8270	HFS	Lead	Mercury	Antimony	Arsenic			Notes
TP-37A	01	9/4/13	1034	Soil	1							X	X					
TP-37B	02		1035		1							X	X					
TP-37C	03		1036		1							X	X					
TP-37D	04		1037		1							X	X					
TP-37E	05		1038		1							X	X					
HSA-1A	06		1124		1							X		X	X			
HSA-1B	07		1125		1							X		X	X			
HSA-1C	08		1126		1							X		X	X			
HSA-1D	09		1127		1							X		X	X			
HSA-1E	10	↓	1128	↓	1							X		X	X			

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Kristin L Addis	Kristin L Addis	EPI	9/5/13	0900
Received by:	Edwards	Postal Y	9/5/13	09:05
Relinquished by:				
Received by:	DDUO	FedEx	9-5-13	9:50

Samples received at 9 °C

FORMS\COC\COC.DOC

309061

SAMPLE CHAIN OF CUSTODY

ME 09-05-13 BI4

Page # 2 of 2

Send Report To Eric Koltes
Company Environmental Partners
Address 295 NE Gilman Blvd Ste 201
City, State, ZIP Issaquah WA 98027
Phone # 425-358-0001 Fax # 425-395-0011

SAMPLERS (signature) Kristin L. Addis
PROJECT NAME/NO.: AvalonBay-Newcastle
PO#: 38814
REMARKS:

TURNAROUND TIME
☒ Standard (2 Weeks)
☐ RUSH
Rush charges authorized by

SAMPLE DISPOSAL
☒ Dispose after 30 days
☐ Return samples
☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by8260	SVOCs by 8270	HFS	Arsenic						Notes
TP-47TailA	11	9/4/13	1146	Soil	1							X						
TP-47TailB	12		1147		1							X						
TP-47TailC	13		1148		1							X						
TP-47TailD	14		1149		1							X						
TP-47TailE	15		1150		1							X						

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

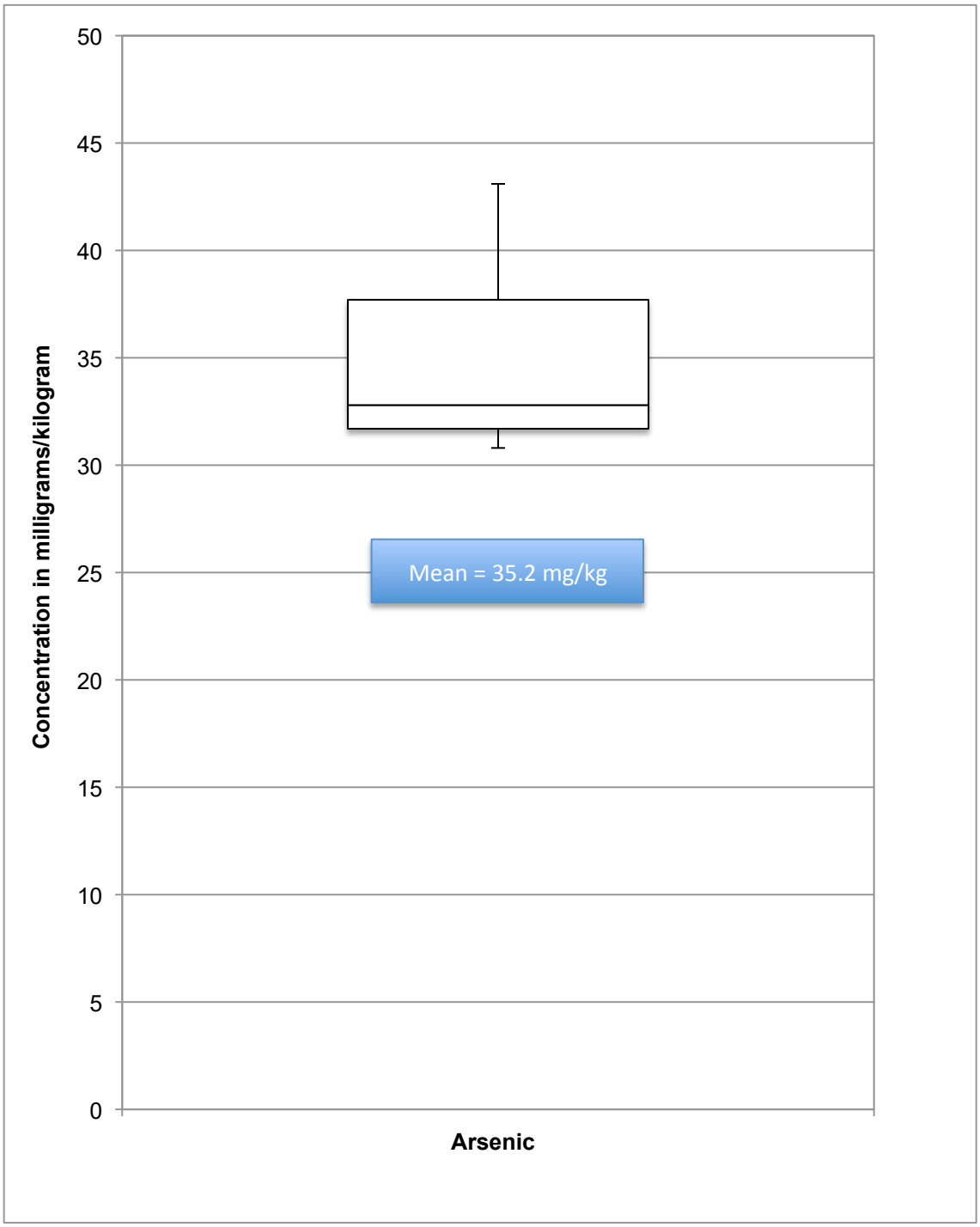
FORMS\COC\COC.DOC

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Kristin L Addis	Kristin L Addis	EPI	9/5/13	0900
Received by: Dave	Dave	F&BI	9-5-13	9:56
Relinquished by:				
Received by:				

Samples received at 9 °C

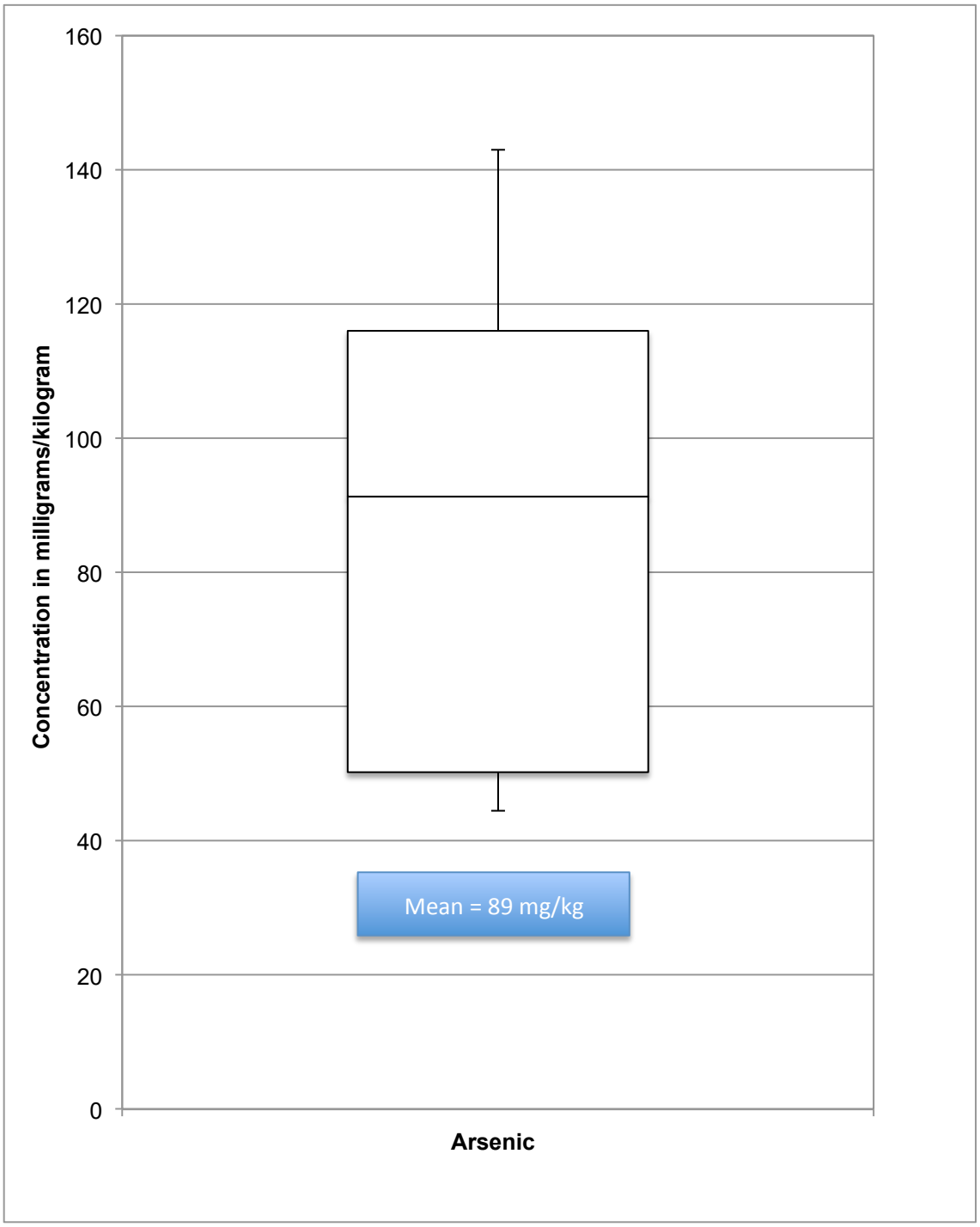
Attachment D
Box-and-Whisker Plot Charts

Chart 1
Box-and-Whisker Plot of TEE Evaluation Data
Arsenic
Sample: TP-47-1



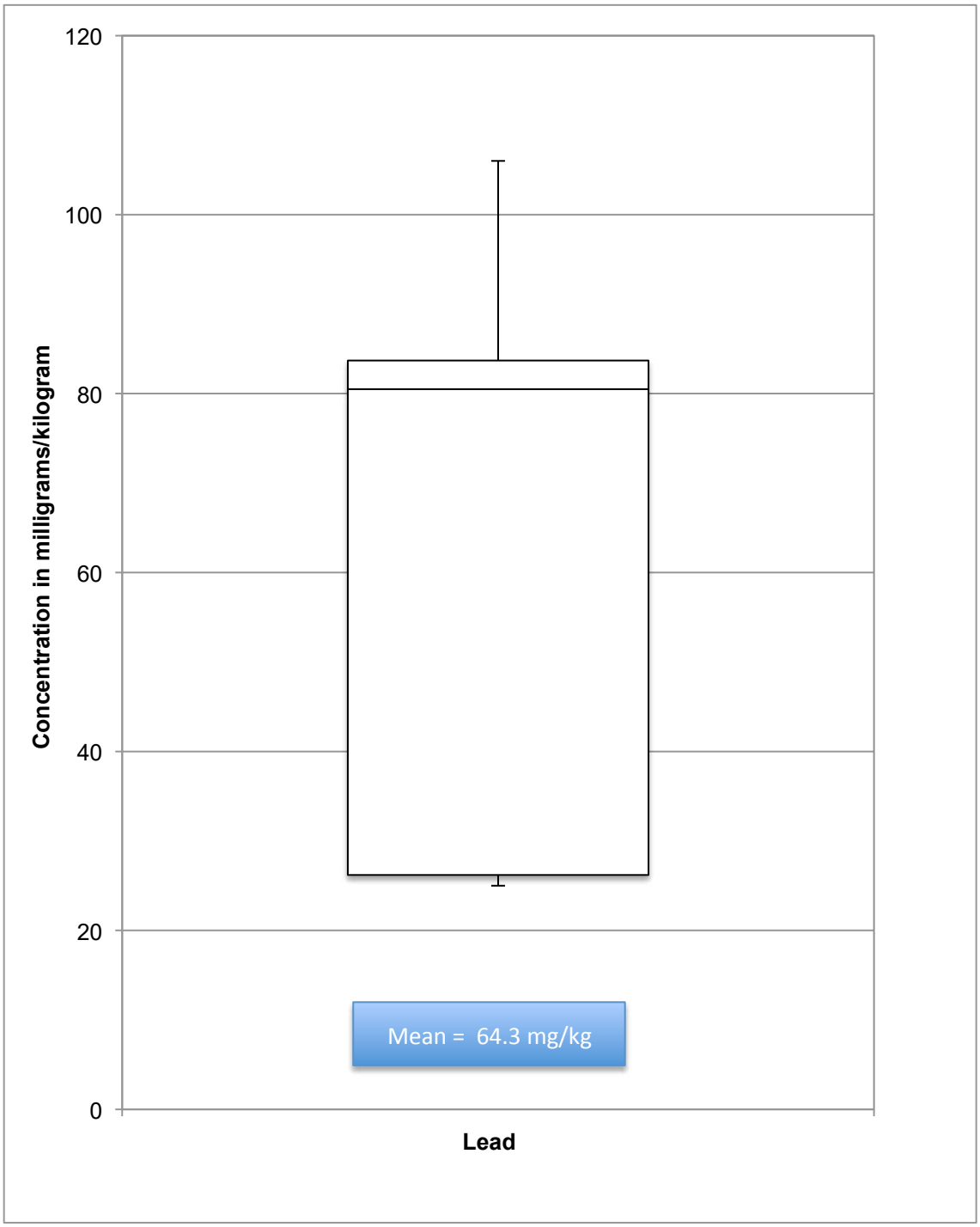
Notes:
TEE Terrestrial Ecological Evaluation

Chart 2
Box-and-Whisker Plot of TEE Evaluation Data
Arsenic
Sample: HSA-1



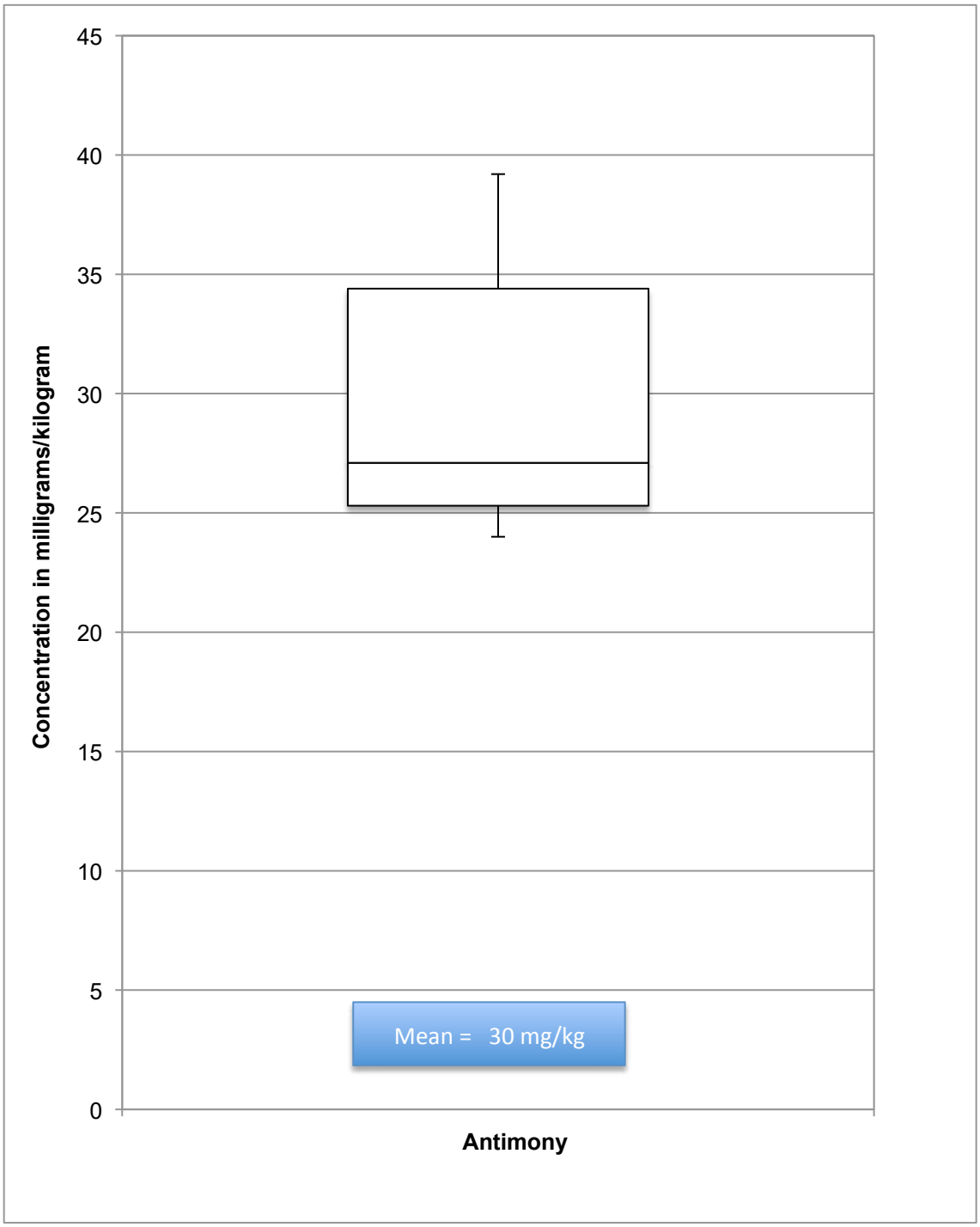
Notes:
TEE Terrestrial Ecological Evaluation

Chart 3
Box-and-Whisker Plot of TEE Evaluation Data
Lead
Sample: HSA-1



Notes:
TEE Terrestrial Ecological Evaluation

Chart 4
Box-and-Whisker Plot of TEE Evaluation Data
Antimony
Sample: HSA-1



Notes:
TEE Terrestrial Ecological Evaluation

Attachment E
AECOM Toxicology,
Soil Toxicology Evaluation Reports

28-Day Bioaccumulation Study Using the Earthworm (*Eisenia fetida*)

For

Environmental Partners, Inc.
Issaquah, WA, USA

Prepared by
AECOM Technical Services, Inc.
Fort Collins Environmental Toxicology Lab
October 2013
60280653-105-022

Bioaccumulation Study using the Earthworm Eisenia fetida

Project ID: 60280653-105-022
October 2013

Sponsor and Laboratory Information

Sponsor	Environmental Partners, Inc. 295 NE Gilman Boulevard, Suite 201 Issaquah, Washington USA 98027
Project Officer	Eric Koltes, (425) 395-0014
Testing Facility	AECOM Environment Fort Collins Environmental Toxicology Laboratory 4303 West LaPorte Ave. Fort Collins, CO 80521 Fax: (970) 490-2963 State of Florida NELAP Laboratory ID: E87972 Washington DOE Laboratory ID: C566
Study Director	Anita B. Rehner, M.S. (970) 416-0916 anita.rehner@aecom.com
Report Author	Anita B. Rehner

Test Information

Test	Soil Bioaccumulation Test with the Lumbricid Earthworm *Eisenia fetida*	
Basis	ASTM E 1676-04 (2012)	
Test Period	October 3, 2013 @ 1200 to October 31, 2013 @ 1400-1430	
Test Length	28 days exposure + 1 day depuration	
Species	*Eisenia fetida*	
Test Material	Whole soil	
Soil ID	Sample (Field) ID	AECOM Laboratory ID
	HSA1:2.5	27106
Control Soil	Artificial Soil	
Hydration Water	Milli-Q® water (as needed)	
Test Concentrations	0 (control) and 100% field soil	

- *Results described in this report apply only to the samples submitted to the laboratory and analyzed, as listed in the report*
- *Test results comply with NELAC standards. Reports are intended to be considered in their entirety; AECOM is not responsible for consequences arising from use of a partial report*
- *This report contains 6 pages plus 3 appendices*

Table 1. Soil Collection and Receipt

Sample ID	Collection Date and Time	AECOM No.	Date of Receipt	Temp. at Arrival (°C)
HSA1:2.5	09/14/13 @ 1134	27106	09/23/13	17.7[a]

[a] Sample was received in a 5-gallon bucket (not in a cooler with ice)
Note: See Appendix A for copy of chain of custody record

Moisture fraction (MF) was determined for the field soil (as received) using Washington Department of Ecology (WDOE) methodology (WDOE 1996). The moisture fraction for HSA1:2.5 was 18.6%.

Control Soil

The control soil was artificial soil prepared as described in Table 2.

Table 2. Composition of Artificial Soil (Control)

Material	% by Weight
2 to 3-mm screened sphagnum peat moss	10
Colloidal kaolin clay	20
Medium silica sand	70
$CaCO_3$	~0.4%[a]

[a] $CaCO_3$ added was added to adjust the pH to a target of 7.0 ± 0.5 s.u. (~0.4% of soil weight)

Dry control soil was moistened with Milli-Q® water to a target 35% moisture fraction (calculated as per WDOE [1996] guidance) and homogenized by stirring prior to testing.

Field Soil Preparation

Due to the composition of the field soil (stones and other large debris visible), stones and debris were removed from the soil on September 27, 2013 by a combination of hand-picking and passing the soil through a 6 mm screen. On the day of test initiation (October 3, 2013) the field soil was removed from refrigerated storage and stirred gently to homogenize. An aliquot of field soil sufficient for this test (1,186 g) was weighed, placed in a stainless steel bowl, moistened, and further homogenized. The target MF was 35% (calculated as per WDOE guidance). The volume of hydration water was calculated based on the dry weight equivalent of soil in the bowl, accounting for the existing moisture fraction of the soil. Water was added gradually, mixing to homogenize the water with the soil. If it appeared that the addition of the entire calculated hydration volume would result in the soil being too wet (relative to the consistency of the control soil), then less water was used. For this field soil, the calculated volume of water was 164 ml, but the soil appeared to be adequately moistened after addition of only 78 ml of water. Therefore, only 78 ml of water was added. See Appendix B for the spreadsheet detailing the calculated and actual amounts of Milli-Q® water added.

Moisture fraction was analyzed for the hydrated artificial soil and field soil on the day of test initiation. The MF for the artificial soil (control) was 40.2%, and the MF for the field soil was 29.6%.

Table 3. Test Conditions

Test Type	28-day Bioaccumulation Test with *Eisenia fetida*
Test Endpoints	Tissue concentration of target constituents
Test Chambers	2-L plastic cylindrical containers
Test Soil Weight (Dry Weight Basis)[a]	497 g (control) 1000 g (HSA1:2.5)
Replicates per Treatment	1
Organisms per Replicate	Target 25 to 50 (control); target 50 to 75 (HSA1:2.5)
Target Test Temperature	22 ± 3°C
Lighting	Fluorescent, continuous
Chamber Placement	Impartial

[a] Soil weight allows ≥ 40 g moistened soil per 1 g of worm mass

Exposure Chambers

The plastic exposure chambers were topped with perforated lids to reduce evaporation but allow air exchange. Container size depended on the amount of worm tissue required for analysis upon test completion, which in turn affected the amount of soil required. Container bottoms had drain holes which were covered with mesh, to allow movement of water but prevent worm escape. Each container was placed in a shallow plastic dish containing Milli-Q water, so that water could be drawn up into the soil. Earthworms were able to move to soil areas with optimum moisture. Milli-Q water was added to each saucer during the test as needed to replenish water lost to evaporation. The exposure was conducted in a temperature-controlled environmental chamber with continuous light.

Test Organisms and Collection of Tissue for Pre-Exposure Chemical Analysis

Information regarding test organisms is provided in Table 4.

Table 4. Test Organism

Species and Lot Number	*Eisenia fetida*, FCETL Lot 13-022
Age	Adult (with clitellum)
Source	Carolina Biological Supply (via the Oak Company), Charlotte, North Carolina
Feeding	Day 14; digested rabbit food pellets (FCETL lot F10-008; JoJo's Best, Eden, ID; 600 g digested in 1.5 L of Milli-Q® water) (4 ml for control and 8 ml for HSA1:2.5)
Reference Toxicant Testing	Initiated July 19, 2013 using potassium chloride (KCl)

On the day of test initiation, a portion of the test organisms sufficient for analysis of chemicals of concern (arsenic, lead, and antimony) was cleaned and depurated for 24 hours on wet filter paper (Whatman, qualitative) in a clean plastic container with a perforated lid (to minimize evaporation but allow air transfer). Organisms were kept in darkness at ambient room temperature during this period. Following the depuration period, the worms were rinsed with Milli-Q water, blotted dry and transferred to a certified clean, 2-oz. sample jar. The jar containing worms was labeled and placed in a freezer. Analysis of these organisms provided "pre-exposure" tissue concentrations for the analytes. At test initiation, other test organisms were rinsed and transferred to the test chambers containing control or field soil (as per the Test Conditions table, above).

Test Termination and Analyses

After 28 days of soil exposure, worms were removed from each exposure chamber and the surviving organisms were counted and the numbers recorded. Worms were then rinsed with Milli-Q water and placed in clean, plastic containers with wet qualitative filter paper (Whatman). The containers were covered with perforated lids to minimize evaporation. Chambers were held in total darkness at ambient room temperature during the depuration phase (i.e., 24 hours). After 24 hours, worms were removed from the depuration containers, rinsed with Milli-Q water, blotted, weighed, and placed in certified clean, 2-oz. glass jars. The samples were frozen prior to shipping to TestAmerica (Pittsburgh) for measurement of the concentration of target chemicals of concern (arsenic, lead, and antimony). Pre-exposure and post-exposure organisms, as well as an aliquot of food, were shipped to the analytical laboratory at the same time.

TEST RESULTS

The number of worms placed into test chambers at test initiation and recovered (alive) at test termination, as well as wet weight of depurated worms after test termination are provided in Table 5.

Table 5. Percent Recovery and Final Blot-Dry Weights

Sample ID	Number of worms at Test Initiation	Number of worms at Test Termination	Percent Recovery (Day 28)	Blot-Dry Weight (g) (post-depuration)
Control	49	46	93.9	6.7
HSA1:2.5	87	86	98.8	13.4

Note: See Appendix B for a copy of the data package

Physical and Chemical Data

Temperature was measured with a min/max thermometer continuously in the environmental chamber containing the exposure vessels. Daily temperatures in the environmental chamber

during soil exposure ranged from 18 to 25 ºC. In addition, soil temperature was measured in each exposure chamber at test initiation and termination. These temperatures ranged from 20.2 to 21.7ºC (Table 6). Initial and final soil pH values (measured using WDOE [1996] methodology) are also presented in Table 6.

Table 6. Soil pH and Temperature– Initial and Final

Sample ID	pH		Soil Temperature (°C)	
	Day 0 (5 min. / 30 min.)[a]	Day 28 (5 min. / 30 min.)[a]	Day 0	Day 28
Control	7.4 / 7.2	7.7 / 7.7	20.2	21.6
HSA1:2.5	6.6 / 6.8	6.2 / 6.3	20.9	21.7

[a] After 5 minutes of stirring / after 30 minutes of settling, per WDOE (1996)

Results of metals and solids analyses conducted by TestAmerica for earthworm tissue (pre- and post-exposure) and earthworm food are presented in Table 7. The full analytical report appears in Appendix C.

Table 7. Analytical Results for Earthworm Tissue and Food

Sample Type	Exposure Soil	Concentration (mg/kg Wet Weight Basis) of Detected COECs[a]			% Solids
		Arsenic	Lead	Antimony	
Earthworm tissue (pre-exposure)	N/A	0.34	0.037 J B	0.060 J	84
Earthworm tissue (post-exposure)	Control	0.64	0.035 J B	0.017 J	81
	HSA1:2.5 (27106)	13	1.0 B	0.43	82
		Concentration (mg/kg Dry Weight Basis) of Detected COECs[a]			% Solids
Earthworm Food (fermented rabbit food pellets)	N/A	ND (<0.12)	0.25 J B	0.26 J	86

[a] Chemicals of Ecological Concern
J = Result is less than the RL (reporting limit) but greater than or equal to the MDL (method detection limit) and the concentration is an approximate value
B = Compound was found in the blank and sample
ND = not detected

Table 8. Reference Toxicant Test Results for *E. fetida*

Organism Lot Number	Test Date	96-Hour LC_{50} (mg/L Cl^-)	FCETL Historical 95% Control Limits	
			Low	High
13-022	July 19-23, 2013	7,704	5,146	12,427

Note: Values are expressed as mg/L of chloride

References

ASTM. 2012. Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm *Eisenia fetida* and the Enchytraeid Potworm *Enchytraeus albidus*. Method E1676-04 In *2012 Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.06, Biological Effects and Environmental Fate; Biotechnology*. American Society of Testing and Materials. Conshohocken, PA.

WDOE. 1996. Earthworm Bioassay Protocol for Soil Toxicity Screening. Washington State Department of Ecology, Publication #96-327. June 1996.

Statement of Procedural Compliance

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, accurate and complete.

Anita Rehner — December 12, 2013

Study Director — Date

Statement of Quality Assurance

The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the appropriate guidance and standard operating procedures, and that the resulting data and report meet the requirements of the NELAC standards. This report is an accurate reflection of the raw data.

Quality Assurance Unit — December 12, 2013

Date

APPENDIX A

Chain of Custody

AECOM

CHAIN OF CUSTODY RECORD

Page 1 of 1

Client/Project Name: Environmental Partners Inc	Project Location: Newcastle, Washington
Project Number: EPI: 38814.1 / AECOM 60280653	Field Logbook No.:
Sampler (Print Name)/(Affiliation): Kristin Addis EPI	Chain of Custody Tape Nos.: none
Signature: Kristin L. Addis	Send Results/Report to: erick@epi-wa.com, kristin@epi-wa.com — TAT: Standard

Analysis Requested: BAF (Antimony, Arsenic & Lead) ↓

Container Type	Preservation
P – Plastic	1 – HCl, 4°
A – Amber Glass	2 – H2SO4, 4°
G – Clear Glass	3 – HNO3, 4°
V – VOA Vial	4 – NaOH, 4°
O – Other	5 – NaOH/ZnAc, 4°
E – Encore	6 – Na2S2O3, 4°
	7 – 4°

Matrix Codes:

DW – Drinking Water	S – Soil
WW – Wastewater	SL – Sludge
GW – Groundwater	SD – Sediment
SW – Surface Water	SO – Solid
ST – Storm Water	A – Air
W – Water	L – Liquid
	P – Product

Field Sample No./Identification	Date	Time	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered	BAF	AECOM #	Lab I.D.	Remarks
HSA1;2.5	9/14/13	1134		X	5 gal bucket	Soil	None	—	X	(27106)		

Relinquished by: (Print Name)/(Affiliation) Kristin Addis EPI Signature: Kristin L. Addis	Date: 9/20/13 Time: 1500	Received by: (Print Name)/(Affiliation) Signature: FedEx	Date: Time:	Analytical Laboratory (Destination): Rec. in bucket temp = 17.7°C (L-4) AECOM Toxicology Lab 4303 W. Laporte Avenue Fort Collins, CO 80521 (970) 416-0916 (970) 490-2963 (FAX)	
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Marley Taufmann (AECOM) Signature:	Date: 9/23/13 Time: 1000		
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Sample Shipped Via: UPS (FedEx) Courier Other	Temp blank: Yes X No

Q:\GRAPHICS\FORMS\Chain of Custody (COC)\Chain-of-Custody_Ft Collins_10_07.doc

Serial No. 050650

APPENDIX B

Data Sheets

FCETL QA Form No. 115
Revision 0
Effective 8/99

SEDIMENT TOXICITY DATA PACKAGE COVER SHEET

QA#* 12/10/13

Test Type: Chronic

Project Number: 60280653-105-(022) [325]

Test Substance: Soil

Species: *Eisenia fetida*

Hydration Water Type: Mod hard

Organism Lot or Batch Number: 13-022

Concurrent Control Overlying Water Type: NA

Age: Adult (adults w/ clitellum) Supplier: Carolina Biological via Oak Co.

Date and Time Test Began: 10/03/13 @ 1200

Date and Time Test Ended: 10/31/13 @ 1400-1430

Protocol Number: ASTM E1676-04

Investigator(s): W/AR/mt/AMM/KB/kh/RD/AR

Background Information

Type of Test: Non-renewal

Renewal Frequency: NA

Test Temperature: 22±3°C

Env. Chmbr/Bath #: 23

Test Chambers: 2-L plastic containers (cylinders) w/ mesh on bottom in spots)

Sediment Vol.: (loading >40g soil/1g worm) actual soil weights on a dry wt. basis: 497g control 1000g sample 27106

Overlying Water Vol: NA

Number of Replicates per Treatment: 1

Lighting: Fluorescent, continuous

Length of Test: 28 days

Number of Organisms per Replicate: Control ≥ 5 g but ≤ 15g (approximately 25 to 75 worms), field soil ≥15 g (at least 75 worms)

Type of Food and Quantity per Chamber: digested rabbit pellets, ~1 ml per 133 g dry soil weight Feeding Frequency: 1X, day 14

Test Substance Characterization Parameters and Frequency: Hardness: NA Alkalinity: NA

Conductivity: NA NH_3: NA Temp: daily in env. chamber; init & term in control and field soil DO: NA pH: Init & term in soils

Test Concentrations (Volume:Volume): 0 (laboratory control sediment), and 100% field soil

Test Sediment(s) Sample Description: HSA1:2.5

FCETL Sample #(s): #27106

Agency Summary Sheet(s)?: NA

Reference Toxicant Data: Test Dates: 07/19/13 to 07/23/13 LC_{50} or IC_{25} (Circle): 7704 mg/L Cl (from KCl)

Hist. 95% Control Limits: 5146 to 12427 Method for Determining Ref. Tox. Value: S-K

Special Procedures and Considerations:

Analytical requires at least 1 g worm wet tissue (6 to 11 g if moisture is to be analyzed), for pre-exposure, post-exposure control, and post-exposure field soil (analytes are antimony, lead, and arsenic). If enough worms, use more worms and soil for field soil to assure enough surviving worms at test end

Study Director Initials: AR Date: 10/03/13

Project # 60280653-105-022 [325]

SEDIMENT/SOIL PREPARATION

QA 12/11/13

Artificial soil	
Constituent/source	**Amount added (units)**
Medium Grain Silica Sand	70% by weight
2-3 screen Sphagnum Peat	10% by weight
Colloidal Kaolinite Clay	20% by weight
$CaCO_3$	0.4% by weight (or enough to adjust pH to a target of 7.0 ± 0.05 s.u.)
Notes:	

Note: field soil was sieved on 09/27/13 using a 6mm screen.

Soil/sediment	FCETL#	Homogenization			
		Date	From	To	Analyst
CONTROL	N/A	10-03-2013	1110	1115	AR
HSA1:2.5	27106	10-03-2013	1130	1135	AR

FCETL QA Form No 090
Revision 0
Effective 3/95

EARTHWORM BIOLOGICAL DATA

QA: AR 12/11/13

Project Number: 60280653-105-022 [325]

Test Species (Circle): ***E. fetida*** Other (Specify):

Test Sediment	Initial Number	Number alive at 28 days	Wet Weight Post-Depuration (g)	Remarks
				% recovery
CONTROL	49	①~~45~~ 46	6.7g	②~~6.7g~~ 93.9
HSA1:2.5	87	86	13.4g	②~~13.4g~~ 98.8
Date	10/03/13	10/31/13		
Time	③~~1159~~ 1200	1400 – ~~1430~~		
Initials	W / AR	AR / W		

weight of depurated pre-exposure worms 4.7 g, 24 worms ①AR 10/31/13 E additional worm found
depurated from 10/03/13 @ 1120 to 10/04/13 @ 1120

10g worms added to control (49 worms)
19g worms added to HSA1:2.5 (87 worms)

② W 11.01.13 WP ③AR 12/3/13 cf, form ww

CHEMICAL DATA - Up to 28-Day Test

QA AR 12/11/13

Project Number: 60280653-105-022 [325]	Test Species (Circle): ***E. fetida*** *L. variegatus* Other (Specify):

Test Concentration (mg/L)	Soil Temperature		Soil pH	
	Day 0	Day 28	Day 0	Day 28
	New	Old	New	Old
CONTROL	20.2	21.6	7.4 / 7.2	7.7 / 7.7
HSA1:2.5	20.9	21.7	6.6 / 6.8	6.2 / 6.3
Meter#	L-6	L-19	FM21	FM20
Date:	10/03/13	10/31/13	10/03/13	10/31/13
Time:	1145/1200	1350	1205/1240	1435-1440 / 1505-1510
Initials:	AR	AR	AR / AR	AR

Note: pH by WDOE method (1996)

FCETL QA Form No. 055
Revision 2
Effective 1/94

DAILY TOXICITY TEST LOG

QA: AR 12/11/13

Project Number: 60280653-105-022 [325]

Test Species (Circle): *C. dubia* *D. magna* *D. pulex* *P. promelas* *O. mykiss* Other (Specify): ***E. fetida***

General Comments	Min/max thermometer # M-14	Feeding Day 14 only	Initials/Date
Test Day 0	Chamber turned on @ 1045 Worms burrowed into control soil within 1hr of setup. Test Organisms Added at: 1200 Worms burrowed into 2710 soil by 1610 Env. Chamber real-time temp = 19 °C @1215 Sub-sample of organisms obtained for wet wt. and pre-exposure worms for analysis washed/depurated starting at 10/03/13 @ 1120		10/03/13 AR/LO
Test Day 1	Env. Chamber real-time temp = 23 °C Min: 18 to Max 25 °C light intensity @ level of soil surface Z = 82 ft.-c. meter #00-ft.-c. 100, 86, 50, 67, 62, 113, 95 (taken around test ch	MQ added to both chambers AR@1455 chambers) - AR @ 1455 None	10/4/13
Test Day 2	Env. Chamber real-time temp = 24 °C Min: 20 to Max 24 °C	none	mt 10/5/13
Test Day 3	Env. Chamber real-time temp = 23 °C Min: 23 to Max 25 °C added mq to trays	none	KB 10/6/13
Test Day 4	Env. Chamber real-time temp = 22 °C Min: 21 to Max 25 °C	None	10/7/13
Test Day 5	Env. Chamber real-time temp = 21 °C Min: 20 to Max 25 °C	none	KB 10/8/13
Test Day 6	Env. Chamber real-time temp = 20 °C Min: 20 to Max 25 °C Added MQ to trays	None	10/9/13
Test Day 7	Env. Chamber real-time temp = 20 °C Min: 19 to Max 24 °C	none	KB 10/10/13
Test Day 8	Env. Chamber real-time temp = 21 °C Min: 19 to Max 22 °C	None	10/11/13

DAILY TOXICITY TEST LOG

QA: JKM 12/13

Project Number: 60280653-105-022 [325]

Test Species (Circle): *C. dubia* *D. magna* *D. pulex* *P. promelas* *O. mykiss* Other (Specify): ***E. fetida***

General Comments	MIN/MAX Thermom # M-14	Feeding Day 14 only	Initials/Date
Test Day 9	Env. Chamber real-time temp = 22 °C Min: 19 to Max 23 °C added MQ water to trays	Nom	BS 10/12/13
Test Day 10	Env. Chamber real-time temp = 21 °C Min: 21 to Max 23 °C	None	AR 10/13/13
Test Day 11	Env. Chamber real-time temp = 23 °C Min: 19 to Max 23 °C	None ~~None~~①	RR 10/14/13
Test Day 12	Env. Chamber real-time temp = 23 °C Min: 20 to Max 24 °C	None	AR 10/15/13
Test Day 13	Env. Chamber real-time temp = 22 °C Min: 20 to Max 24 °C Added MQ to trays	~~Added~~② None	~~Am~~ 10/16/13
Test Day 14	Env. Chamber real-time temp = 20 °C Min: 19 to Max 22 °C ADDED MQ to control tray only (27106 still had water) FED WORMS SLURRY OF F10-008 prepped 01/12/12.	*** @ 1245 4 ml (control) 8 ml (27106) ~~None~~ AR ③	AR 10/17/13
Test Day 15	Env. Chamber real-time temp = 22 °C Min: 19 to Max 22 °C	none	KB 10/18/13
Test Day 16	Env. Chamber real-time temp = 22 °C Min: 19 to Max 23 °C Added MQ to trays	None	AR 10/19/13
Test Day 17	Env. Chamber real-time temp = 21 °C Min: 21 to Max 24 °C	none	KB 10/20/13
Test Day 18	Env. Chamber real-time temp = 23 °C Min: 21 to Max 23 °C	none	KB 10/21/13

① RR 10/14/13 E ③ AR for AMR 10/17/13 E
② ~~Am~~ 10/16/13 cvp

DAILY TOXICITY TEST LOG

BM-WK 12/11/13

Project Number: 60280653-105-022 [325]

Test Species (Circle): *C. dubia* *D. magna* *D. pulex* *P. promelas* *O. mykiss* Other (Specify): ***E. fetida***

General Comments	MIN/MAX Thermom# M-14	Feeding Day 14 only	Initials/Date
Test Day 19	Env. Chamber real-time temp = 22 °C Min: 20 to Max 23 °C	None	AM 10/22/13
Test Day 20	Env. Chamber real-time temp = 24 °C Min: 20 to Max 24 °C	None	AM 10/23/13
Test Day 21	Env. Chamber real-time temp = 23 °C Min: 20 to Max 25 °C	none	KB 10/24/13
Test Day 22	Env. Chamber real-time temp = 23 °C Min: 22 to Max 25 °C Added MQ in AM	N/A	* 10/25/13
Test Day 23	Env. Chamber real-time temp = 21 °C Min: 20 to Max 24 °C Added MQ in AM	None	AS 10/26/13
Test Day 24	Env. Chamber real-time temp = 23 °C Min: 20 to Max 23 °C	none	KB 10/27/13
Test Day 25	Env. Chamber real-time temp = 21 °C Min: 20 to Max 24 °C	None	A 10/28/13
Test Day 26	Env. Chamber real-time temp = 22 °C Min: 19 to Max 23 °C	None	* 10/29/13
Test Day 27	Env. Chamber real-time temp = 22 °C Min: 21 to Max 22 °C Added MQ to trays	None	10/30/13 A
Test Day 28	Env. Chamber real-time temp = 21 °C Min: 19 to Max 22 °C Earthworms removed and counted from 1400 to 1430 Start depuration of worms: control @ ~~1440~~ 1440 ; 27106 @ 1445	None	AR 10/31/13
Test Day 29	Depurated organisms collected,washed, and placed into tared weigh boats @ 1505 Transferred worms to sample jars, placed in freezer @ 1530	None	11.01.13

DW 10-31-13 E

60280653 Environmental Partners, Inc.

Moisture Fraction Calculation Using WDOE MF Formula

Soil as received

PAGE 8 OF 12

AR 10/11/13

Date of analysis: 09/27/13

Client Sample ID	AECOM Sample ID	Tare Wt. (g)	Wet Wt. Soil (g)	Initial Wet Wt. Soil + Pan (g)	Final Dry Wt. Soil + Pan (g)	Moisture Fraction (%)
HSA1:2.5	27106	0.9454	11.2145	12.1599	10.3996	18.62

AECOM

Δ weighed

Moisture Fraction Calculation

Technician: AR	Test Substance: SOIL AECOM# 27106 EPI # HSA1:2.5	Date Received: 09/23/13	Date(s) Homogenized: 09/27/13
Project No: 60280653	Date Sampled: FIELD: 9/14/13 @ 1134 ②	Oven #: 2	Date In Oven: 9/27/13 Time In: 1545
HSA1:2.5	@ 1425 09/27/13 ↓	Oven target temp ~~103 to 105°C~~ 100±2°C ②	Date Out: 09/30/13 Time Out: 1750

Sample Number	Test Substance Number or Sample ID	Container Size (ml) (alum. pan)	Δ Pan Boat Weight (g) (A)	Weight of Soil (g) (B)	Δ 09/27/13 @ ~1540 Total Initial Wet Wt. (Soil +Boat) (g) (C)	Δ 10/01/13 @ 1315 Total Final Dry Weight (g) (D)	Moisture Fraction (MF) (E)		Amount of Soil per Treatment (at initial MF) (g)	Amount of DI Water Added (ml) to Achieve Desired MF	
27106	27106	① Ø	~~0.9461~~ ① 0.9454		12.1599	10.3996					
Blank			0.9460			0.9450					

Per Washington Department of Ecology, Moisture Fraction (E) = [(C-D)/(D-A)]*100 (this is calculated differently than MF as per SOP 5312)

① MR 09/27/13 MP ② MR 09/27/13 CF

Refer to SOP 5326 for instructions on adjusting moisture fraction to the required level

AR 10/11/13

60280653-105-022 Environmental Partners, Inc.

Moisture Fraction Calculation Using WDOE MF Formula Target MF = 35%

At test initiation for 28-day bioaccumulation study (October 3, 2013)

Date of analysis: 10/03/13

Client Sample ID	AECOM Sample ID	Tare Wt. (g)	Calculated Wet Wt. Soil (g)	Initial Wet Wt. Soil + Pan (g)	Final Dry Wt. Soil + Pan (g)	Moisture Fraction (%)
N/A	Control	0.9276	10.0510	10.9786	8.0979	40.18
HSA1:2.5	27106	0.9271	12.0207	12.9478	10.1990	29.65

AECOM

Page:_____
FCETL QA Form No. 071B
Revision: 0
Effective: 01/13

▲ weighed

MF check @ test initiation for soils in bioaccumulation test chambers

AECOM #27106 is Env. Partners ID HSA1:2.5

Moisture Fraction Calculation

Technician: AR	**Test Substance:** SOIL (control, field)	**Date Received:** FIELD: 09/23/13	**Date(s) Homogenized:** Moistened + 10/03/13
Project No: 60280653-105-022	**Date Sampled:** (for MF) 10/03/13	**Oven #:** 2	**Date In Oven:** 10/03/13 **Time In:** 1610
	↓ 10/03/13 1605 ↓ 10/03/13 1605 ②	**Oven target temp** ~~103 to 105°C~~ 100±2°C ①	**Date Out:** 10/09/13 **Time Out:** 1645

Sample Number	Test Substance Number or Sample ID	Container Size (ml)	▲ ~~Boat~~ (pan) ① Weight (g) (A)	Weight of Soil (g) (B)	▲ Total Initial ① Wet Wt. (~~Soil+Boat~~) pan (g) (C)	▲ 10/11/13 1435 ② Total Final Dry Weight (g) (D)	Moisture Fraction (MF) (E)		Amount of Soil per Treatment (at initial MF) (g)	Amount of DI Water Added (ml) to Achieve Desired MF	
	control		0.9276		10.9786	8.0979					
	27106		0.9271		12.9478	10.~~3~~990 ②					

Per Washington Department of Ecology, Moisture Fraction (E) = [(C-D)/(D-A)]*100 (this is calculated differently than MF as per SOP 5312)

①AR 10/03/13 CF ②AR 10/11/13 E

Refer to SOP 5326 for instructions on adjusting moisture fraction to the required level

Moisture fraction and calculation of how much water to add to reach target % moisture.
325 worm study 60280653-105-022

Milli-Q

Test Substance No.	Boat Weight (g)	Weight of Wet Soil (g) (A)	Total Initial Wet Wt. (g) (Soil+Boat) (B)	Total Final Dry Wt. (g) C	Moisture Fraction (E)	Amt. of H2O lost (g or ml)	Amt. of Dry Soil (g)	#g "as is" soil equiv. to X g dry weight (below)	Target % Moisture	Vol. (ml) water to add (see A below)	Total wet wt (g)
Control		0.0000			0.0000	0.0000	0.0000	497.0	35	174.0	671.0
27106 (HSA1:2.5)		0.0000			0.1862	0.0000	0.0000	1186.2	35	163.8	1350.0

↑ 78 ml actually used. AR Appeared wet enough.

MF calculation modified to agree with ASTM bioacoum method (similar to WDOE, where MF = moisture/dwt of soil)

A: volume (ml) of water to add to the calculated weight of "As Is" soil (equiv. to X g dry below), to achieve the target final % moisture

497 g of dry soil to allow for between 5 and 10g worms (~25 to 50 worms) CONTROL
we have 497 g dry control soil available

Assumption is that one worm weighs ~0.3g

1,000 g of dry soil, 27106, at least 15 g worms (~50 to 75 worms)

APPENDIX C

TestAmerica Report for Tissue Concentrations of Chemicals of Concern

Soil Toxicity Evaluation using the Washington DOE Early Seedling Growth Protocol for Lettuce (*Lactuca sativa*)

For

Environmental Partners
Issaquah, WA, USA

Prepared by
AECOM Technical Services, Inc.
Fort Collins Environmental Toxicology Lab
October / November 2013
60280653-105-024

Report of Soil Toxicity Evaluation using the Washington DOE Early Seedling Growth Protocol for Lactuca sativa *(Buttercrunch Lettuce)*

Project ID: 60280653-105-024
October /November 2013

Sponsor and Laboratory Information

Sponsor	Environmental Partners, Inc. 295 NE Gilman Boulevard, Suite 201 Issaquah, Washington USA 98027
Sponsor Project Officer	Eric Koltes (425) 395-0014
Testing Facility	AECOM Environment Fort Collins Environmental Toxicology Laboratory 4303 West LaPorte Ave. Fort Collins, CO 80521 Fax: (970) 490-2963 State of Florida NELAP Laboratory ID: E87972 Washington DOE Laboratory ID: C566
Study Director	Anita B. Rehner, M.S. (970) 416-0916 email: anita.rehner@aecom.com

Test Information

Test	Soil Toxicity Evaluation using the Washington DOE Early Seedling Growth Protocol for Lactuca sativa (Buttercrunch Lettuce)	
Basis	Washington State Department of Ecology method 96-324 (1996)	
Test Period	October 28, 2013 @ 1400 to November 11, 2013 @ 1500	
Test Length	14 days	
Species	*Lactuca sativa* (Buttercrunch Lettuce)	
Test Material	Whole soil	
Soil ID	Sample (Field) ID	AECOM Laboratory ID
	TP-47A-1	27121
Control /Dilution Soil	Artificial Soil (per WDOE method 96-324, with minor modification)	
Hydration Water	Type I Deionized Water (as needed)	
Test Concentrations	0 (control), 25, 50, and 100% field soil (dry weight basis)	

Table 1. Field Soil Collection and Receipt

Sample ID	Collection Date and Time	AECOM No.	Date of Receipt	Cooler Air Temp. at Arrival (°C)
TP-47A-1	09/24/13 @ 1157	27121	09/30/13	18.0[a]

[a] Sample was received in a 5-gallon bucket (not in a cooler with ice)
Note: See Appendix A for chain of custody records

Control Soil Description and Preparation

Artificial soil was used for the control and to dilute the field soil. The soil was prepared per Walsh (1991) as a modification of the artificial soil specified by Washington State Department of Ecology guidelines (WDOE 1996), since reliable germination of 90% or greater control seeds was not possible using the WDOE soil. Table 2 provides a comparison of WDOE and Walsh artificial soil compositions.

Table 2. Composition of Artificial Soil (Control)

Material	Percentage by Weight (WDOE 1996)	Percentage by Weight (Walsh 1991)
2-3 mm screened sphagnum peat	10	7
Colloidal kaolinite clay	20	8
Fine silica sand (7030; 30% retained on 70 mesh or coarser; 0.10 mm effective size)	70	72
Medium silica sand (4060; 60% retained on 40 mesh or coarser, 0.35 mm effective size)	0	10
Coarse silica sand (4095; 40% retained on 95 mesh or coarser; 0.50 mm effective size)	0	3

Sand used for the artificial soil was washed by rinsing with deionized water until the water ran clear. Washed sand was then baked at ~104°C until dry. After mixture of all components, calcium carbonate ($CaCO_3$) was added at a rate of 0.4% of the combined weight (5000 g soil prepared, 20 g $CaCO_3$ added). Following mixing by hand, the soil was transferred to 1 gallon containers and tumbled overnight on a rotary tumbler. The pH was determined prior to use in testing, and was 6.5 s.u., within the target range or 7.0 ± 0.5 s.u.).

Prior to test initiation Type I deionized water (Milli-Q®) was added to the artificial soil to achieve a target of ~40% moisture fraction (calculated per WDOE 1996 guidance).

Test Soil Preparation

Due to the composition of the field soil (extremely rocky, with stones ranging from a few millimeters in length to 3 or 4 cm in length), stones had been removed from the field soil at an earlier date by passing the soil through a 6 mm screen. Test (field) soil was removed from refrigerated storage on the morning of test initiation and was stirred gently to homogenize.

Preparation of Soil Dilutions / Placement of Soil into Test Chambers

Field soil dilutions were mixed on a dry weight basis, beginning with the lowest concentration (i.e., 25%) and moving up the concentration series to 100% field soil. An amount of moist field soil ("as is") equivalent to the appropriate amount of soil on a dry weight basis (this amount varied depending on the percent dilution of field soil to be prepared) was weighed and transferred to a stainless steel bowl. For dilutions, the calculated amount of dry artificial soil was weighed and added to the bowl and mixed with the field soil to homogenize. Then an amount of Type I deionized water sufficient to bring the soil mixture to 40% moisture fraction (MF, calculated per WDOE 1996) was measured volumetrically. The amount of water to be added was calculated based on the dry weight equivalent of field soil and the dry weight of artificial soil added for dilution, and accounting for the existing field soil moisture fraction. Water was added gradually, mixing to homogenize the water with the field soil/artificial soil. Following mixture of the 50% field soil treatment, the 100% field soil treatment was moistened and homogenized. Four 300 g aliquots of each moistened soil treatment (concentration) were weighed and distributed to the replicate test chambers. Soil was gently packed into the test chambers to eliminate large air pockets.

Test Conditions

A summary of test conditions is provided in Table 3. Test chambers (500-ml plastic cups) had small perforations in the bottom to allow drainage. Each test chamber sat inside a disposable styrofoam bowl. A layer of glass beads on the bottom of the bowl allowed the test chamber bottom to sit above any water that drained down into the bowl so that the soil did not become saturated. Once planted, each of the test chambers was placed on top of a piece of foam board floating in an environmental bath. The water bath was temperature controlled to a target of ~25°C to maintain air temperature within the correct range (the test method allows a range of 20 to 30°C). Two humidifiers provided humidity, and the water bath area was enclosed by PVC curtains to maintain better control over temperature and humidity. Overhead light was provided by 12, 48-inch fluorescent bulbs, a mixture of 4 natural light bulbs (5000K color temperature) and 8 daylight deluxe bulbs (6500 K color temperature).

Table 3. Test Conditions

Test Type	Static Chronic Test
Test Endpoints	Emergence/Survival; wet and dry weight of shoots
Test Chambers	~500-ml plastic cups; ~6.5 cm diameter at bottom, 12 cm height
Test Soil Volume	300 g (wet weight basis)
Hydration Water and Volume	Type I deionized water as needed after initial moistening to maintain optimal soil moisture
Replicates per Treatment	4
Organisms per Replicate	20
Test Temperature	20 to 30°C
Lighting	Fluorescent, 16 hours light:8 hours dark
Target Light Intensity	100 µE/m^2/sec (minimum)
Chamber Placement	Randomized

Planting Seeds

Once the test chambers were filled with soil / dilutions, 20 seeds were placed into each test chamber and gently covered with a small amount of the surrounding soil. After all 20 seeds were planted the soil was misted with a spray bottle containing Type I water, to moisten. After all the test chambers were planted and moistened the chambers were placed in the environmental bath according to the assigned random chart and finally, covered with plastic wrap.

Table 4. Test Organism

Species and Lot Number	*Lactuca sativa* seeds, FCETL Lot 13-017
Age	Seeds
Source	Mountain Valley Seed Company, Salt Lake City, Utah
Reference Toxicant Testing	Initiated October 21, 2013 using KCl

Test Monitoring

Test chambers were monitored for seedling emergence/survival daily, and the number of emerged/surviving plants was recorded daily. Air temperature (°C) inside the water bath enclosure was monitored continuously with a min/max thermometer and real-time temperature as well as daily minimum/maximum temperature was recorded daily. The min/max thermometer was reset daily after temperature was recorded. Bath temperature was monitored continuously using a data logger, and the daily mean, minimum, and maximum bath temperatures were recorded daily. Air humidity above the water bath was monitored and recorded daily. Light intensity (photon flux density or photosynthetically active radiation [PAR], µE/m^2/sec) was measured at the level of the tops of the test chambers at test initiation, on day 7, and at termination, using an Apogee quantum meter. Soil pH was measured at test initiation (control

and 100% field soil) and at termination (all treatments) following Washington State Department of Ecology guidance (WDOE 1996).

On day 14, final emergence/survival observations were made and recorded, and shoots were then cut at soil level. The wet weight of shoots from each replicate was determined. Shoots from each replicate were then dried at 70 ± 5°C for at least 24 hours, placed in a desiccator until cool, and weighed to the nearest 0.00001 g to determine dry weight.

Data Analysis

Survival of plants in all field soil treatments was first compared to the survival of control plants to identify any statistical differences (i.e., decreases). Survival data were first transformed using arcsine squareroot y and then tested for normality and homogeneity of variance. Data were then tested using the appropriate (parametric or nonparametric) 1-tailed test at $\alpha = 0.05$ and, $\alpha = 0.01$ using Toxstat version 3.5 (WEST, Inc. and Gulley 1996). Any treatments identified as having a statistically significant reduction in survival relative to the control were excluded from statistical analysis of shoot weight.

Weight endpoints are reported on a per original basis and on a per surviving basis. Weight data were first tested for normality and homogeneity of variance. Data were then tested using the appropriate (parametric or nonparametric) 1-tailed test at $\alpha = 0.05$. Inhibition concentrations (an estimation of the soil concentrations at which 25 and 50% reductions from the control plants for wet or dry weight per original organism occurred) were calculated, where appropriate, using linear interpolation (IC_p version 2.0, Norberg-King 1993).

TEST RESULTS

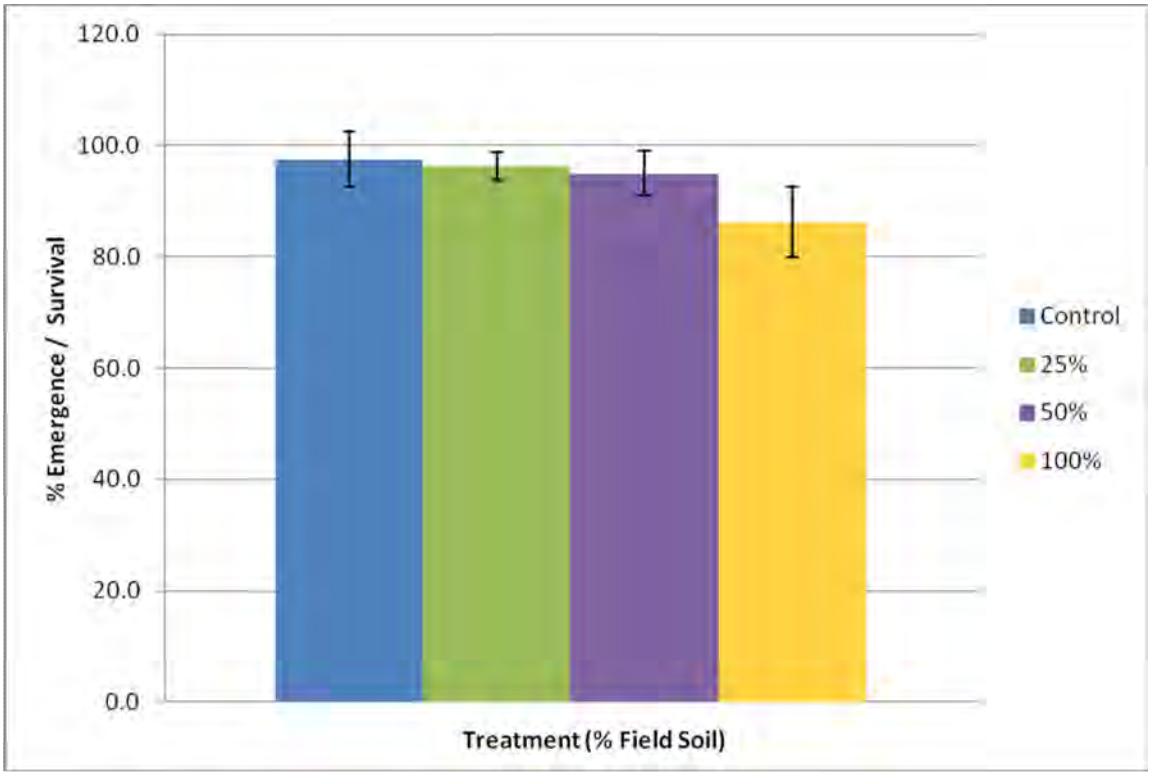
No mortality of emerged plants was observed in this test. The control met the quality criterion of ≥ 90% emergence. Plants in the field soil treatments exhibited slightly lower emergence/survival than the control plants (Table 5 and Figure 1). Emergence/survival of plants in the 100% field soil was significantly reduced (α = 0.05 and α = 0.01) relative to the control plants. Inhibition concentrations (IC_{25} or IC_{50}) were not calculated since the percent reduction from the control was <25%.

Table 5. Biological Data – Emergence / Survival at Test Termination

Treatment (% Field Soil)	Mean % Emergence or Survival[a] ± Std. Dev	Statistically Sig. Reduction Compared to Control? (α = 0.05 / α = 0.01)
0 (Control)	97.5 ± 5.0	N/A
25	96.2 ± 2.5	No / No
50	95.0 ± 4.1	No / No
100	86.2 ± 6.3	Yes / Yes

[a] For this test, percent emergence and percent survival were equivalent (i.e., no mortality of plants was observed).
Note: See Appendix B for copies of laboratory data sheets

Figure 1. Emergence / Survival at Test Termination



Tables 6 and 7 and Figure 2 show shoot wet weight (both as biomass and on a per surviving basis) with increasing field soil concentration. Tables 6 and 7 and Figure 3 show shoot dry weight (both as biomass and on a per surviving basis) with increasing field soil concentration. There was not a consistent concentration response for wet or dry weight in the field soil treatments, although for wet weight and dry weight per original number of seeds planted, weight tended to decrease slightly with increasing field soil concentration. There were no statistically significant reductions in wet or dry weight for treatments included in the statistical analysis (the 100% field soil treatment was excluded from statistical analysis of weight because of its lethality effect). Inhibition concentrations (IC_{25} or IC_{50}) were not calculated since the percent reduction from the control was <25%.

Table 6. Weight Data Expressed as per Original Number of Seeds Planted

Treatment (% Field Soil)	Mean Wet Weight (mg) per Original # Seeds Planted ± Std. Dev.	Statistically Sig. Reduction Compared to Control? (α = 0.05)	Mean Dry Weight (mg) per Original # Seeds Planted ± Std. Dev	Statistically Sig. Reduction Compared to Control? (α = 0.05)
0 (Control)	39.96 ± 3.44	N/A	3.05 ± 0.22	N/A
25	44.32 ± 4.15	No	3.08 ± 0.35	No
50	38.42 ± 2.79	No	3.00 ± 0.16	No
100	37.47 ± 8.09	---	2.92 ± 0.35	---

Note: See Appendix B for copies of laboratory data sheets

Table 7. Weight Data Expressed per Emerged (Surviving) Plant

Treatment (% Field Soil)	Mean Wet Weight (mg) per # of Emerged/Surviving Plant ± Std. Dev.	Statistically Sig. Reduction Compared to Control? (α = 0.05)	Mean Dry Weight (mg) per # of Emerged/Surviving Plant ± Std. Dev	Statistically Sig. Reduction Compared to Control? (α = 0.05)
0 (Control)	40.93 ± 1.62	N/A	3.13 ± 0.07	N/A
25	46.01 ± 3.39	No	3.20 ± 0.32	No
50	40.53 ± 3.88	No	3.16 ± 0.15	No
100	43.56 ± 9.82	---	3.40 ± 0.54	---

Note: See Appendix B for copies of laboratory data sheets

Figure 2. Wet Weight Data
Comparison of "Biomass" (Weight per Original) and Weight per Surviving Plant

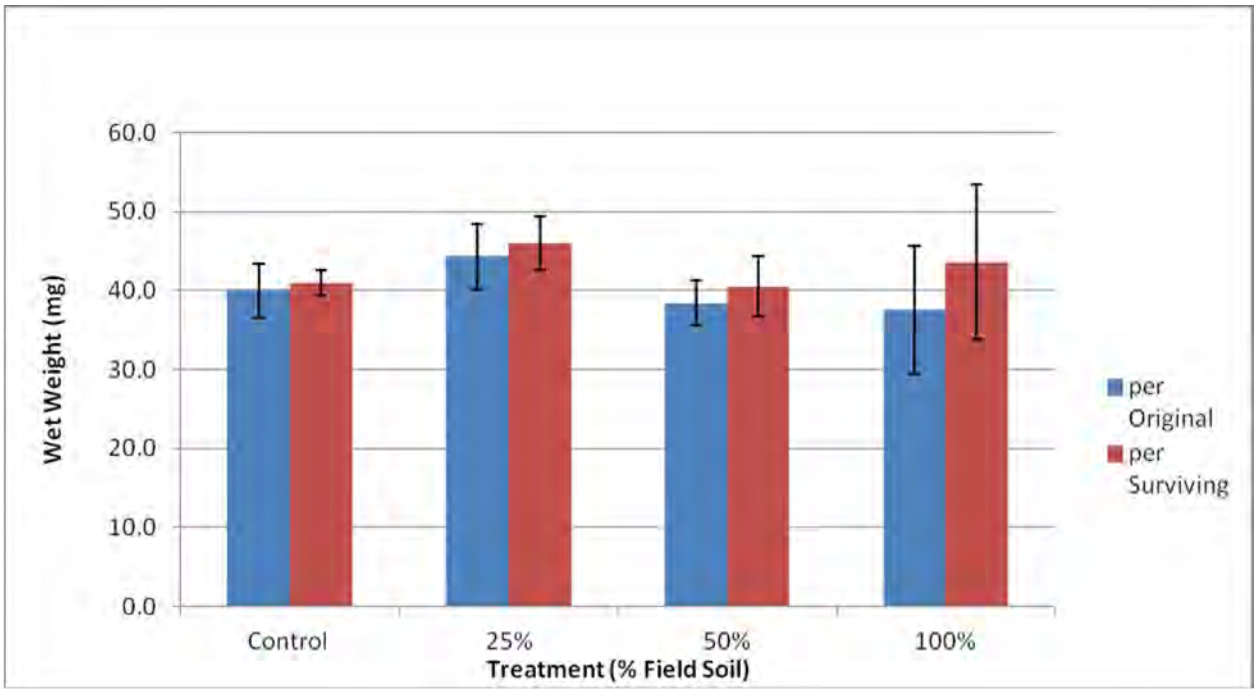


Figure 3. Dry Weight Data
Comparison of "Biomass" (Weight per Original) and Weight per Surviving Plant

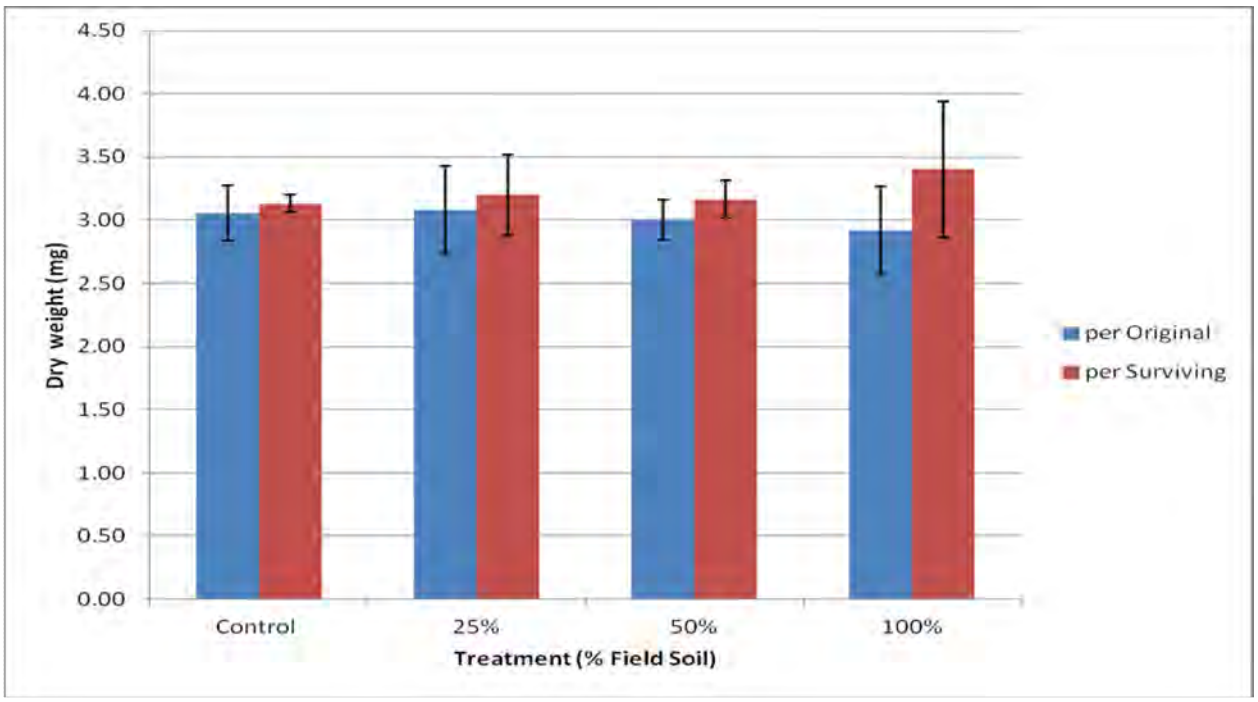


Table 8 provides the statistical endpoints for survival, biomass (shoot wet and dry weight per original organism), and for shoot wet and dry weight on a per surviving basis.

Table 8. Statistical Endpoints

Biological Endpoint	Statistical Endpoint	Value (% Field Soil)
Emergence/Survival	NOEC	50
	LOEC	100
	IC_{25}	>100
	IC_{50}	>100
Wet Weight (Biomass) Per Original Organism	NOEC	50
	LOEC	100
	IC_{25}	>100
	IC_{50}	>100
Dry Weight (Biomass) Per Original Organism	NOEC	50
	LOEC	100
	IC_{25}	>100
	IC_{50}	>100
Wet Weight (Per Surviving Organism)	NOEC	50
	LOEC	100
Dry Weight (Per Surviving Organism)	NOEC	50
	LOEC	100

NOEC = No Observed Effect Concentration
LOEC = Lowest Observed Effect Concentration
IC_{25} = 25% Inhibition Concentration
IC_{50} = 50% Inhibition Concentration

Soil pH values, air temperature, and air humidity for this study are provided in Table 9. Humidity averaged 25.2% during the course of the study. Daily mean air temperatures in the study enclosure during soil exposure ranged from 20.4 to 23.6°C, with an overall mean of 21.5ºC for the daily average temperature. Light intensity at the level of the top of the test chambers averaged 96 µE/m^2/sec at test initiation, 100 µE/m^2/sec on day 7, and 95 µE/m^2/sec at test termination.

Table 9. Physical and Chemical Data

Treatment (% Field Soil)	pH (S.U.)		Daily Mean Air Temp (°C)	Humidity (%)
	Day 0 (5 min. / 30 min.)[a]	Day 14 (5 min. / 30 min.)[a]		
Control	8.0 / 7.9	8.2 / 8.5	Mean = 21.5 (20.4 – 23.6)	Mean = 25.2 (20 – 34)[b]
25%	---	6.2 / 6.3		
50%	---	5.6 / 5.7		
100%	5.4 / 5.4	51. / 5.2		

[a] After 5 minutes of stirring / after 30 minutes of settling, per WDOE (1996)
[b] Humidity range in the study enclosure
Note: See Appendix B for copies of laboratory data sheets

Physical Appearance of Plants in Studies 024

Photographs of test chambers were taken at test termination (day 14, November 11, 2013). These photos appear in Appendix C.

Reference toxicant test results for the lot of *L. sativa* seeds used in testing are provided in Table 10.

Table 10. Reference Toxicant Test Results for *L. sativa*

Organism Lot Number	Test Date	5-d LC_{50} (Emergence)	FCETL Historical 95% Control Limits	
			Low	High
13-017	October 21 – 26, 2013	6,123	1,023	9,480

Note: LC_{50} expressed as mg/L chloride (toxicant KCl). Five-day data was taken from a 14-day reference toxicant test.

Organism Lot Number	Test Date	Biological Endpoint	14-d LC_{50}	FCETL Historical 95% Control Limits	
				Low	High
13-017	October 21 to November 4, 2013	Emergence/Survival	8,700	4,041	10,161

Note: LC_{50} (emergence/survival) or EC_{50} (weights per original) expressed as mg/L chloride (toxicant KCl).

References

Norberg-King, T. J. 1993. A linear interpolation method for sublethal toxicity: the inhibition concentration (ICp) approach (version 2.0). National Effluent Toxicity Assessment Center Technical Report 03-93, U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, MN.

Walsh, G.E. 1991. Plant toxicity testing with sediment and marsh soils. Technical Report, NPS/NRWRD/NRTR-91/03. National Park Service, Water Resources Division.

WDOE. 1996. Early Seedling Growth Protocol for Soil Toxicity Screening. Washington State Department of Ecology, Publication #96-324. June 1996.

WEST, Inc. and D.D. Gulley. 1996. Toxstat Version 3.5. Western EcoSystems Technology, Inc., Cheyenne, WY.

Statement of Procedural Compliance

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, accurate and complete.

Juanita Rehmer — December 19, 2013

Study Director — Date

Statement of Quality Assurance

The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the appropriate guidance and standard operating procedures, and that the resulting data and report meet the requirements of the NELAC standards. This report is an accurate reflection of the raw data.

Amber Potts — December 19, 2013

Quality Assurance Unit — Date

APPENDIX A

Chain of Custody

AECOM

CHAIN OF CUSTODY RECORD

Page 1 of 1

Client/Project Name: EPI AvalonBay-Newcastle	Project Location: Newcastle, WA
Project Number: 38814.1	Field Logbook No.:
Sampler (Print Name)/(Affiliation): Kristin L. Addis, EPI	Chain of Custody Tape Nos.:
Signature: Kristin L Addis	Send Results/Report to: erick@epi-wa.com TAT: Standard

Analysis Requested: 14-day plant bioassay; 5-day plant bioassay

Container Type: P – Plastic; A – Amber Glass; G – Clear Glass; V – VOA Vial; O – Other; E – Encore

Preservation: 1 – HCl, 4°; 2 – H2SO4, 4°; 3 – HNO3, 4°; 4 – NaOH, 4°; 5 – NaOH/ZnAc, 4°; 6 – Na2S2O3, 4°; 7 – 4°

Matrix Codes: DW – Drinking Water; WW – Wastewater; GW – Groundwater; SW – Surface Water; ST – Storm Water; W – Water; S – Soil; SL – Sludge; SD – Sediment; SO – Solid; A – Air; L – Liquid; P – Product

Field Sample No./Identification	Date	Time	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered	14-day	5-day	Lab I.D.	Remarks
TP-47A-1	9/24/13	1157		x	5 gal bucket	Soil	—	—	X	X	27121	*Please conduct dilutions of 100, 50 and 25 for both bioassay

Relinquished by: (Print Name)/(Affiliation) Kristin L Addis Signature:	Date: 9/27/13 Time: 1500	Received by: (Print Name)/(Affiliation) Signature: FedEX	Date: Time:	Analytical Laboratory (Destination): Arrived @ 15.0°C (1-4) **AECOM Toxicology Lab** 4303 W. Laporte Avenue Fort Collins, CO 80521 (970) 416-0916 (970) 490-2963 (FAX)	
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Mike Wirth/AECOM Signature:	Date: 9/30/13 Time: 1015		
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Sample Shipped Via: UPS (FedEx) Courier Other	Temp blank: Yes (No)

Q:\GRAPHICS\FORMS\Chain of Custody (COC)\Chain-of-Custody_Ft. Collins_10_07.doc

Serial No. 050651

APPENDIX B

Data Sheets

SOIL TOXICITY DATA PACKAGE COVER SHEET

QA: AR 12/17/13

Test Type: Chronic

Test Substance: Field Soil

Dilution Substance: Artificial Soil

Hydration Water Type: Deionized Water

Concurrent Control Overlying Water Type: NA

Date and Time Test Began: 10/28/13 @ 1400

Protocol Number: WA DOE method 96-324

Project Number: 60280653-105-024 [325]

Species: *Lactuca sativa*

Organism Lot or Batch Number: 13-017

Age: seeds Supplier: Mountain Valley Seed CO, SLC, UT

Date and Time Test Ended: 11/11/13 @ 500

Investigator(s): AMZ/RR/AR/KB/MW

Background Information

Type of Test: Non-renewal

Test Temperature: 20 – 30 °C

Photoperiod: 16 h light : 8 h dark

Soil Vol.: 300g (wet wt. basis)

Length of Test: 14 days

Type of Food and Quantity per Chamber: None

Env. Chmbr/Bath #: 7

Test Chambers: 500 mL plastic cups/ disposable bowls w/ glass beads for saucers

Light Intensity: 100 µE/m^2/sec (minimum)

Number of Replicates per Treatment: 4

Number of Organisms per Replicate: 20

Feeding Frequency: see below

Test Concentrations (Volume:Volume): 0 (laboratory control soil), 25, 50, and 100% field soil

Test Soil(s) Sample Description: Field Soil

Agency Summary Sheet(s)?: NA

Germination / survival

Reference Toxicant Data: Test Dates: 10/21/13 to 11/04/13 (LC_{50} or IC_{25} (Circle): 8,700 mg/L Cl^-

Hist. 95% Control Limits: 4,041 to 10,161 Method for Determining Ref. Tox. Value: 5-K

Special Procedures and Considerations:

All containers maintained at hydration levels close to that at test initiation using deionized water. Do not overwater!!

Measure light intensity every 7 days. Do not measure temperature in test chambers.

Laboratory control/dilution soil is artificial soil (based on Walsh 1991 recipe).

Study Director Initials: AR Date: 10/28/13

At 0915 on 11-03-03, the lab clocks were set back one hour to 0815 to adjust time to Mountain Standard Time. All times recorded for data on this day are Mountain Standard times. Initials: KB

TEST SUBSTANCE USAGE LOG

QA: 10/28/13

Project Number 60280653-105-024 [325]

	Sample 1	Sample 2	Sample 3	Sample 4
Test Substance Number	27121			
Test Substance Collection Date and Time	From: 09/24/13 @ 1157	From: @	From: @	From: @
	To: N/A @ N/A	To: @	To: @	To: @
Sample Type (Grab or Comp)	Grab			
Date Test Substance Received	09/30/13			
Dilution Substrate	Artificial Soil			
Concurrent Control Water RW#	Artificial Soil			
Date(s) Used	10/28/13			

PREPARATION OF TEST SOILS

Test Substance % Conc.	Test Substance Volume (g field soil)	Dilution Soil (g soil)	Total Volume (s soil)	Test Substance Volume (g field soil)	Dilution Soil (g soil)	Total Volume (s soil)	Test Substance Volume (g field soil)	Dilution Soil (g soil)	Total Volume (s soil)
	See spreadsheet								
Total									

Initials/Date	DP 10/28/13		
Initials/Date			
Initials/Date			
Initials/Date			
Initials/Date			
Initials/Date			
Initials/Date			

325 Environmental Partners Inc. 60280653-105-024 October 2013 QA: JK 12/17/13

14-day *Lactuca sativa* test using WDOE method 96-324 Calculate wts on a dry wt. basis

Soil sample ID: 27121 TP-47A-1 received 09/30/2013 Four replicates to allow NOEC calculation

Target is 300 g (moistened to 40% MF, at least for control & lower field soil concs) of soil per replicate

Total weight of **WET Wt. basis** field soil required for one test: 2313.5 g 5.100 lbs

For lettuce, the 40% MF is arbitrary, more water can be added later

Field soil moisture fraction (MF,%) : 10/21/13 32.2 Assume artificial soil is DRY (0% MF)

Start at target MF = 40% 40 Target MF

Lettuce studies are 300 g wet wt (moistened to test conditions) per rep. enter

Mix extra field soil and dilutions to have enough for pH, etc. and to allow addition of less water if soil is odd (you will still need 300 g per rep of wet soil)

% Field Soil	A DRY (AS IS) TWEAK COLUMN Artificial Soil (g)	DRY Wt. Basis TWEAK COLUMN Field Soil (g)	B Per Treatment "As is" (wet wt) g field soil	C Per Treatment Amount of Hydration Water (ml)	MIXED A+B+C (need ≥ 1200g) Per Treatment Wet wt basis at Target MF	Added MF (%) Check
0	950	0	0	380.00	1330.0	40
25	750	250	330.5	319.50	1400.0	40
50	500	500	661	239.00	1400.0	40
100	0	1000	1322	78.00	1400.0	40
Totals	2200		2313.5	1016.50	5530.0	

Dilution % based on dry wt basis

artificial soil — weigh

field soil weights

H_2O

60280653-105-024
Walsh Soil "*Echinochloa Soil*" for 325 14 day *L. sativa* studies
Date Prepped: 10/21/13 Technician: MW

QA: 12/17/13

	% by Vol.	g to weigh	
Sphagnum Peat Moss	7%	350 g	200+150
Kaolin Clay	8%	400 g	
Fine Silica Sand	72%	3600 g	1000.0
Medium Silica Sand	10%	500 g	1000.1
Coarse Silica Sand	3%	150 g	1000.0
	TOTAL	5000 g	
CaCO3 (for pH adjustment)		10 g	
		+ 5 g	
	Are on 10/23/13	+ 5 g	

dry = 6.1/5.8

moistened.

Soil pH: 6.2 / 5.8 [WDOE Method] 10/21/13
6.8/6.6 10/21/13

pH on 10/23/13, soil that was moistened on 10/21/13:
10g $CaCO_3$ add 5.4/5.4
15g total $CaCO_3$ add 6.3/6.3.

Added 5g more $CaCO_3$ on 10/23/13
Tumbled 10/24/13 from 0840 to ①~~8~~ 1730

pH 6.5/6.4 on 10/25/13

①Are 10/25/13 E

SEED GERMINATION BIOLOGICAL DATA

QA: JR 12/17/13

Project Number: 60280653-105-024 [325]

Test Species (Circle): *L. sativa* Other (Specify):

Conc.	Replicate	Initial # of Seeds (Day 0)	Emergence (# of seeds) / Survival (# of plants) Test Day 1	2	3	4	5	6	7	Remarks
0	A	20	0	15	16	17	19	19	19 (1)	(1) 1 about to emerge
	B	20	0	10	16	19	19	19	20	
	C	20	0	7	16	18*	19	20	20	* 1 about to emerge (19)
	D	20	0	9	16	16	17	18	18	
25%	A	20	0	14	17	18	18	18	18	
	B	20	0	16	19	19	19	19	19	
	C	20	0	19	20	20	20	20	20	
	D	20	0	15	19	19	19	19	19	
50%	A	20	0	18	18	18	18	18	18	
	B	20	0	19	19	19	19	19	19	
	C	20	0	15	20	20	20	20	20	
	D	20	0	16	18	19	19	19	19	
100%	A	20	0	13	13	17	17	17	17	
	B	20	0	14	17	17	17	18	18	
	C	20	0	12	15	15*	17	17	17	* Indigenous plant growing
	D	20	0	10	18	19	19	19	19*	* indigenous plant growing
Date:		10/28/13	10/29/13	10/30/13	10/31/13	11/1/13	11/2/13	11/3/13	11/4/13	
Time:		1400	1210	1430	1630	1630	1320	1735	1130	
Initials:		AM/RF	JR	JR	JR	JR	RS	RS	RS	

(1) JR 11/1/13, E
(2) JR 12/18/13, E

SEED GERMINATION BIOLOGICAL DATA

Project Number: 60280653-105-024 [325]

Test Species (Circle): L. sativa Other (Specify):

Arr 11/11/13
DA: 12/17/13

Conc.	Replicate	Emergence (# of seeds) / Survival (# of plants) — Test Day 8	9	10	11	12	13	14	Remarks % Emergence-Germination (*) / Survival
0	A	19	19	19	19	19	19	20	
	B	20	20	20	20	20	20	20	97.5
	C	20	20	20	20	20	20	20	
	D	18	18	18	18	18	18	18	
25%	A	19	19	19	19	19	19	19	
	B	19	19	19	19	19	19	19	96.2
	C	20	20	20	20	20	20	20	
	D	19	19	19	19	19	19	19	
50%	A	18	18	18	18	18	③ ~~19~~ 18	18	
	B	19	19	19	19	19	19	19	95
	C	20	20	20	20	20	20	20	
	D	19	19	19	19	19	19	② ~~19~~ 19	
100%	A	17	17	17	17	17	17	17	
	B	18	18	18	18	18	18	17 (*)	(*) Double counted 86.2
	C	17	17	17	17	17	17	~~18~~ 16 (*)	
	D	19	19	19	19	19	19	19	
Date:		11/5/13	11/6/13	11/7/13	11/8/13	11/9/13	11/10/13	11/11/13	
Time:		1110	1630	1145	1700	1640	1300	1500	
Initials:		KB		KB				KB/MW	

(*) The most accurate counts for all treatments occurred on day 14, when plants were removed from test chambers to obtain weight data

① DA 11/11/13 E
② AR for (*) 12/19/13 CF
③ AR for KB 12/19/13 E
(most accurate counts are on day 14)

QUALITATIVE OBSERVATIONS – At test termination

QA'd 12/17/13

Project Number: 60280653-105-024 [325]	Test Species (Circle): *L. sativa* Other (Specify):

Conc.	Number of seedlings alive	Wilting?	Discoloration?
0	78	N/A	N/A
25%	77	N/A	N/A
50%	76	N/A	N/A
100%	69	N/A	N/A
Date:	11/11/13	11/11/13	11/11/13
Time:	1500	1500	1500
Initials:	[illegible]	[illegible]	[illegible]

The following scale was used for discoloration and wilting for all plants which were alive at test termination:
1 = <25% of total plant mass
2 = 25-50% of total plant mass
3 = 50-75% of total plant mass
4 = >75% of total plant mass

CHEMICAL DATA - Up to 14-Day Test

Project Number: 60280653-105-024 [325]	Test Species (Circle): *D. magna* *H. azteca* *C. tentans* *E. foetida* *L. variegatus* Other (Specify): ***L. sativa***

		Soil pH	
Conc.	Rep	Day 0	Day 14 (see note below)
0	A	8.0 / 7.9	8.2 / 8.5
	B		
	C		
	D		
10%	A	Not measured (1)	(1)
	B		
	C		
(1)	(1) D		
25%	A	Not measured	6.2 / 6.3
	B		
	C		
	D		
50%	A	Not measured	5.6 / 5.7
	B		
	C		
	D		
100%	A	6.4 / 6.4	5.1 / 5.2
	B		
	C		
	D		
Meter#		FM24	FM24
Date:		10/28/13	~~10~~ 11/11/13
Time:		1830/1600	1600/1630
Initials:		AM	AR

(1) AR 12/13/13 NA

Note: pH determined using methodology in WA DOE method 96-324 (do not add $CaCl_2$ solution). **At test termination (day 14), measure pH in one replicate per treatment**

AR 11/14/13. E

FCETL QA Form No. 055
Revision 2
Effective 1/94

DAILY TOXICITY TEST LOG

Project Number: 60280653-105-024 [325] AR 12/16/16

Test Species (Circle): *C. dubia* *D. magna* *D. pulex* *P. promelas* *O. mykiss* Other (Specify): *L. sativa*

General Comments		Deionized water added?	Initials/Date
Test Day 0	Test Soil Mixed@ : 0900-~~1055~~ 0955 (1) Seeds Added @: 1400 Replicate light intensity readings (6 min.): 90, 97, 99, 99, 94, 97 (µmol/m²/sec) ⇒ X=96 452, 552, 529, 497, 489, 487 (ft-c) Mean light intensity: 502 (µE/m²/sec) (foot-candles) (4) Light Meter #: 00 Air Temp. °C : 21.7 (Min. °C 21.4 Max. °C 23.2) Therm# M-11 Bath CT Temp Mean. = 20.0 °C Bath CT Temp Range: 19.2-20.8 °C Humidity: 29 %	D.I. water added in PM	AM-/RR 10/28/13
Test Day 1	Air Temp. °C : 23.5 (Min. °C 21.9 Max. °C 23.8) Therm# M-11 Bath CT Temp Mean. = 19.8 °C Bath CT Temp Range: 19.2-20.4 °C Humidity: 34 %	N/A	★ 10/29/13
Test Day 2	Air Temp. °C : 23.8 (Min. °C 23.1 Max. °C 24.0) Therm# M-11 Bath CT Temp Mean. = 19.6 °C Bath CT Temp Range: 19.2-20.0 °C Humidity: 30 %	N/A	★ 10/30/13
Test Day 3	Air Temp. °C : 23.8 (Min. °C 22.8 Max. °C 23.8) Therm# M-11 Bath CT Temp Mean. = ~~20~~ (2) 19.6 °C Bath CT Temp Range: 19.2-20.4 °C Humidity: 26 %	~~N/A~~ (2) Milli-Q PM	★ 10/31/13
Test Day 4	Air Temp. °C : 22.5 (Min. °C 22.1 Max. °C 22.9) Therm# M-11 Bath CT Temp Mean. = 19.2 °C Bath CT Temp Range: 18.6-19.6 °C Humidity: 23 % 22.1 (5) 18.6 (3) 22.6 (3)	Milli-Q pm ~~N/A~~ (2)	★ 11/1/13
Test Day 5	Air Temp. °C : ~~22.5~~ (Min. °C 22.1 Max. °C 22.9) Therm# M-11 Bath CT Temp Mean. = 18.8 °C Bath CT Temp Range: 18.2-19.2 °C Humidity: 31 %	milli-Q in PM	KB 11/2/13
Test Day 6	Air Temp. °C : 23.4 (Min. °C 18.8 Max. °C 23.9) Therm# M-11 Bath CT Temp Mean. = 18.8 °C Bath CT Temp Range: 18.2-19.2 °C Humidity: 27 %	milli-Q in AM milli-Q in PM	KB 11/3/13
Test Day 7	Replicate light intensity readings (6 min.): (µE/m²/sec) (ft-c) (3) 96, 103, 106, 98, 96, 103 Mean light intensity: 100 (µE/m²/sec) Light Meter #: 02 Air Temp. °C : 23.7 (Min. °C 18.8 Max. °C 23.7) Therm# M-11 Bath CT Temp Mean. = 19.0 °C Bath CT Temp Range: 18.6-19.6 °C Humidity: 22 %	milli-Q in AM milli-Q PM	FD 11/4/13

(2) AR 10/28/13 E (3) KB 11/4/13 E (5) Refork KB 12/19/13 CF
(6) AR 10/31/13 E (4) AR 12/16/16 CF

FCETL QA Form No. 055
Revision 2
Effective 1/94

DAILY TOXICITY TEST LOG

QA: dd 12/17/13

Project Number: 60280653-105-024 [325] AR 12/16/16

Test Species (Circle): *C. dubia* *D. magna* *D. pulex* *P. promelas* *O. mykiss* Other (Specify): *L. sativa*

General Comments		Deionized water added?	Initials/Date
Test Day 8	Air Temp. °C : 23.8 (Min. °C 19.2 Max. °C 24.0) Therm# M-11 Bath CT Temp Mean. = 19.0 °C Bath CT Temp Range: 18.6-19.2 °C Humidity: 20 %	milli-Q in Am	KB 11/5/13
Test Day 9	Air Temp. °C : 22.5 (Min. °C 18.3 Max. °C 22.6) Therm# M-11 Bath CT Temp Mean. = 18.8 °C Bath CT Temp Range: 18.8-17.2 °C Humidity: 20 %	MQ AM	AM 11/6/13
Test Day 10	Air Temp. °C : 22.6 (Min. °C 18.3 Max. °C 22.6) Therm# M-11 Bath CT Temp Mean. = 18.6 °C Bath CT Temp Range: 18.2-19.0 °C Humidity: 21 %	MQ in AM	KB 11/7/13
Test Day 11	Air Temp. °C : 23.2 (Min. °C 18.2 Max. °C 23.2) Therm# M-11 Bath CT Temp Mean. = 18.6 °C Bath CT Temp Range: 18.2-19.0 °C Humidity: 21 %	MQ in PM	11/8/13
Test Day 12	Air Temp. °C : 22.8 (Min. °C 18.3 Max. °C 22.9) Therm# M-11 Bath CT Temp Mean. = 18.8 °C Bath CT Temp Range: 18.6-19.2 °C Humidity: 21 %	MQ in Am	AB 11/9/13
Test Day 13	Air Temp. °C : 23.0 (Min. °C 18.7 Max. °C 23.1) Therm# M-11 Bath CT Temp Mean. = 19.0 °C Bath CT Temp Range: 18.6-19.6 °C Humidity: 23 %	MQ in Am	KB 11/10/13
Test Day 14	Replicate light intensity readings (6 min.): 490, 490, 426, 526, 464, 488 → $\bar{x}$ = 481 ft-c (ft-c) (meter 00) Mean light intensity: 95 (µE/m²/sec) Light Meter #: ~~100~~ 102 (2) Air Temp. °C : 22.1 (Min. °C ~~18.6~~ 22.4 Max. °C 22.4) Therm# M-11 Bath CT Temp Mean. = 19.2 °C Bath CT Temp Range: 18.9-19.6 °C Humidity: 30 % meter O2 Readings: 98, 98, 104, 86, 102, 87	None	11/11/13

DRM 11/11/13 LP (2) AR for AMR 12/16/16 CF

Project No.: 60280653-105-024 DA: 12/17/13

FOUR TREATMENTS FOUR REPLICATES RANDOM CHAMBER LOCATION "TUV"

4A	2C	3B	4C
1A	4B	3A	1C
3D	1B	3C	2D
2A	2B	1D	4D

1 = Control
2 = 25
3 = 50 } % soil
4 = 100

AR 12/16/13 ①
DA: 12/17/13

	Air Temp. (degrees C)				
Day	Real time	Min	Max	Daily avg	Humidity (%)
0	21.7	21.4	23.2	22.3	29
1	23.5	21.9	23.8	22.9	34
2	23.8	23.1	24.0	23.6	30
3	23.8	22.8	23.8	23.3	26
4	22.5	22.1	22.9	22.5	23
5	22.6	18.6	22.6	20.6	31
6	23.4	18.8	23.9	21.4	27
7	23.7	18.8	23.7	21.3	22
8	23.8	19.2	24.0	21.6	20
9	22.5	18.3	22.6	20.5	20
10	22.6	18.3	22.6	20.5	21
11	23.2	18.2	23.2	20.7	21
12	22.8	18.3	22.9	20.6	21
13	23.0	18.7	23.1	20.9	23
14	22.1	18.6	22.4	20.5	30
Overall Min	21.7	18.2		20.45	
Overall Max	23.8		24.0	23.55	
Overall Mean	23.00			21.53	25.2

① AR 12/19/13 JE

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 60280653-105-024 [325]	Test Substance: soil	Comments: Analytical Balance ID: SARET#1
Species: *L. sativa*	Analyst Tare: JDM Analyst Gross: AR for AMR/ANP	Dried in Oven # NA from Date: Time: to Date: Time:
Date/Time of Tare Wt.: 11/11/13 @ 1135	Date/Time of Gross Wt.: 11/11/13 @ 1500	

Weight Type (Circle): (Wet) Blot Dry Dry (>100°C) AFDW (>500°C)

Lot or Batch Number: 13-017

Boat No.	Treatment	Rep.	Length Units:	Tare Weight (g)	WET Gross Weight (g)	WET Net Weight (g)		No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
1	Control	A		0.93197	1.78736								
2		B		0.93614	1.75642								
3		C		0.93387	1.75615								
4		D		0.93348	1.63226								
5	25%	A		0.93509	1.78 28 40						19		
6		B		0.93675	1.79064 (2)								
7		C		0.93289	1.92140								
8		D		0.93339	1.84352								
9	50%	A		0.93222	1.71803								
10		B		0.93256 (1) 66	1.77050								
11		C		0.92961	1.66076								
12		D		0.92997	1.64039								
Blank				0.93362									
Range													
Mean													

Test Solution Volume:	Loading Rate:

(1) JDM 11/11/13 E
(2) AR 11/12/13 E

FCETL QA Form No.010
Revision 5
Effective 08/99

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 60280653-105-024 [325]	Test Substance: soil	Comments:
Species: *L. sativa*	Analyst Tare: JDM Analyst Gross: ARF or AMR/PMP	Analytical Balance ID: SARTY#4
Date/Time of Tare Wt.: 11/11/13 @ 1135	Date/Time of Gross Wt.: 11/11/13 @ 1500	Dried in Oven # NA from Date: Time: to Date: Time:

Weight Type (Circle): (Wet) Blot Dry Dry (>100°C) AFDW (>500°C) Lot or Batch Number: 13-017

Boat No.	Treatment	Rep.	Length Units:	Tare Weight (g)	WET Gross Weight (g)	WET Net Weight (g)		No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
13	100%	A		0.93095	1.49347								
14		B		0.93065	1.59698								
15		C		0.92967	1.82597 1.80140								
16		D		0.93128	1.80401 1.82584								
17		A											
18		B											
19		C											
20		D											
21		A											
22		B											
23		C											
24		D											
Blank													
Range													
Mean													

Test Solution Volume:	Loading Rate:

① JDM 11/11/13 E
② AMR 11/20/13 MP

FCETL QA Form No. 010a
Revision 0
Effective 10/06

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 60280653-105-024 Shoots Species: *Lactuca sativa*

QA: AVE 11/20/13
11/20/13

Treatment	Rep	Tare Weight (g)	Wet Gross Weight (g)	Wet Net Weight (g)	No of Orig. Organisms	Mean WET Wt./ Original Organism (g)	Mean WET Wt./ Treatment (g) (Original)	Number of Surv. Organisms	Mean WET Wt./ Surviving Organism (g)	Mean WET Wt./ Treatment (g) (Surviving)
Control	A	0.93197	1.78736	0.85539	20	0.04277	0.03996	20	0.04277	0.04093
	B	0.93614	1.75642	0.82028	20	0.04101		20	0.04101	
	C	0.93387	1.75615	0.82228	20	0.04111		20	0.04111	
	D	0.93348	1.63226	0.69878	20	0.03494		18	0.03882	
25%	A	0.93509	1.72840	0.79331	20	0.03967	0.04432	19	0.04175	0.04601
	B	0.93675	1.79064	0.85389	20	0.04269		19	0.04494	
	C	0.93289	1.92140	0.98851	20	0.04943		20	0.04943	
	D	0.93339	1.84352	0.91013	20	0.04551		19	0.04790	
50%	A	0.93222	1.71803	0.78581	20	0.03929	0.03842	18	0.04366	0.04053
	B	0.93266	1.77050	0.83784	20	0.04189		19	0.04410	
	C	0.92961	1.66881	0.73920	20	0.03696		20	0.03696	
	D	0.92997	1.64039	0.71042	20	0.03552		19	0.03739	
100%	A	0.93095	1.49347	0.56252	20	0.02813	0.03747	17	0.03309	0.04356
	B	0.93065	1.59698	0.66633	20	0.03332		17	0.03920	
	C	0.92967	1.82594	0.89627	20	0.04481		16	0.05602	
	D	0.93128	1.80401	0.87273	20	0.04364		19	0.04593	
Blank		0.93362								

Project Number: 60280653-105-024 Shoots (WET) Species: *Lactuca sativa*

QA: AKH 11/20/13
AKH 11/20/13

Summary Statistics for Survival Data

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.900	1.000	0.9750	0.0500	5.128%
25%	4	0.950	1.000	0.9625	0.0250	2.597%
50%	4	0.900	1.000	0.9500	0.0408	4.297%
100%	4	0.800	0.950	0.8625	0.0629	7.295%

Summary Statistics for Growth Data (wet wt per original)

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.0349	0.0428	0.03996	0.00344	8.614%
25%	4	0.0397	0.0494	0.04432	0.00415	9.373%
50%	4	0.0355	0.0419	0.03842	0.00279	7.262%
100%	4	0.0281	0.0448	0.03747	0.00809	21.598%

Summary Statistics for Growth Data (wet wt per surviving organism)

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.0388	0.0428	0.04093	0.00162	3.958%
25%	4	0.0418	0.0494	0.04601	0.00339	7.372%
50%	4	0.0370	0.0441	0.04053	0.00388	9.567%
100%	4	0.0331	0.0560	0.04356	0.00982	22.552%

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

~~SRT~~ 12/17/13

Project Number: 60280653-105-024 [325]	Test Substance: soil	Comments: Analytical Balance ID: SART#1
Species: *L. sativa*	Analyst Tare: ' Analyst Gross: AB	Dried in Oven # 5 from Date: 11/11/13 Time: ~~1500~~ 1500 ① to Date: 11/12/13 Time: 1150
Date/Time of Tare Wt.:	Date/Time of Gross Wt.: 11/13/13 @ 1630	

Weight Type (Circle): Wet Blot Dry **Dry (70°C)** AFDW (>500°C) — Lot or Batch Number: 13-017

Boat No.	Treatment	Rep.	Length Units:	Tare Weight (g)	DRY Gross Weight (g)	DRY Net Weight (g)	Adjusted Net Weight (g)[1]	No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
1	Control	A			0.99557								
2		B			0.99965								
3		C			0.99653								
4		D			0.98809								
5	25%	A			0.98822								
6		B			0.99574								
7		C			1.00116								
8		D			0.99965								
9	50%	A			0.99073								
10		B			0.99545								
11		C			0.99240								
12		D			0.99612								
Blank					0.93375								
Range													
Mean													

Test Solution Volume:	Loading Rate:

[1] Add in weight loss of blank boat, if appropriate.

① AB 11/13/13

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

QA 11/27/13

Project Number: 60280653-105-024 [325]	Test Substance: soil	Comments: Analytical Balance ID: SMRT#1
Species: *L. sativa*	Analyst Tare: _____ Analyst Gross: [illegible]	Dried in Oven # 3 from Date: 11/12/13 Time: 1500 to Date: 11/27/13 Time: 1450
Date/Time of Tare Wt.:	Date/Time of Gross Wt.: 11/13/13 @ 1630	

Weight Type (Circle): Wet Blot Dry **Dry (70°C)** AFDW (>500°C)

(Lot) or Batch Number: 13-017

Boat No.	Treatment	Rep.	Length Units:	Tare Weight (g)	DRY Gross Weight (g)	DRY Net Weight (g)	Adjusted Net Weight (g)[1]	No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
13	100%	A			0.98103								
14		B			0.98762								
15		C			0.99649								
16		D			0.99080								
17		A											
18		B											
19		C											
20		D											
21		A											
22		B											
23		C											
24		D											
Blank													
Range													
Mean													

Test Solution Volume:	Loading Rate:

[1] Add in weight loss of blank boat, if appropriate.

FCETL QA Form No. 010a
Revision 0
Effective 10/06
11/20/13
QA: AKU/20113

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 60280653-105-024 Shoots Species: *Lactuca sativa*

Treatment	Rep	Tare Weight (g)	Dry Gross Weight (g)	Dry Net Weight (g)	Adjusted Net Weight (g)	No of Orig. Organisms	Mean DRY Wt./ Original Organism (g)	Mean DRY Wt./ Treatment (g) (Original)	Number of Surv. Organisms	Mean DRY Wt./ Surviving Organism (g)	Mean DRY Wt./ Treatment (g) (Surviving)
Control	A	0.93197	0.99557	0.06360	0.06360	20	0.00318	0.00305	20	0.00318	0.00313
	B	0.93614	0.99965	0.06351	0.06351	20	0.00318		20	0.00318	
	C	0.93387	0.99653	0.06266	0.06266	20	0.00313		20	0.00313	
	D	0.93348	0.98809	0.05461	0.05461	20	0.00273		18	0.00303	
25%	A	0.93509	0.98822	0.05313	0.05313	20	0.00266	0.00308	19	0.00280	0.00320
	B	0.93675	0.99574	0.05899	0.05899	20	0.00295		19	0.00310	
	C	0.93289	1.00116	0.06827	0.06827	20	0.00341		20	0.00341	
	D	0.93339	0.99965	0.06626	0.06626	20	0.00331		19	0.00349	
50%	A	0.93222	0.99073	0.05851	0.05851	20	0.00293	0.00300	18	0.00325	0.00316
	B	0.93266	0.99545	0.06279	0.06279	20	0.00314		19	0.00330	
	C	0.92961	0.99240	0.06279	0.06279	20	0.00314		20	0.00314	
	D	0.92997	0.98612	0.05615	0.05615	20	0.00281		19	0.00296	
100%	A	0.93095	0.98103	0.05008	0.05008	20	0.00250	0.00292	17	0.00295	0.00340
	B	0.93065	0.98762	0.05697	0.05697	20	0.00285		17	0.00335	
	C	0.92967	0.99649	0.06682	0.06682	20	0.00334		16	0.00418	
	D	0.93128	0.99080	0.05952	0.05952	20	0.00298		19	0.00313	
Blank		0.93362	0.93375	0.00013							

FCETL QA Form No. 010a
Revision 0
Effective 10/06

4/11/2013
QA: 4/11/2013

Project Number: 60280653-105-024 Shoots (DRY) Species: *Lactuca sativa*

Summary Statistics for Survival Data

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.900	1.000	0.9750	0.0500	5.128%
25%	4	0.950	1.000	0.9625	0.0250	2.597%
50%	4	0.900	1.000	0.9500	0.0408	4.297%
100%	4	0.800	0.950	0.8625	0.0629	7.295%

Summary Statistics for Growth Data (dry wt per original)

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.0027	0.0032	0.00305	0.00022	7.110%
25%	4	0.0027	0.0034	0.00308	0.00035	11.265%
50%	4	0.0028	0.0031	0.00300	0.00016	5.488%
100%	4	0.0025	0.0033	0.00292	0.00035	11.850%

Summary Statistics for Growth Data (dry wt per surviving organism)

Treatment	N	Min	Max	Mean	SD	C.V.
Control	4	0.0030	0.0032	0.00313	0.00007	2.168%
25%	4	0.0028	0.0035	0.00320	0.00032	9.884%
50%	4	0.0030	0.0033	0.00316	0.00015	4.880%
100%	4	0.0029	0.0042	0.00340	0.00054	15.946%

QA: AR 11/12/13
AR 11/12/13

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners
Lactuca sativa
Summary Statistics for 14-day Survival

Title: 60280653-105-024
File: 325024.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	0.9000	1.0000	0.9750
2	25%	4	0.9500	1.0000	0.9625
3	50%	4	0.9000	1.0000	0.9500
4	100%	4	0.8000	0.9500	0.8625

Title: 60280653-105-024
File: 325024.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Control	0.0025	0.0500	0.0250	5.1282
2	25%	0.0006	0.0250	0.0125	2.5974
3	50%	0.0017	0.0408	0.0204	4.2974
4	100%	0.0040	0.0629	0.0315	7.2945

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners
Lactuca sativa
Determination of NOEC and LOEC for 14-day Survival

QA: AR 11/12/13
dk 11/12/13

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.0959
W = 0.9649

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Bartlett's Test for Homogeneity of Variance

Calculated B1 statistic = 1.0797 (p-value = 0.7820)

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.

Critical B = 11.3449 (alpha = 0.01, df = 3)
= 7.8147 (alpha = 0.05, df = 3)

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners
Lactuca sativa
Determination of NOEC and LOEC for 14-day Survival ($\alpha = 0.05$)

QA: AR 11/12/13
& 11/12/13

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	3	0.1003	0.0334	4.1858
Within (Error)	12	0.0959	0.0080	
Total	15	0.1962		

(p-value = 0.0304)

Critical F = 5.9525 (alpha = 0.01, df = 3,12)
= 3.4903 (alpha = 0.05, df = 3,12)

Since F > Critical F REJECT Ho: All equal (alpha = 0.05)

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	Control	1.4063	0.9750		
2	25%	1.3737	0.9625	0.5170	
3	50%	1.3496	0.9500	0.8977	
4	100%	1.1997	0.8625	3.2698	*

Dunnett critical value = 2.2900 (1 Tailed, alpha = 0.05, df = 3,12)

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	25%	4	0.0658	6.8	0.0125
3	50%	4	0.0658	6.8	0.0250
4	100%	4	0.0658	6.8	0.1125

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners
Lactuca sativa
Determination of NOEC and LOEC for 14-day Survival (α = 0.01)

AR 11/12/13
QA: KR 12/17/13

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	3	0.1003	0.0334	4.1858
Within (Error)	12	0.0959	0.0080	
Total	15	0.1962		

(p-value = 0.0304)

Critical F = 5.9525 (alpha = 0.01, df = 3,12)
= 3.4903 (alpha = 0.05, df = 3,12)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.01)

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.01
1	Control	1.4063	0.9750		
2	25%	1.3737	0.9625	0.5170	
3	50%	1.3496	0.9500	0.8977	
4	100	1.1997	0.8625	3.2698	*

Dunnett critical value = 3.1900 (1 Tailed, alpha = 0.01, df = 3,12)

Title: 60280653-105-024
File: 325024.dat Transform: ARC SINE(SQUARE ROOT(Y))

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	25%	4	0.1013	10.4	0.0125
3	50%	4	0.1013	10.4	0.0250
4	100	4	0.1013	10.4	0.1125

AR 12/6/13
QA 12/17/13

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Summary Statistics for WET Weight (mg) per Original Organism

File: 325024wo.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	34.9400	42.7700	39.9575
2	25	4	39.6700	49.4300	44.3250
3	50	4	35.5200	41.8900	38.4150

File: 325024wo.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Control	11.8405	3.4410	1.7205	8.6117
2	25	17.2692	4.1556	2.0778	9.3753
3	50	7.7798	2.7892	1.3946	7.2608

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Analysis of WET Weight (mg) per Original Organism

AR 12/6/13
QA 12/17/13

File: 325024wo.dat Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 110.6683
W = 0.9545

Critical W = 0.8050 (alpha = 0.01 , N = 12)
W = 0.8590 (alpha = 0.05 , N = 12)

Data PASS normality test (alpha = 0.01). Continue analysis.

File: 325024wo.dat Transform: NO TRANSFORMATION

Bartlett's Test for Homogeneity of Variance

Calculated Bl statistic = 0.4075 (p-value = 0.8157)

Data PASS Bl homogeneity test at 0.01 level. Continue analysis.

Critical B = 9.2103 (alpha = 0.01, df = 2)
= 5.9915 (alpha = 0.05, df = 2)

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Determination of NOEC for WET Weight(mg) per Original Organism

AR 12/6/13
QA/AR 12/17/13

File: 325024wo.dat Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	2	75.1766	37.5883	3.0568
Within (Error)	9	110.6683	12.2965	
Total	11	185.8449		

(p-value = 0.0970)

Critical F = 8.0215 (alpha = 0.01, df = 2,9)
= 4.2565 (alpha = 0.05, df = 2,9)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

File: 325024wo.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Control	39.9575	39.9575		
2	25	44.3250	44.3250	-1.7614	
3	50	38.4150	38.4150	0.6221	

Dunnett critical value = 2.1800 (1 Tailed, alpha = 0.05, df = 2,9)

File: 325024wo.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	25	4	5.4054	13.5	-4.3675
3	50	4	5.4054	13.5	1.5425

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Summary Statistics for WET Weight (mg) per Surviving Organism

AR 12/6/13
QA 12/17/13

File: 325024ws.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	38.8200	42.7700	40.9275
2	25	4	41.7500	49.4300	46.0050
3	50	4	36.9600	44.1000	40.5275

File: 325024ws.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Control	2.6255	1.6203	0.8102	3.9590
2	25	11.5203	3.3942	1.6971	7.3778
3	50	15.0488	3.8793	1.9396	9.5720

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Analysis of WET Weight (mg) per Surviving Organism

AR 12/6/13
AR 12/12/13

File: 325024ws.dat Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 87.5836
W = 0.9224

Critical W = 0.8050 (alpha = 0.01 , N = 12)
W = 0.8590 (alpha = 0.05 , N = 12)

Data PASS normality test (alpha = 0.01). Continue analysis.

File: 325024ws.dat Transform: NO TRANSFORMATION

Bartlett's Test for Homogeneity of Variance

Calculated B1 statistic = 1.8432 (p-value = 0.3979)

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.

Critical B = 9.2103 (alpha = 0.01, df = 2)
= 5.9915 (alpha = 0.05, df = 2)

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Determination of NOEC for WET Weight(mg) per Surviving Organism

AR 12/6/13
QA: AR 12/17/13

File: 325024ws.dat Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	2	74.5920	37.2960	3.8325
Within (Error)	9	87.5836	9.7315	
Total	11	162.1757		

(p-value = 0.0625)

Critical F = 8.0215 (alpha = 0.01, df = 2,9)
= 4.2565 (alpha = 0.05, df = 2,9)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

File: 325024ws.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Control	40.9275	40.9275		
2	25	46.0050	46.0050	-2.3018	
3	50	40.5275	40.5275	0.1813	

Dunnett critical value = 2.1800 (1 Tailed, alpha = 0.05, df = 2,9)

File: 325024ws.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	25	4	4.8087	11.7	-5.0775
3	50	4	4.8087	11.7	0.4000

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Summary Statistics for DRY Weight (mg) per Original Organism

AR 12/6/13
QA: A 12/17/13

File: 325024do.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Control	4	2.7300	3.1800	3.0550
2	25	4	2.6600	3.4100	3.0825
3	50	4	2.8100	3.1400	3.0050

File: 325024do.dat Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Control	0.0475	0.2179	0.1090	7.1340
2	25	0.1184	0.3440	0.1720	11.1608
3	50	0.0267	0.1634	0.0817	5.4376

AR 12/6/13
QA: AR 12/17/13

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Analysis of DRY Weight (mg) per Original Organism

File: 325024do.dat Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.5777
W = 0.9330

Critical W = 0.8050 (alpha = 0.01 , N = 12)
W = 0.8590 (alpha = 0.05 , N = 12)

Data PASS normality test (alpha = 0.01). Continue analysis.

File: 325024do.dat Transform: NO TRANSFORMATION

Bartlett's Test for Homogeneity of Variance

Calculated B1 statistic = 1.4796 (p-value = 0.4772)

Data PASS B1 homogeneity test at 0.01 level. Continue analysis.

Critical B = 9.2103 (alpha = 0.01, df = 2)
= 5.9915 (alpha = 0.05, df = 2)

Toxstat Version 3.5
Study # 60280653-105-024
Environmental Partners, Inc.
Site: TP-47A-1 (AECOM #27121)
Lactuca sativa 14-day Test per WDOE method 96-234
Determination of NOEC for DRY Weight (mg) per Original Organism

AR 12/6/13
QA 12/17/13

File: 325024do.dat Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	2	0.0124	0.0062	0.0962
Within (Error)	9	0.5777	0.0642	
Total	11	0.5900		

(p-value = 0.9092)

Critical F = 8.0215 (alpha = 0.01, df = 2,9)
= 4.2565 (alpha = 0.05, df = 2,9)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

File: 325024do.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Control	3.0550	3.0550		
2	25	3.0825	3.0825	-0.1535	
3	50	3.0050	3.0050	0.2791	

Dunnett critical value = 2.1800 (1 Tailed, alpha = 0.05, df = 2,9)

File: 325024do.dat Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Control	4			
2	25	4	0.3905	12.8	-0.0275
3	50	4	0.3905	12.8	0.0500

APPENDIX C

Photo Log

Control Replicates A through D at Test Termination

TP-47A-1 (AECOM # 27121) 25% Replicates A through D at Test Termination

TP-47A-1 (AECOM # 27121) 50% Replicates A through D at Test Termination

TP-47A-1 (AECOM # 27121) 100% Replicates A through D at Test Termination

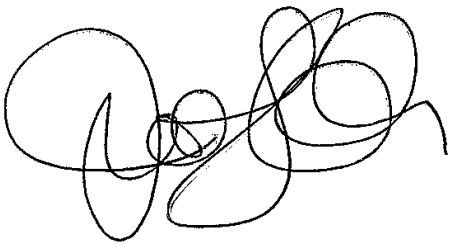
ANALYTICAL REPORT

Job Number: 180-26836-1

Job Description: Tissue 60280653-105-022

For:
AECOM, Inc.
1601 Prospect Parkway
Fort Collins, CO 80525

Attention: Ms. Anita Rehner



Approved for release.
Jill L Colussy
Project Manager I
11/19/2013 1:46 PM

Designee for
Carrie L Gamber, Senior Project Manager
301 Alpha Drive, Pittsburgh, PA, 15238
(412)963-2428
carrie.gamber@testamericainc.com
11/19/2013

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager or designee who has signed this report.

Table of Contents

Cover Title Page 1

Data Summaries 4

- Report Narrative 4
- Sample Summary 5
- Executive Summary 6
- Method Summary 7
- Method / Analyst Summary 8
- Sample Datasheets 9
- QC Data Summary 17
- Data Qualifiers 25
- QC Association Summary 26
- Lab Chronicle 29
- Reagent Traceability 33
  - COAs 36
- Certification Summary 71

Inorganic Sample Data 72

- Metals Data 72
  - Met Cover Page 73
  - Met Sample Data 74
  - Met QC Data 78
    - Met ICV/CCV 78
    - Met CRQL 82
    - Met Blanks 83
    - Met ICSA/ICSAB 93
    - Met MS/MSD/PDS 97
    - Met LCS/LCSD 100

Table of Contents

Met Serial Dilution 106

Met MDL 108

Met Linear Ranges 112

Met Preparation Log 113

Met Analysis Run Log 117

Met ICP/MS Int Stds 124

Met Raw Data 128

Met Prep Data 381

General Chemistry Data 387

Gen Chem Cover Page 388

Gen Chem MDL 389

Gen Chem Analysis Run Log 393

Gen Chem Prep Data 395

Shipping and Receiving Documents 397

Client Chain of Custody 398

Sample Receipt Checklist 400

CASE NARRATIVE

Client: AECOM, Inc.

Project: Tissue 60280653-105-022

Report Number: 180-26836-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 11/05/2013; the samples arrived in good condition, properly preserved and on ice. The temperature of the cooler at receipt was 2.7 C.

METALS (ICPMS)

The blanks had analytes detected at levels that were above the method detection limit but below the reporting limit. The values should be considered an estimate, and have been flagged. If the associated sample reported a result above the MDL and/or RL, the result has been flagged.

The serial dilution of sample POST-EXPOSURE 27106 WORMS (180-26836-4) was outside of the control limits for antimony and arsenic.

GENERAL CHEMISTRY

No difficulties were encountered during the general chemistry analysis.

SAMPLE SUMMARY

Client: AECOM, Inc. Job Number: 180-26836-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
180-26836-1	PRE-EXPOSURE WORMS	Tissue	10/04/2013 1130	11/05/2013 0850
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	Solid	11/01/2013 1530	11/05/2013 0850
180-26836-3	POST-EXPOSURE CONTROL WORMS	Tissue	11/01/2013 1520	11/05/2013 0850
180-26836-4	POST-EXPOSURE 27106 WORMS	Tissue	11/01/2013 1520	11/05/2013 0850

EXECUTIVE SUMMARY - Detections

Client: AECOM, Inc. Job Number: 180-26836-1

Lab Sample ID / Analyte	Client Sample ID	Result	Qualifier	Reporting Limit	Units	Method
180-26836-1	**PRE-EXPOSURE WORMS**					
Arsenic		0.34		0.10	mg/Kg	6020A
Lead		0.037	J B	0.10	mg/Kg	6020A
Antimony		0.060	J	0.21	mg/Kg	6020A
Percent Moisture		84		0.10	%	2540G
180-26836-2	**FOOD-FERMENTED F10-008 PREPPED**					
Lead		0.25	J B	0.69	mg/Kg	6020A
Antimony		0.26	J	1.4	mg/Kg	6020A
Percent Moisture		86		0.10	%	2540G
180-26836-3	**POST-EXPOSURE CONTROL WORMS**					
Arsenic		0.64		0.096	mg/Kg	6020A
Lead		0.035	J B	0.096	mg/Kg	6020A
Antimony		0.017	J	0.19	mg/Kg	6020A
Percent Moisture		81		0.10	%	2540G
180-26836-4	**POST-EXPOSURE 27106 WORMS**					
Arsenic		13		0.099	mg/Kg	6020A
Lead		1.0	B	0.10	mg/Kg	6020A
Antimony		0.43		0.20	mg/Kg	6020A
Percent Moisture		82		0.10	%	2540G

METHOD SUMMARY

Client: AECOM, Inc. Job Number: 180-26836-1

Description	Lab Location	Method	Preparation Method
Matrix: Solid			
Metals (ICP/MS)	TAL PIT	SW846 6020A	
Preparation, Metals	TAL PIT		SW846 3050B
SM 2540G	TAL PIT	SM22 2540G	
Matrix: Tissue			
Metals (ICP/MS)	TAL PIT	SW846 6020A	
Preparation, Metals	TAL PIT		SW846 3050B
Tissue Handling and Preparation	TAL PIT		NOAA In House
SM 2540G	TAL PIT	SM22 2540G	

Lab References:

TAL PIT = TestAmerica Pittsburgh

Method References:

NOAA = National Marine Fisheries Service, National Oceanic And Atmospheric Administration, Seattle, WA, November 1988

SM22 = Standard Methods For The Examination Of Water And Wastewater, 22nd Edition

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: AECOM, Inc. Job Number: 180-26836-1

Method	Analyst	Analyst ID
SW846 6020A	Ferguson, Caitlin N	CNS
SM22 2540G	McLaughlin, Jeremiah W	JWM
SM22 2540G	Wolfe, Adam	ADW

Client: AECOM, Inc. Job Number: 180-26836-1

Client Sample ID: **PRE-EXPOSURE WORMS**

Lab Sample ID: 180-26836-1 Date Sampled: 10/04/2013 1130
Client Matrix: Tissue Date Received: 11/05/2013 0850

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00000.96 g
Analysis Date:	11/13/2013 1428			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Lead		0.037	J B	0.0040	0.10
Antimony		0.060	J	0.0027	0.21

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00000.98 g
Analysis Date:	11/13/2013 1531			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Arsenic		0.34		0.018	0.10

Client: AECOM, Inc. Job Number: 180-26836-1

Client Sample ID: **FOOD-FERMENTED F10-008 PREPPED**

Lab Sample ID: 180-26836-2 Date Sampled: 11/01/2013 1530
Client Matrix: Solid % Moisture: 85.6 Date Received: 11/05/2013 0850

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	180-89888	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	1.0			Initial Weight/Volume:	00001.00 g
Analysis Date:	11/14/2013 2002			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
Lead		0.25	J B	0.026	0.69
Antimony		0.26	J	0.018	1.4

Analysis Method:	6020A	Analysis Batch:	180-89888	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	1.0			Initial Weight/Volume:	00001.01 g
Analysis Date:	11/14/2013 2049			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				

Analyte	DryWt Corrected: Y	Result (mg/Kg)	Qualifier	MDL	RL
Arsenic		ND		0.12	0.69

Client: AECOM, Inc. Job Number: 180-26836-1

Client Sample ID: **POST-EXPOSURE CONTROL WORMS**

Lab Sample ID: 180-26836-3 Date Sampled: 11/01/2013 1520
Client Matrix: Tissue Date Received: 11/05/2013 0850

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00001.04 g
Analysis Date:	11/13/2013 1446			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Lead		0.035	J B	0.0037	0.096
Antimony		0.017	J	0.0025	0.19

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00001.04 g
Analysis Date:	11/13/2013 1536			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Arsenic		0.64		0.017	0.096

Client: AECOM, Inc. Job Number: 180-26836-1

Client Sample ID: **POST-EXPOSURE 27106 WORMS**

Lab Sample ID: 180-26836-4 Date Sampled: 11/01/2013 1520
Client Matrix: Tissue Date Received: 11/05/2013 0850

6020A Metals (ICP/MS)

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00000.98 g
Analysis Date:	11/13/2013 1450			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Lead		1.0	B	0.0039	0.10
Antimony		0.43		0.0027	0.20

Analysis Method:	6020A	Analysis Batch:	180-89757	Instrument ID:	M
Prep Method:	3050B	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0			Initial Weight/Volume:	00001.01 g
Analysis Date:	11/13/2013 1554			Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	MDL	RL
Arsenic		13		0.018	0.099

General Chemistry

Client Sample ID: **PRE-EXPOSURE WORMS**

Lab Sample ID: 180-26836-1 Date Sampled: 10/04/2013 1130

Client Matrix: Tissue Date Received: 11/05/2013 0850

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Moisture	84		%	0.10	0.10	1.0	2540G

Analysis Batch: 180-89697 Analysis Date: 11/13/2013 1749 DryWt Corrected: N

Client: AECOM, Inc. Job Number: 180-26836-1

General Chemistry

Client Sample ID: **FOOD-FERMENTED F10-008 PREPPED**

Lab Sample ID: 180-26836-2 Date Sampled: 11/01/2013 1530
Client Matrix: Solid Date Received: 11/05/2013 0850

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Moisture	86		%	0.10	0.10	1.0	2540G

Analysis Batch: 180-89011 Analysis Date: 11/06/2013 1941 DryWt Corrected: N

General Chemistry

Client Sample ID: **POST-EXPOSURE CONTROL WORMS**

Lab Sample ID: 180-26836-3 Date Sampled: 11/01/2013 1520

Client Matrix: Tissue Date Received: 11/05/2013 0850

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Moisture	81		%	0.10	0.10	1.0	2540G

Analysis Batch: 180-89697 Analysis Date: 11/13/2013 1749 DryWt Corrected: N

General Chemistry

Client Sample ID: **POST-EXPOSURE 27106 WORMS**

Lab Sample ID: 180-26836-4 Date Sampled: 11/01/2013 1520

Client Matrix: Tissue Date Received: 11/05/2013 0850

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Percent Moisture	82		%	0.10	0.10	1.0	2540G

Analysis Batch: 180-89697 Analysis Date: 11/13/2013 1749 DryWt Corrected: N

Client: AECOM, Inc. Job Number: 180-26836-1

Method Blank - Batch: 180-89482

Method: 6020A
Preparation: 3050B

Lab Sample ID:	MB 180-89482/1-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.12 g
Analysis Date:	11/13/2013 1405	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Lead	0.00571	J	0.0034	0.089
Antimony	ND		0.0023	0.18

Preparation / Extraction Blank - Batch: 180-89482

Method: 6020A
Preparation: 3050B

Lab Sample ID:	PB 180-89081/4-B	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/13/2013 1410	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0914				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Lead	0.0118	J	0.0038	0.099
Antimony	0.00881	J	0.0026	0.20

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 180-89482

Method: 6020A
Preparation: 3050B

LCS Lab Sample ID:	LCS 180-89482/2-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.03 g
Analysis Date:	11/13/2013 1415	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 180-89482/3-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00000.99 g
Analysis Date:	11/13/2013 1420	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Lead	102	104	80 - 120	6	20		
Antimony	89	89	80 - 120	5	20		

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 180-89482

Method: 6020A
Preparation: 3050B

LCS Lab Sample ID:	LCS 180-89482/2-A	Units:	mg/Kg	LCSD Lab Sample ID:	LCSD 180-89482/3-A
Client Matrix:	Tissue			Client Matrix:	Tissue
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/13/2013 1415			Analysis Date:	11/13/2013 1420
Prep Date:	11/12/2013 0913			Prep Date:	11/12/2013 0913
Leach Date:	N/A			Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Lead	1.94	2.02	1.98	2.09
Antimony	48.5	50.5	43.0	45.0

Post Digestion Spike - Batch: 180-89482

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-4	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00000.98 g
Analysis Date:	11/13/2013 1500	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Spike Amount	Result	% Rec.	Limit	Qual
Lead	1.0	2.04	3.28	111	75 - 125	
Antimony	0.33	51.0	48.9	95	75 - 125	

Serial Dilution - Batch: 180-89482

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-4	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89482	Lab File ID:	M31113A.xml
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	00000.98 g
Analysis Date:	11/13/2013 1455	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0913				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	%Diff	Limit	Qual
Lead	1.0	0.983	2.5	10	
Antimony	0.33	0.453	36	10	J V

Client: AECOM, Inc. Job Number: 180-26836-1

Method Blank - Batch: 180-89486

Method: 6020A
Preparation: 3050B

Lab Sample ID:	MB 180-89486/1-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.05 g
Analysis Date:	11/13/2013 1509	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Arsenic	ND		0.017	0.095

Preparation / Extraction Blank - Batch: 180-89486

Method: 6020A
Preparation: 3050B

Lab Sample ID:	PB 180-89081/4-C	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/13/2013 1514	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Arsenic	ND		0.018	0.099

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 180-89486

Method: 6020A
Preparation: 3050B

LCS Lab Sample ID:	LCS 180-89486/2-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.02 g
Analysis Date:	11/13/2013 1518	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

LCSD Lab Sample ID:	LCSD 180-89486/3-A	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.07 g
Analysis Date:	11/13/2013 1523	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Arsenic	85	87	80 - 120	3	20		

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Control/
Laboratory Duplicate Data Report - Batch: 180-89486

Method: 6020A
Preparation: 3050B

LCS Lab Sample ID:	LCS 180-89486/2-A	Units: mg/Kg	LCSD Lab Sample ID:	LCSD 180-89486/3-A
Client Matrix:	Tissue		Client Matrix:	Tissue
Dilution:	1.0		Dilution:	1.0
Analysis Date:	11/13/2013 1518		Analysis Date:	11/13/2013 1523
Prep Date:	11/12/2013 0924		Prep Date:	11/12/2013 0924
Leach Date:	N/A		Leach Date:	N/A

Analyte	LCS Spike Amount	LCSD Spike Amount	LCS Result/Qual	LCSD Result/Qual
Arsenic	3.92	3.74	3.34	3.24

Post Digestion Spike - Batch: 180-89486

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-4	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/13/2013 1603	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Spike Amount	Result	% Rec.	Limit	Qual
Arsenic	13	3.96	16.0	83	75 - 125	

Serial Dilution - Batch: 180-89486

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-4	Analysis Batch:	180-89757	Instrument ID:	M
Client Matrix:	Tissue	Prep Batch:	180-89486	Lab File ID:	M31113A.xml
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/13/2013 1559	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/12/2013 0924				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	%Diff	Limit	Qual
Arsenic	13	14.1	11	10	V

Client: AECOM, Inc. Job Number: 180-26836-1

Method Blank - Batch: 180-89655

Method: 6020A
Preparation: 3050B

Lab Sample ID:	MB 180-89655/1-A	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.06 g
Analysis Date:	11/14/2013 1940	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Lead	0.00717	J	0.0036	0.094
Antimony	ND		0.0025	0.19

Lab Control Sample - Batch: 180-89655

Method: 6020A
Preparation: 3050B

Lab Sample ID:	LCS 180-89655/2-A	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.04 g
Analysis Date:	11/14/2013 1950	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Lead	1.92	1.99	104	80 - 120	
Antimony	48.1	43.3	90	80 - 120	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 180-89655

Method: 6020A
Preparation: 3050B

MS Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.02 g
Analysis Date:	11/14/2013 2012			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				
Leach Date:	N/A				

MSD Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.04 g
Analysis Date:	11/14/2013 2017			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Lead	101	104	75 - 125	1	20		
Antimony	88	90	75 - 125	1	20		

Client: AECOM, Inc. Job Number: 180-26836-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 180-89655

Method: 6020A
Preparation: 3050B

MS Lab Sample ID:	180-26836-2	Units:	mg/Kg	MSD Lab Sample ID:	180-26836-2
Client Matrix:	Solid			Client Matrix:	Solid
Dilution:	1.0			Dilution:	1.0
Analysis Date:	11/14/2013 2012			Analysis Date:	11/14/2013 2017
Prep Date:	11/13/2013 1256			Prep Date:	11/13/2013 1256
Leach Date:	N/A			Leach Date:	N/A

Analyte	Sample Result/Qual		MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Lead	0.25	J	13.6	13.4	14.0	14.1
Antimony	0.26	J	340	334	300	302

Serial Dilution - Batch: 180-89655

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89655	Lab File ID:	M31114A.xml
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.00 g
Analysis Date:	11/14/2013 2007	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1256				
Leach Date:	N/A				

Analyte	Sample Result/Qual		Result	%Diff	Limit	Qual
Lead	0.25	J	0.278	NC	10	J
Antimony	0.26	J	0.198	NC	10	J

Client: AECOM, Inc. Job Number: 180-26836-1

Method Blank - Batch: 180-89656

Method: 6020A
Preparation: 3050B

Lab Sample ID:	MB 180-89656/1-A	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.12 g
Analysis Date:	11/14/2013 1945	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				
Leach Date:	N/A				

Analyte	Result	Qual	MDL	RL
Arsenic	ND		0.016	0.089

Lab Control Sample - Batch: 180-89656

Method: 6020A
Preparation: 3050B

Lab Sample ID:	LCS 180-89656/2-A	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/14/2013 1954	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				
Leach Date:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Arsenic	3.96	3.42	86	80 - 120	

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 180-89656

Method: 6020A
Preparation: 3050B

MS Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.02 g
Analysis Date:	11/14/2013 2058			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				
Leach Date:	N/A				

MSD Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	1.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.03 g
Analysis Date:	11/14/2013 2103			Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				
Leach Date:	N/A				

	% Rec.						
Analyte	MS	MSD	Limit	RPD	RPD Limit	MS Qual	MSD Qual
Arsenic	88	87	75 - 125	3	20		

Client: AECOM, Inc.

Job Number: 180-26836-1

Matrix Spike/
Matrix Spike Duplicate Recovery Report - Batch: 180-89656

Method: 6020A
Preparation: 3050B

MS Lab Sample ID:	180-26836-2	Units: mg/Kg	MSD Lab Sample ID:	180-26836-2
Client Matrix:	Solid		Client Matrix:	Solid
Dilution:	1.0		Dilution:	1.0
Analysis Date:	11/14/2013 2058		Analysis Date:	11/14/2013 2103
Prep Date:	11/13/2013 1257		Prep Date:	11/13/2013 1257
Leach Date:	N/A		Leach Date:	N/A

Analyte	Sample Result/Qual	MS Spike Amount	MSD Spike Amount	MS Result/Qual	MSD Result/Qual
Arsenic	ND	27.2	27.0	24.1	23.4

Serial Dilution - Batch: 180-89656

Method: 6020A
Preparation: 3050B

Lab Sample ID:	180-26836-2	Analysis Batch:	180-89888	Instrument ID:	M
Client Matrix:	Solid	Prep Batch:	180-89656	Lab File ID:	M31114A.xml
Dilution:	5.0	Leach Batch:	N/A	Initial Weight/Volume:	00001.01 g
Analysis Date:	11/14/2013 2054	Units:	mg/Kg	Final Weight/Volume:	100 mL
Prep Date:	11/13/2013 1257				
Leach Date:	N/A				

Analyte	Sample Result/Qual	Result	%Diff	Limit	Qual
Arsenic	ND	ND	NC	10	

DATA REPORTING QUALIFIERS

Client: AECOM, Inc. Job Number: 180-26836-1

Lab Section	Qualifier	Description
Metals		
	B	Compound was found in the blank and sample.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	V	Serial Dilution exceeds the control limits

Client: AECOM, Inc. Job Number: 180-26836-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
Metals					
Prep Batch: 180-89482					
LCS 180-89482/2-A	Lab Control Sample	T	Tissue	3050B	
LCSD 180-89482/3-A	Lab Control Sample Duplicate	T	Tissue	3050B	
MB 180-89482/1-A	Method Blank	T	Tissue	3050B	
PB 180-89081/4-B	Preparation / Extraction Blank	T	Tissue	3050B	
180-26836-1	PRE-EXPOSURE WORMS	T	Tissue	3050B	
180-26836-3	POST-EXPOSURE CONTROL WORMS	T	Tissue	3050B	
180-26836-4	POST-EXPOSURE 27106 WORMS	T	Tissue	3050B	
Prep Batch: 180-89486					
LCS 180-89486/2-A	Lab Control Sample	T	Tissue	3050B	
LCSD 180-89486/3-A	Lab Control Sample Duplicate	T	Tissue	3050B	
MB 180-89486/1-A	Method Blank	T	Tissue	3050B	
PB 180-89081/4-C	Preparation / Extraction Blank	T	Tissue	3050B	
180-26836-1	PRE-EXPOSURE WORMS	T	Tissue	3050B	
180-26836-3	POST-EXPOSURE CONTROL WORMS	T	Tissue	3050B	
180-26836-4	POST-EXPOSURE 27106 WORMS	T	Tissue	3050B	
Prep Batch: 180-89655					
LCS 180-89655/2-A	Lab Control Sample	T	Solid	3050B	
MB 180-89655/1-A	Method Blank	T	Solid	3050B	
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	T	Solid	3050B	
180-26836-2MS	Matrix Spike	T	Solid	3050B	
180-26836-2MSD	Matrix Spike Duplicate	T	Solid	3050B	
Prep Batch: 180-89656					
LCS 180-89656/2-A	Lab Control Sample	T	Solid	3050B	
MB 180-89656/1-A	Method Blank	T	Solid	3050B	
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	T	Solid	3050B	
180-26836-2MS	Matrix Spike	T	Solid	3050B	
180-26836-2MSD	Matrix Spike Duplicate	T	Solid	3050B	

Client: AECOM, Inc. Job Number: 180-26836-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
Metals					
Analysis Batch:180-89757					
LCS 180-89482/2-A	Lab Control Sample	T	Tissue	6020A	180-89482
LCSD 180-89482/3-A	Lab Control Sample Duplicate	T	Tissue	6020A	180-89482
MB 180-89482/1-A	Method Blank	T	Tissue	6020A	180-89482
PB 180-89081/4-B	Preparation / Extraction Blank	T	Tissue	6020A	180-89482
LCS 180-89486/2-A	Lab Control Sample	T	Tissue	6020A	180-89486
LCSD 180-89486/3-A	Lab Control Sample Duplicate	T	Tissue	6020A	180-89486
MB 180-89486/1-A	Method Blank	T	Tissue	6020A	180-89486
PB 180-89081/4-C	Preparation / Extraction Blank	T	Tissue	6020A	180-89486
180-26836-1	PRE-EXPOSURE WORMS	T	Tissue	6020A	180-89482
180-26836-1	PRE-EXPOSURE WORMS	T	Tissue	6020A	180-89486
180-26836-3	POST-EXPOSURE CONTROL WORMS	T	Tissue	6020A	180-89482
180-26836-3	POST-EXPOSURE CONTROL WORMS	T	Tissue	6020A	180-89486
180-26836-4	POST-EXPOSURE 27106 WORMS	T	Tissue	6020A	180-89482
180-26836-4	POST-EXPOSURE 27106 WORMS	T	Tissue	6020A	180-89486
Analysis Batch:180-89888					
LCS 180-89655/2-A	Lab Control Sample	T	Solid	6020A	180-89655
MB 180-89655/1-A	Method Blank	T	Solid	6020A	180-89655
LCS 180-89656/2-A	Lab Control Sample	T	Solid	6020A	180-89656
MB 180-89656/1-A	Method Blank	T	Solid	6020A	180-89656
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	T	Solid	6020A	180-89655
180-26836-2MS	Matrix Spike	T	Solid	6020A	180-89655
180-26836-2MSD	Matrix Spike Duplicate	T	Solid	6020A	180-89655
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	T	Solid	6020A	180-89656
180-26836-2MS	Matrix Spike	T	Solid	6020A	180-89656
180-26836-2MSD	Matrix Spike Duplicate	T	Solid	6020A	180-89656

Report Basis
T = Total

Client: AECOM, Inc. Job Number: 180-26836-1

QC Association Summary

Lab Sample ID	Client Sample ID	Report Basis	Client Matrix	Method	Prep Batch
General Chemistry					
Analysis Batch:180-89011					
180-26836-2	FOOD-FERMENTED F10-008 PREPPED	T	Solid	2540G	
Analysis Batch:180-89697					
180-26836-1	PRE-EXPOSURE WORMS	T	Tissue	2540G	
180-26836-3	POST-EXPOSURE CONTROL WORMS	T	Tissue	2540G	
180-26836-4	POST-EXPOSURE 27106 WORMS	T	Tissue	2540G	

Report Basis
T = Total

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Chronicle

Lab ID: 180-26836-1 **Client ID:** PRE-EXPOSURE WORMS

Sample Date/Time: 10/04/2013 11:30 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-1-C		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	180-26836-A-1-C		180-89757	180-89482	11/13/2013 14:28	1	TAL PIT	CNS
P:3050B	180-26836-A-1-D		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	180-26836-A-1-D		180-89757	180-89486	11/13/2013 15:31	1	TAL PIT	CNS
A:2540G	180-26836-A-1		180-89697		11/13/2013 17:49	1	TAL PIT	ADW

Lab ID: 180-26836-2 **Client ID:** FOOD-FERMENTED F10-008 PREPPED

Sample Date/Time: 11/01/2013 15:30 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-2-A		180-89888	180-89655	11/13/2013 12:56	1	TAL PIT	CEH
A:6020A	180-26836-A-2-A		180-89888	180-89655	11/14/2013 20:02	1	TAL PIT	CNS
P:3050B	180-26836-A-2-D		180-89888	180-89656	11/13/2013 12:57	1	TAL PIT	CEH
A:6020A	180-26836-A-2-D		180-89888	180-89656	11/14/2013 20:49	1	TAL PIT	CNS
A:2540G	180-26836-A-2		180-89011		11/06/2013 19:41	1	TAL PIT	JWM

Lab ID: 180-26836-2 MS **Client ID:** FOOD-FERMENTED F10-008 PREPPED

Sample Date/Time: 11/01/2013 15:30 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-2-B MS		180-89888	180-89655	11/13/2013 12:56	1	TAL PIT	CEH
A:6020A	180-26836-A-2-B MS		180-89888	180-89655	11/14/2013 20:12	1	TAL PIT	CNS
P:3050B	180-26836-A-2-E MS		180-89888	180-89656	11/13/2013 12:57	1	TAL PIT	CEH
A:6020A	180-26836-A-2-E MS		180-89888	180-89656	11/14/2013 20:58	1	TAL PIT	CNS

Lab ID: 180-26836-2 MSD **Client ID:** FOOD-FERMENTED F10-008 PREPPED

Sample Date/Time: 11/01/2013 15:30 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-2-C MSD		180-89888	180-89655	11/13/2013 12:56	1	TAL PIT	CEH
A:6020A	180-26836-A-2-C MSD		180-89888	180-89655	11/14/2013 20:17	1	TAL PIT	CNS
P:3050B	180-26836-A-2-F MSD		180-89888	180-89656	11/13/2013 12:57	1	TAL PIT	CEH
A:6020A	180-26836-A-2-F MSD		180-89888	180-89656	11/14/2013 21:03	1	TAL PIT	CNS

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Chronicle

Lab ID: 180-26836-2 SD **Client ID:** FOOD-FERMENTED F10-008 PREPPED

Sample Date/Time: 11/01/2013 15:30 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-2-A SD ^5		180-89888	180-89655	11/13/2013 12:56	5	TAL PIT	CEH
A:6020A	180-26836-A-2-A SD ^5		180-89888	180-89655	11/14/2013 20:07	5	TAL PIT	CNS
P:3050B	180-26836-A-2-D SD ^5		180-89888	180-89656	11/13/2013 12:57	5	TAL PIT	CEH
A:6020A	180-26836-A-2-D SD ^5		180-89888	180-89656	11/14/2013 20:54	5	TAL PIT	CNS

Lab ID: 180-26836-3 **Client ID:** POST-EXPOSURE CONTROL WORMS

Sample Date/Time: 11/01/2013 15:20 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-3-C		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	180-26836-A-3-C		180-89757	180-89482	11/13/2013 14:46	1	TAL PIT	CNS
P:3050B	180-26836-A-3-D		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	180-26836-A-3-D		180-89757	180-89486	11/13/2013 15:36	1	TAL PIT	CNS
A:2540G	180-26836-A-3		180-89697		11/13/2013 17:49	1	TAL PIT	ADW

Lab ID: 180-26836-4 **Client ID:** POST-EXPOSURE 27106 WORMS

Sample Date/Time: 11/01/2013 15:20 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-4-C		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	180-26836-A-4-C		180-89757	180-89482	11/13/2013 14:50	1	TAL PIT	CNS
P:3050B	180-26836-A-4-D		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	180-26836-A-4-D		180-89757	180-89486	11/13/2013 15:54	1	TAL PIT	CNS
A:2540G	180-26836-A-4		180-89697		11/13/2013 17:49	1	TAL PIT	ADW

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Chronicle

Lab ID: 180-26836-4 SD **Client ID:** POST-EXPOSURE 27106 WORMS

Sample Date/Time: 11/01/2013 15:20 Received Date/Time: 11/05/2013 08:50

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	180-26836-A-4-C SD ^5		180-89757	180-89482	11/12/2013 09:13	5	TAL PIT	RJR
A:6020A	180-26836-A-4-C SD ^5		180-89757	180-89482	11/13/2013 14:55	5	TAL PIT	CNS
P:3050B	180-26836-A-4-C PDS		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	180-26836-A-4-C PDS		180-89757	180-89482	11/13/2013 15:00	1	TAL PIT	CNS
P:3050B	180-26836-A-4-D SD ^5		180-89757	180-89486	11/12/2013 09:24	5	TAL PIT	RJR
A:6020A	180-26836-A-4-D SD ^5		180-89757	180-89486	11/13/2013 15:59	5	TAL PIT	CNS
P:3050B	180-26836-A-4-D PDS		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	180-26836-A-4-D PDS		180-89757	180-89486	11/13/2013 16:03	1	TAL PIT	CNS

Lab ID: MB **Client ID:** N/A

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	MB 180-89482/1-A		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	MB 180-89482/1-A		180-89757	180-89482	11/13/2013 14:05	1	TAL PIT	CNS
P:3050B	MB 180-89486/1-A		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	MB 180-89486/1-A		180-89757	180-89486	11/13/2013 15:09	1	TAL PIT	CNS
P:3050B	MB 180-89655/1-A		180-89888	180-89655	11/13/2013 12:56	1	TAL PIT	CEH
A:6020A	MB 180-89655/1-A		180-89888	180-89655	11/14/2013 19:40	1	TAL PIT	CNS
P:3050B	MB 180-89656/1-A		180-89888	180-89656	11/13/2013 12:57	1	TAL PIT	CEH
A:6020A	MB 180-89656/1-A		180-89888	180-89656	11/14/2013 19:45	1	TAL PIT	CNS

Lab ID: PB **Client ID:** N/A

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	PB 180-89081/4-B		180-89757	180-89482	11/12/2013 09:14	1	TAL PIT	RJR
A:6020A	PB 180-89081/4-B		180-89757	180-89482	11/13/2013 14:10	1	TAL PIT	CNS
P:3050B	PB 180-89081/4-C		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	PB 180-89081/4-C		180-89757	180-89486	11/13/2013 15:14	1	TAL PIT	CNS

Client: AECOM, Inc. Job Number: 180-26836-1

Laboratory Chronicle

Lab ID: LCS **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	LCS 180-89482/2-A		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	LCS 180-89482/2-A		180-89757	180-89482	11/13/2013 14:15	1	TAL PIT	CNS
P:3050B	LCS 180-89486/2-A		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	LCS 180-89486/2-A		180-89757	180-89486	11/13/2013 15:18	1	TAL PIT	CNS
P:3050B	LCS 180-89655/2-A		180-89888	180-89655	11/13/2013 12:56	1	TAL PIT	CEH
A:6020A	LCS 180-89655/2-A		180-89888	180-89655	11/14/2013 19:50	1	TAL PIT	CNS
P:3050B	LCS 180-89656/2-A		180-89888	180-89656	11/13/2013 12:57	1	TAL PIT	CEH
A:6020A	LCS 180-89656/2-A		180-89888	180-89656	11/14/2013 19:54	1	TAL PIT	CNS

Lab ID: LCSD **Client ID: N/A**

Sample Date/Time: N/A Received Date/Time: N/A

Method	Bottle ID	Run	Analysis Batch	Prep Batch	Date Prepared / Analyzed	Dil	Lab	Analyst
P:3050B	LCSD 180-89482/3-A		180-89757	180-89482	11/12/2013 09:13	1	TAL PIT	RJR
A:6020A	LCSD 180-89482/3-A		180-89757	180-89482	11/13/2013 14:20	1	TAL PIT	CNS
P:3050B	LCSD 180-89486/3-A		180-89757	180-89486	11/12/2013 09:24	1	TAL PIT	RJR
A:6020A	LCSD 180-89486/3-A		180-89757	180-89486	11/13/2013 15:23	1	TAL PIT	CNS

Lab References:
TAL PIT = TestAmerica Pittsburgh

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
MCCV1X_00051	11/22/13	10/22/13	2% Nitric Acid, Lot 25106	500 mL	MCALSPECAREV_00004	10 mL	Arsenic	0.1 ppm
							Lead	0.1 ppm
					MCALSPECB_00005	10 mL	Antimony	0.1 ppm
.MCALSPECAREV_00004	04/01/14	Inorganic Ventures, Lot F2-MEB415031			(Purchased Reagent)		Arsenic	5 ppm
							Lead	5 ppm
.MCALSPECB_00005	04/01/14	Inorganic Ventures, Lot F2-MEB415032			(Purchased Reagent)		Antimony	5 ppm
MCRIX_00041	12/05/13	11/05/13	HNO3, Lot K09N65	250 mL	MMSCRI-1B_00003	1 mL	Arsenic	0.001 ppm
							Lead	0.001 ppm
					MMSCRI-2_00005	1 mL	Antimony	0.002 ppm
.MMSCRI-1B_00003	10/01/14	Inorganic Ventures, Lot G2-MEB496135			(Purchased Reagent)		Arsenic	0.25 ppm
							Lead	0.25 ppm
.MMSCRI-2_00005	10/01/14	Inorganic Ventures, Lot F2-MEB439153			(Purchased Reagent)		Antimony	0.5 ppm
MICSABX_00044	01/28/14	10/28/13	2% Nitric Acid, Lot J38N82	100 mL	M6020ICS-0A_00004	10 mL	Al	100 ppm
							Ca	100 ppm
							Fe	100 ppm
							K	100 ppm
							Mg	100 ppm
							Mo	2 ppm
							Na	100 ppm
							Ti	2 ppm
					M6020ICS-0B_00005	1 mL	Ag	0.02 ppm
							Arsenic	0.02 ppm
							Cd	0.02 ppm
							Co	0.02 ppm
							Cr	0.02 ppm
							Cu	0.02 ppm
							Mn	0.0225 ppm
							Ni	0.02 ppm
							Zn	0.025 ppm
					MMSICSAB-1_00006	0.2 mL	Ba	0.02 ppm
							Be	0.02 ppm
							Lead	0.02 ppm
							Sr	0.025 ppm
							Tl	0.02 ppm
							V	0.02 ppm
					MMSICSAB-2_00005	0.2 mL	Antimony	0.02 ppm
							B	0.05 ppm
							Se	0.05 ppm
							Si	0.5 ppm
							Sn	0.1 ppm
.M6020ICS-0A_00004	09/01/14	Inorganic Ventures, Lot G2-MEB476152			(Purchased Reagent)		Al	1000 ppm
							Ca	1000 ppm
							Fe	1000 ppm
							K	1000 ppm
							Mg	1000 ppm

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
							Mo	20 ppm
							Na	1000 ppm
							Ti	20 ppm
.M6020ICS-0B_00005	09/01/14	Inorganic Ventures, Lot G2-MEB463151			(Purchased Reagent)		Ag	2 ppm
							Arsenic	2 ppm
							Cd	2 ppm
							Co	2 ppm
							Cr	2 ppm
							Cu	2 ppm
							Mn	2.25 ppm
							Ni	2 ppm
							Zn	2.5 ppm
.MMSICSAB-1_00006	04/01/14	Inorganic Ventures, Lot F2-MEB415033			(Purchased Reagent)		Ba	10 ppm
							Be	10 ppm
							Lead	10 ppm
							Sr	12.5 ppm
							Tl	10 ppm
							V	10 ppm
.MMSICSAB-2_00005	04/01/14	Inorganic Ventures, Lot G2-MEB467043			(Purchased Reagent)		Antimony	10 ppm
							B	25 ppm
							Se	25 ppm
							Si	250 ppm
							Sn	50 ppm
MICSAX_00040	01/28/14	10/28/13	DI Water, Lot J38N82	100 mL	M6020ICS-0A_00004	10 mL	Al	100 ppm
							Ca	100 ppm
							Fe	100 ppm
							K	100 ppm
							Mg	100 ppm
							Mo	2 ppm
							Na	100 ppm
							Ti	2 ppm
.M6020ICS-0A_00004	09/01/14	Inorganic Ventures, Lot G2-MEB476152			(Purchased Reagent)		Al	1000 ppm
							Ca	1000 ppm
							Fe	1000 ppm
							K	1000 ppm
							Mg	1000 ppm
							Mo	20 ppm
							Na	1000 ppm
							Ti	20 ppm
MICVX_00013	12/30/13	11/07/13	2% Nitric Acid, Lot 25106	250 mg/L	MICPMSICV_00013	10 mg/L	Antimony	0.08 mg/L
							Arsenic	0.08 mg/L
							Lead	0.08 mg/L
.MICPMSICV_00013	12/30/13	SPEX CertiPrep, Lot 17-147CR			(Purchased Reagent)		Antimony	2 ppm
							Arsenic	2 ppm
							Lead	2 ppm
MSTD2X_00026	11/22/13	10/22/13	DI Water, Lot 25106	250 mL	MCALSPECAREV_00004	10 mg/L	Arsenic	0.2 ppm

REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
							Lead	0.2 ppm
.MCALSPECAREV_00004	04/01/14	Inorganic Ventures, Lot F2-MEB415031			(Purchased Reagent)		Arsenic	5 ppm
							Lead	5 ppm
MSTD3X_00027	11/22/13	10/22/13	2% Nitric Acid, Lot 25106	250 mL	MCALSPECB_00005	10 mg/L	Antimony	0.2 ppm
.MCALSPECB_00005	04/01/14	Inorganic Ventures, Lot F2-MEB415032			(Purchased Reagent)		Antimony	5 ppm
MTAPITTICPMS_00016	08/01/14	INORGANIC VENTURES, Lot G2-MEB455121			(Purchased Reagent)		Ag	5 ug/mL
							Al	200 ug/mL
							Arsenic	4 ug/mL
							B	100 ug/mL
							Ba	200 ug/mL
							Be	5 ug/mL
							Cd	5 ug/mL
							Co	50 ug/mL
							Cr	20 ug/mL
							Cu	25 ug/mL
							Fe	100 ug/mL
							Lead	2 ug/mL
							Mn	50 ug/mL
							Ni	50 ug/mL
							Se	1 ug/mL
							Sr	100 ug/mL
							Tl	5 ug/mL
							V	50 ug/mL
							Zn	50 ug/mL
MTAPITTMSA_00017	11/01/14	INORGANIC VENTURES, Lot G2-MEB494149			(Purchased Reagent)		Ca	5000 ug/mL
							K	5000 ug/mL
							Mg	5000 ug/mL
							Na	5000 ug/mL
MTAPITTMSC_00023	11/01/14	Inorganic Ventures, Lot G2-MEB494150			(Purchased Reagent)		Antimony	50 ug/mL
							Mo	100 ug/mL
							Si	1000 ug/mL
							SiO2	2140 ug/mL
							Sn	200 ug/mL
							Ti	100 ug/mL

INORGANIC VENTURES™
300 Technology Drive
Christiansburg, VA 24073 • USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

Rec 31313

tel: 800.669.6799 • 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

765217

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01

ACCREDITED Reference Material Producer Certificate 883.02

2.0 **DESCRIPTION OF CRM** **Custom Solution**

Catalog No.: TAPITT-CAL-SPECA-REV

Lot Number: **F2-MEB415031**

Matrix: 3% HNO3(v/v)

2,500 µg/mL ea:
Ca, K, Mg, Na,

1,250 µg/mL ea:
Fe,

25 µg/mL ea:
Al, Mn,

5 µg/mL ea:
Ag, As, Ba, Be, Cd, Co, Cr3, Cu, Ni,
Pb, Se, Sr, Tl, V, Zn

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Aluminum, Al	25.00 ± 0.18 µg/mL	Arsenic, As	5.000 ± 0.032 µg/mL	Barium, Ba	4.999 ± 0.036 µg/mL
Beryllium, Be	5.002 ± 0.036 µg/mL	Cadmium, Cd	5.000 ± 0.032 µg/mL	Calcium, Ca	2,500 ± 16 µg/mL
Chromium+3, Cr3	5.001 ± 0.032 µg/mL	Cobalt, Co	5.003 ± 0.032 µg/mL	Copper, Cu	5.001 ± 0.032 µg/mL
Iron, Fe	1,250 ± 8 µg/mL	Lead, Pb	5.002 ± 0.032 µg/mL	Magnesium, Mg	2,500 ± 16 µg/mL
Manganese, Mn	25.02 ± 0.15 µg/mL	Nickel, Ni	4.999 ± 0.028 µg/mL	Potassium, K	2,500 ± 16 µg/mL
Selenium, Se	5.002 ± 0.028 µg/mL	Silver, Ag	4.999 ± 0.032 µg/mL	Sodium, Na	2,500 ± 16 µg/mL
Strontium, Sr	5.001 ± 0.032 µg/mL	Thallium, Tl	5.002 ± 0.032 µg/mL	Vanadium, V	4.999 ± 0.032 µg/mL
Zinc, Zn	5.001 ± 0.028 µg/mL				

Certified Density: 1.051 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Certified Value $(\bar{x}) = \frac{\sum x_i}{n}$

$(\bar{x})$ = mean

x_i = individual results

n = number of measurements

Uncertainty $(\pm) = 2\,[\,\Sigma(s_i)^2\,]^{1/2}$

2 = the coverage factor.

$[\,\Sigma(s_i)^2\,]^{1/2}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999b	999b
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
As	Calculated		See Sec. 4.2
As	ICP Assay	3103a	010713
Ba	Gravimetric		See Sec. 4.2
Ba	ICP Assay	3104a	070222
Be	Calculated		See Sec. 4.2
Be	ICP Assay	3105a	892707
Ca	ICP Assay	3109a	050825
Ca	EDTA	928	928
Cd	ICP Assay	3108	060531
Cd	EDTA	928	928
Co	ICP Assay	3113	00630
Co	EDTA	928	928
Cr3	Calculated		See Sec. 4.2
Cr3	ICP Assay	3112a	030730
Cu	ICP Assay	3114	011017
Cu	EDTA	928	928
Fe	ICP Assay	3126a	051031
Fe	EDTA	928	928
K	Gravimetric		See Sec. 4.2
K	ICP Assay	3141a	051220
Mg	ICP Assay	3131a	050302
Mg	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Na	Gravimetric		See Sec. 4.2
Na	ICP Assay	3152a	010728
Ni	ICP Assay	3136	000612
Ni	EDTA	928	928
Pb	ICP Assay	3128	030721
Pb	EDTA	928	928
Se	Calculated		See Sec. 4.2
Se	ICP Assay	3149	992106
Sr	ICP Assay	3153a	990906
Sr	EDTA	928	928
Tl	Calculated		See Sec. 4.2
Tl	ICP Assay	3158	993012
V	ICP Assay	3165	992706
V	EDTA	928	928
Zn	ICP Assay	3168a	080123
Zn	EDTA	928	928

4.2 **BALANCE CALIBRATION** - All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION** - All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION** - An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

Low Silver Note: This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous.

Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: March 06, 2012

Expiration Date: EXPIRES 01 APR 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

REC: 31313

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 • 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

765240

is an ISO Guide 34 "General Requirements for the
e Material Producers" and ISO 9001 registered
icturing laboratory is accredited to ISO/IEC 17025
or the Competence of Testing and Calibration

ACCREDITED
Testing Laboratory
Certificate 883.01

ACCREDITED
Reference Material Producer
Certificate 883.02

Custom Solution

TAPITT-CAL-SPECB

F2-MEB415032

3% HNO3(v/v), tr. HF

Sn, Ti

UNCERTAINTIES

	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
nL	Boron, B	5.000 ± 0.032 µg/mL	Molybdenum, Mo	5.002 ± 0.035 µg/mL
nL	Tin, Sn	5.002 ± 0.041 µg/mL	Titanium, Ti	5.002 ± 0.039 µg/mL

6 g/mL (measured at 20 ± 1° C)

alculation of the certified value and the uncertainty. Reported uncertainties represent expanded
the 95% confidence level using a coverage factor of k = 2.

$(\bar{x})$ = mean

x_i = individual results

n = number of measurements

2 = the coverage factor.

$[\Sigma(s_i)^2]^{1/2}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
B	Calculated		See Sec. 4.2
B	ICP Assay	3107	070514
Mo	Calculated		See Sec. 4.2
Mo	ICP Assay	3134	891307
Sb	Calculated		See Sec. 4.2
Sb	ICP Assay	3102A	061229
Si	Calculated		See Sec. 4.2
Si	ICP Assay	3150	071204
Sn	Calculated		See Sec. 4.2
Sn	ICP Assay	3161a	070330
Ti	Calculated		See Sec. 4.2
Ti	ICP Assay	3162a	060808

4.2 **BALANCE CALIBRATION -** All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION -** All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION -** An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous.

Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: March 06, 2012

Expiration Date: EXPIRES 01 APR 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

Reference Materials Producer
Cert #2495.01

SPEXertificate®

Certificate of Reference Material

Chemical Testing
Cert #2495.02

Catalog Number: ZCAL-60-250 **Lot No.** 17-147CR

Description: Custom Claritas Standard

Matrix: 5% HNO_3 / Tr. Tart. Acid / Tr. HF

This CLARITAS PPT® Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICP-OES, DCP, AA, ICP-MS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

The CRM is prepared from high purity single element concentrates of individual elements using Class A laboratory ware to give precise concentrations.

Instrumental Analysis by ICP Spectrometer:

Analyte	Labeled	Uncertainty	SRM	Analyte	Labeled	Uncertainty	SRM
Ca	1000 mg/L	±5 mg/L	3109a*	Co	2 mg/L	±0.01 mg/L	3113*
K	1000 mg/L	±5 mg/L	3141a*	Cr	2 mg/L	±0.01 mg/L	3112a*
Mg	1000 mg/L	±5 mg/L	3131a*	Cu	2 mg/L	±0.01 mg/L	3114*
Na	1000 mg/L	±5 mg/L	3152a*	Mo	2 mg/L	±0.01 mg/L	3134*
Fe	500 mg/L	±3 mg/L	3126a*	Ni	2 mg/L	±0.01 mg/L	3136*
Si	100 mg/L	±0.5 mg/L	3150*	Pb	2 mg/L	±0.01 mg/L	3128*
Al	10 mg/L	±0.05 mg/L	3101a*	Sb	2 mg/L	±0.01 mg/L	3102a*
Mn	10 mg/L	±0.05 mg/L	3132*	Se	2 mg/L	±0.01 mg/L	3149*
Ag	2 mg/L	±0.01 mg/L	3151*	Sn	2 mg/L	±0.01 mg/L	3161a*
As	2 mg/L	±0.01 mg/L	3103a*	Sr	2 mg/L	±0.01 mg/L	3153a*
B	2 mg/L	±0.01 mg/L	3107*	Tl	2 mg/L	±0.01 mg/L	3162a*
Ba	2 mg/L	±0.01 mg/L	3104a*	Tl	2 mg/L	±0.01 mg/L	3158*
Be	2 mg/L	±0.01 mg/L	3105a*	V	2 mg/L	±0.01 mg/L	3165*
Cd	2 mg/L	±0.01 mg/L	3108*	Zn	2 mg/L	±0.01 mg/L	3168a*

* - indicates NIST SRM † - indicates SPEX CertiPrep CRM (when NIST SRM is not available)

SPEX CertiPrep Reference Multi: Lot# ALL8

Trace Metallic Impurities in the Actual Solution via ICP/ICP-MS Analysis:

Element	µg/L	Element	µg/L	Element	µg/L	Element	µg/L	Element	µg/L	Element	µg/L
Au	<0.7	Ga	<3	Ir	20	Pd	<2	Sc	<1	Tm	<0.1
Bi	6	Gd	<0.01	La	1	Pr	<0.05	Sm	<0.4	U	<0.2
Ce	1	Ge	<6	Li	<30	Pt	<1	Ta	20	W	<7
Cs	<0.3	Hf	0.2	Lu	<0.05	Rb	40	Tb	0.1	Y	0.4
Dy	<0.2	Hg	<4	Nb	2	Re	<0.4	Te	<6	Yb	<0.3
Er	<0.2	Ho	<0.1	Nd	<0.2	Rh	<0.8	Th	0.4	Zr	<50
Eu	<0.1	In	<6	P	<400	Ru	<0.8				

Balances are calibrated regularly with weight sets traceable to NIST#s 32856, 32867 and others. This CRM is guaranteed stable and accurate to ±0.5% of the labeled value. This includes uncertainty components due to preparation, measurement, homogeneity, short-term and long-term stability, as well as transpiration loss. This guarantee is valid for a period of one year from the date of certification only when the material is kept tightly closed and stored under ambient laboratory conditions.

Date of Certification: DEC 2012 Certifying Officer:

©2011 SPEX CertiPrep, Inc.

INORGANIC VENTURES™
300 Technology Drive
Christiansburg, VA 24073 • USA
inorganicventures.com
tel: 800.669.6799 • 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

Rec 3B13

CERTIFICATE OF ANALYSIS

773262

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01
ACCREDITED Reference Material Producer Certificate 883.02

2.0 DESCRIPTION OF CRM **Custom Solution**

Catalog No.: TAPITT-MSICSAB-1

Lot Number: **F2-MEB415033**

Matrix: 3% HNO3(v/v)

10 µg/mL ea:
Ba, Be, Pb, Sr, Tl, V

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Barium, Ba	10.00 ± 0.07 µg/mL	Beryllium, Be	10.00 ± 0.07 µg/mL	Lead, Pb	10.00 ± 0.06 µg/mL
Strontium, Sr	10.00 ± 0.06 µg/mL	Thallium, Tl	10.00 ± 0.06 µg/mL	Vanadium, V	10.00 ± 0.06 µg/mL

Certified Density: 1.014 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

$$\text{Certified Value } (\bar{x}) = \frac{\Sigma x_i}{n}$$

$$\text{Uncertainty } (\pm) = 2\,[\,\Sigma(s_i)^2\,]^{1/2}$$

$(\bar{x})$ = mean
x_i = individual results
n = number of measurements
2 = the coverage factor.
$[\,\Sigma(s_i)^2\,]^{1/2}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
Ba	Gravimetric		See Sec. 4.2
Ba	ICP Assay	3104a	070222
Be	Calculated		See Sec. 4.2
Be	ICP Assay	3105a	892707
Pb	ICP Assay	3128	030721
Pb	EDTA	928	928
Sr	ICP Assay	3153a	990906
Sr	EDTA	928	928
Tl	Calculated		See Sec. 4.2
Tl	ICP Assay	3158	993012
V	ICP Assay	3165	992706
V	EDTA	928	928

4.2 **BALANCE CALIBRATION** - All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION** - All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION** - An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous.

Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

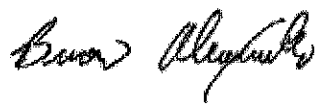
Certification Date: March 06, 2012

Expiration Date: EXPIRES 01 APR 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director



Certifying Officer: Paul Gaines
PhD., Senior Technical Director

INORGANIC VENTURES™
300 Technology Drive
Christiansburg, VA 24073 • USA
inorganicventures.com

Rec 3B13

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 • 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

773263

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01 ACCREDITED Reference Material Producer Certificate 883.02

2.0 **DESCRIPTION OF CRM** **Custom Solution**

Catalog No.: TAPITT-MSICSAB-2

Lot Number: **G2-MEB467043**

Matrix: 3% HNO3(v/v), tr. HF

250 µg/mL ea:
Si,

50 µg/mL ea:
Sn,

25 µg/mL ea:
B, Se,

10 µg/mL ea:
Sb

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Antimony, Sb	10.00 ± 0.06 µg/mL	Boron, B	24.98 ± 0.17 µg/mL	Selenium, Se	25.01 ± 0.21 µg/mL
Silicon, Si	249.9 ± 1.6 µg/mL	Tin, Sn	50.04 ± 0.36 µg/mL		

Certified Density: 1.018 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Certified Value $(\bar{x}) = \frac{\Sigma x_i}{n}$

$(\bar{x})$ = mean
x_i = individual results
n = number of measurements

Uncertainty $(\pm) = 2\,[\,\Sigma(s_i)^2\,]^{1/2}$

2 = the coverage factor.

$[\,\Sigma(s_i)^2\,]^{1/2}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
B	ICP Assay	3107	070514
Sb	Calculated		See Sec. 4.2
Sb	ICP Assay	3102A	061229
Se	Calculated		See Sec. 4.2
Se	ICP Assay	3149	992106
Si	Calculated		See Sec. 4.2
Si	ICP Assay	3150	071204
Sn	Calculated		See Sec. 4.2
Sn	ICP Assay	3161a	070330

4.2 BALANCE CALIBRATION - All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 THERMOMETER CALIBRATION - All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 GLASSWARE CALIBRATION - An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: March 08, 2013

Expiration Date: EXPIRES 01 APR 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

8886866

INORGANIC VENTURES™

300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

CERTIFICATE OF ANALYSIS

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 863.01

ACCREDITED Reference Material Producer Certificate 863.02

2.0 **DESCRIPTION OF CRM** **Custom Solution**

Catalog No.: TAPITT-MS-ICPMS

Lot Number: **G2-MEB455121**

Matrix: 0.7% HNO3(v/v)

Recd 7/11/13 RJR

200 µg/mL ea:
Al, Ba,

100 µg/mL ea:
B, Fe, Sr,

50 µg/mL ea:
Co, Mn, Ni, V, Zn,

25 µg/mL ea:
Cu,

20 µg/mL ea:
Cr3,

5 µg/mL ea:
Ag, Be, Cd, Tl,

4 µg/mL ea:
As,

2 µg/mL ea:
Pb,

1 µg/mL ea:
Se

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Aluminum, Al	200.1 ± 1.3 µg/mL	Arsenic, As	4.001 ± 0.026 µg/mL	Barium, Ba	200.0 ± 1.3 µg/mL
Beryllium, Be	5.001 ± 0.028 µg/mL	Boron, B	100.0 ± 0.7 µg/mL	Cadmium, Cd	5.001 ± 0.032 µg/mL
Chromium+3, Cr3	20.01 ± 0.13 µg/mL	Cobalt, Co	50.02 ± 0.33 µg/mL	Copper, Cu	25.00 ± 0.17 µg/mL
Iron, Fe	100.0 ± 0.6 µg/mL	Lead, Pb	2.000 ± 0.013 µg/mL	Manganese, Mn	50.01 ± 0.32 µg/mL
Nickel, Ni	50.01 ± 0.33 µg/mL	Selenium, Se	1.001 ± 0.007 µg/mL	Silver, Ag	5.001 ± 0.032 µg/mL
Strontium, Sr	100.0 ± 0.6 µg/mL	Thallium, Tl	5.001 ± 0.032 µg/mL	Vanadium, V	50.00 ± 0.35 µg/mL
Zinc, Zn	50.00 ± 0.33 µg/mL				

Certified Density: 1.005 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Certified Value $(\bar{x}) = \frac{\sum x_i}{n}$ ($\bar{x}$) = mean

x_i = individual results

n = number of measurements

Uncertainty $(\pm) = 2 [\Sigma(s_i)^2]^{\frac{1}{2}}$ 2 = the coverage factor.

$[\Sigma(s_i)^2]^{\frac{1}{2}}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
Ag	ICP Assay	3151	992212
Ag	Volhard	999b	999b
Al	ICP Assay	3101a	060502
Al	EDTA	928	928
As	Calculated		See Sec. 4.2
As	ICP Assay	3103a	100818
B	ICP Assay	3107	070514
Ba	Gravimetric		See Sec. 4.2
Ba	ICP Assay	3104a	070222
Be	Calculated		See Sec. 4.2
Be	ICP Assay	3105a	090514
Cd	ICP Assay	3108	060531
Cd	EDTA	928	928
Co	ICP Assay	3113	00630
Co	EDTA	928	928
Cr3	Calculated		See Sec. 4.2
Cr3	ICP Assay	3112a	030730
Cu	ICP Assay	3114	011017
Cu	EDTA	928	928
Fe	ICP Assay	3126a	051031
Fe	EDTA	928	928
Mn	ICP Assay	3132	050429
Mn	EDTA	928	928
Ni	ICP Assay	3136	000612
Ni	EDTA	928	928
Pb	ICP Assay	3128	101026
Pb	EDTA	928	928
Se	Calculated		See Sec. 4.2
Se	ICP Assay	3149	100901
Sr	ICP Assay	3153a	990906
Sr	EDTA	928	928
Tl	Calculated		See Sec. 4.2
Tl	ICP Assay	3158	993012
V	ICP Assay	3165	992706
V	EDTA	928	928
Zn	ICP Assay	3168a	080123
Zn	EDTA	928	928

4.2 **BALANCE CALIBRATION -** All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION -** All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION -** An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

Low Silver Note: This solution contains "LOW" levels of Silver. Please store this entire bottle inside a sealed glass jar.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous.

Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: January 09, 2013

Expiration Date: EXPIRES 01 Oct 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Christy Shortridge
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

INORGANIC VENTURES™
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01 ACCREDITED Reference Material Producer Certificate 883.02

2.0 **DESCRIPTION OF CRM** **Custom Solution**

Catalog No.: TAPITT-MS-A

Lot Number: **G2-MEB494149**

Matrix: 3% HNO3(v/v)

5,000 µg/mL ea:
Ca, K, Mg, Na

3.0 CERTIFIED VALUES AND UNCERTAINTIES

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Calcium, Ca	5,000 ± 22 µg/mL	Magnesium, Mg	5,000 ± 32 µg/mL	Potassium, K	5,000 ± 22 µg/mL
Sodium, Na	5,000 ± 22 µg/mL				

Certified Density: 1.072 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Certified Value $(\bar{x}) = \frac{\Sigma x_i}{n}$ ($\bar{x}$) = mean

x_i = individual results

n = number of measurements

Uncertainty $(\pm) = 2\,[\,\Sigma(s_i)^2\,]^{1/2}$ 2 = the coverage factor.

$[\,\Sigma(s_i)^2\,]^{1/2}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
Ca	ICP Assay	3109a	050825
Ca	EDTA	928	928
K	Gravimetric		See Sec. 4.2
K	ICP Assay	3141a	051220
Mg	ICP Assay	3131a	050302
Mg	EDTA	928	928
Na	Gravimetric		See Sec. 4.2
Na	ICP Assay	3152a	120715

4.2 **BALANCE CALIBRATION** - All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 **THERMOMETER CALIBRATION** - All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 **GLASSWARE CALIBRATION** - An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous.

Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: October 07, 2013

Expiration Date: EXPIRES 01 NOV 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

MATERIAL SAFETY DATA SHEET
TAPITT-MS-A

Revision Number 3, Revision Date April 08, 2013

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product code	TAPITT MS A
Product name	Multi-element Solution Standard in Dilute Nitric Acid
Common Name	Contains: 5000 µg/mL ea: Ca, K, Mg, Na
Manufacturer, importer, supplier	Inorganic Ventures 300 Technology Drive Christiansburg, VA 24073 web: www.inorganicventures.com
Emergency telephone number	800-424-9300 CHEMTREC (24 hrs)

2. COMPOSITION/INFORMATION ON INGREDIENTS

CAS	Chemical Name	% Weight	ACGIH*	OSHA*
7732-18-5	Water	~93.3	N/A	N/A
7697-37-2	Nitric Acid	~3.0	2 ppm TWA	2 ppm TWA; 5 mg/m3 TWA
1305-78-8	Calcium Oxide	~0.7	2 mg/m3 TWA	5 mg/m3 TWA
7439-95-4	Magnesium	~0.5	N/A	N/A
7757-79-1	Potassium nitrate	~1.3	N/A	N/A
497-19-8	Sodium Carbonate	~1.2	N/A	N/A

* ACGIH - Occupational Exposure Limits - TWAs
* OSHA - Final PELs - Time Weighted Averages (TWAs)

3. HAZARDS IDENTIFICATION

Emergency Overview
- Vapours may be irritating to eyes, nose, throat, and lungs
- Corrosive

Eye contact	• Contact with eyes may cause irritation
Skin contact	• Substance may cause slight skin irritation
Inhalation	• May cause irritation of respiratory tract
Ingestion	• Harmful if swallowed

4. FIRST AID MEASURES

General advice	• Show this safety data sheet to the doctor in attendance
Skin contact	• Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes • Consult a physician if necessary
Eye contact	• Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes • Keep eye wide open while rinsing • If eye irritation persists, consult a specialist
Inhalation	• Move to fresh air in case of accidental inhalation of vapours • If breathing is difficult, give oxygen • Consult a physician if necessary
Ingestion	• Call a physician or Poison Control Centre immediately • If swallowed, seek medical advice immediately and show this container or label • If conscious, drink plenty of water

5. FIRE-FIGHTING MEASURES

Flash point	NA
Suitable extinguishing media	• Use extinguishing measures that are appropriate to local circumstances and the surrounding environment
Specific hazards	• Thermal decomposition can lead to release of irritating gases and vapours

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product code	TAPITT MS A
Product name	Multi-element Solution Standard in Dilute Nitric Acid
Common Name	Contains: 5000 µg/mL ea: Ca, K, Mg, Na
Manufacturer, importer, supplier	Inorganic Ventures 300 Technology Drive Christiansburg, VA 24073 web: www.inorganicventures.com
Emergency telephone number	800-424-9300 CHEMTREC (24 hrs)

2. COMPOSITION/INFORMATION ON INGREDIENTS

CAS	Chemical Name	% Weight	ACGIH*	OSHA*
7732-18-5	Water	~93.3	N/A	N/A
7697-37-2	Nitric Acid	~3.0	2 ppm TWA	2 ppm TWA; 5 mg/m3 TWA
1305-78-8	Calcium Oxide	~0.7	2 mg/m3 TWA	5 mg/m3 TWA
7439-95-4	Magnesium	~0.5	N/A	N/A
7757-79-1	Potassium nitrate	~1.3	N/A	N/A
497-19-8	Sodium Carbonate	~1.2	N/A	N/A

* ACGIH - Occupational Exposure Limits - TWAs
* OSHA - Final PELs - Time Weighted Averages (TWAs)

3. HAZARDS IDENTIFICATION

Emergency Overview
- Vapours may be irritating to eyes, nose, throat, and lungs
- Corrosive

Eye contact	• Contact with eyes may cause irritation
Skin contact	• Substance may cause slight skin irritation
Inhalation	• May cause irritation of respiratory tract
Ingestion	• Harmful if swallowed

4. FIRST AID MEASURES

General advice	• Show this safety data sheet to the doctor in attendance
Skin contact	• Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes • Consult a physician if necessary
Eye contact	• Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes • Keep eye wide open while rinsing • If eye irritation persists, consult a specialist
Inhalation	• Move to fresh air in case of accidental inhalation of vapours • If breathing is difficult, give oxygen • Consult a physician if necessary
Ingestion	• Call a physician or Poison Control Centre immediately • If swallowed, seek medical advice immediately and show this container or label • If conscious, drink plenty of water

5. FIRE-FIGHTING MEASURES

Flash point	NA
Suitable extinguishing media	• Use extinguishing measures that are appropriate to local circumstances and the surrounding environment
Specific hazards	• Thermal decomposition can lead to release of irritating gases and vapours

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	• In accordance with local and national regulations
Contaminated packaging	• Empty containers should be taken for local recycling, recovery or waste disposal

14. TRANSPORT INFORMATION

DOT

UN-No UN3264 / Class 8
Proper shipping name Corrosive liquid, acidic, inorganic, n.o.s
Packing group III

IATA-DGR

UN-No UN3264 / Class 8
Proper shipping name Corrosive liquid, acidic, inorganic, n.o.s
Packing group III

15. REGULATORY INFORMATION

U.S. INVENTORIES:

CAS	Chemical Name	% Weight	CPCL*	NJRTK*	CERCLA/SARA*
7732-18-5	Water	~93.3	N/A	N/A	N/A
7697-37-2	Nitric Acid	~3.0	N/A	sn 1356	1000 lb final RQ; 454 kg final RQ
1305-78-8	Calcium Oxide	~0.7	N/A	sn 0325	N/A
7439-95-4	Magnesium	~0.5	N/A	sn 1136	N/A
7757-79-1	Potassium nitrate	~1.3	N/A	sn 1574	N/A
497-19-8	Sodium Carbonate	~1.2	N/A	N/A	N/A

* CPCL - California - Proposition 65 - Carcinogens List
* NJRTK - New Jersey - Department of Health RTK List
* CERCLA/SARA - Hazardous Substances and their Reportable Quantities
:

INTERNATIONAL INVENTORIES:

CAS	Chemical Name	% Weight	WHMIS*	EINECCS - European Union*
7732-18-5	Water	~93.3	Uncontrolled product according to WHMIS classification criteria	231-791-2
7697-37-2	Nitric Acid	~3.0	C, E (including 60%, 61.3%, 63%, 67%, 67.18%, 70%, 90%); E (10%)	231-714-2
1305-78-8	Calcium Oxide	~0.7	E	215-138-9
7439-95-4	Magnesium	~0.5	B4, B6	231-104-6
7757-79-1	Potassium nitrate	~1.3	C	231-818-8
497-19-8	Sodium Carbonate	~1.2	N/A	207-838-8

* WHMIS - Canada - WHMIS - Classifications of Substances
* EINECCS - European Union - European inventory of Existing Commercial Chemical Substances (EINECCS)
:

16. OTHER INFORMATION

The above information is believed to be accurate and represents the best information available to us. It has been compiled from the data presented in various technical publications and our experience and should only be used as a guide for handling this product. It is the user's responsibility to determine the suitability of this information for their particular purposes. We assume that only qualified individuals, trained and familiar with procedures suitable to this product will handle this material. Inorganic Ventures, Inc. assumes no responsibility and shall not be held liable for any damage resulting from misuse of this product.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	• In accordance with local and national regulations
Contaminated packaging	• Empty containers should be taken for local recycling, recovery or waste disposal

14. TRANSPORT INFORMATION

DOT

UN-No	UN3264 / Class 8
Proper shipping name	Corrosive liquid, acidic, inorganic, n.o.s
Packing group	III

IATA-DGR

UN-No	UN3264 / Class 8
Proper shipping name	Corrosive liquid, acidic, inorganic, n.o.s
Packing group	III

15. REGULATORY INFORMATION

U.S. INVENTORIES:

CAS	Chemical Name	% Weight	CPCL*	NJRTK*	CERCLA/SARA*
7732-18-5	Water	~93.3	N/A	N/A	N/A
7697-37-2	Nitric Acid	~3.0	N/A	sn 1356	1000 lb final RQ; 454 kg final RQ
1305-78-8	Calcium Oxide	~0.7	N/A	sn 0325	N/A
7439-95-4	Magnesium	~0.5	N/A	sn 1136	N/A
7757-79-1	Potassium nitrate	~1.3	N/A	sn 1574	N/A
497-19-8	Sodium Carbonate	~1.2	N/A	N/A	N/A

* CPCL - California - Proposition 65 - Carcinogens List
* NJRTK - New Jersey - Department of Health RTK List
* CERCLA/SARA - Hazardous Substances and their Reportable Quantities
:

INTERNATIONAL INVENTORIES:

CAS	Chemical Name	% Weight	WHMIS*	EINECCS - European Union*
7732-18-5	Water	~93.3	Uncontrolled product according to WHMIS classification criteria	231-791-2
7697-37-2	Nitric Acid	~3.0	C, E (including 60%, 61.3%, 63%, 67%, 67.18%, 70%, 90%); E (10%)	231-714-2
1305-78-8	Calcium Oxide	~0.7	E	215-138-9
7439-95-4	Magnesium	~0.5	B4, B6	231-104-6
7757-79-1	Potassium nitrate	~1.3	C	231-818-8
497-19-8	Sodium Carbonate	~1.2	N/A	207-838-8

* WHMIS - Canada - WHMIS - Classifications of Substances
* EINECCS - European Union - European inventory of Existing Commercial Chemical Substances (EINECCS)
:

16. OTHER INFORMATION

The above information is believed to be accurate and represents the best information available to us. It has been compiled from the data presented in various technical publications and our experience and should only be used as a guide for handling this product. It is the user's responsibility to determine the suitability of this information for their particular purposes. We assume that only qualified individuals, trained and familiar with procedures suitable to this product will handle this material. Inorganic Ventures, Inc. assumes no responsibility and shall not be held liable for any damage resulting from misuse of this product.

INORGANIC VENTURES™
300 Technology Drive
Christiansburg, VA 24073 · USA
inorganicventures.com

CERTIFICATE OF ANALYSIS

tel: 800.669.6799 · 540.585.3030
fax: 540.585.3012
info@inorganicventures.com

1.0 **INORGANIC VENTURES** is an ISO Guide 34 "General Requirements for the Competence of Reference Material Producers" and ISO 9001 registered manufacturer. Our manufacturing laboratory is accredited to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories."

ACCREDITED Testing Laboratory Certificate 883.01

ACCREDITED Reference Material Producer Certificate 883.02

2.0 **DESCRIPTION OF CRM** **Custom Solution**

Catalog No.: TAPITT-MS-C

Lot Number: **G2-MEB494150**

Matrix: 3% HNO3(v/v), tr. HF

1,000 µg/mL ea:
Si,

200 µg/mL ea:
Sn,

100 µg/mL ea:
Mo, Ti,

50 µg/mL ea:
Sb

3.0 **CERTIFIED VALUES AND UNCERTAINTIES**

ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE	ELEMENT	CERTIFIED VALUE
Antimony, Sb	50.00 ± 0.38 µg/mL	Molybdenum, Mo	100.0 ± 0.5 µg/mL	Silicon, Si	1,000 ± 7 µg/mL
Tin, Sn	200.0 ± 1.4 µg/mL	Titanium, Ti	100.0 ± 0.7 µg/mL		

Certified Density: 1.018 g/mL (measured at 20 ± 1° C)

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Certified Value $(\bar{x}) = \frac{\Sigma x_i}{n}$ ($\bar{x}$) = mean

x_i = individual results

n = number of measurements

Uncertainty (±) = $2 [\Sigma(s_i)^2]^{½}$ 2 = the coverage factor.

$[\Sigma(s_i)^2]^{½}$ = The square root of the sum of the squares of the most common errors (where 's' stands for the standard deviation) from instrumental measurement, density, NIST SRM uncertainty, weighing, dilution to volume, homogeneity, long term stability and short term stability.

4.0 TRACEBILITY TO NIST AND VALUES OBTAINED BY INDEPENDENT METHODS

· "Property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (ISO VIM, 2nd ed., 1993, definition 6.10)

· This product is Traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRMs are available, the term 'in-house std.' is specified.

- The Calculated Value is a value calculated from the weight of a starting material that has been certified directly vs. a NIST SRM/RM. See section 4.2 for balance traceability.

4.1 ASSAY INFORMATION

ELEMENT	METHOD	NIST SRM#	SRM LOT#
Mo	Calculated		See Sec. 4.2
Mo	ICP Assay	3134	891307
Sb	Calculated		See Sec. 4.2
Sb	ICP Assay	3102A	061229
Si	Calculated		See Sec. 4.2
Si	ICP Assay	3150	071204
Sn	Calculated		See Sec. 4.2
Sn	ICP Assay	3161a	070330
Ti	ICP Assay	3162a	060808

4.2 BALANCE CALIBRATION - All analytical balances are calibrated yearly by an accredited calibration laboratory and are traceable to a class E 2 analytical weight set with NIST Traceability. All balances are checked daily using an in-house procedure. The weights used for testing are annually compared to master weights and are traceable to the National Institute of Standards and Technology (NIST).

4.3 THERMOMETER CALIBRATION - All thermometers are NIST traceable through thermometers that are calibrated by an A2LA accredited calibration laboratory.

4.4 GLASSWARE CALIBRATION - An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM's.

5.0 TRACE METALLIC IMPURITIES (TMI) DETERMINED BY ICP-MS AND ICP-OES IN µg/mL - N/A

6.0 INTENDED USE

For the calibration of analytical instruments including but not limited to the following:
HPLC, IC, TLC, ISE, IR, NMR, UV/VIS, MS, Capillary Electrophoresis, Potentiometry, Wet Chemistry and Voltammetry
For the validation of analytical methods
For the preparation of "working reference samples"
For interference studies and the determination of correction coefficients
For detection limit and linearity studies
For additional intended uses, contact Technical Staff

This CRM was manufactured using 18 megohm doubly deionized water that has been filtered through a 0.2 micron filter.

7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL

Storage & Handling - Keep **Tightly** sealed when not in use. Store and use at 20 ± 4°C. **Do Not** pipette from the container. **Do Not** return portions removed from pipetting to container.

Element Specific Information - For specific information regarding any element: Contact technical staff.

Uranium Note: If uranium is present in this standard, it is natural abundance unless specified in Section 3.0.

HF Note: This standard should not be prepared or stored in glass.

8.0 HAZARDOUS INFORMATION - Please refer to the enclosed Material Safety Data sheet for information regarding this CRM.

9.0 HOMOGENEITY - This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Inorganic Ventures homogeneity data indicate that the end user should take a minimum sample size of 0.2mL to assure homogeneity.

10.0 QUALITY STANDARD DOCUMENTATION

10.1 ISO 9001 Quality Management System Registration
- SAI Global File Number 010105

10.2 ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration"
- Chemical Testing - Accredited A2LA Certificate Number 883.01

10.3 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"
- Reference Materials Production - Accredited A2LA Certificate Number 883.02

10.4 10CFR50 Appendix B - Nuclear Regulatory Commission
- Domestic Licensing of Production and Utilization Facilities

10.5 10CFR21 - Nuclear Regulatory Commission
- Reporting Defects and Non-Compliance

11.0 DATE OF CERTIFICATION AND PERIOD OF VALIDITY

11.1 Shelf Life - The period of time during which the concentration of the analyte(s) in a properly packaged, unopened, and unused standard stored under environmentally controlled and monitored conditions will remain within the specified uncertainty range. Shelf life is limited primarily by transpiration (loss of water from the solution) and infrequently, by chemical instability. Transpiration studies of chemically-stable solutions performed at the manufacturer's facility show a CRM shelf-life of twenty one months for solutions packaged in 125-mL low density polyethylene bottles. When stored under special conditions that minimize transpiration and instability, the shelf life can be extended past this limit.

11.2 Expiration Date - The date after which a CRM should not be used. Routine laboratory use of a CRM increases transpiration losses and the chance of contamination which affect the integrity of the CRM and limit its useful life. Manufacturer concurs with state and federal regulatory agencies' recommendations that solution standards be assigned a one-year expiration date.

11.3 Chemical Stability - Studies have been conducted on this or similar CRMs and it has been demonstrated that this CRM is chemically stable for a period of not less than two years provided the "Storage & Handling" conditions are followed that are described in section 7.0.

Certification Date: October 07, 2013

Expiration Date: EXPIRES 01 NOV 2014

12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS

Certificate Prepared By: Donna Senn
Product Documentation Technician

Certificate Approved By: Brian Alexander
PhD., Technical Process Director

Certifying Officer: Paul Gaines
PhD., Senior Technical Director

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product code TAPITT MS C
Product name Multi-element Solution Standard in Dilute Nitric Acid / Trace Hydrofluoric Acid
Common Name Contains: 1000 µg/mL Si; 200 µg/mL Sn; 100 µg/mL ea: Mo, Ti; 50 µg/mL Sb
Manufacturer, importer, supplier Inorganic Ventures
300 Technology Drive
Christiansburg, VA 24073
Web: www.inorganicventures.com
Emergency telephone number 800-424-9300 CHEMTREC (24 hrs)

2. COMPOSITION/INFORMATION ON INGREDIENTS

CAS	Chemical Name	% Weight	ACGIH*	OSHA*
7732-18-5	Water	~96.8	N/A	N/A
7697-37-2	Nitric Acid	~3.0	2 ppm TWA	2 ppm TWA; 5 mg/m3 TWA
7664-39-3	Hydrogen fluoride	<0.1	0.5 ppm TWA (as F)	3 ppm TWA
60676-86-0	Silica, fused	~0.2	0.1 mg/m3 TWA (respirable fraction)	N/A

* ACGIH - Occupational Exposure Limits - TWAs
* OSHA - Final PELs - Time Weighted Averages (TWAs)

3. HAZARDS IDENTIFICATION

Emergency Overview
- Vapours may be irritating to eyes, nose, throat, and lungs
- Corrosive

Eye contact	• Contact with eyes may cause irritation
Skin contact	• Causes severe burns
Inhalation	• May cause irritation of respiratory tract
Ingestion	• Harmful if swallowed

4. FIRST AID MEASURES

General advice	• Show this safety data sheet to the doctor in attendance
Skin contact	• Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes • First treatment with calcium gluconate paste • Immediate medical attention is required
Eye contact	• Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes • Keep eye wide open while rinsing • Immediate medical attention is required
Inhalation	• Move to fresh air in case of accidental inhalation of vapours • If breathing is difficult, give oxygen • Immediate medical attention is required
Ingestion	• Call a physician or Poison Control Centre immediately • If swallowed, seek medical advice immediately and show this container or label • If conscious, drink plenty of water
Notes to physician	• Treat symptomatically
Protection of first-aiders	• Use personal protective equipment

5. FIRE-FIGHTING MEASURES

Flash point	NA
Suitable extinguishing media	• Use extinguishing measures that are appropriate to local circumstances and the surrounding environment
Specific hazards	• Thermal decomposition can lead to release of irritating gases and vapours
Specific methods	• Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations
Special protective equipment for firefighters	• As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear
NFPA (National Fire Protection Association)	• Health - 2 • Fire Hazard - 0 • Reactivity - 0
Under conditions giving incomplete combustion, hazardous gases produced may consist of:	• nitrogen oxides (NOx). • F^{-1}.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	• Evacuate personnel to safe areas • Keep people away from and upwind of spill/leak • Wear personal protective equipment • Ensure adequate ventilation
Environmental precautions	• Prevent further leakage or spillage if safe to do so • Prevent product from entering drains
Methods for cleaning up	• Dam up • Neutralize with lime milk or soda and flush with plenty of water • Absorb spill with inert material (e.g. dry sand or earth), then place in a chemical waste container • After cleaning, flush away traces with water

7. HANDLING AND STORAGE

Handling

Technical measures/Precautions	• Use only in area provided with appropriate exhaust ventilation
Safe handling advice	• Wear personal protective equipment • Use product only in closed system

Storage

Technical measures/Precautions	• Keep in properly labelled containers • Store at room temperature in the original container • Keep containers tightly closed in a dry, cool and well-ventilated place
Incompatible products	• organic materials • reducing agents

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Personal protective equipment	
Hand protection	• impervious gloves
Eye protection	• tightly fitting safety goggles
Respiratory protection	• Ensure adequate ventilation
Skin and body protection	• Chemical resistant apron • Lab coat
Hygiene measures	• When using, do not eat, drink or smoke • Regular cleaning of equipment, work area and clothing

9. PHYSICAL AND CHEMICAL PROPERTIES

General Information

Form	liquid.
Appearance	clear
Colour	colorless.
Odour	None.

Important Health Safety and Environmental Information

pH	0 to 2
Boiling point/range	100°C
Flash point	NA
Vapour density	NA.
Water solubility	miscible.

10. STABILITY AND REACTIVITY

Stability	• Stable under normal conditions • Hazardous polymerization does not occur
Materials to avoid	• organic materials • reducing agents
Hazardous decomposition products	• nitrogen oxides (NOx) • F^{-1}

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Component Information

CAS	Chemical Name	% Weight	LD50/oral/rat =	LD50/dermal/rat =
7732-18-5	Water	~96.8	N/A	N/A
7697-37-2	Nitric Acid	~3.0	Inhalation LC50 Rat: 130 mg/kg/4H	Inhalation LC50 Rat: 130 mg/kg/4H
7664-39-3	Hydrogen fluoride	<0.1	Inhalation LC50 Rat: 1276 ppm/1H	Inhalation LC50 Rat: 1276 ppm/1H
60676-86-0	Silica, fused	~0.2	N/A	N/A

Product Information

Local effects	HF is toxic and can cause severe burns that are not apparent immediately.
Skin irritation	Causes severe burns.
Eye irritation	Irritant.
Inhalation	Irritant.
Ingestion	If ingested, severe burns of the mouth and throat, as well as a danger of perforation of the esophagus and the stomach. Harmful if swallowed.
Chronic toxicity	HF-. Avoid repeated exposure. Prolonged exposure may cause chronic effects.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Component Information

CAS	Chemical Name	% Weight	EFAD*	EFFSD*	EMD - Ecotoxicity*
7732-18-5	Water	~96.8	N/A	N/A	N/A
7697-37-2	Nitric Acid	~3.0	N/A	N/A	N/A
7664-39-3	Hydrogen fluoride	<0.1	N/A	N/A	N/A
60676-86-0	Silica, fused	~0.2	N/A	N/A	N/A

* EFAD - Ecotoxicity - Freshwater Algae Data
* EFFSD - Ecotoxicity - Freshwater Fish Species Data
* EMD - Ecotoxicity - Microtox Data

Product Information

Do not allow material to contaminate ground water or sewage system

Other information

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	• In accordance with local and national regulations
Contaminated packaging	• Empty containers should be taken for local recycling, recovery or waste disposal

14. TRANSPORT INFORMATION

DOT

UN-No	UN3264 / Class 8
Proper shipping name	Corrosive liquid, acidic, inorganic, n.o.s
Packing group	III

IATA-DGR

UN-No	UN3264 / Class 8
Proper shipping name	Corrosive liquid, acidic, inorganic, n.o.s
Packing group	III

15. REGULATORY INFORMATION

U.S. INVENTORIES:

CAS	Chemical Name	% Weight	CPCL*	NJRTK*	CERCLA/SARA*
7732-18-5	Water	~96.8	N/A	N/A	N/A
7697-37-2	Nitric Acid	~3.0	N/A	sn 1356	1000 lb final RQ; 454 kg final RQ
7664-39-3	Hydrogen fluoride	<0.1	N/A	sn 1014	100 lb final RQ; 45.4 kg final RQ
60676-86-0	Silica, fused	~0.2	N/A	sn 1656	N/A

* CPCL - California - Proposition 65 - Carcinogens List
* NJRTK - New Jersey - Department of Health RTK List
* CERCLA/SARA - Hazardous Substances and their Reportable Quantities

:

INTERNATIONAL INVENTORIES:

CAS	Chemical Name	% Weight	WHMIS*	EINECCS - European Union*
7732-18-5	Water	~96.8	Uncontrolled product according to WHMIS classification criteria	231-791-2
7697-37-2	Nitric Acid	~3.0	C, E (including 60%, 61.3%, 63%, 67%, 67.18%, 70%, 90%); E (10%)	231-714-2
7664-39-3	Hydrogen fluoride	<0.1	D1A, E; D1B (including 12%, 24%, 48-50%, 52%, 70%)	231-634-8
60676-86-0	Silica, fused	~0.2	Uncontrolled product according to WHMIS classification criteria	262-373-8

* WHMIS - Canada - WHMIS - Classifications of Substances
* EINECCS - European Union - European inventory of Existing Commercial Chemical Substances (EINECCS)

:

16. OTHER INFORMATION

The above information is believed to be accurate and represents the best information available to us. It has been compiled from the data presented in various technical publications and our experience and should only be used as a guide for handling this product. It is the user's responsibility to determine the

suitability of this information for their particular purposes. We assume that only qualified individuals, trained and familiar with procedures suitable to this product will handle this material. Inorganic Ventures, Inc. assumes no responsibility and shall not be held liable for any damage resulting from misuse of this product.

Certification Summary

Client: AECOM, Inc.
Project/Site: Tissue 60280653-105-022

TestAmerica Job ID: 180-26836-1

Laboratory	Authority	Program	EPA Region	Certification ID
TestAmerica Pittsburgh	Arkansas DEQ	State Program	6	88-0690
TestAmerica Pittsburgh	California	NELAP	9	4224CA
TestAmerica Pittsburgh	Connecticut	State Program	1	PH-0688
TestAmerica Pittsburgh	Florida	NELAP	4	E871008
TestAmerica Pittsburgh	Illinois	NELAP	5	002602
TestAmerica Pittsburgh	Kansas	NELAP	7	E-10350
TestAmerica Pittsburgh	L-A-B	DoD ELAP		L2314
TestAmerica Pittsburgh	Louisiana	NELAP	6	04041
TestAmerica Pittsburgh	New Hampshire	NELAP	1	203011
TestAmerica Pittsburgh	New Jersey	NELAP	2	PA005
TestAmerica Pittsburgh	New York	NELAP	2	11182
TestAmerica Pittsburgh	North Carolina DENR	State Program	4	434
TestAmerica Pittsburgh	Pennsylvania	NELAP	3	02-00416
TestAmerica Pittsburgh	South Carolina	State Program	4	89014
TestAmerica Pittsburgh	US Fish & Wildlife	Federal		LE94312A-1
TestAmerica Pittsburgh	USDA	Federal		P330-10-00139
TestAmerica Pittsburgh	USDA	Federal		P-Soil-01
TestAmerica Pittsburgh	Utah	NELAP	8	STLP
TestAmerica Pittsburgh	Virginia	NELAP	3	460189
TestAmerica Pittsburgh	West Virginia DEP	State Program	3	142
TestAmerica Pittsburgh	Wisconsin	State Program	5	998027800

Accreditation may not be offered or required for all methods and analytes reported in this package. Please contact your project manager for the laboratory's current list of certified methods and analytes.

METALS

COVER PAGE
METALS

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG No.:

Project: Tissue 60280653-105-022

Client Sample ID	Lab Sample ID
PRE-EXPOSURE WORMS	180-26836-1
FOOD-FERMENTED F10-008 PREPPED	180-26836-2
POST-EXPOSURE CONTROL WORMS	180-26836-3
POST-EXPOSURE 27106 WORMS	180-26836-4

Comments:

1A-IN
INORGANIC ANALYSIS DATA SHEET
METALS

Client Sample ID: PRE-EXPOSURE WORMS
Lab Sample ID: 180-26836-1
Lab Name: TestAmerica Pittsburgh
Job No.: 180-26836-1
SDG ID.:
Matrix: Tissue
Date Sampled: 10/04/2013 11:30
Reporting Basis: WET
Date Received: 11/05/2013 08:50

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	0.34	0.10	0.018	mg/Kg			1	6020A
7439-92-1	Lead	0.037	0.10	0.0040	mg/Kg	J	B	1	6020A
7440-36-0	Antimony	0.060	0.21	0.0027	mg/Kg	J		1	6020A

1A-IN
INORGANIC ANALYSIS DATA SHEET
METALS

Client Sample ID: FOOD-FERMENTED F10-008 PREPPED
Lab Sample ID: 180-26836-2
Lab Name: TestAmerica Pittsburgh
Job No.: 180-26836-1
SDG ID.:
Matrix: Solid
Date Sampled: 11/01/2013 15:30
Reporting Basis: DRY
Date Received: 11/05/2013 08:50
% Solids: 14.4

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	ND	0.69	0.12	mg/Kg			1	6020A
7439-92-1	Lead	0.25	0.69	0.026	mg/Kg	J	B	1	6020A
7440-36-0	Antimony	0.26	1.4	0.018	mg/Kg	J		1	6020A

1A-IN
INORGANIC ANALYSIS DATA SHEET
METALS

Client Sample ID: POST-EXPOSURE CONTROL WORMS
Lab Sample ID: 180-26836-3
Lab Name: TestAmerica Pittsburgh
Job No.: 180-26836-1
SDG ID.:
Matrix: Tissue
Date Sampled: 11/01/2013 15:20
Reporting Basis: WET
Date Received: 11/05/2013 08:50

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	0.64	0.096	0.017	mg/Kg			1	6020A
7439-92-1	Lead	0.035	0.096	0.0037	mg/Kg	J	B	1	6020A
7440-36-0	Antimony	0.017	0.19	0.0025	mg/Kg	J		1	6020A

1A-IN
INORGANIC ANALYSIS DATA SHEET
METALS

Client Sample ID: POST-EXPOSURE 27106 WORMS
Lab Sample ID: 180-26836-4
Lab Name: TestAmerica Pittsburgh
Job No.: 180-26836-1
SDG ID.:
Matrix: Tissue
Date Sampled: 11/01/2013 15:20
Reporting Basis: WET
Date Received: 11/05/2013 08:50

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7440-38-2	Arsenic	13	0.099	0.018	mg/Kg			1	6020A
7439-92-1	Lead	1.0	0.10	0.0039	mg/Kg		B	1	6020A
7440-36-0	Antimony	0.43	0.20	0.0027	mg/Kg			1	6020A

2A-IN
CALIBRATION VERIFICATIONS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICV Source: MICVX_00013 Concentration Units: ug/L

CCV Source: MCCV1X_00051

Analyte	ICV 180-89757/5 11/13/2013 10:45				CCV 180-89757/10 11/13/2013 11:09				CCV 180-89757/34 11/13/2013 13:24			
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
Antimony	80.4		80.0	101	100		100	100	102		100	102
Arsenic	83.6		80.0	105	104		100	104	106		100	106
Lead	81.9		80.0	102	108		100	108	102		100	102

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.
Italicized analytes were not requested for this sequence.

2A-IN
CALIBRATION VERIFICATIONS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICV Source: MICVX_00013 Concentration Units: ug/L

CCV Source: MCCV1X_00051

Analyte	CCV 180-89757/46 11/13/2013 14:33				CCV 180-89757/58 11/13/2013 15:41				CCV 180-89757/70 11/13/2013 16:54			
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
Antimony	103		100	103	102		100	102	102		100	102
Arsenic	104		100	104	106		100	106	106		100	106
Lead	105		100	105	105		100	105	107		100	107

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.
Italicized analytes were not requested for this sequence.

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICV Source: MICVX_00013 Concentration Units: ug/L

CCV Source: MCCV1X_00051

Analyte	ICV 180-89888/5 11/14/2013 12:40				CCV 180-89888/10 11/14/2013 13:04				CCV 180-89888/70 11/14/2013 19:14			
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
Antimony	80.9		80.0	101	99.6		100	100	100		100	100
Arsenic	83.0		80.0	104	104		100	104	103		100	103
Lead	83.2		80.0	104	105		100	105	105		100	105

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.
Italicized analytes were not requested for this sequence.

2A-IN
CALIBRATION VERIFICATIONS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICV Source: MICVX_00013 Concentration Units: ug/L

CCV Source: MCCV1X_00051

Analyte	CCV 180-89888/82 11/14/2013 20:21				CCV 180-89888/91 11/14/2013 21:16							
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
Antimony	102		100	102	101		100	101				
Arsenic	103		100	103	103		100	103				
Lead	106		100	106	105		100	105				

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.
Italicized analytes were not requested for this sequence.

2B-IN
CRQL CHECK STANDARD
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Method: 6020A Instrument ID: M

Lab Sample ID: CRI 180-89757/7 Concentration Units: ug/L

CRQL Check Standard Source: MCRIX_00041

Analyte	CRQL Check Standard				
	True	Found	Qualifiers	%R(1)	Limits
Arsenic	1.00	1.12		112	70-130
Lead	1.00	1.03		103	70-130
Antimony	2.00	2.05		103	70-130

Lab Sample ID: CRI 180-89757/84 Concentration Units: ug/L

CRQL Check Standard Source: MCRIX_00041

Analyte	CRQL Check Standard				
	True	Found	Qualifiers	%R(1)	Limits
Arsenic	1.00	1.17		117	70-130
Lead	1.00	0.993	J	99	70-130
Antimony	2.00	1.97	J	99	70-130

Lab Sample ID: CRI 180-89888/7 Concentration Units: ug/L

CRQL Check Standard Source: MCRIX_00041

Analyte	CRQL Check Standard				
	True	Found	Qualifiers	%R(1)	Limits
Arsenic	1.00	1.23		123	70-130
Lead	1.00	1.05		105	70-130
Antimony	2.00	2.06		103	70-130

Lab Sample ID: CRI 180-89888/84 Concentration Units: ug/L

CRQL Check Standard Source: MCRIX_00041

Analyte	CRQL Check Standard				
	True	Found	Qualifiers	%R(1)	Limits
Arsenic	1.00	0.971	J	97	70-130
Lead	1.00	1.10		110	70-130
Antimony	2.00	2.09		105	70-130

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM IIB-IN

3-IN
INSTRUMENT BLANKS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: ug/L

Analyte	RL	ICB 180-89757/6 11/13/2013 10:50		CCB1 180-89757/11 11/13/2013 11:18		CCB3 180-89757/35 11/13/2013 13:33		CCB4 180-89757/47 11/13/2013 14:41	
		Found	C	Found	C	Found	C	Found	C
Antimony	2.0	ND		ND		ND		0.0770	J
Arsenic	1.0	ND		ND		ND		ND	
Lead	1.0	ND		ND		ND		ND	

Italicized analytes were not requested for this sequence.

3-IN
INSTRUMENT BLANKS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: ug/L

Analyte	RL	CCB5 180-89757/59 11/13/2013 15:49		CCB6 180-89757/71 11/13/2013 17:03					
		Found	C	Found	C	Found	C	Found	C
Antimony	2.0	ND		0.0440	J				
Arsenic	1.0	ND		ND					
Lead	1.0	ND		0.0210	J				

Italicized analytes were not requested for this sequence.

3-IN
INSTRUMENT BLANKS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: ug/L

Analyte	RL	ICB 180-89888/6 11/14/2013 12:45		CCB1 180-89888/11 11/14/2013 13:12		CCB6 180-89888/71 11/14/2013 19:22		CCB7 180-89888/83 11/14/2013 20:29	
		Found	C	Found	C	Found	C	Found	C
Antimony	2.0	ND		ND		ND		0.0680	J
Arsenic	1.0	ND		ND		ND		ND	
Lead	1.0	ND		ND		0.0610	J	0.0550	J

Italicized analytes were not requested for this sequence.

3-IN
INSTRUMENT BLANKS
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: ug/L

Analyte	RL	CCB8 180-89888/92 11/14/2013 21:24							
		Found	C	Found	C	Found	C	Found	C
Antimony	2.0	ND							
Arsenic	1.0	ND							
Lead	1.0	ND							

Italicized analytes were not requested for this sequence.

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: MB 180-89482/1-A

Instrument Code: M Batch No.: 89757

CAS No.	Analyte	Concentration	C	Q	Method
7439-92-1	Lead	0.00571	J		6020A
7440-36-0	Antimony	ND			6020A

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: PB 180-89081/4-B

Instrument Code: M Batch No.: 89757

CAS No.	Analyte	Concentration	C	Q	Method
7439-92-1	Lead	0.0118	J		6020A
7440-36-0	Antimony	0.00881	J		6020A

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: MB 180-89486/1-A

Instrument Code: M Batch No.: 89757

CAS No.	Analyte	Concentration	C	Q	Method
7440-38-2	Arsenic	ND			6020A

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: PB 180-89081/4-C

Instrument Code: M Batch No.: 89757

CAS No.	Analyte	Concentration	C	Q	Method
7440-38-2	Arsenic	ND			6020A

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: MB 180-89655/1-A

Instrument Code: M Batch No.: 89888

CAS No.	Analyte	Concentration	C	Q	Method
7439-92-1	Lead	0.00717	J		6020A
7440-36-0	Antimony	ND			6020A

3-IN
METHOD BLANK
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Concentration Units: mg/Kg Lab Sample ID: MB 180-89656/1-A

Instrument Code: M Batch No.: 89888

CAS No.	Analyte	Concentration	C	Q	Method
7440-38-2	Arsenic	ND			6020A

4A-IN
INTERFERENCE CHECK STANDARD
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Lab Sample ID: ICSA 180-89757/8 Instrument ID: M

Lab File ID: M31113A.xml ICS Source: MICSAX_00040

Concentration Units: ug/L

Analyte	True Solution A	Found Solution A	Percent Recovery
Antimony		**0.143**	
Arsenic		**0.181**	
Lead		**0.389**	
Aluminum	*100000*	*105700*	*106*
Barium		*0.319*	
Beryllium		*0.0180*	
Boron		*1.31*	
Cadmium		*0.322*	
Calcium	*100000*	*110900*	*111*
Chromium		*1.19*	
Cobalt		*0.117*	
Copper		*1.97*	
Iron	*100000*	*108200*	*108*
Magnesium	*100000*	*107700*	*108*
Manganese		*1.05*	
Molybdenum	*2000*	*2348*	*117*
Nickel		*-0.202*	
Potassium	*100000*	*105400*	*105*
Selenium		*0.372*	
Silicon		*21.1*	
Silver		*0.190*	
Sodium	*100000*	*106500*	*107*
Strontium		*1.80*	
Thallium		*0.0210*	
Tin		*0.288*	
Titanium	*2000*	*2227*	*111*
Vanadium		*-0.191*	
Zinc		*7.80*	

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM IVA-IN

4A-IN
INTERFERENCE CHECK STANDARD
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Lab Sample ID: ICSAB 180-89757/9 Instrument ID: M

Lab File ID: M31113A.xml ICS Source: MICSABX_00044

Concentration Units: ug/L

Analyte	True Solution AB	Found Solution AB	Found Percent Recovery
Antimony	**20.0**	**22.2**	**111**
Arsenic	**20.0**	**23.8**	**119**
Lead	**20.0**	**23.7**	**118**
Aluminum	*100000*	*108567*	*109*
Barium	*20.0*	*22.5*	*113*
Beryllium	*20.0*	*20.5*	*103*
Boron	*50.0*	*50.0*	*100*
Cadmium	*20.0*	*22.8*	*114*
Calcium	*100000*	*110767*	*111*
Chromium	*20.0*	*22.4*	*112*
Cobalt	*20.0*	*21.0*	*105*
Copper	*20.0*	*22.7*	*113*
Iron	*100000*	*107067*	*107*
Magnesium	*100000*	*110633*	*111*
Manganese	*22.5*	*22.3*	*99*
Molybdenum	*2000*	*2338*	*117*
Nickel	*20.0*	*20.3*	*102*
Potassium	*100000*	*104730*	*105*
Selenium	*50.0*	*57.8*	*116*
Silicon	*500*	*560*	*112*
Silver	*20.0*	*22.1*	*110*
Sodium	*100000*	*108267*	*108*
Strontium	*25.0*	*25.5*	*102*
Thallium	*20.0*	*23.1*	*115*
Tin	*100*	*111*	*111*
Titanium	*2000*	*2213*	*111*
Vanadium	*20.0*	*21.3*	*107*
Zinc	*25.0*	*26.9*	*108*

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM IVA-IN

4A-IN
INTERFERENCE CHECK STANDARD
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Lab Sample ID: ICSA 180-89888/8 Instrument ID: M

Lab File ID: M31114A.xml ICS Source: MICSAX_00040

Concentration Units: ug/L

Analyte	True Solution A	Found Solution A	Percent Recovery
Antimony		**0.126**	
Arsenic		**0.0530**	
Lead		**0.395**	
Aluminum	*100000*	*112900*	*113*
Barium		*0.337*	
Beryllium		*-0.0320*	
Boron		*1.79*	
Cadmium		*0.350*	
Calcium	*100000*	*118400*	*118*
Chromium		*-0.399*	
Cobalt		*0.131*	
Copper		*2.05*	
Iron	*100000*	*118400*	*118*
Magnesium	*100000*	*116800*	*117*
Manganese		*1.36*	
Molybdenum	*2000*	*2336*	*117*
Nickel		*0.0030*	
Potassium	*100000*	*114500*	*115*
Selenium		*-0.137*	
Silicon		*28.9*	
Silver		*0.0260*	
Sodium	*100000*	*114900*	*115*
Strontium		*1.81*	
Thallium		*0.0170*	
Tin		*0.154*	
Titanium	*2000*	*2340*	*117*
Vanadium		*-0.773*	
Zinc		*8.94*	

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM IVA-IN

4A-IN
INTERFERENCE CHECK STANDARD
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Lab Sample ID: ICSAB 180-89888/9 Instrument ID: M

Lab File ID: M31114A.xml ICS Source: MICSABX_00044

Concentration Units: ug/L

Analyte	True Solution AB	Found Solution AB	Found Percent Recovery
Antimony	**20.0**	**21.9**	**109**
Arsenic	**20.0**	**22.6**	**113**
Lead	**20.0**	**23.7**	**118**
Aluminum	*100000*	*111100*	*111*
Barium	*20.0*	*22.7*	*113*
Beryllium	*20.0*	*21.9*	*109*
Boron	*50.0*	*53.1*	*106*
Cadmium	*20.0*	*22.5*	*112*
Calcium	*100000*	*115500*	*116*
Chromium	*20.0*	*22.4*	*112*
Cobalt	*20.0*	*22.2*	*111*
Copper	*20.0*	*22.9*	*114*
Iron	*100000*	*112367*	*112*
Magnesium	*100000*	*114133*	*114*
Manganese	*22.5*	*23.8*	*106*
Molybdenum	*2000*	*2274*	*114*
Nickel	*20.0*	*21.2*	*106*
Potassium	*100000*	*110233*	*110*
Selenium	*50.0*	*54.7*	*109*
Silicon	*500*	*601*	*120*
Silver	*20.0*	*22.1*	*110*
Sodium	*100000*	*112400*	*112*
Strontium	*25.0*	*24.2*	*97*
Thallium	*20.0*	*23.0*	*115*
Tin	*100*	*110*	*110*
Titanium	*2000*	*2267*	*113*
Vanadium	*20.0*	*22.5*	*112*
Zinc	*25.0*	*27.7*	*111*

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM IVA-IN

5A-IN
MATRIX SPIKE SAMPLE RECOVERY
METALS

Client ID: FOOD-FERMENTED F10-008 PREPPED MS Lab ID: 180-26836-2 MS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Matrix: Solid Concentration Units: mg/Kg

% Solids: 14.4

Analyte	SSR	C	Sample Result (SR)	C	Spike Added (SA)	%R	Control Limit %R	Q	Method
Arsenic	24.1		ND		27.2	88	75-125		6020A
Lead	14.0		0.25	J	13.6	101	75-125		6020A
Antimony	300		0.26	J	340	88	75-125		6020A

SSR = Spiked Sample Result

Calculations are performed before rounding to avoid round-off errors in calculated results.
Note - Results and Reporting Limits have been adjusted for dry weight.

FORM VA - IN

5A-IN
MATRIX SPIKE DUPLICATE SAMPLE RECOVERY
METALS

Client ID: FOOD-FERMENTED F10-008 PREPPED MSD Lab ID: 180-26836-2 MSD

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Matrix: Solid Concentration Units: mg/Kg

% Solids: 14.4

Analyte	(SDR)	C	Spike Added (SA)	%R	Control Limit %R	RPD	RPD Limit	Q	Method
Arsenic	23.4		27.0	87	75-125	3	20		6020A
Lead	14.1		13.4	104	75-125	1	20		6020A
Antimony	302		334	90	75-125	1	20		6020A

SDR = Sample Duplicate Result

Calculations are performed before rounding to avoid round-off errors in calculated results.
Note - Results and Reporting Limits have been adjusted for dry weight.

FORM VD - IN

5B-IN
POST DIGESTION SPIKE SAMPLE RECOVERY
METALS

Client ID: POST-EXPOSURE 27106 WORMS PDS Lab ID: 180-26836-4 PDS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Matrix: Tissue Concentration Units: mg/Kg

Analyte	SSR	C	Sample Result (SR)	C	Spike Added (SA)	%R	Control Limit %R	Q	Method
Arsenic	16.0		13		3.96	83	75-125		6020A
Lead	3.28		1.0		2.04	111	75-125		6020A
Antimony	48.9		0.33		51.0	95	75-125		6020A

SSR = Spiked Sample Result

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VB - IN

7A-IN
LAB CONTROL SAMPLE
METALS

Lab ID: LCS 180-89482/2-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Tissue LCS Source: MTAPITTICPMS_00016

Analyte	Tissue(mg/Kg)							
	True	Found	C	%R	Limits		Q	Method
Lead	1.94	1.98		102	80	120		6020A
Antimony	48.5	43.0		89	80	120		6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA - IN

7D-IN
LAB CONTROL SAMPLE DUPLICATE
METALS

Lab ID: LCSD 180-89482/3-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Tissue LCS Source: MTAPITTICPMS_00016

Analyte	(SDR)	C	Spike Added	%R	Control Limit %R	RPD	RPD Limit	Q	Method
Lead	2.09		2.02	104	80-120	6	20		6020A
Antimony	45.0		50.5	89	80-120	5	20		6020A

SDR = Spike Duplicate Results
Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIID - IN

7A-IN
LAB CONTROL SAMPLE
METALS

Lab ID: LCS 180-89486/2-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Tissue LCS Source: MTAPITTICPMS_00016

Analyte	Tissue(mg/Kg)							
	True	Found	C	%R	Limits		Q	Method
Arsenic	3.92	3.34		85	80	120		6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA - IN

7D-IN
LAB CONTROL SAMPLE DUPLICATE
METALS

Lab ID: LCSD 180-89486/3-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Tissue LCS Source: MTAPITTICPMS_00016

Analyte	(SDR)	C	Spike Added	%R	Control Limit %R	RPD	RPD Limit	Q	Method
Arsenic	3.24		3.74	87	80-120	3	20		6020A

SDR = Spike Duplicate Results
Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIID - IN

7A-IN
LAB CONTROL SAMPLE
METALS

Lab ID: LCS 180-89655/2-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Solid LCS Source: MTAPITTICPMS_00016

Analyte	Solid(mg/Kg)							
	True	Found	C	%R	Limits		Q	Method
Lead	1.92	1.99		104	80	120		6020A
Antimony	48.1	43.3		90	80	120		6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA - IN

7A-IN
LAB CONTROL SAMPLE
METALS

Lab ID: LCS 180-89656/2-A

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

Sample Matrix: Solid LCS Source: MTAPITTICPMS_00016

Analyte	Solid(mg/Kg)							
	True	Found	C	%R	Limits		Q	Method
Arsenic	3.96	3.42		86	80	120		6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA - IN

8-IN
ICP-AES AND ICP-MS SERIAL DILUTIONS
METALS

Lab ID: 180-26836-2

SDG No:

Lab Name: TestAmerica Pittsburgh Job No: 180-26836-1

Matrix: Solid Concentration Units: mg/Kg

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	Method
Arsenic	ND		ND		NC		6020A
Lead	0.25	J	0.278	J	NC		6020A
Antimony	0.26	J	0.198	J	NC		6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIII-IN

8-IN
ICP-AES AND ICP-MS SERIAL DILUTIONS
METALS

Lab ID: 180-26836-4

SDG No:

Lab Name: TestAmerica Pittsburgh Job No: 180-26836-1

Matrix: Tissue Concentration Units: mg/Kg

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	Method
Arsenic	13		14.1		11	V	6020A
Lead	1.0		0.983		2.5		6020A
Antimony	0.33		0.453	J	36	V	6020A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIII-IN

9-IN
DETECTION LIMITS
METALS

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Solid Instrument ID: M

Method: 6020A MDL Date: 01/23/2010 19:04

Prep Method: 3050B

Analyte	Wavelength/ Mass	RL (mg/Kg)	MDL (mg/Kg)
Antimony	121	0.2	0.0026
Arsenic	75	0.1	0.0181
Lead	208	0.1	0.0038

9-IN
CALIBRATION BLANK DETECTION LIMITS
METALS

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Solid Instrument ID: M

Method: 6020A XMDL Date: 01/23/2010 19:04

Analyte	Wavelength/ Mass	XRL (ug/L)	XMDL (ug/L)
Antimony	121	2	0.0187
Arsenic	75	1	0.2908
Lead	208	1	0.0192

9-IN
DETECTION LIMITS
METALS

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Tissue Instrument ID: M

Method: 6020A MDL Date: 01/23/2010 19:04

Prep Method: 3050B

Analyte	Wavelength/ Mass	RL (mg/Kg)	MDL (mg/Kg)
Antimony	121	0.2	0.0026
Arsenic	75	0.1	0.0181
Lead	208	0.1	0.0038

9-IN
CALIBRATION BLANK DETECTION LIMITS
METALS

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Tissue Instrument ID: M

Method: 6020A XMDL Date: 01/23/2010 19:04

Analyte	Wavelength/ Mass	XRL (ug/L)	XMDL (ug/L)
Antimony	121	2	0.0187
Arsenic	75	1	0.2908
Lead	208	1	0.0192

11-IN
LINEAR RANGES
METALS

Lab Name: TestAmerica Pittsburgh Job No: 180-26836-1

SDG No.:

Instrument ID: M Date: 03/14/2011 22:35

Analyte	Integ. Time (Sec.)	Concentration (ug/L)	Method
Arsenic		4500	6020A
Lead		20000	6020A
Antimony		13500	6020A

12-IN
PREPARATION LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Prep Method: 3050B

Lab Sample ID	Preparation Date	Prep Batch	Initial Weight (g)	Initial Volume	Final Volume (mL)
MB 180-89482/1-A	11/12/2013 09:13	89482	00001.12		100
LCS 180-89482/2-A	11/12/2013 09:13	89482	00001.03		100
LCSD 180-89482/3-A	11/12/2013 09:13	89482	00000.99		100
180-26836-1	11/12/2013 09:13	89482	00000.96		100
180-26836-3	11/12/2013 09:13	89482	00001.04		100
180-26836-4	11/12/2013 09:13	89482	00000.98		100
PB 180-89081/4-B	11/12/2013 09:14	89482	00001.01		100

12-IN
PREPARATION LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Prep Method: 3050B

Lab Sample ID	Preparation Date	Prep Batch	Initial Weight (g)	Initial Volume	Final Volume (mL)
MB 180-89486/1-A	11/12/2013 09:24	89486	00001.05		100
LCS 180-89486/2-A	11/12/2013 09:24	89486	00001.02		100
LCSD 180-89486/3-A	11/12/2013 09:24	89486	00001.07		100
180-26836-1	11/12/2013 09:24	89486	00000.98		100
180-26836-3	11/12/2013 09:24	89486	00001.04		100
180-26836-4	11/12/2013 09:24	89486	00001.01		100
PB 180-89081/4-C	11/12/2013 09:24	89486	00001.01		100

12-IN
PREPARATION LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Prep Method: 3050B

Lab Sample ID	Preparation Date	Prep Batch	Initial Weight (g)	Initial Volume	Final Volume (mL)
MB 180-89655/1-A	11/13/2013 12:56	89655	00001.06		100
LCS 180-89655/2-A	11/13/2013 12:56	89655	00001.04		100
180-26836-2	11/13/2013 12:56	89655	00001.00		100
180-26836-2 MS	11/13/2013 12:56	89655	00001.02		100
180-26836-2 MSD	11/13/2013 12:56	89655	00001.04		100

12-IN
PREPARATION LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Prep Method: 3050B

Lab Sample ID	Preparation Date	Prep Batch	Initial Weight (g)	Initial Volume	Final Volume (mL)
MB 180-89656/1-A	11/13/2013 12:57	89656	00001.12		100
LCS 180-89656/2-A	11/13/2013 12:57	89656	00001.01		100
180-26836-2	11/13/2013 12:57	89656	00001.01		100
180-26836-2 MS	11/13/2013 12:57	89656	00001.02		100
180-26836-2 MSD	11/13/2013 12:57	89656	00001.03		100

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/13/2013 09:09 End Date: 11/13/2013 23:57

Lab Sample ID	D / F	Type	Time	Analytes																				
				As	Pb	Sb																		
ITUNE 180-89757/1			09:09																					
STD1 180-89757/2 IC	1		10:32	X	X	X																		
STD2 180-89757/3 IC	1		10:36	X	X	X																		
STD3 180-89757/4 IC	1		10:40	X	X	X																		
ICV 180-89757/5	1		10:45	X	X	X																		
ICB 180-89757/6	1		10:50	X	X	X																		
CRI 180-89757/7	1		10:55	X	X	X																		
ICSA 180-89757/8	1		11:00	X	X	X																		
ICSAB 180-89757/9	1		11:05	X	X	X																		
CCV 180-89757/10	1		11:09	X	X	X																		
CCB1 180-89757/11	1		11:18	X	X	X																		
ZZZZZZ			11:22																					
ZZZZZZ			11:27																					
ZZZZZZ			11:32																					
ZZZZZZ			11:40																					
ZZZZZZ			11:45																					
ZZZZZZ			11:50																					
ZZZZZZ			11:58																					
ZZZZZZ			12:03																					
ZZZZZZ			12:07																					
ZZZZZZ			12:15																					
CCV 180-89757/22			12:20																					
CCB2 180-89757/23			12:28																					
ZZZZZZ			12:33																					
ZZZZZZ			12:38																					
ZZZZZZ			12:43																					
ZZZZZZ			12:48																					
ZZZZZZ			12:52																					
ZZZZZZ			12:57																					
ZZZZZZ			13:05																					
ZZZZZZ			13:10																					
ZZZZZZ			13:15																					
ZZZZZZ			13:20																					
CCV 180-89757/34	1		13:24	X	X	X																		
CCB3 180-89757/35	1		13:33	X	X	X																		
ZZZZZZ			13:37																					
ZZZZZZ			13:42																					
ZZZZZZ			13:47																					
ZZZZZZ			13:52																					
ZZZZZZ			13:57																					
MB 180-89482/1-A	1	T	14:05		X	X																		
PB 180-89081/4-B	1	T	14:10		X	X																		

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/13/2013 09:09 End Date: 11/13/2013 23:57

Lab Sample ID	D/F	Type	Time	Analytes																			
				As	Pb	Sb																	
LCS 180-89482/2-A	1	T	14:15		X	X																	
LCSD 180-89482/3-A	1	T	14:20		X	X																	
180-26836-1	1	T	14:28		X	X																	
CCV 180-89757/46	1		14:33	X	X	X																	
CCB4 180-89757/47	1		14:41	X	X	X																	
180-26836-3	1	T	14:46		X	X																	
180-26836-4	1	T	14:50		X	X																	
180-26836-4 SD	5	T	14:55		X	X																	
180-26836-4 PDS	1	T	15:00		X	X																	
MB 180-89486/1-A	1	T	15:09	X																			
PB 180-89081/4-C	1	T	15:14	X																			
LCS 180-89486/2-A	1	T	15:18	X																			
LCSD 180-89486/3-A	1	T	15:23	X																			
180-26836-1	1	T	15:31	X																			
180-26836-3	1	T	15:36	X																			
CCV 180-89757/58	1		15:41	X	X	X																	
CCB5 180-89757/59	1		15:49	X	X	X																	
180-26836-4	1	T	15:54	X																			
180-26836-4 SD	5	T	15:59	X																			
180-26836-4 PDS	1	T	16:03	X																			
ZZZZZZ			16:12																				
ZZZZZZ			16:17																				
ZZZZZZ			16:27																				
ZZZZZZ			16:32																				
ZZZZZZ			16:40																				
ZZZZZZ			16:45																				
ZZZZZZ			16:50																				
CCV 180-89757/70	1		16:54	X	X	X																	
CCB6 180-89757/71	1		17:03	X	X	X																	
ZZZZZZ			17:08																				
ZZZZZZ			17:12																				
ZZZZZZ			17:17																				
ZZZZZZ			17:22																				
ZZZZZZ			17:30																				
ZZZZZZ			17:35																				
ZZZZZZ			17:40																				
ZZZZZZ			17:44																				
ZZZZZZ			17:53																				
ZZZZZZ			17:57																				
CCV 180-89757/82			18:02																				
CCB7 180-89757/83			18:10																				
CRI 180-89757/84	1		18:15	X	X	X																	

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/13/2013 09:09 End Date: 11/13/2013 23:57

Lab Sample ID	D / F	Type	Time	Analytes																				
				As	Pb	Sb																		
ZZZZZZ			18:25																					
ZZZZZZ			18:30																					
ZZZZZZ			18:34																					
ZZZZZZ			18:39																					
ZZZZZZ			18:44																					
ZZZZZZ			18:49																					
CCV 180-89757/91			18:58																					
CCB8 180-89757/92			19:08																					
ZZZZZZ			19:13																					
ZZZZZZ			19:17																					
ZZZZZZ			19:22																					
ZZZZZZ			19:27																					
ZZZZZZ			19:32																					
ZZZZZZ			19:37																					
ZZZZZZ			19:41																					
ZZZZZZ			19:46																					
ZZZZZZ			19:51																					
ZZZZZZ			19:56																					
CCV 180-89757/103			20:04																					
CCB9 180-89757/104			20:12																					
ZZZZZZ			20:17																					
ZZZZZZ			20:22																					
ZZZZZZ			20:27																					
ZZZZZZ			20:31																					
ZZZZZZ			20:36																					
ZZZZZZ			20:41																					
ZZZZZZ			20:46																					
ZZZZZZ			20:50																					
ZZZZZZ			20:55																					
ZZZZZZ			21:00																					
CCV 180-89757/115			21:05																					
CCB10 180-89757/116			21:13																					
ZZZZZZ			21:18																					
ZZZZZZ			21:23																					
ZZZZZZ			21:27																					
ZZZZZZ			21:32																					
ZZZZZZ			21:37																					
ZZZZZZ			21:42																					
ZZZZZZ			21:47																					
ZZZZZZ			21:51																					
ZZZZZZ			21:56																					
ZZZZZZ			22:01																					

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/13/2013 09:09 End Date: 11/13/2013 23:57

Lab Sample ID	D / F	Type	Time	Analytes																				
				As	Pb	Sb																		
CCV 180-89757/127			22:06																					
CCB11 180-89757/128			22:14																					
ZZZZZZ			22:19																					
ZZZZZZ			22:24																					
ZZZZZZ			22:28																					
ZZZZZZ			22:33																					
ZZZZZZ			22:38																					
ZZZZZZ			22:43																					
ZZZZZZ			22:48																					
ZZZZZZ			22:52																					
ZZZZZZ			22:57																					
ZZZZZZ			23:02																					
CCV 180-89757/139			23:07																					
CCB12 180-89757/140			23:15																					
ZZZZZZ			23:20																					
ZZZZZZ			23:25																					
ZZZZZZ			23:29																					
ZZZZZZ			23:34																					
ZZZZZZ			23:39																					
ZZZZZZ			23:44																					
CCV 180-89757/147			23:49																					
CCB13 180-89757/148			23:57																					

Prep Types

T = Total/NA

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/14/2013 09:56 End Date: 11/14/2013 22:11

Lab Sample ID	D/F	Type	Time	Analytes																				
				As	Pb	Sb																		
ITUNE 180-89888/1			09:56																					
STD1 180-89888/2 IC	1		12:09	X	X	X																		
STD2 180-89888/3 IC	1		12:31	X	X	X																		
STD3 180-89888/4 IC	1		12:35	X	X	X																		
ICV 180-89888/5	1		12:40	X	X	X																		
ICB 180-89888/6	1		12:45	X	X	X																		
CRI 180-89888/7	1		12:50	X	X	X																		
ICSA 180-89888/8	1		12:55	X	X	X																		
ICSAB 180-89888/9	1		12:59	X	X	X																		
CCV 180-89888/10	1		13:04	X	X	X																		
CCB1 180-89888/11	1		13:12	X	X	X																		
ZZZZZZ			13:17																					
ZZZZZZ			13:35																					
ZZZZZZ			13:40																					
ZZZZZZ			13:45																					
ZZZZZZ			13:49																					
ZZZZZZ			13:54																					
ZZZZZZ			13:59																					
ZZZZZZ			14:04																					
ZZZZZZ			14:08																					
ZZZZZZ			14:13																					
CCV 180-89888/22			14:21																					
CCB2 180-89888/23			14:30																					
ZZZZZZ			14:34																					
ZZZZZZ			14:39																					
ZZZZZZ			14:44																					
ZZZZZZ			14:49																					
ZZZZZZ			14:53																					
ZZZZZZ			14:58																					
ZZZZZZ			15:03																					
ZZZZZZ			15:08																					
ZZZZZZ			15:13																					
ZZZZZZ			15:17																					
CCV 180-89888/34			15:22																					
CCB3 180-89888/35			15:30																					
ZZZZZZ			15:35																					
ZZZZZZ			15:40																					
ZZZZZZ			15:45																					
ZZZZZZ			15:49																					
ZZZZZZ			15:54																					
ZZZZZZ			15:59																					
ZZZZZZ			16:04																					

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/14/2013 09:56 End Date: 11/14/2013 22:11

Lab Sample ID	D / F	Type	Time	Analytes																				
				As	Pb	Sb																		
ZZZZZZ			16:09																					
ZZZZZZ			16:13																					
ZZZZZZ			16:18																					
CCV 180-89888/46			16:23																					
CCB4 180-89888/47			16:31																					
ZZZZZZ			16:36																					
ZZZZZZ			16:41																					
ZZZZZZ			16:49																					
ZZZZZZ			16:54																					
ZZZZZZ			16:59																					
ZZZZZZ			17:03																					
ZZZZZZ			17:08																					
ZZZZZZ			17:13																					
ZZZZZZ			17:18																					
ZZZZZZ			17:22																					
CCV 180-89888/58			17:27																					
CCB5 180-89888/59			17:35																					
ZZZZZZ			17:40																					
ZZZZZZ			17:45																					
ZZZZZZ			17:50																					
ZZZZZZ			17:55																					
ZZZZZZ			17:59																					
ZZZZZZ			18:04																					
ZZZZZZ			18:09																					
ZZZZZZ			18:14																					
ZZZZZZ			18:19																					
ZZZZZZ			19:09																					
CCV 180-89888/70	1		19:14	X	X	X																		
CCB6 180-89888/71	1		19:22	X	X	X																		
ZZZZZZ			19:27																					
ZZZZZZ			19:31																					
MB 180-89655/1-A	1	T	19:40		X	X																		
MB 180-89656/1-A	1	T	19:45	X																				
LCS 180-89655/2-A	1	T	19:50		X	X																		
LCS 180-89656/2-A	1	T	19:54	X																				
180-26836-2	1	T	20:02		X	X																		
180-26836-2 SD	5	T	20:07		X	X																		
180-26836-2 MS	1	T	20:12		X	X																		
180-26836-2 MSD	1	T	20:17		X	X																		
CCV 180-89888/82	1		20:21	X	X	X																		
CCB7 180-89888/83	1		20:29	X	X	X																		
CRI 180-89888/84	1		20:34	X	X	X																		

13-IN
ANALYSIS RUN LOG
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: M Method: 6020A

Start Date: 11/14/2013 09:56 End Date: 11/14/2013 22:11

Lab Sample ID	D / F	Type	Time	Analytes																				
				As	Pb	Sb																		
ZZZZZZ			20:44																					
180-26836-2	1	T	20:49	X																				
180-26836-2 SD	5	T	20:54	X																				
180-26836-2 MS	1	T	20:58	X																				
180-26836-2 MSD	1	T	21:03	X																				
ZZZZZZ			21:11																					
CCV 180-89888/91	1		21:16	X	X	X																		
CCB8 180-89888/92	1		21:24	X	X	X																		
ZZZZZZ			21:29																					
ZZZZZZ			21:34																					
ZZZZZZ			21:39																					
ZZZZZZ			21:43																					
ZZZZZZ			21:48																					
ZZZZZZ			21:53																					
ZZZZZZ			21:58																					
CCV 180-89888/100			22:03																					
CCB9 180-89888/101			22:11																					

Prep Types

D = Dissolved

R = Total Recoverable

T = Total/NA

15-IN
ICP-MS INTERNAL STANDARDS RELATIVE INTENSITY SUMMARY
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICP-MS Instrument ID: M Start Date: 11/13/2013 End Date: 11/13/2013

Lab Sample ID	Time	Internal Standards %RI For:									
		Element Li-6	Q	Element Sc	Q	Element Y-89	Q	Element Rh-103	Q	Element In	Q
STD1 180-89757/2 IC	10:32	100		100		100		100		100	
STD2 180-89757/3 IC	10:36	85		83		82		77		80	
STD3 180-89757/4 IC	10:40	84		84		85		85		86	
ICV 180-89757/5	10:45	88		86		84		82		84	
ICB 180-89757/6	10:50	102		101		100		99		99	
CRI 180-89757/7	10:55	118		116		97		97		97	
ICSA 180-89757/8	11:00	72		70		68		65		72	
ICSAB 180-89757/9	11:05	65		67		67		64		71	
CCV 180-89757/10	11:09	71		74		79		74		81	
CCB1 180-89757/11	11:18	90		92		94		94		96	
CCV 180-89757/34	13:24	70		74		77		77		80	
CCB3 180-89757/35	13:33	86		89		91		94		95	
MB 180-89482/1-A	14:05	63		64		69		71		74	
PB 180-89081/4-B	14:10	58		57		69		69		74	
LCS 180-89482/2-A	14:15	57		60		69		66		72	
LCSD 180-89482/3-A	14:20	60		60		70		67		73	
180-26836-1	14:28	62		63		70		69		74	
CCV 180-89757/46	14:33	76		75		79		75		78	
CCB4 180-89757/47	14:41	96		94		93		95		94	
180-26836-3	14:46	67		69		74		73		78	
180-26836-4	14:50	63		66		73		72		77	
180-26836-4 SD	14:55	75		75		78		79		81	
180-26836-4 PDS	15:00	62		62		70		67		73	
MB 180-89486/1-A	15:09	93		87		85		87		87	
PB 180-89081/4-C	15:14	95		91		89		90		90	
LCS 180-89486/2-A	15:18	85		79		72		76		78	
LCSD 180-89486/3-A	15:23	82		76		71		75		78	
180-26836-1	15:31	85		79		79		79		81	
180-26836-3	15:36	81		79		80		80		82	
CCV 180-89757/58	15:41	85		77		80		76		78	
CCB5 180-89757/59	15:49	103		97		94		97		95	
180-26836-4	15:54	90		84		84		84		86	
180-26836-4 SD	15:59	91		87		88		89		89	
180-26836-4 PDS	16:03	80		78		78		75		78	
CCV 180-89757/70	16:54	83		78		79		74		76	
CCB6 180-89757/71	17:03	101		94		90		92		90	
CRI 180-89757/84	18:15	94		89		89		87		87	

15-IN
ICP-MS INTERNAL STANDARDS RELATIVE INTENSITY SUMMARY
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICP-MS Instrument ID: M Start Date: 11/13/2013 End Date: 11/13/2013

Lab Sample ID	Time	Internal Standards %RI For:									
		Element Tb	Q	Element Ho	Q	Element Bi	Q	Element	Q	Element	Q
STD1 180-89757/2 IC	10:32	100		100		100					
STD2 180-89757/3 IC	10:36	82		82		78					
STD3 180-89757/4 IC	10:40	88		88		91					
ICV 180-89757/5	10:45	86		86		83					
ICB 180-89757/6	10:50	97		97		98					
CRI 180-89757/7	10:55	96		95		96					
ICSA 180-89757/8	11:00	76		77		75					
ICSAB 180-89757/9	11:05	77		77		75					
CCV 180-89757/10	11:09	84		85		81					
CCB1 180-89757/11	11:18	99		99		101					
CCV 180-89757/34	13:24	87		88		88					
CCB3 180-89757/35	13:33	98		99		103					
MB 180-89482/1-A	14:05	84		85		90					
PB 180-89081/4-B	14:10	86		88		90					
LCS 180-89482/2-A	14:15	85		87		83					
LCSD 180-89482/3-A	14:20	87		88		83					
180-26836-1	14:28	85		87		87					
CCV 180-89757/46	14:33	83		84		81					
CCB4 180-89757/47	14:41	95		95		98					
180-26836-3	14:46	88		90		89					
180-26836-4	14:50	89		90		90					
180-26836-4 SD	14:55	87		87		89					
180-26836-4 PDS	15:00	84		86		81					
MB 180-89486/1-A	15:09	88		88		90					
PB 180-89081/4-C	15:14	92		92		90					
LCS 180-89486/2-A	15:18	83		83		76					
LCSD 180-89486/3-A	15:23	83		83		77					
180-26836-1	15:31	85		86		83					
180-26836-3	15:36	87		87		84					
CCV 180-89757/58	15:41	82		82		78					
CCB5 180-89757/59	15:49	94		93		95					
180-26836-4	15:54	89		89		86					
180-26836-4 SD	15:59	90		90		91					
180-26836-4 PDS	16:03	83		83		77					
CCV 180-89757/70	16:54	78		78		74					
CCB6 180-89757/71	17:03	88		87		88					
CRI 180-89757/84	18:15	86		86		87					

15-IN
ICP-MS INTERNAL STANDARDS RELATIVE INTENSITY SUMMARY
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICP-MS Instrument ID: M Start Date: 11/14/2013 End Date: 11/14/2013

Lab Sample ID	Time	Internal Standards %RI For:									
		Element Li-6	Q	Element Sc	Q	Element Y-89	Q	Element Rh-103	Q	Element In	Q
STD1 180-89888/2 IC	12:09	100		100		100		100		100	
STD2 180-89888/3 IC	12:31	83		84		83		80		82	
STD3 180-89888/4 IC	12:35	87		86		85		87		87	
ICV 180-89888/5	12:40	92		91		85		83		84	
ICB 180-89888/6	12:45	97		99		98		99		99	
CRI 180-89888/7	12:50	97		93		91		93		92	
ICSA 180-89888/8	12:55	66		65		69		68		73	
ICSAB 180-89888/9	12:59	63		64		71		66		72	
CCV 180-89888/10	13:04	77		78		82		81		83	
CCB1 180-89888/11	13:12	88		85		87		89		89	
CCV 180-89888/70	19:14	89		79		81		74		75	
CCB6 180-89888/71	19:22	101		89		87		86		86	
MB 180-89655/1-A	19:40	78		71		75		75		77	
MB 180-89656/1-A	19:45	88		82		82		82		83	
LCS 180-89655/2-A	19:50	63		57		64		64		68	
LCS 180-89656/2-A	19:54	87		81		81		77		79	
180-26836-2	20:02	70		64		72		70		73	
180-26836-2 SD	20:07	81		72		76		76		79	
180-26836-2 MS	20:12	65		57		67		64		68	
180-26836-2 MSD	20:17	61		57		67		64		68	
CCV 180-89888/82	20:21	86		82		81		75		77	
CCB7 180-89888/83	20:29	101		87		86		85		86	
CRI 180-89888/84	20:34	97		94		92		86		87	
180-26836-2	20:49	82		73		75		74		76	
180-26836-2 SD	20:54	89		79		80		80		81	
180-26836-2 MS	20:58	89		80		79		76		78	
180-26836-2 MSD	21:03	93		84		82		78		81	
CCV 180-89888/91	21:16	84		79		81		73		76	
CCB8 180-89888/92	21:24	94		87		85		85		86	

15-IN
ICP-MS INTERNAL STANDARDS RELATIVE INTENSITY SUMMARY
METALS

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

ICP-MS Instrument ID: M Start Date: 11/14/2013 End Date: 11/14/2013

Lab Sample ID	Time	Internal Standards %RI For:									
		Element Tb	Q	Element Ho	Q	Element Bi	Q	Element	Q	Element	Q
STD1 180-89888/2 IC	12:09	100		100		100					
STD2 180-89888/3 IC	12:31	85		86		80					
STD3 180-89888/4 IC	12:35	90		90		91					
ICV 180-89888/5	12:40	87		87		83					
ICB 180-89888/6	12:45	98		99		98					
CRI 180-89888/7	12:50	93		93		94					
ICSA 180-89888/8	12:55	78		79		77					
ICSAB 180-89888/9	12:59	78		79		76					
CCV 180-89888/10	13:04	91		92		87					
CCB1 180-89888/11	13:12	93		94		95					
CCV 180-89888/70	19:14	77		77		72					
CCB6 180-89888/71	19:22	85		85		85					
MB 180-89655/1-A	19:40	84		85		85					
MB 180-89656/1-A	19:45	86		86		86					
LCS 180-89655/2-A	19:50	82		84		77					
LCS 180-89656/2-A	19:54	84		85		77					
180-26836-2	20:02	85		87		84					
180-26836-2 SD	20:07	86		87		87					
180-26836-2 MS	20:12	81		83		77					
180-26836-2 MSD	20:17	82		84		78					
CCV 180-89888/82	20:21	81		81		76					
CCB7 180-89888/83	20:29	87		87		87					
CRI 180-89888/84	20:34	88		88		89					
180-26836-2	20:49	82		83		80					
180-26836-2 SD	20:54	84		84		84					
180-26836-2 MS	20:58	82		82		75					
180-26836-2 MSD	21:03	83		84		76					
CCV 180-89888/91	21:16	79		80		75					
CCB8 180-89888/92	21:24	86		87		87					

Dilution Corrected Concentrations

STD1 1009603 INT STD 11/13/2013 10:32:13 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	101.939%	0.003	0.300	-0.040	0.000	-0.024	0.072	0.021
2	10:33:39	99.522%	-0.019	-0.296	0.048	0.000	0.087	-0.038	-0.016
3	10:34:22	98.539%	0.016	-0.004	-0.009	0.000	-0.063	-0.034	-0.005
x		100.000%	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000
σ		1.750%	0.018	0.298	0.045	0.000	0.078	0.063	0.019
%RSD		1.750	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	-0.019	-0.043	0.000	0.366	1.099	-0.352	100.231%	0.007
2	10:33:39	0.013	-0.026	0.000	0.179	-0.980	-0.684	100.232%	-0.002
3	10:34:22	0.006	0.069	0.000	-0.545	-0.119	1.035	99.537%	-0.005
x		0.000	-0.000	0.000	0.000	0.000	0.000	100.000%	0.000
σ		0.016	0.060	0.000	0.481	1.044	0.912	0.401%	0.006
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.401	0.000

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	0.002	-0.009	-0.001	0.000	-0.131	0.129	-0.000	-0.004
2	10:33:39	-0.002	-0.003	0.003	0.001	-0.286	-0.105	-0.001	-0.001
3	10:34:22	0.000	0.013	-0.002	-0.001	0.417	-0.024	0.001	0.005
x		-0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000
σ		0.002	0.011	0.003	0.001	0.369	0.119	0.001	0.005
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	-0.001	0.002	-0.000	-0.037	-0.004	0.000	0.041	-0.003
2	10:33:39	0.002	0.003	0.025	0.022	0.013	-0.001	-0.044	0.053
3	10:34:22	-0.001	-0.005	-0.024	0.016	-0.010	0.001	0.003	-0.050
x		0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000
σ		0.002	0.004	0.024	0.032	0.012	0.001	0.043	0.052
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	0.000	-0.001	99.035%	-0.000	0.003	99.076%	-0.007	-0.285
2	10:33:39	0.000	-0.000	100.449%	-0.002	-0.000	100.282%	-0.000	0.152
3	10:34:22	0.000	0.001	100.517%	0.002	-0.003	100.642%	0.007	0.134
x		0.000	0.000	100.000%	0.000	0.000	100.000%	-0.000	-0.000
σ		0.000	0.001	0.837%	0.002	0.003	0.820%	0.007	0.247
%RSD		0.000	0.000	0.837	0.000	0.000	0.820	0.000	0.000

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	-0.003	0.023	0.014	99.510%	0.004	-0.004	0.002	0.002
2	10:33:39	0.001	-0.013	-0.007	100.361%	0.004	0.005	-0.003	-0.010
3	10:34:22	0.002	-0.010	-0.007	100.130%	-0.007	-0.001	0.001	0.008
x		-0.000	-0.000	0.000	100.000%	0.000	-0.000	-0.000	-0.000
σ		0.003	0.020	0.012	0.440%	0.006	0.004	0.002	0.009
%RSD		0.000	0.000	0.000	0.440	0.000	0.000	0.000	0.000

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:32:56	0.000	98.514%	98.885%	0.000	-0.000	-0.000	98.679%
2	10:33:39	-0.002	100.587%	100.760%	-0.001	0.000	0.000	100.902%
3	10:34:22	0.002	100.900%	100.356%	0.000	0.000	0.000	100.419%
x		-0.000	100.000%	100.000%	0.000	0.000	0.000	100.000%
σ		0.002	1.297%	0.987%	0.001	0.000	0.000	1.169%
%RSD		0.000	1.297	0.987	0.000	0.000	0.000	1.169

STD2 993937 11/13/2013 10:36:11 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	86.411%	195.800	-0.049	0.085	0.000	97800.000	97970.000	98220.000
2	10:37:37	85.452%	200.200	-0.116	0.152	0.000	100300.000	101000.000	100800.000
3	10:38:20	83.707%	204.000	0.194	0.071	0.000	101900.000	101100.000	101000.000
x		85.190%	200.000	0.010	0.103	0.000	100000.000	100000.000	100000.000
σ		1.371%	4.093	0.163	0.043	0.000	2078.000	1757.000	1543.000
%RSD		1.609	2.047	1626.000	41.830	0.000	2.078	1.757	1.543
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	985.500	9.127	0.000	98740.000	98830.000	99670.000	84.843%	0.114
2	10:37:37	1007.000	9.804	0.000	101000.000	100800.000	99870.000	82.983%	0.197
3	10:38:20	1008.000	10.150	0.000	100300.000	100400.000	100500.000	82.014%	0.116
x		1000.000	9.693	0.000	100000.000	100000.000	100000.000	83.280%	0.142
σ		12.540	0.520	0.000	1144.000	1043.000	409.500	1.437%	0.047
%RSD		1.254	5.360	0.000	1.144	1.043	0.409	1.726	33.120
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	196.300	196.200	5.033	983.400	49350.000	49510.000	196.700	195.700
2	10:37:37	200.700	200.500	5.668	1004.000	50280.000	50240.000	200.200	202.000
3	10:38:20	203.000	203.200	4.950	1013.000	50370.000	50240.000	203.000	202.300
x		200.000	200.000	5.217	1000.000	50000.000	50000.000	200.000	200.000
σ		3.423	3.540	0.393	15.090	565.600	421.500	3.149	3.720
%RSD		1.712	1.770	7.527	1.509	1.131	0.843	1.575	1.860
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	197.100	198.300	197.200	197.900	198.400	-0.724	199.600	199.200
2	10:37:37	201.500	201.300	201.100	200.500	200.600	-0.794	198.300	199.800
3	10:38:20	201.400	200.400	201.800	201.700	201.000	-0.750	202.100	200.900
x		200.000	200.000	200.000	200.000	200.000	-0.756	200.000	200.000
σ		2.527	1.495	2.479	1.954	1.374	0.035	1.955	0.881
%RSD		1.264	0.748	1.239	0.977	0.687	4.684	0.977	0.441
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	0.000	200.000	81.922%	0.310	0.297	77.982%	198.000	3.041
2	10:37:37	0.000	199.400	81.687%	0.247	0.301	77.228%	199.100	6.376
3	10:38:20	0.000	200.500	81.014%	0.276	0.285	76.265%	202.900	3.824
x		0.000	200.000	81.541%	0.277	0.294	77.158%	200.000	4.414
σ		0.000	0.542	0.471%	0.032	0.008	0.860%	2.571	1.744
%RSD		0.000	0.271	0.577	11.390	2.761	1.115	1.285	39.510
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:36:54	199.800	199.400	199.600	80.645%	0.069	0.110	0.127	199.800
2	10:37:37	199.600	199.100	199.000	80.373%	0.074	0.115	0.128	199.400
3	10:38:20	200.600	201.500	201.300	79.020%	0.070	0.107	0.111	200.800
x		200.000	200.000	200.000	80.013%	0.071	0.111	0.122	200.000
σ		0.559	1.337	1.196	0.870%	0.003	0.004	0.010	0.706
%RSD		0.279	0.668	0.598	1.088	3.531	3.861	7.852	0.353
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	10:36:54	197.700	82.508%	82.504%	195.600	196.500	195.300	79.820%	
2	10:37:37	200.100	81.651%	81.980%	200.600	200.000	200.600	77.259%	
3	10:38:20	202.200	81.118%	81.451%	203.800	203.500	204.100	75.628%	
x		200.000	81.759%	81.979%	200.000	200.000	200.000	77.569%	
σ		2.289	0.701%	0.527%	4.159	3.487	4.420	2.113%	
%RSD		1.144	0.858	0.642	2.080	1.743	2.210	2.725	

STD3 993938 11/13/2013 10:40:58 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	86.496%	0.057	197.400	200.000	0.000	11.670	6.571	6.297
2	10:42:24	82.440%	0.070	200.700	201.000	0.000	8.885	4.127	4.247
3	10:43:07	82.195%	0.035	201.900	199.000	0.000	8.053	3.555	3.329
x		83.711%	0.054	200.000	200.000	0.000	9.537	4.751	4.624
σ		2.416%	0.018	2.313	1.007	0.000	1.896	1.602	1.519
%RSD		2.886	32.590	1.156	0.503	0.000	19.880	33.720	32.860

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	1.343	10010.000	0.000	8.773	2.480	71.570	85.071%	200.500
2	10:42:24	1.675	10020.000	0.000	5.782	4.595	64.520	83.675%	200.900
3	10:43:07	1.747	9966.000	0.000	4.799	3.079	62.670	83.908%	198.600
x		1.588	10000.000	0.000	6.451	3.385	66.250	84.218%	200.000
σ		0.216	30.490	0.000	2.070	1.090	4.699	0.748%	1.248
%RSD		13.580	0.305	0.000	32.090	32.210	7.092	0.888	0.624

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	0.015	0.003	0.038	0.052	9.269	11.700	0.012	0.081
2	10:42:24	0.014	0.011	0.027	0.035	3.389	6.476	0.011	0.045
3	10:43:07	0.007	-0.001	0.034	0.019	1.118	3.734	0.008	0.046
x		0.012	0.004	0.033	0.036	4.592	7.303	0.010	0.058
σ		0.004	0.006	0.006	0.017	4.207	4.047	0.002	0.021
%RSD		36.140	131.000	17.070	46.410	91.600	55.410	17.550	36.030

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	0.178	0.117	0.050	-0.076	0.172	-0.010	0.227	0.481
2	10:42:24	0.182	0.112	0.065	0.028	0.083	-0.001	0.154	0.199
3	10:43:07	0.162	0.131	0.024	-0.019	-0.002	0.007	0.108	-0.107
x		0.174	0.120	0.046	-0.023	0.084	-0.001	0.163	0.191
σ		0.011	0.010	0.021	0.052	0.087	0.008	0.060	0.294
%RSD		6.066	8.413	45.210	230.500	103.200	594.100	36.760	154.200

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	0.000	0.021	84.332%	197.700	198.600	84.636%	0.133	2.806
2	10:42:24	0.000	0.016	83.828%	202.300	202.000	84.283%	0.123	3.493
3	10:43:07	0.000	0.017	85.472%	200.000	199.400	85.850%	0.118	3.797
x		0.000	0.018	84.544%	200.000	200.000	84.923%	0.124	3.365
σ		0.000	0.002	0.843%	2.319	1.821	0.822%	0.008	0.508
%RSD		0.000	14.000	0.997	1.160	0.910	0.968	6.270	15.090

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	0.121	0.061	-0.489	84.731%	199.800	199.100	199.200	0.048
2	10:42:24	0.107	-0.008	-0.427	85.787%	201.200	201.100	201.100	0.061
3	10:43:07	0.123	-0.051	-0.461	86.799%	199.000	199.900	199.700	0.065
x		0.117	0.001	-0.459	85.772%	200.000	200.000	200.000	0.058
σ		0.009	0.056	0.031	1.034%	1.135	1.021	1.019	0.009
%RSD		7.775	9090.000	6.837	1.206	0.568	0.511	0.509	14.700

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:41:41	0.253	86.566%	86.720%	0.076	0.074	0.017	89.657%
2	10:42:24	0.242	87.834%	88.253%	0.056	0.054	0.008	90.818%
3	10:43:07	0.222	89.413%	90.142%	0.043	0.043	0.007	92.099%
x		0.239	87.938%	88.372%	0.058	0.057	0.011	90.858%
σ		0.016	1.427%	1.714%	0.017	0.016	0.005	1.221%
%RSD		6.593	1.622	1.939	28.690	27.920	49.420	1.344

ICV 1013779 11/13/2013 10:45:45 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	89.378%	84.580	84.330	83.080	0.000	41480.000	40180.000	39920.000
2	10:47:11	89.515%	83.580	79.150	80.360	0.000	40580.000	39960.000	39930.000
3	10:47:54	85.606%	84.030	84.920	83.640	0.000	41840.000	41290.000	40860.000
x		88.166%	105.078%	103.499%	102.949%	0.000	103.254%	101.201%	100.593%
σ		2.219%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.516	0.599	3.838	2.127	0.000	1.577	1.757	1.338

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	405.800	4354.000	0.000	41110.000	40540.000	40680.000	86.614%	81.710
2	10:47:11	403.700	4336.000	0.000	40860.000	40940.000	40440.000	86.018%	81.980
3	10:47:54	411.600	4396.000	0.000	41480.000	41140.000	40720.000	84.828%	82.130
x		101.760%	109.049%	0.000	102.874%	102.175%	101.537%	85.820%	102.425%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.910%	n/a
%RSD		1.006	0.705	0.000	0.753	0.745	0.368	1.060	0.258

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	82.760	83.610	2.628	410.000	20290.000	20390.000	84.090	86.540
2	10:47:11	82.960	82.440	1.893	405.200	20370.000	20260.000	83.460	85.140
3	10:47:54	83.250	83.350	3.006	416.900	20600.000	20470.000	83.250	84.040
x		103.742%	103.919%	2.509	102.675%	102.095%	101.857%	104.504%	106.551%
σ		n/a	n/a	0.566	n/a	n/a	n/a	n/a	n/a
%RSD		0.296	0.740	22.560	1.429	0.784	0.520	0.524	1.468

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	86.060	86.570	86.360	86.350	83.740	-0.300	84.810	85.070
2	10:47:11	84.870	85.480	87.100	86.370	83.860	-0.312	85.180	84.410
3	10:47:54	85.630	85.970	88.130	86.330	83.260	-0.313	85.170	85.630
x		106.901%	107.513%	109.000%	107.934%	104.522%	-0.308	106.317%	106.297%
σ		n/a	n/a	n/a	n/a	n/a	0.007	n/a	n/a
%RSD		0.708	0.635	1.021	0.023	0.383	2.375	0.250	0.715

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	0.000	80.810	84.421%	81.730	81.970	81.779%	83.570	3.187
2	10:47:11	0.000	80.950	84.782%	81.060	82.050	81.760%	83.660	1.211
3	10:47:54	0.000	82.140	83.750%	82.130	82.770	80.900%	84.610	5.244
x		0.000	101.624%	84.318%	102.051%	102.826%	81.480%	104.932%	3.214
σ		0.000	n/a	0.524%	n/a	n/a	0.502%	n/a	2.017
%RSD		0.000	0.898	0.621	0.661	0.533	0.616	0.688	62.760

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	83.740	83.030	83.150	84.311%	79.930	79.570	78.730	82.050
2	10:47:11	83.800	84.330	83.920	83.487%	81.280	80.600	79.510	81.350
3	10:47:54	84.500	83.840	84.200	83.220%	81.850	81.050	81.140	83.810
x		105.019%	104.670%	104.699%	83.673%	101.274%	100.508%	99.743%	103.007%
σ		n/a	n/a	n/a	0.569%	n/a	n/a	n/a	n/a
%RSD		0.498	0.786	0.651	0.680	1.218	0.947	1.539	1.540

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:46:28	82.280	84.840%	85.092%	81.130	81.950	80.090	82.966%
2	10:47:11	82.540	85.775%	86.227%	82.440	83.310	82.160	82.954%
3	10:47:54	83.310	86.151%	86.236%	84.150	85.170	83.340	82.321%
x		103.389%	85.589%	85.851%	103.222%	104.347%	102.329%	82.747%
σ		n/a	0.675%	0.658%	n/a	n/a	n/a	0.369%
%RSD		0.642	0.789	0.766	1.835	1.933	2.008	0.446

ICB 11/13/2013 10:50:35 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	100.506%	0.067	1.902	2.071	0.000	5.447	2.218	2.123
2	10:52:01	102.452%	-0.019	1.491	1.586	0.000	3.791	1.231	1.304
3	10:52:44	102.018%	0.051	1.345	1.436	0.000	3.249	0.851	1.166
x		101.658%	0.033	1.579	1.698	0.000	4.162	1.433	1.531
σ		1.022%	0.046	0.288	0.332	0.000	1.145	0.706	0.517
%RSD		1.005	137.100	18.260	19.560	0.000	27.520	49.220	33.800
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	-0.009	3.553	0.000	5.674	-0.104	1.791	99.010%	0.039
2	10:52:01	-0.011	3.176	0.000	3.410	-0.183	0.481	101.140%	0.015
3	10:52:44	0.007	2.729	0.000	3.064	-0.205	0.635	101.788%	0.010
x		-0.004	3.153	0.000	4.050	-0.164	0.969	100.646%	0.021
σ		0.009	0.412	0.000	1.418	0.053	0.716	1.453%	0.015
%RSD		218.600	13.070	0.000	35.010	32.470	73.890	1.444	72.690
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	0.008	-0.005	0.003	0.022	4.596	3.871	0.005	-0.002
2	10:52:01	0.008	0.013	-0.006	0.006	2.268	2.639	0.002	0.006
3	10:52:44	-0.000	0.004	0.002	0.006	1.872	1.179	0.001	0.005
x		0.006	0.004	-0.000	0.011	2.912	2.563	0.002	0.003
σ		0.005	0.009	0.005	0.009	1.472	1.348	0.002	0.004
%RSD		86.610	243.400	1401.000	83.470	50.540	52.590	81.930	153.700
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	0.082	-0.004	0.040	0.076	0.130	-0.011	0.192	0.427
2	10:52:01	0.063	0.005	0.032	0.120	-0.036	0.005	0.202	-0.064
3	10:52:44	0.073	-0.003	0.078	0.010	0.018	-0.001	0.159	0.072
x		0.073	-0.001	0.050	0.069	0.037	-0.002	0.184	0.145
σ		0.009	0.005	0.024	0.055	0.085	0.008	0.022	0.253
%RSD		12.940	571.000	49.100	80.240	226.000	353.200	11.980	174.600
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	0.000	0.004	97.510%	0.235	0.200	97.900%	0.009	0.013
2	10:52:01	0.000	0.001	100.346%	0.168	0.182	99.389%	0.013	-0.216
3	10:52:44	0.000	0.004	100.972%	0.130	0.143	100.724%	0.027	0.132
x		0.000	0.003	99.609%	0.178	0.175	99.338%	0.016	-0.023
σ		0.000	0.002	1.845%	0.053	0.029	1.413%	0.009	0.177
%RSD		0.000	62.050	1.852	29.910	16.650	1.422	57.940	755.900
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:51:18	0.013	0.008	0.010	96.932%	0.059	0.008	0.017	0.001
2	10:52:01	0.021	0.020	0.011	99.204%	0.050	0.009	0.014	0.002
3	10:52:44	0.021	-0.007	-0.004	99.786%	0.046	0.015	0.009	0.006
x		0.019	0.007	0.006	98.641%	0.052	0.010	0.013	0.003
σ		0.005	0.013	0.008	1.508%	0.007	0.004	0.004	0.003
%RSD		24.680	190.300	149.500	1.529	13.340	36.370	31.920	81.820
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	10:51:18	0.003	95.581%	95.489%	0.024	0.022	0.005	97.546%	
2	10:52:01	-0.002	97.767%	97.319%	0.024	0.020	0.003	98.649%	
3	10:52:44	-0.001	98.917%	98.193%	0.019	0.016	0.000	99.074%	
x		0.000	97.422%	97.000%	0.022	0.019	0.003	98.423%	
σ		0.003	1.695%	1.380%	0.003	0.003	0.002	0.789%	
%RSD		7320.000	1.740	1.422	14.720	14.580	83.850	0.801	

CRI 1011230 11/13/2013 10:55:24 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	122.044%	0.964	4.631	4.794	0.000	84.460	90.620	88.850
2	10:56:50	117.786%	0.996	4.412	4.960	0.000	83.670	92.260	90.850
3	10:57:33	114.469%	0.902	4.739	4.818	0.000	83.770	91.930	92.250
x		118.100%	95.410%	91.880%	97.146%	0.000	83.964%	91.604%	90.649%
σ		3.797%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		3.215	4.961	3.621	1.850	0.000	0.512	0.950	1.886
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	37.300	443.800	0.000	84.940	91.040	92.270	117.246%	4.227
2	10:56:50	38.020	453.200	0.000	86.510	93.730	96.040	115.403%	4.362
3	10:57:33	39.180	459.000	0.000	85.130	97.460	95.380	115.018%	4.623
x		127.218%	90.407%	0.000	85.525%	94.075%	94.560%	115.889%	88.085%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.191%	n/a
%RSD		2.475	1.697	0.000	1.003	3.426	2.128	1.028	4.574
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	0.894	1.869	0.016	4.716	45.620	47.440	0.486	1.103
2	10:56:50	0.940	1.942	-0.013	4.749	47.270	48.350	0.490	1.045
3	10:57:33	0.866	1.924	0.073	4.763	45.430	49.640	0.511	1.115
x		90.043%	95.568%	0.025	948.523%	92.220%	96.955%	99.100%	108.781%
σ		n/a	n/a	0.044	n/a	n/a	n/a	n/a	n/a
%RSD		4.154	1.987	174.900	0.504	2.196	2.273	2.660	3.453
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	2.261	2.206	6.130	6.590	1.095	-0.010	5.052	5.606
2	10:56:50	2.166	2.240	6.247	6.243	1.082	-0.017	5.442	5.582
3	10:57:33	2.174	2.198	6.316	6.586	1.187	-0.022	5.329	5.471
x		110.021%	110.736%	124.620%	129.467%	112.122%	-0.016	105.488%	111.060%
σ		n/a	n/a	n/a	n/a	n/a	0.006	n/a	n/a
%RSD		2.388	1.019	1.509	3.078	5.134	37.230	3.802	1.296
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	0.000	5.070	96.236%	4.844	4.970	96.995%	1.134	0.249
2	10:56:50	0.000	5.125	97.044%	4.970	4.925	97.391%	1.087	0.232
3	10:57:33	0.000	5.147	96.427%	5.011	4.903	97.209%	1.150	0.362
x		0.000	102.277%	96.569%	98.837%	98.651%	97.198%	112.363%	0.281
σ		0.000	n/a	0.422%	n/a	n/a	0.198%	n/a	0.071
%RSD		0.000	0.779	0.437	1.764	0.693	0.204	2.899	25.170
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	10:56:07	1.080	1.046	1.049	96.128%	5.182	2.095	1.983	10.420
2	10:56:50	1.119	1.030	1.084	97.046%	5.300	2.006	2.064	10.550
3	10:57:33	1.157	1.043	1.091	96.336%	5.414	2.062	2.090	10.250
x		111.878%	103.953%	107.489%	96.503%	105.975%	102.710%	102.287%	104.059%
σ		n/a	n/a	n/a	0.481%	n/a	n/a	n/a	n/a
%RSD		3.461	0.795	2.115	0.498	2.193	2.189	2.712	1.489
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	10:56:07	10.470	93.883%	93.572%	1.011	0.993	0.996	95.934%	
2	10:56:50	10.440	96.480%	96.111%	1.003	0.996	1.022	97.013%	
3	10:57:33	10.670	96.549%	96.287%	1.015	1.026	1.057	95.884%	
x		105.272%	95.637%	95.323%	100.955%	100.497%	102.507%	96.277%	
σ		n/a	1.519%	1.519%	n/a	n/a	n/a	0.638%	
%RSD		1.201	1.589	1.594	0.623	1.799	2.994	0.663	

ICSA 1002133 11/13/2013 11:00:13 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	73.826%	0.003	1.177	1.436	0.000	107500.000	109100.000	108700.000
2	11:01:39	71.731%	0.018	1.077	1.317	0.000	108000.000	109900.000	109800.000
3	11:02:22	69.968%	0.034	0.999	1.167	0.000	103900.000	106100.000	104700.000
x		71.842%	0.018	1.084	1.307	0.000	106500.000	108300.000	107700.000
σ		1.931%	0.016	0.089	0.135	0.000	2245.000	2001.000	2671.000
%RSD		2.689	86.610	8.237	10.300	0.000	2.109	1.847	2.480

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	107200.000	22.490	0.000	108800.000	112900.000	113000.000	68.809%	2285.000
2	11:01:39	106300.000	21.030	0.000	107500.000	113200.000	113800.000	67.717%	2273.000
3	11:02:22	103600.000	19.650	0.000	99830.000	104800.000	105900.000	72.429%	2122.000
x		105700.000	21.060	0.000	105400.000	110300.000	110900.000	69.652%	2227.000
σ		1855.000	1.416	0.000	4860.000	4763.000	4324.000	2.466%	90.550
%RSD		1.755	6.725	0.000	4.611	4.318	3.899	3.541	4.066

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	-0.199	1.246	1.655	1.074	110600.000	111000.000	0.118	-0.157
2	11:01:39	-0.246	1.225	1.774	1.055	110400.000	111200.000	0.127	-0.198
3	11:02:22	-0.129	1.084	1.447	1.031	103400.000	103900.000	0.105	-0.251
x		-0.191	1.185	1.626	1.053	108200.000	108700.000	0.117	-0.202
σ		0.059	0.088	0.165	0.021	4083.000	4200.000	0.011	0.047
%RSD		30.840	7.459	10.180	2.020	3.775	3.863	9.228	23.410

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	1.583	2.109	8.041	6.691	0.231	0.022	0.303	0.516
2	11:01:39	1.669	1.957	7.970	6.718	0.180	0.029	0.262	0.400
3	11:02:22	1.578	1.850	7.399	6.607	0.132	0.028	0.418	0.200
x		1.610	1.972	7.803	6.672	0.181	0.026	0.328	0.372
σ		0.051	0.130	0.351	0.057	0.049	0.004	0.081	0.160
%RSD		3.199	6.602	4.505	0.861	27.260	13.500	24.630	42.910

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	0.000	1.790	68.139%	2336.000	2340.000	65.195%	0.186	26.470
2	11:01:39	0.000	1.755	68.316%	2343.000	2341.000	65.304%	0.210	25.930
3	11:02:22	0.000	1.839	67.903%	2347.000	2363.000	64.775%	0.175	25.090
x		0.000	1.795	68.120%	2342.000	2348.000	65.091%	0.190	25.830
σ		0.000	0.042	0.207%	6.012	13.020	0.279%	0.018	0.697
%RSD		0.000	2.324	0.305	0.257	0.555	0.429	9.298	2.698

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	0.178	0.384	0.348	71.595%	0.297	0.140	0.148	0.342
2	11:01:39	0.177	0.230	0.251	72.393%	0.293	0.136	0.138	0.334
3	11:02:22	0.172	0.352	0.202	71.705%	0.273	0.153	0.141	0.324
x		0.175	0.322	0.267	71.897%	0.288	0.143	0.142	0.333
σ		0.003	0.081	0.074	0.433%	0.013	0.009	0.005	0.009
%RSD		1.627	25.250	27.870	0.602	4.467	6.160	3.742	2.738

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:00:56	0.331	74.911%	75.114%	0.028	0.030	0.404	74.087%
2	11:01:39	0.337	76.566%	77.092%	0.017	0.018	0.387	74.784%
3	11:02:22	0.290	76.849%	77.420%	0.017	0.014	0.377	74.827%
x		0.319	76.109%	76.542%	0.021	0.021	0.389	74.566%
σ		0.026	1.047%	1.247%	0.006	0.008	0.013	0.415%
%RSD		8.076	1.375	1.630	30.190	38.710	3.449	0.557

ICSAB 1002160 11/13/2013 11:05:03 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	66.963%	20.580	49.370	48.330	0.000	108600.000	111100.000	110400.000
2	11:06:28	62.075%	21.000	51.420	52.360	0.000	109600.000	114400.000	113400.000
3	11:07:11	64.444%	19.930	49.810	49.160	0.000	106600.000	109500.000	108100.000
x		64.494%	102.520%	100.396%	99.898%	0.000	108.256%	111.671%	110.646%
σ		2.444%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		3.790	2.641	2.151	4.270	0.000	1.399	2.234	2.435

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	107700.000	562.300	0.000	107500.000	112900.000	112800.000	66.377%	2251.000
2	11:06:28	111600.000	574.600	0.000	106900.000	113300.000	113300.000	64.925%	2268.000
3	11:07:11	106400.000	541.700	0.000	99790.000	106000.000	106200.000	69.652%	2121.000
x		108.572%	111.908%	0.000	104.739%	110.714%	110.769%	66.985%	110.670%
σ		n/a	n/a	0.000	n/a	n/a	n/a	2.422%	n/a
%RSD		2.491	2.964	0.000	4.099	3.717	3.573	3.615	3.627

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	21.760	22.860	2.397	22.670	109100.000	109400.000	21.430	20.780
2	11:06:28	21.510	22.880	2.227	22.870	109300.000	109500.000	21.470	21.060
3	11:07:11	20.660	21.550	2.028	21.390	102800.000	103200.000	20.240	19.190
x		106.557%	112.143%	2.217	97.006%	107.080%	107.380%	105.235%	101.716%
σ		n/a	n/a	0.184	n/a	n/a	n/a	n/a	n/a
%RSD		2.695	3.395	8.318	3.590	3.431	3.341	3.338	4.977

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	22.280	23.070	27.200	26.820	23.900	-0.207	57.090	57.880
2	11:06:28	22.550	22.900	27.390	26.860	23.940	-0.196	57.280	57.950
3	11:07:11	21.270	22.010	26.130	25.600	23.550	-0.221	56.710	57.580
x		110.167%	113.294%	107.633%	105.712%	118.974%	-0.208	114.051%	115.613%
σ		n/a	n/a	n/a	n/a	n/a	0.013	n/a	n/a
%RSD		3.064	2.521	2.515	2.718	0.891	6.058	0.504	0.344

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	0.000	25.360	66.642%	2314.000	2339.000	64.047%	22.100	22.870
2	11:06:28	0.000	25.470	66.499%	2320.000	2322.000	63.872%	21.950	22.380
3	11:07:11	0.000	25.660	66.487%	2353.000	2354.000	63.384%	22.220	22.930
x		0.000	127.489%	66.543%	116.456%	116.907%	63.768%	110.466%	22.730
σ		0.000	n/a	0.086%	n/a	n/a	0.343%	n/a	0.300
%RSD		0.000	0.590	0.129	0.912	0.690	0.538	0.603	1.322

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	22.000	22.920	21.940	71.436%	109.900	22.070	22.000	22.330
2	11:06:28	21.680	22.590	21.840	71.492%	110.300	22.270	22.020	22.720
3	11:07:11	21.770	22.740	21.860	71.190%	111.300	22.120	21.980	22.710
x		109.080%	113.759%	109.408%	71.373%	110.501%	110.758%	110.000%	112.923%
σ		n/a	n/a	n/a	0.161%	n/a	n/a	n/a	n/a
%RSD		0.749	0.713	0.244	0.225	0.620	0.472	0.098	0.992

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:05:45	22.530	76.080%	76.301%	22.400	22.620	23.470	74.699%
2	11:06:28	22.450	76.962%	77.546%	22.760	23.210	23.730	75.293%
3	11:07:11	22.660	77.044%	77.496%	22.790	23.390	23.850	75.484%
x		112.746%	76.695%	77.114%	113.261%	115.371%	118.419%	75.159%
σ		n/a	0.534%	0.705%	n/a	n/a	n/a	0.409%
%RSD		0.464	0.697	0.914	0.960	1.755	0.814	0.545

CCV 993939 11/13/2013 11:09:51 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	72.001%	108.200	99.380	101.300	0.000	51200.000	52550.000	53330.000
2	11:11:17	70.464%	105.900	98.970	99.260	0.000	53490.000	54540.000	54070.000
3	11:12:01	69.912%	109.400	102.300	103.800	0.000	54580.000	55390.000	54630.000
x		70.792%	107.817%	100.205%	101.465%	0.000	106.178%	108.321%	108.021%
σ		1.083%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.529	1.673	1.796	2.260	0.000	3.251	2.687	1.207

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	540.700	5147.000	0.000	51030.000	52490.000	52950.000	74.700%	100.900
2	11:11:17	523.600	5108.000	0.000	50300.000	52090.000	52310.000	73.788%	102.300
3	11:12:01	541.100	5258.000	0.000	51350.000	52690.000	53230.000	73.652%	103.800
x		107.031%	103.418%	0.000	101.791%	104.848%	105.660%	74.047%	102.321%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.570%	n/a
%RSD		1.865	1.507	0.000	1.062	0.587	0.894	0.769	1.437

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	100.800	102.000	2.594	509.200	25460.000	25400.000	101.000	101.600
2	11:11:17	101.500	101.900	2.608	509.700	25510.000	25590.000	100.300	99.590
3	11:12:01	102.600	103.000	3.810	520.100	26040.000	25970.000	102.400	102.700
x		101.628%	102.327%	3.004	102.601%	102.688%	102.620%	101.226%	101.301%
σ		n/a	n/a	0.698	n/a	n/a	n/a	n/a	n/a
%RSD		0.910	0.592	23.240	1.192	1.256	1.130	1.026	1.559

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	102.400	104.100	107.200	108.000	103.200	-0.407	108.300	107.400
2	11:11:17	101.600	102.800	107.800	107.100	104.000	-0.457	106.900	107.600
3	11:12:01	103.200	105.200	109.700	109.900	104.600	-0.454	107.800	108.300
x		102.408%	104.047%	108.259%	108.337%	103.962%	-0.439	107.654%	107.753%
σ		n/a	n/a	n/a	n/a	n/a	0.028	n/a	n/a
%RSD		0.782	1.154	1.222	1.301	0.670	6.445	0.669	0.446

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	0.000	101.100	78.521%	104.800	106.800	74.063%	104.100	1.910
2	11:11:17	0.000	102.200	78.843%	103.900	106.100	74.421%	103.400	2.604
3	11:12:01	0.000	102.600	78.753%	105.400	107.200	74.092%	105.200	2.884
x		0.000	101.998%	78.706%	104.699%	106.686%	74.192%	104.227%	2.466
σ		0.000	n/a	0.166%	n/a	n/a	0.199%	n/a	0.501
%RSD		0.000	0.771	0.212	0.685	0.534	0.268	0.831	20.330

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	103.200	105.300	103.900	80.685%	99.010	99.430	99.540	101.000
2	11:11:17	103.100	104.600	103.900	81.278%	98.350	99.690	100.100	101.500
3	11:12:01	103.500	107.000	105.000	80.930%	100.500	101.500	101.200	102.800
x		103.283%	105.640%	104.266%	80.965%	99.293%	100.212%	100.299%	101.784%
σ		n/a	n/a	n/a	0.298%	n/a	n/a	n/a	n/a
%RSD		0.226	1.154	0.591	0.368	1.117	1.137	0.845	0.923

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:10:34	101.800	82.644%	83.461%	103.800	105.300	106.600	81.292%
2	11:11:17	101.400	84.463%	85.388%	105.100	106.500	107.800	81.851%
3	11:12:01	103.200	83.550%	84.809%	106.900	108.800	110.800	80.966%
x		102.136%	83.552%	84.553%	105.290%	106.884%	108.391%	81.370%
σ		n/a	0.909%	0.989%	n/a	n/a	n/a	0.447%
%RSD		0.963	1.088	1.169	1.447	1.688	2.006	0.550

CCB1 11/13/2013 11:18:02 AM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	91.107%	0.068	0.994	0.867	0.000	5.801	0.473	0.495
2	11:19:28	89.260%	-0.009	0.472	0.801	0.000	5.426	0.657	0.504
3	11:20:12	90.079%	-0.001	0.381	0.410	0.000	4.880	0.232	0.352
x		90.149%	0.020	0.616	0.693	0.000	5.369	0.454	0.450
σ		0.925%	0.042	0.331	0.247	0.000	0.463	0.213	0.085
%RSD		1.026	216.200	53.740	35.640	0.000	8.627	46.900	18.980
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	0.048	-0.199	0.000	4.740	0.679	0.450	91.268%	0.015
2	11:19:28	0.055	0.199	0.000	4.264	-1.628	0.580	92.180%	0.057
3	11:20:12	0.029	-0.129	0.000	3.017	-1.222	-0.240	93.865%	0.013
x		0.044	-0.043	0.000	4.007	-0.724	0.263	92.438%	0.028
σ		0.013	0.212	0.000	0.890	1.232	0.441	1.318%	0.025
%RSD		30.390	491.900	0.000	22.200	170.200	167.300	1.425	86.960
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	-0.018	-0.011	0.042	0.022	-0.185	1.491	-0.000	0.011
2	11:19:28	-0.000	0.000	0.024	0.024	-0.846	1.477	-0.000	-0.000
3	11:20:12	-0.007	-0.003	0.022	0.013	-2.380	0.290	-0.001	-0.012
x		-0.008	-0.004	0.030	0.020	-1.137	1.086	-0.000	-0.000
σ		0.009	0.005	0.011	0.006	1.126	0.689	0.000	0.011
%RSD		109.100	121.200	37.500	31.780	99.040	63.480	84.880	3914.000
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	0.079	-0.015	0.048	0.046	-0.057	0.007	-0.065	-0.262
2	11:19:28	0.067	-0.002	-0.033	0.022	0.002	0.000	-0.029	0.053
3	11:20:12	0.061	-0.005	-0.052	0.006	-0.047	0.006	-0.008	-0.224
x		0.069	-0.007	-0.013	0.024	-0.034	0.005	-0.034	-0.144
σ		0.009	0.007	0.053	0.020	0.032	0.004	0.029	0.172
%RSD		12.810	92.790	422.900	81.880	93.690	80.960	84.690	119.500
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	0.000	-0.001	92.190%	0.481	0.477	92.674%	-0.021	0.358
2	11:19:28	0.000	0.002	93.683%	0.409	0.418	93.472%	-0.027	0.584
3	11:20:12	0.000	-0.000	96.007%	0.361	0.367	95.083%	-0.017	0.408
x		0.000	0.000	93.960%	0.417	0.421	93.743%	-0.022	0.450
σ		0.000	0.002	1.923%	0.061	0.055	1.227%	0.005	0.119
%RSD		0.000	3412.000	2.047	14.560	13.170	1.309	23.610	26.350
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:18:45	-0.026	-0.028	-0.016	93.527%	0.028	0.011	0.014	-0.014
2	11:19:28	-0.011	-0.043	-0.035	95.666%	0.021	0.009	0.021	0.003
3	11:20:12	-0.029	-0.033	-0.026	97.160%	-0.001	0.001	0.012	-0.010
x		-0.022	-0.035	-0.026	95.451%	0.016	0.007	0.016	-0.007
σ		0.010	0.007	0.010	1.826%	0.015	0.006	0.004	0.009
%RSD		44.160	21.230	37.580	1.913	95.630	81.010	28.070	124.100
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	11:18:45	0.005	96.049%	96.685%	0.012	0.012	0.003	98.712%	
2	11:19:28	-0.005	98.339%	98.325%	0.012	0.012	0.005	100.342%	
3	11:20:12	0.001	101.294%	101.684%	0.011	0.009	0.003	103.404%	
x		0.000	98.560%	98.898%	0.012	0.011	0.004	100.819%	
σ		0.005	2.629%	2.548%	0.001	0.002	0.001	2.382%	
%RSD		2567.000	2.668	2.576	4.915	17.140	25.360	2.363	

MB 11/13/2013 11:22:51 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	88.097%	-0.039	0.599	0.506	0.000	4.615	-0.189	-0.135
2	11:24:17	89.928%	-0.026	0.169	0.331	0.000	4.171	-0.022	-0.146
3	11:25:00	88.792%	0.036	0.322	0.241	0.000	4.125	-0.189	-0.147
x		88.939%	-0.010	0.363	0.359	0.000	4.304	-0.133	-0.143
σ		0.925%	0.040	0.218	0.135	0.000	0.271	0.096	0.007
%RSD		1.040	416.900	60.050	37.610	0.000	6.296	72.400	4.837
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	-0.179	-1.142	0.000	3.965	0.293	0.467	89.789%	0.017
2	11:24:17	-0.185	-0.570	0.000	3.479	-0.176	0.464	89.780%	0.003
3	11:25:00	-0.183	-0.659	0.000	3.757	-0.158	0.571	89.393%	-0.031
x		-0.183	-0.790	0.000	3.734	-0.014	0.500	89.654%	-0.004
σ		0.003	0.308	0.000	0.244	0.266	0.061	0.226%	0.025
%RSD		1.511	38.960	0.000	6.529	1923.000	12.150	0.252	644.000
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	-0.003	0.002	0.015	0.012	-1.555	0.311	-0.002	-0.004
2	11:24:17	-0.014	0.005	0.039	0.008	-1.309	-0.090	-0.001	-0.002
3	11:25:00	-0.007	-0.009	0.019	0.016	-1.286	0.124	0.000	-0.005
x		-0.008	-0.001	0.024	0.012	-1.383	0.115	-0.001	-0.004
σ		0.005	0.007	0.013	0.004	0.149	0.201	0.001	0.001
%RSD		67.590	1450.000	52.320	35.610	10.790	174.400	112.900	35.920
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	0.060	0.012	-0.139	-0.137	0.091	-0.009	0.167	0.359
2	11:24:17	0.040	0.004	-0.195	-0.138	0.012	-0.001	0.106	0.016
3	11:25:00	0.044	-0.006	-0.223	-0.142	0.019	-0.001	0.144	0.037
x		0.048	0.003	-0.185	-0.139	0.041	-0.004	0.139	0.137
σ		0.010	0.009	0.043	0.003	0.043	0.005	0.031	0.192
%RSD		21.840	265.900	23.070	1.826	107.200	129.600	22.170	140.000
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	0.000	-0.002	91.598%	0.210	0.207	91.872%	-0.032	0.241
2	11:24:17	0.000	-0.001	91.823%	0.216	0.199	91.385%	-0.032	0.717
3	11:25:00	0.000	-0.001	91.516%	0.238	0.220	91.851%	-0.030	0.397
x		0.000	-0.001	91.645%	0.222	0.208	91.703%	-0.031	0.452
σ		0.000	0.001	0.159%	0.015	0.010	0.275%	0.002	0.243
%RSD		0.000	47.830	0.174	6.668	4.886	0.300	5.059	53.700
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:23:34	-0.033	-0.016	-0.014	92.772%	-0.009	-0.004	-0.011	-0.009
2	11:24:17	-0.023	-0.058	-0.043	94.110%	0.008	-0.007	0.000	-0.000
3	11:25:00	-0.024	-0.032	-0.024	93.734%	-0.010	-0.005	0.004	-0.009
x		-0.027	-0.035	-0.027	93.538%	-0.004	-0.006	-0.002	-0.006
σ		0.005	0.021	0.015	0.690%	0.010	0.001	0.007	0.005
%RSD		20.290	58.880	53.790	0.737	271.800	24.430	309.600	86.440
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	11:23:34	-0.008	96.029%	95.692%	0.007	0.005	-0.000	99.816%	
2	11:24:17	-0.007	97.138%	97.117%	0.004	0.005	-0.000	99.765%	
3	11:25:00	-0.002	96.342%	96.459%	0.005	0.005	0.001	98.264%	
x		-0.006	96.503%	96.423%	0.006	0.005	0.000	99.281%	
σ		0.003	0.572%	0.713%	0.001	0.000	0.001	0.882%	
%RSD		49.670	0.593	0.739	24.780	7.755	348.400	0.888	

LCS 11/13/2013 11:27:37 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	76.305%	54.490	1014.000	1004.000	0.000	52580.000	53760.000	53560.000
2	11:29:03	74.308%	53.910	1006.000	1006.000	0.000	53080.000	54430.000	53890.000
3	11:29:46	72.379%	55.420	1042.000	1052.000	0.000	54760.000	56160.000	55610.000
x		74.331%	54.610	1021.000	1021.000	0.000	53480.000	54790.000	54350.000
σ		1.963%	0.761	18.850	26.990	0.000	1142.000	1239.000	1098.000
%RSD		2.641	1.394	1.846	2.644	0.000	2.136	2.261	2.019

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	2133.000	10390.000	0.000	51970.000	53980.000	53950.000	76.081%	1049.000
2	11:29:03	2171.000	10420.000	0.000	51980.000	53720.000	53910.000	76.166%	1049.000
3	11:29:46	2217.000	10660.000	0.000	53480.000	55030.000	55000.000	76.320%	1061.000
x		2174.000	10490.000	0.000	52480.000	54240.000	54290.000	76.189%	1053.000
σ		41.820	150.600	0.000	867.200	694.900	617.100	0.121%	6.708
%RSD		1.924	1.435	0.000	1.653	1.281	1.137	0.159	0.637

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	550.700	213.300	6.648	529.800	1103.000	1265.000	538.200	529.000
2	11:29:03	539.200	207.400	7.049	531.100	1091.000	1235.000	524.000	512.700
3	11:29:46	547.700	212.700	5.484	534.200	1094.000	1256.000	526.700	525.500
x		545.900	211.100	6.393	531.700	1096.000	1252.000	529.600	522.400
σ		5.979	3.256	0.813	2.247	6.109	15.440	7.560	8.612
%RSD		1.095	1.542	12.710	0.423	0.557	1.233	1.427	1.649

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	268.400	269.700	548.900	545.300	41.840	-0.050	11.030	11.190
2	11:29:03	264.800	267.500	547.600	546.200	41.430	-0.049	10.830	11.340
3	11:29:46	267.400	270.000	549.600	544.600	41.960	-0.049	10.920	11.220
x		266.900	269.100	548.700	545.400	41.740	-0.049	10.930	11.250
σ		1.858	1.366	1.012	0.819	0.274	0.000	0.099	0.080
%RSD		0.696	0.507	0.184	0.150	0.657	0.380	0.907	0.714

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	0.000	1065.000	76.684%	1058.000	1089.000	73.861%	54.130	14.990
2	11:29:03	0.000	1056.000	78.021%	1065.000	1101.000	74.199%	54.260	15.770
3	11:29:46	0.000	1072.000	77.648%	1076.000	1110.000	73.767%	54.920	14.020
x		0.000	1065.000	77.451%	1066.000	1100.000	73.942%	54.440	14.930
σ		0.000	7.899	0.689%	9.128	10.100	0.227%	0.424	0.878
%RSD		0.000	0.742	0.890	0.856	0.918	0.308	0.778	5.882

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	53.530	55.330	49.400	77.721%	2125.000	521.000	519.500	762.000
2	11:29:03	53.970	55.380	48.640	78.264%	2162.000	529.200	527.800	475.500
3	11:29:46	54.840	56.340	48.980	78.411%	2181.000	534.200	532.900	768.200
x		54.110	55.680	49.010	78.132%	2156.000	528.100	526.700	668.600
σ		0.662	0.570	0.384	0.364%	28.470	6.690	6.758	167.200
%RSD		1.223	1.024	0.784	0.465	1.320	1.267	1.283	25.020

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:28:20	2130.000	83.411%	84.259%	51.290	52.120	21.170	83.040%
2	11:29:03	2142.000	85.510%	85.814%	52.400	53.530	21.580	83.393%
3	11:29:46	2167.000	85.748%	86.334%	53.120	54.440	21.840	83.475%
x		2146.000	84.889%	85.469%	52.270	53.360	21.530	83.302%
σ		19.100	1.286%	1.080%	0.921	1.165	0.337	0.231%
%RSD		0.890	1.515	1.264	1.761	2.182	1.564	0.277

LCSD 11/13/2013 11:32:23 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	75.234%	54.450	1034.000	1021.000	0.000	55690.000	55790.000	55090.000
2	11:33:49	73.506%	56.540	1093.000	1059.000	0.000	55380.000	56330.000	55420.000
3	11:34:32	76.052%	52.250	1017.000	995.200	0.000	51730.000	52780.000	52440.000
x		74.931%	54.410	1048.000	1025.000	0.000	54270.000	54960.000	54320.000
σ		1.300%	2.146	40.130	32.350	0.000	2204.000	1912.000	1633.000
%RSD		1.735	3.943	3.829	3.156	0.000	4.062	3.478	3.007
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	2170.000	10620.000	0.000	54060.000	54890.000	54890.000	75.983%	1067.000
2	11:33:49	2215.000	10580.000	0.000	53360.000	55210.000	55220.000	75.158%	1063.000
3	11:34:32	2074.000	9964.000	0.000	50480.000	52200.000	52330.000	77.222%	1006.000
x		2153.000	10390.000	0.000	52630.000	54100.000	54150.000	76.121%	1045.000
σ		71.620	368.300	0.000	1898.000	1653.000	1582.000	1.039%	34.080
%RSD		3.326	3.545	0.000	3.606	3.056	2.923	1.365	3.260
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	551.800	212.700	7.337	541.700	1109.000	1265.000	539.700	536.900
2	11:33:49	551.400	215.000	6.306	546.200	1114.000	1248.000	532.600	526.600
3	11:34:32	523.300	201.800	5.730	506.900	1037.000	1185.000	501.100	499.800
x		542.200	209.800	6.458	531.600	1087.000	1233.000	524.500	521.100
σ		16.330	7.024	0.814	21.480	43.230	42.120	20.540	19.110
%RSD		3.013	3.347	12.610	4.041	3.978	3.417	3.917	3.668
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	268.400	270.200	551.200	550.900	42.010	-0.039	11.090	11.450
2	11:33:49	269.000	273.100	556.000	554.900	41.360	-0.033	11.320	10.490
3	11:34:32	254.100	255.200	522.700	523.400	39.120	-0.018	10.590	10.330
x		263.800	266.100	543.300	543.100	40.830	-0.030	11.000	10.760
σ		8.416	9.593	18.020	17.130	1.514	0.011	0.371	0.606
%RSD		3.190	3.605	3.316	3.153	3.708	35.680	3.368	5.634
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	0.000	1069.000	76.506%	1077.000	1108.000	73.058%	54.710	14.310
2	11:33:49	0.000	1079.000	76.715%	1085.000	1120.000	72.681%	55.170	16.080
3	11:34:32	0.000	1024.000	77.855%	1034.000	1060.000	73.833%	52.250	14.050
x		0.000	1057.000	77.026%	1066.000	1096.000	73.191%	54.040	14.820
σ		0.000	29.290	0.726%	27.570	31.900	0.587%	1.569	1.106
%RSD		0.000	2.770	0.943	2.587	2.911	0.803	2.903	7.461
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:33:06	54.350	55.980	49.310	77.301%	2167.000	530.900	527.900	323.300
2	11:33:49	55.140	55.930	49.590	77.671%	2169.000	535.400	535.600	280.700
3	11:34:32	52.320	53.070	46.970	79.390%	2065.000	509.400	507.800	643.300
x		53.940	54.990	48.620	78.121%	2134.000	525.200	523.800	415.800
σ		1.453	1.662	1.439	1.115%	59.510	13.900	14.390	198.200
%RSD		2.694	3.022	2.959	1.427	2.789	2.646	2.747	47.670
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	11:33:06	2147.000	83.298%	83.947%	52.260	53.100	21.480	82.100%	
2	11:33:49	2157.000	84.675%	85.224%	53.100	54.140	21.910	81.754%	
3	11:34:32	2051.000	85.798%	86.577%	50.940	52.020	20.820	83.532%	
x		2118.000	84.591%	85.250%	52.100	53.090	21.400	82.462%	
σ		58.630	1.252%	1.315%	1.091	1.062	0.553	0.943%	
%RSD		2.768	1.480	1.543	2.093	2.000	2.585	1.143	

180-27065-A-1 11/13/2013 11:40:31 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	75.321%	-0.065	142.800	143.600	0.000	47660.000	27440.000	27050.000
2	11:41:57	72.352%	-0.055	142.200	145.300	0.000	48010.000	27980.000	27530.000
3	11:42:40	71.488%	-0.004	143.900	146.100	0.000	47770.000	28050.000	27760.000
x		73.054%	-0.042	143.000	145.000	0.000	47810.000	27820.000	27450.000
σ		2.011%	0.033	0.854	1.283	0.000	177.800	336.900	360.400
%RSD		2.752	79.270	0.597	0.885	0.000	0.372	1.211	1.313

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	26.960	8364.000	0.000	3361.000	48260.000	48090.000	75.148%	1.458
2	11:41:57	28.180	8473.000	0.000	3390.000	48280.000	48400.000	74.781%	1.539
3	11:42:40	28.350	8522.000	0.000	3350.000	48070.000	48010.000	74.180%	1.354
x		27.830	8453.000	0.000	3367.000	48200.000	48170.000	74.703%	1.450
σ		0.759	80.810	0.000	20.900	116.700	205.600	0.489%	0.093
%RSD		2.726	0.956	0.000	0.621	0.242	0.427	0.654	6.392

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	6.061	0.523	0.956	8.580	25.510	177.700	0.149	0.485
2	11:41:57	6.058	0.463	0.968	8.657	24.760	173.100	0.119	0.532
3	11:42:40	5.954	0.364	0.883	8.498	23.050	166.700	0.127	0.450
x		6.024	0.450	0.936	8.578	24.440	172.500	0.132	0.489
σ		0.061	0.080	0.046	0.080	1.259	5.524	0.016	0.041
%RSD		1.013	17.880	4.912	0.931	5.152	3.202	11.840	8.455

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	1.002	0.933	4.361	4.268	12.110	-0.000	0.696	0.782
2	11:41:57	0.959	0.926	4.293	4.114	11.750	0.004	0.516	0.949
3	11:42:40	0.996	0.935	4.345	4.357	11.800	0.002	0.635	0.682
x		0.986	0.931	4.333	4.246	11.890	0.002	0.616	0.804
σ		0.023	0.005	0.036	0.123	0.196	0.002	0.092	0.135
%RSD		2.329	0.505	0.826	2.892	1.646	116.300	14.910	16.740

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	0.000	726.300	76.705%	2.567	2.528	74.479%	-0.041	0.827
2	11:41:57	0.000	726.400	77.658%	2.486	2.575	74.795%	-0.035	0.899
3	11:42:40	0.000	722.000	77.907%	2.338	2.383	74.686%	-0.032	0.879
x		0.000	724.900	77.423%	2.464	2.495	74.653%	-0.036	0.868
σ		0.000	2.517	0.635%	0.116	0.100	0.161%	0.005	0.037
%RSD		0.000	0.347	0.820	4.698	3.997	0.215	13.650	4.304

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	-0.030	-0.060	-0.050	78.894%	0.724	0.464	0.416	55.170
2	11:41:57	-0.031	-0.066	-0.039	78.755%	0.682	0.441	0.435	55.760
3	11:42:40	-0.032	-0.062	-0.052	79.907%	0.594	0.421	0.395	54.720
x		-0.031	-0.063	-0.047	79.185%	0.667	0.442	0.415	55.220
σ		0.001	0.003	0.007	0.629%	0.067	0.021	0.020	0.520
%RSD		3.018	4.819	14.660	0.794	9.973	4.856	4.806	0.942

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:41:13	55.560	85.273%	86.412%	0.009	0.008	0.104	84.081%
2	11:41:57	54.950	86.615%	87.774%	0.008	0.006	0.107	85.504%
3	11:42:40	54.850	87.405%	88.033%	0.007	0.005	0.108	86.344%
x		55.120	86.431%	87.406%	0.008	0.006	0.106	85.310%
σ		0.382	1.078%	0.870%	0.001	0.002	0.002	1.144%
%RSD		0.693	1.247	0.996	11.910	25.640	1.964	1.341

180-27065-A-2 11/13/2013 11:45:18 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	72.732%	-0.040	101.000	100.700	0.000	37390.000	33010.000	32670.000
2	11:46:44	71.671%	-0.001	98.780	101.100	0.000	37890.000	33550.000	33360.000
3	11:47:27	69.428%	0.015	104.100	103.400	0.000	37830.000	33920.000	33630.000
x		71.277%	-0.009	101.300	101.700	0.000	37700.000	33490.000	33220.000
σ		1.687%	0.028	2.649	1.468	0.000	270.500	459.000	496.500
%RSD		2.366	329.600	2.615	1.443	0.000	0.717	1.370	1.495
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	10.900	7056.000	0.000	2450.000	106200.000	106500.000	75.019%	0.644
2	11:46:44	10.000	7151.000	0.000	2445.000	106700.000	107600.000	75.060%	0.558
3	11:47:27	9.435	7166.000	0.000	2484.000	108300.000	108500.000	73.814%	0.615
x		10.110	7124.000	0.000	2460.000	107100.000	107600.000	74.631%	0.606
σ		0.742	59.300	0.000	21.120	1094.000	995.900	0.708%	0.044
%RSD		7.332	0.832	0.000	0.859	1.022	0.926	0.948	7.283
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	-0.296	-1.868	1.472	26.490	1.245	335.200	0.269	-0.005
2	11:46:44	-0.341	-1.978	1.499	26.300	-0.890	318.100	0.267	-0.014
3	11:47:27	-0.380	-2.068	1.598	26.680	-0.519	318.200	0.253	-0.064
x		-0.339	-1.971	1.523	26.490	-0.055	323.800	0.263	-0.028
σ		0.042	0.100	0.067	0.190	1.141	9.874	0.008	0.032
%RSD		12.340	5.072	4.376	0.718	2084.000	3.049	3.138	115.600
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	3.961	3.945	18.030	18.240	0.416	-0.006	0.742	1.057
2	11:46:44	3.894	3.816	17.880	17.920	0.348	0.004	0.750	0.932
3	11:47:27	3.801	3.903	18.030	17.970	0.318	0.008	0.965	0.800
x		3.885	3.888	17.980	18.040	0.361	0.002	0.819	0.930
σ		0.080	0.066	0.088	0.169	0.051	0.007	0.127	0.129
%RSD		2.070	1.702	0.489	0.935	14.030	358.600	15.470	13.840
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	0.000	114.100	77.367%	0.852	0.766	74.027%	-0.040	0.975
2	11:46:44	0.000	114.600	78.159%	0.808	0.799	74.696%	-0.037	0.794
3	11:47:27	0.000	115.700	77.124%	0.761	0.773	73.888%	-0.038	0.781
x		0.000	114.800	77.550%	0.807	0.779	74.204%	-0.038	0.850
σ		0.000	0.809	0.541%	0.045	0.018	0.432%	0.001	0.109
%RSD		0.000	0.704	0.698	5.587	2.249	0.582	3.857	12.770
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:46:01	-0.037	-0.068	-0.047	79.018%	0.299	0.172	0.165	46.570
2	11:46:44	-0.037	-0.052	-0.051	79.950%	0.299	0.173	0.181	46.830
3	11:47:27	-0.027	-0.049	-0.035	79.250%	0.276	0.162	0.169	46.710
x		-0.034	-0.056	-0.044	79.406%	0.291	0.169	0.172	46.700
σ		0.006	0.010	0.008	0.485%	0.014	0.006	0.008	0.131
%RSD		18.250	17.960	18.870	0.611	4.735	3.492	4.624	0.281
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	11:46:01	46.370	85.585%	86.368%	0.014	0.010	0.276	83.991%	
2	11:46:44	46.380	87.156%	88.518%	0.011	0.012	0.281	85.319%	
3	11:47:27	46.870	87.154%	88.023%	0.010	0.012	0.285	85.031%	
x		46.540	86.631%	87.636%	0.012	0.011	0.281	84.780%	
σ		0.284	0.906%	1.126%	0.002	0.001	0.004	0.699%	
%RSD		0.611	1.046	1.285	16.000	10.620	1.602	0.824	

180-27065-A-2 SD@5 11/13/2013 11:50:05 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	78.509%	0.018	25.880	25.790	0.000	7553.000	6663.000	6547.000
2	11:51:31	78.102%	-0.041	25.150	25.580	0.000	7440.000	6557.000	6515.000
3	11:52:14	77.844%	-0.029	24.470	23.930	0.000	7411.000	6510.000	6499.000
x		78.152%	-0.017	25.170	25.100	0.000	7468.000	6577.000	6520.000
σ		0.336%	0.031	0.705	1.020	0.000	74.850	78.640	24.360
%RSD		0.430	181.000	2.802	4.064	0.000	1.002	1.196	0.374

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	-0.201	1397.000	0.000	462.300	21510.000	21410.000	77.689%	0.171
2	11:51:31	-0.183	1407.000	0.000	457.100	21380.000	21250.000	77.741%	0.132
3	11:52:14	-0.181	1391.000	0.000	445.100	21390.000	21660.000	78.082%	0.081
x		-0.188	1398.000	0.000	454.800	21430.000	21440.000	77.837%	0.128
σ		0.011	7.927	0.000	8.800	72.130	203.100	0.213%	0.045
%RSD		5.795	0.567	0.000	1.935	0.337	0.947	0.274	35.180

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	-0.045	-0.349	0.310	5.253	-2.259	72.400	0.058	0.026
2	11:51:31	-0.051	-0.356	0.299	5.352	-2.486	66.740	0.055	-0.016
3	11:52:14	-0.050	-0.371	0.304	5.366	-2.865	67.980	0.050	0.056
x		-0.048	-0.358	0.304	5.323	-2.537	69.040	0.054	0.022
σ		0.003	0.011	0.005	0.062	0.306	2.977	0.004	0.036
%RSD		6.651	3.109	1.683	1.158	12.070	4.312	7.252	165.200

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	0.837	0.825	3.231	3.239	0.060	0.001	-0.177	0.189
2	11:51:31	0.797	0.840	3.302	3.124	0.066	0.001	-0.055	0.340
3	11:52:14	0.802	0.793	3.207	3.076	-0.002	0.007	-0.172	-0.035
x		0.812	0.819	3.247	3.146	0.041	0.003	-0.135	0.165
σ		0.022	0.024	0.050	0.084	0.038	0.004	0.069	0.189
%RSD		2.689	2.907	1.529	2.668	91.670	114.200	51.000	114.500

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	0.000	22.690	79.763%	0.346	0.344	78.844%	-0.036	0.414
2	11:51:31	0.000	22.860	79.863%	0.352	0.340	79.061%	-0.040	0.466
3	11:52:14	0.000	22.800	80.326%	0.310	0.331	78.886%	-0.040	0.889
x		0.000	22.780	79.984%	0.336	0.338	78.931%	-0.039	0.590
σ		0.000	0.087	0.300%	0.023	0.007	0.115%	0.002	0.261
%RSD		0.000	0.381	0.375	6.828	2.019	0.146	5.626	44.160

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	-0.027	-0.033	-0.029	81.750%	0.450	0.180	0.174	9.298
2	11:51:31	-0.031	-0.037	-0.027	82.839%	0.408	0.205	0.212	9.171
3	11:52:14	-0.029	-0.069	-0.047	82.363%	0.350	0.176	0.177	9.365
x		-0.029	-0.046	-0.034	82.317%	0.403	0.187	0.188	9.278
σ		0.002	0.020	0.011	0.546%	0.050	0.016	0.021	0.099
%RSD		7.617	43.070	30.810	0.663	12.440	8.378	11.270	1.062

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:50:48	9.238	86.112%	86.512%	0.004	0.005	0.049	91.674%
2	11:51:31	9.233	87.609%	88.389%	0.004	0.002	0.050	91.191%
3	11:52:14	9.257	87.815%	88.687%	0.003	0.005	0.052	90.569%
x		9.243	87.179%	87.863%	0.004	0.004	0.050	91.145%
σ		0.013	0.929%	1.179%	0.000	0.001	0.002	0.554%
%RSD		0.136	1.066	1.342	10.190	35.560	3.490	0.608

MB 180-89510/1-A 11/13/2013 11:58:13 AM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	75.744%	-0.027	4.517	4.646	0.000	4.684	0.344	0.198
2	11:59:39	76.720%	-0.018	4.273	3.972	0.000	4.442	0.323	0.306
3	12:00:22	73.512%	-0.058	4.107	3.676	0.000	4.981	0.510	0.249
x		75.326%	-0.034	4.299	4.098	0.000	4.702	0.392	0.251
σ		1.644%	0.021	0.206	0.497	0.000	0.270	0.103	0.054
%RSD		2.183	59.470	4.791	12.140	0.000	5.737	26.210	21.480
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	0.152	0.881	0.000	5.396	3.854	5.372	75.418%	0.029
2	11:59:39	0.086	0.830	0.000	3.923	4.861	5.126	76.279%	-0.000
3	12:00:22	0.073	1.299	0.000	5.244	2.324	6.215	73.868%	-0.003
x		0.104	1.003	0.000	4.854	3.680	5.571	75.188%	0.009
σ		0.043	0.257	0.000	0.810	1.278	0.571	1.222%	0.018
%RSD		41.050	25.640	0.000	16.690	34.720	10.250	1.625	207.300
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	-0.017	0.005	0.983	0.037	-4.371	0.178	-0.001	0.001
2	11:59:39	-0.032	0.008	1.020	0.030	-5.887	0.220	0.001	0.004
3	12:00:22	0.007	0.003	0.976	0.026	-4.652	-0.037	-0.001	0.003
x		-0.014	0.005	0.993	0.031	-4.970	0.120	-0.000	0.003
σ		0.020	0.002	0.024	0.005	0.807	0.138	0.001	0.002
%RSD		143.700	46.630	2.367	16.740	16.230	114.600	295.900	55.540
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	0.039	0.021	0.681	0.790	-0.019	0.022	-0.253	-0.202
2	11:59:39	0.030	0.027	0.780	0.839	-0.041	0.023	-0.388	-0.380
3	12:00:22	0.046	0.016	0.772	0.828	0.122	0.009	-0.251	0.199
x		0.038	0.021	0.744	0.819	0.021	0.018	-0.297	-0.128
σ		0.008	0.005	0.055	0.026	0.089	0.008	0.078	0.296
%RSD		21.730	23.390	7.407	3.132	428.300	42.210	26.390	232.200
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	0.000	0.006	78.259%	0.164	0.139	77.868%	-0.040	0.129
2	11:59:39	0.000	0.007	78.456%	0.118	0.159	78.489%	-0.033	0.471
3	12:00:22	0.000	0.009	77.780%	0.127	0.130	77.361%	-0.033	0.477
x		0.000	0.007	78.165%	0.137	0.142	77.906%	-0.035	0.359
σ		0.000	0.002	0.347%	0.024	0.015	0.565%	0.004	0.199
%RSD		0.000	25.940	0.444	17.920	10.480	0.726	11.080	55.490
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	11:58:56	-0.035	-0.014	-0.011	80.899%	0.235	0.076	0.073	0.001
2	11:59:39	-0.034	-0.039	-0.037	82.064%	0.223	0.080	0.074	0.015
3	12:00:22	-0.022	-0.040	-0.032	80.870%	0.179	0.088	0.084	0.015
x		-0.030	-0.031	-0.026	81.277%	0.212	0.081	0.077	0.010
σ		0.007	0.015	0.014	0.681%	0.029	0.006	0.006	0.008
%RSD		23.200	47.140	52.020	0.838	13.860	7.563	8.006	74.490
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	11:58:56	0.002	85.464%	86.097%	0.001	0.001	0.067	92.939%	
2	11:59:39	0.001	87.914%	88.469%	0.001	0.002	0.059	93.051%	
3	12:00:22	0.012	87.543%	88.029%	0.002	0.000	0.062	91.628%	
x		0.005	86.974%	87.532%	0.001	0.001	0.063	92.539%	
σ		0.006	1.320%	1.262%	0.000	0.001	0.004	0.791%	
%RSD		118.000	1.518	1.441	28.580	58.890	6.745	0.855	

LCS 180-89510/2-A 11/13/2013 12:03:01 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	70.705%	55.470	1044.000	1019.000	0.000	55190.000	56660.000	55620.000
2	12:04:27	71.427%	55.790	1039.000	1030.000	0.000	54450.000	56060.000	55310.000
3	12:05:10	70.702%	56.240	1084.000	1076.000	0.000	55410.000	56350.000	56210.000
x		70.945%	55.830	1056.000	1042.000	0.000	55010.000	56360.000	55720.000
σ		0.418%	0.387	24.380	30.290	0.000	501.000	302.200	459.400
%RSD		0.589	0.692	2.309	2.908	0.000	0.911	0.536	0.825

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	2165.000	10500.000	0.000	52920.000	55190.000	55220.000	70.898%	1049.000
2	12:04:27	2163.000	10560.000	0.000	53530.000	55270.000	55760.000	70.726%	1054.000
3	12:05:10	2217.000	10630.000	0.000	53300.000	56030.000	56190.000	70.902%	1051.000
x		2182.000	10560.000	0.000	53250.000	55500.000	55720.000	70.842%	1052.000
σ		30.860	64.710	0.000	309.100	464.800	486.300	0.100%	2.673
%RSD		1.415	0.613	0.000	0.581	0.838	0.873	0.142	0.254

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	542.200	209.300	11.820	532.800	1070.000	1217.000	520.600	513.100
2	12:04:27	547.600	210.800	9.580	533.600	1074.000	1209.000	520.300	509.200
3	12:05:10	546.500	209.300	10.370	529.000	1075.000	1231.000	519.400	509.500
x		545.400	209.800	10.590	531.800	1073.000	1219.000	520.100	510.600
σ		2.822	0.896	1.135	2.407	2.746	11.150	0.579	2.184
%RSD		0.517	0.427	10.720	0.453	0.256	0.914	0.111	0.428

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	260.900	258.800	550.100	546.500	40.200	0.033	10.560	10.560
2	12:04:27	256.300	259.100	552.200	551.400	40.490	0.039	10.490	10.850
3	12:05:10	259.500	261.300	554.400	553.100	41.180	0.016	10.620	11.040
x		258.900	259.700	552.200	550.300	40.620	0.029	10.560	10.820
σ		2.395	1.412	2.155	3.467	0.505	0.012	0.063	0.241
%RSD		0.925	0.543	0.390	0.630	1.244	39.390	0.596	2.225

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	0.000	983.300	81.158%	985.900	1034.000	72.637%	53.600	14.380
2	12:04:27	0.000	981.200	81.708%	1003.000	1051.000	72.864%	53.340	12.720
3	12:05:10	0.000	992.000	80.862%	1013.000	1061.000	72.292%	53.790	13.940
x		0.000	985.500	81.243%	1001.000	1049.000	72.598%	53.580	13.680
σ		0.000	5.734	0.429%	13.810	13.880	0.288%	0.226	0.859
%RSD		0.000	0.582	0.528	1.379	1.324	0.396	0.421	6.279

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	52.610	54.930	47.530	78.486%	2082.000	517.700	516.600	845.500
2	12:04:27	53.090	55.310	48.870	79.185%	2091.000	518.800	521.300	799.500
3	12:05:10	53.190	55.530	49.890	79.149%	2094.000	521.300	524.300	430.800
x		52.960	55.260	48.760	78.940%	2089.000	519.300	520.700	691.900
σ		0.312	0.303	1.185	0.394%	5.905	1.806	3.894	227.300
%RSD		0.589	0.549	2.431	0.499	0.283	0.348	0.748	32.850

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:03:44	2126.000	81.566%	82.534%	52.580	53.470	21.640	82.583%
2	12:04:27	2129.000	83.406%	83.820%	53.410	54.470	22.130	81.991%
3	12:05:10	2138.000	82.957%	83.968%	54.520	55.860	22.330	81.059%
x		2131.000	82.643%	83.441%	53.500	54.600	22.030	81.878%
σ		6.082	0.959%	0.788%	0.972	1.203	0.356	0.769%
%RSD		0.285	1.161	0.945	1.816	2.204	1.617	0.939

LCSD 180-89510/3-A 11/13/2013 12:07:49 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	71.782%	54.090	998.300	990.400	0.000	50710.000	51960.000	52190.000
2	12:09:15	69.395%	52.130	999.500	1015.000	0.000	52140.000	53780.000	53310.000
3	12:09:58	68.676%	53.380	1010.000	1008.000	0.000	51290.000	53220.000	53040.000
x		69.951%	53.200	1002.000	1005.000	0.000	51380.000	52990.000	52850.000
σ		1.626%	0.994	6.175	12.750	0.000	719.000	934.300	587.200
%RSD		2.324	1.869	0.616	1.269	0.000	1.399	1.763	1.111

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	2056.000	9983.000	0.000	50250.000	51680.000	51820.000	70.746%	995.500
2	12:09:15	2078.000	10040.000	0.000	50430.000	52570.000	52630.000	69.425%	1005.000
3	12:09:58	2061.000	9969.000	0.000	50070.000	52220.000	52380.000	69.366%	996.000
x		2065.000	9997.000	0.000	50250.000	52160.000	52280.000	69.846%	998.700
σ		11.470	36.610	0.000	178.300	447.900	412.300	0.780%	5.136
%RSD		0.555	0.366	0.000	0.355	0.859	0.789	1.117	0.514

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	517.600	202.500	8.396	506.900	1026.000	1170.000	497.700	495.700
2	12:09:15	527.100	202.500	8.759	509.200	1040.000	1186.000	499.600	494.300
3	12:09:58	517.600	199.700	9.658	506.300	1022.000	1170.000	496.900	480.600
x		520.800	201.500	8.938	507.500	1029.000	1175.000	498.000	490.200
σ		5.524	1.619	0.650	1.569	9.983	9.016	1.401	8.326
%RSD		1.061	0.803	7.268	0.309	0.970	0.767	0.281	1.699

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	251.100	252.200	540.500	541.800	40.220	0.003	10.650	11.090
2	12:09:15	249.500	254.000	542.400	535.900	39.900	0.015	10.830	10.620
3	12:09:58	248.800	250.300	536.100	535.800	39.530	0.010	10.570	10.900
x		249.800	252.200	539.700	537.900	39.880	0.010	10.680	10.870
σ		1.179	1.825	3.247	3.417	0.346	0.006	0.133	0.240
%RSD		0.472	0.724	0.602	0.635	0.867	61.420	1.248	2.207

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	0.000	969.200	75.893%	985.600	1029.000	69.676%	52.240	13.300
2	12:09:15	0.000	971.300	77.020%	991.900	1028.000	69.903%	52.500	14.230
3	12:09:58	0.000	970.500	77.181%	992.100	1030.000	70.302%	52.160	15.890
x		0.000	970.300	76.698%	989.900	1029.000	69.960%	52.300	14.470
σ		0.000	1.086	0.701%	3.694	1.328	0.317%	0.175	1.308
%RSD		0.000	0.112	0.915	0.373	0.129	0.452	0.335	9.040

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	52.570	54.550	48.690	73.896%	2053.000	512.500	511.700	890.700
2	12:09:15	52.310	54.560	48.670	74.807%	2050.000	513.400	512.300	968.900
3	12:09:58	51.930	54.440	47.980	75.191%	2047.000	511.800	513.700	1017.000
x		52.270	54.520	48.450	74.631%	2050.000	512.600	512.600	958.900
σ		0.322	0.068	0.406	0.665%	2.680	0.845	1.049	63.750
%RSD		0.617	0.124	0.839	0.892	0.131	0.165	0.205	6.649

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:08:32	2056.000	81.286%	81.753%	50.180	50.780	20.510	80.123%
2	12:09:15	2039.000	82.268%	82.986%	50.500	51.380	20.880	80.995%
3	12:09:58	2050.000	82.879%	84.043%	50.990	51.970	20.940	81.589%
x		2048.000	82.144%	82.927%	50.560	51.380	20.780	80.902%
σ		8.430	0.804%	1.147%	0.406	0.597	0.231	0.738%
%RSD		0.412	0.979	1.383	0.803	1.161	1.113	0.912

180-26978-A-1-B 11/13/2013 12:15:58 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	70.255%	0.792	30.410	30.520	0.000	2447.000	10310.000	10130.000
2	12:17:24	68.588%	0.910	28.450	29.490	0.000	2484.000	10450.000	10280.000
3	12:18:07	66.059%	0.888	28.000	28.980	0.000	2475.000	10660.000	10430.000
x		68.300%	0.864	28.950	29.660	0.000	2469.000	10470.000	10280.000
σ		2.113%	0.063	1.282	0.786	0.000	19.310	177.000	150.400
%RSD		3.093	7.280	4.427	2.650	0.000	0.782	1.690	1.462

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	5531.000	11170.000	0.000	1588.000	5104.000	4902.000	70.337%	1.141
2	12:17:24	5684.000	11350.000	0.000	1609.000	5106.000	4884.000	69.344%	1.028
3	12:18:07	5737.000	11400.000	0.000	1609.000	5199.000	4915.000	69.516%	1.012
x		5651.000	11310.000	0.000	1602.000	5136.000	4901.000	69.732%	1.060
σ		107.100	119.500	0.000	12.390	54.640	15.530	0.531%	0.070
%RSD		1.896	1.057	0.000	0.774	1.064	0.317	0.761	6.631

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	-0.000	0.734	6.514	1476.000	235.800	257.900	60.350	104.200
2	12:17:24	0.046	0.732	7.009	1491.000	239.300	261.700	60.980	104.100
3	12:18:07	0.076	0.739	7.270	1481.000	235.000	258.100	59.770	103.100
x		0.041	0.735	6.931	1483.000	236.700	259.200	60.370	103.800
σ		0.038	0.004	0.384	7.795	2.291	2.151	0.602	0.639
%RSD		94.370	0.487	5.542	0.526	0.968	0.830	0.998	0.616

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	121.200	121.600	346.700	345.600	-0.069	0.137	-0.025	0.051
2	12:17:24	121.200	123.000	349.600	349.900	0.004	0.137	0.130	0.242
3	12:18:07	120.300	122.500	349.300	349.000	0.069	0.137	0.079	0.127
x		120.900	122.400	348.600	348.200	0.001	0.137	0.061	0.140
σ		0.552	0.692	1.606	2.235	0.069	0.000	0.079	0.096
%RSD		0.456	0.565	0.461	0.642	5904.000	0.139	128.900	68.830

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	0.000	35.950	79.353%	0.856	0.863	72.654%	-0.022	0.313
2	12:17:24	0.000	36.410	79.953%	0.713	0.731	73.124%	-0.021	1.315
3	12:18:07	0.000	36.590	80.484%	0.632	0.653	72.759%	-0.020	0.556
x		0.000	36.320	79.930%	0.734	0.749	72.846%	-0.021	0.728
σ		0.000	0.330	0.566%	0.114	0.106	0.246%	0.001	0.523
%RSD		0.000	0.909	0.708	15.470	14.190	0.338	5.049	71.840

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	-0.026	2.613	2.576	76.540%	1.424	0.771	0.785	53.990
2	12:17:24	-0.013	2.473	2.546	77.786%	1.259	0.718	0.676	53.980
3	12:18:07	-0.020	2.613	2.634	78.182%	1.082	0.608	0.651	53.900
x		-0.020	2.566	2.585	77.503%	1.255	0.699	0.704	53.960
σ		0.006	0.081	0.045	0.857%	0.171	0.083	0.071	0.048
%RSD		32.030	3.151	1.741	1.105	13.640	11.870	10.130	0.089

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:16:41	54.060	83.250%	84.797%	0.150	0.144	1.350	88.304%
2	12:17:24	53.860	85.848%	86.902%	0.151	0.142	1.383	88.781%
3	12:18:07	54.660	86.743%	88.052%	0.145	0.143	1.377	90.076%
x		54.200	85.280%	86.584%	0.149	0.143	1.370	89.054%
σ		0.418	1.814%	1.650%	0.004	0.001	0.018	0.917%
%RSD		0.771	2.127	1.906	2.356	0.538	1.287	1.029

CCV 993939 11/13/2013 12:20:47 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	71.175%	108.200	107.800	107.100	0.000	52010.000	52310.000	51910.000
2	12:22:13	72.296%	107.300	107.600	106.400	0.000	51560.000	52160.000	51920.000
3	12:22:56	69.869%	113.000	115.300	111.700	0.000	52590.000	53450.000	53330.000
x		71.113%	109.509%	110.262%	108.399%	0.000	104.101%	105.281%	104.771%
σ		1.215%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.708	2.753	3.997	2.620	0.000	0.994	1.332	1.555
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	515.400	5059.000	0.000	49680.000	50980.000	50640.000	75.066%	98.760
2	12:22:13	512.500	5060.000	0.000	50610.000	51120.000	51360.000	75.422%	97.120
3	12:22:56	525.600	5155.000	0.000	51030.000	51310.000	51510.000	75.347%	98.730
x		103.568%	101.827%	0.000	100.876%	102.278%	102.346%	75.278%	98.200%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.187%	n/a
%RSD		1.321	1.082	0.000	1.366	0.322	0.907	0.249	0.957
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	99.250	99.570	3.253	504.600	25020.000	25040.000	99.030	97.550
2	12:22:13	97.920	98.320	2.784	500.600	25090.000	24970.000	98.830	99.470
3	12:22:56	99.180	100.300	3.238	506.200	25480.000	25430.000	100.100	100.900
x		98.781%	99.393%	3.091	100.760%	100.792%	100.595%	99.328%	99.295%
σ		n/a	n/a	0.266	n/a	n/a	n/a	n/a	n/a
%RSD		0.760	1.003	8.619	0.573	0.984	0.979	0.708	1.678
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	100.900	102.100	106.000	106.600	103.000	-0.447	106.600	106.500
2	12:22:13	100.500	101.300	105.900	105.500	102.900	-0.444	105.000	106.600
3	12:22:56	102.300	102.700	107.400	107.100	104.100	-0.464	106.500	107.500
x		101.242%	102.043%	106.407%	106.404%	103.337%	-0.452	106.032%	106.840%
σ		n/a	n/a	n/a	n/a	n/a	0.011	n/a	n/a
%RSD		0.931	0.696	0.781	0.757	0.625	2.440	0.852	0.538
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	0.000	101.800	77.224%	102.300	103.800	73.040%	105.100	2.162
2	12:22:13	0.000	101.400	77.435%	102.600	104.900	72.428%	106.100	4.744
3	12:22:56	0.000	101.700	77.191%	104.300	105.100	72.669%	106.400	7.802
x		0.000	101.653%	77.284%	103.089%	104.583%	72.712%	105.871%	4.903
σ		0.000	n/a	0.132%	n/a	n/a	0.309%	n/a	2.823
%RSD		0.000	0.206	0.171	1.013	0.639	0.424	0.653	57.590
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:21:30	105.400	108.200	109.500	75.599%	104.000	105.500	104.600	104.900
2	12:22:13	106.200	109.300	109.100	75.955%	104.200	105.000	104.000	104.700
3	12:22:56	106.300	108.500	109.400	75.457%	105.700	105.800	105.300	106.000
x		105.942%	108.674%	109.332%	75.670%	104.615%	105.435%	104.621%	105.218%
σ		n/a	n/a	n/a	0.257%	n/a	n/a	n/a	n/a
%RSD		0.469	0.546	0.214	0.339	0.866	0.378	0.582	0.683
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	12:21:30	105.400	81.765%	82.687%	103.200	105.000	106.000	81.267%	
2	12:22:13	105.000	82.026%	82.859%	104.600	105.900	107.400	80.494%	
3	12:22:56	105.700	81.926%	83.038%	105.400	106.700	108.500	79.791%	
x		105.366%	81.906%	82.862%	104.440%	105.874%	107.296%	80.518%	
σ		n/a	0.132%	0.175%	n/a	n/a	n/a	0.738%	
%RSD		0.312	0.161	0.212	1.063	0.767	1.126	0.917	

CCB2 11/13/2013 12:28:57 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	94.579%	-0.032	5.001	5.210	0.000	2.157	0.358	0.297
2	12:30:23	92.795%	-0.061	4.789	4.727	0.000	2.156	0.227	0.366
3	12:31:06	92.683%	-0.041	5.058	4.679	0.000	1.853	0.343	0.224
x		93.352%	-0.045	4.949	4.872	0.000	2.055	0.310	0.296
σ		1.064%	0.015	0.142	0.293	0.000	0.175	0.072	0.071
%RSD		1.140	32.400	2.865	6.019	0.000	8.508	23.210	24.020

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	-0.005	-1.102	0.000	-0.141	-0.251	-0.564	91.478%	-0.013
2	12:30:23	-0.056	-0.794	0.000	-1.053	-0.279	-0.655	92.311%	0.001
3	12:31:06	-0.006	-1.087	0.000	-1.205	1.975	-1.258	92.444%	0.019
x		-0.022	-0.995	0.000	-0.800	0.482	-0.825	92.078%	0.002
σ		0.029	0.174	0.000	0.576	1.294	0.377	0.524%	0.016
%RSD		130.900	17.470	0.000	72.000	268.500	45.700	0.569	698.000

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	-0.010	-0.018	0.066	0.020	-3.782	1.504	-0.000	-0.003
2	12:30:23	-0.009	-0.030	0.053	0.015	-5.422	0.383	-0.001	-0.008
3	12:31:06	-0.025	-0.026	0.070	0.013	-5.721	0.168	-0.002	-0.004
x		-0.015	-0.025	0.063	0.016	-4.975	0.685	-0.001	-0.005
σ		0.009	0.006	0.009	0.003	1.044	0.718	0.001	0.003
%RSD		65.090	24.520	14.290	21.630	20.990	104.800	76.340	48.980

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	0.006	0.001	0.044	0.060	-0.041	0.005	-0.349	-0.114
2	12:30:23	0.010	-0.006	-0.037	0.068	-0.108	0.012	-0.337	-0.362
3	12:31:06	0.009	-0.001	-0.015	-0.059	-0.031	0.003	-0.352	-0.070
x		0.008	-0.002	-0.003	0.023	-0.060	0.007	-0.346	-0.182
σ		0.002	0.004	0.042	0.072	0.042	0.004	0.008	0.158
%RSD		23.320	207.900	1615.000	309.500	69.880	63.950	2.289	86.510

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	0.000	0.002	85.687%	0.269	0.278	85.952%	-0.041	0.367
2	12:30:23	0.000	-0.000	87.087%	0.232	0.224	87.800%	-0.034	0.091
3	12:31:06	0.000	0.001	87.163%	0.237	0.240	87.377%	-0.032	0.135
x		0.000	0.001	86.646%	0.246	0.247	87.043%	-0.035	0.198
σ		0.000	0.001	0.831%	0.020	0.027	0.968%	0.005	0.148
%RSD		0.000	102.200	0.959	8.212	11.110	1.113	13.430	74.900

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	-0.035	-0.028	-0.023	87.981%	0.331	0.101	0.107	-0.002
2	12:30:23	-0.029	-0.010	-0.014	89.585%	0.293	0.110	0.107	0.007
3	12:31:06	-0.031	-0.012	-0.014	90.252%	0.303	0.081	0.091	-0.002
x		-0.032	-0.017	-0.017	89.273%	0.309	0.098	0.102	0.001
σ		0.003	0.010	0.005	1.168%	0.019	0.015	0.009	0.005
%RSD		10.480	58.750	31.210	1.308	6.284	15.500	9.274	511.300

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:29:40	-0.003	90.518%	90.978%	0.005	0.006	0.005	95.739%
2	12:30:23	0.007	93.057%	93.383%	0.004	0.005	0.006	96.442%
3	12:31:06	-0.000	94.686%	95.073%	0.004	0.005	0.004	96.746%
x		0.001	92.754%	93.145%	0.005	0.005	0.005	96.309%
σ		0.005	2.100%	2.058%	0.001	0.001	0.001	0.517%
%RSD		356.100	2.265	2.209	12.570	12.210	18.040	0.537

180-26887-H-1-A 11/13/2013 12:33:47 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	53.945%	0.030	1235.000	1226.000	0.000	399400.000	69360.000	68500.000
2	12:35:13	51.966%	0.095	1228.000	1234.000	0.000	406700.000	70050.000	69420.000
3	12:35:56	52.401%	0.009	1233.000	1197.000	0.000	398400.000	69590.000	69030.000
x		52.771%	0.045	1232.000	1219.000	0.000	401500.000	69670.000	68980.000
σ		1.040%	0.045	3.457	19.710	0.000	4556.000	353.700	457.800
%RSD		1.971	99.980	0.281	1.617	0.000	1.135	0.508	0.664

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	58.340	4977.000	0.000	30110.000	529500.000	497200.000	55.303%	1.727
2	12:35:13	57.100	4935.000	0.000	30070.000	525600.000	499100.000	56.403%	1.799
3	12:35:56	56.830	4959.000	0.000	29900.000	529000.000	502900.000	55.768%	2.035
x		57.420	4957.000	0.000	30030.000	528000.000	499700.000	55.824%	1.854
σ		0.805	21.140	0.000	112.700	2107.000	2920.000	0.552%	0.161
%RSD		1.402	0.426	0.000	0.375	0.399	0.584	0.989	8.670

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	0.235	0.260	3.172	3120.000	2170.000	3481.000	2.344	-0.268
2	12:35:13	0.212	0.273	3.260	3052.000	2125.000	3343.000	2.341	-0.288
3	12:35:56	0.215	0.260	3.296	3084.000	2130.000	3357.000	2.300	-0.147
x		0.221	0.264	3.243	3085.000	2142.000	3394.000	2.328	-0.234
σ		0.012	0.007	0.064	33.890	24.320	76.000	0.024	0.076
%RSD		5.622	2.762	1.979	1.098	1.136	2.239	1.048	32.440

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	1.560	1.881	6.240	5.190	2.115	-0.055	0.336	6.753
2	12:35:13	1.619	1.840	5.886	4.954	2.104	-0.067	0.313	6.768
3	12:35:56	1.607	1.693	6.132	5.173	2.065	-0.051	0.452	6.834
x		1.595	1.805	6.086	5.106	2.094	-0.058	0.367	6.785
σ		0.031	0.099	0.181	0.132	0.026	0.008	0.074	0.043
%RSD		1.961	5.490	2.982	2.575	1.251	14.120	20.250	0.636

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	0.000	2026.000	63.730%	0.869	0.922	58.049%	-0.038	0.428
2	12:35:13	0.000	2019.000	64.498%	0.956	0.867	58.124%	-0.028	1.455
3	12:35:56	0.000	2019.000	64.756%	0.863	0.812	58.610%	-0.029	1.789
x		0.000	2021.000	64.328%	0.896	0.867	58.261%	-0.032	1.224
σ		0.000	3.792	0.534%	0.052	0.055	0.305%	0.006	0.709
%RSD		0.000	0.188	0.830	5.801	6.355	0.523	18.410	57.970

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	-0.032	-0.007	-0.012	64.786%	0.282	0.102	0.110	55.750
2	12:35:13	-0.033	-0.085	-0.062	65.949%	0.307	0.120	0.117	55.490
3	12:35:56	-0.037	-0.107	-0.076	66.690%	0.229	0.111	0.113	56.380
x		-0.034	-0.066	-0.050	65.808%	0.273	0.111	0.113	55.870
σ		0.003	0.052	0.034	0.960%	0.040	0.009	0.004	0.455
%RSD		7.364	79.320	67.930	1.458	14.640	7.833	3.128	0.815

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:34:30	55.600	73.718%	74.973%	0.018	0.014	0.191	70.638%
2	12:35:13	55.590	75.804%	76.859%	0.018	0.017	0.193	70.993%
3	12:35:56	55.980	76.686%	77.930%	0.016	0.016	0.196	71.291%
x		55.720	75.403%	76.588%	0.017	0.016	0.193	70.974%
σ		0.222	1.524%	1.497%	0.001	0.002	0.003	0.327%
%RSD		0.399	2.021	1.955	5.944	10.990	1.382	0.461

180-26887-I-1-A 11/13/2013 12:38:34 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	55.753%	0.011	1204.000	1179.000	0.000	383900.000	66570.000	66450.000
2	12:40:00	54.152%	0.013	1205.000	1184.000	0.000	388900.000	67470.000	67170.000
3	12:40:43	52.179%	0.004	1236.000	1214.000	0.000	388000.000	68690.000	67720.000
x		54.028%	0.009	1215.000	1192.000	0.000	387000.000	67580.000	67110.000
σ		1.790%	0.005	18.390	18.900	0.000	2668.000	1067.000	640.000
%RSD		3.313	48.280	1.513	1.586	0.000	0.689	1.578	0.954

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	2.005	4681.000	0.000	29130.000	514400.000	488300.000	57.155%	0.468
2	12:40:00	1.923	4658.000	0.000	28690.000	517300.000	491300.000	56.336%	0.529
3	12:40:43	2.003	4699.000	0.000	29270.000	520900.000	495200.000	56.408%	0.543
x		1.977	4679.000	0.000	29030.000	517500.000	491600.000	56.633%	0.514
σ		0.047	20.990	0.000	303.400	3260.000	3457.000	0.454%	0.040
%RSD		2.379	0.449	0.000	1.045	0.630	0.703	0.801	7.765

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	-0.011	0.151	4.926	3001.000	983.600	2333.000	2.214	0.330
2	12:40:00	0.103	0.153	4.809	3017.000	988.100	2232.000	2.186	-0.031
3	12:40:43	0.063	0.147	4.804	3001.000	979.700	2234.000	2.200	-0.401
x		0.052	0.150	4.846	3007.000	983.800	2266.000	2.200	-0.034
σ		0.058	0.003	0.069	9.382	4.207	57.690	0.014	0.366
%RSD		111.000	1.961	1.427	0.312	0.428	2.546	0.634	1076.000

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	1.532	1.412	4.283	3.475	2.129	-0.025	0.460	7.084
2	12:40:00	1.621	1.569	4.184	3.239	1.802	0.006	0.500	6.480
3	12:40:43	1.619	1.548	4.174	3.188	2.126	-0.022	0.698	6.969
x		1.590	1.509	4.214	3.301	2.019	-0.014	0.553	6.844
σ		0.051	0.085	0.061	0.153	0.188	0.017	0.127	0.321
%RSD		3.195	5.655	1.438	4.643	9.318	121.900	23.030	4.686

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	0.000	1971.000	66.168%	0.869	0.910	59.659%	-0.038	0.692
2	12:40:00	0.000	1976.000	66.184%	0.860	0.867	59.738%	-0.029	0.996
3	12:40:43	0.000	1985.000	66.763%	0.857	0.821	59.925%	-0.035	0.768
x		0.000	1977.000	66.372%	0.862	0.866	59.774%	-0.034	0.819
σ		0.000	6.910	0.339%	0.006	0.045	0.137%	0.004	0.158
%RSD		0.000	0.349	0.511	0.725	5.156	0.228	12.920	19.320

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	-0.030	-0.040	-0.041	67.411%	0.256	0.086	0.096	53.270
2	12:40:00	-0.034	-0.061	-0.054	67.770%	0.250	0.089	0.102	53.000
3	12:40:43	-0.038	-0.051	-0.037	68.929%	0.208	0.090	0.087	53.510
x		-0.034	-0.050	-0.044	68.037%	0.238	0.088	0.095	53.260
σ		0.004	0.011	0.009	0.793%	0.026	0.002	0.007	0.254
%RSD		11.020	21.150	20.380	1.166	11.000	2.608	7.681	0.477

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:39:17	53.460	76.932%	78.146%	0.015	0.014	0.059	71.845%
2	12:40:00	53.190	78.215%	79.669%	0.010	0.013	0.058	72.126%
3	12:40:43	52.790	79.915%	81.460%	0.011	0.013	0.060	74.263%
x		53.140	78.354%	79.758%	0.012	0.013	0.059	72.745%
σ		0.340	1.496%	1.659%	0.003	0.001	0.001	1.322%
%RSD		0.640	1.910	2.080	25.490	5.665	2.180	1.818

180-26887-I-2-A 11/13/2013 12:43:19 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	58.391%	0.399	186.200	193.000	0.000	106000.000	38600.000	38070.000
2	12:44:45	55.208%	0.466	192.600	196.900	0.000	108500.000	39870.000	38640.000
3	12:45:28	54.452%	0.518	186.100	189.700	0.000	107000.000	39270.000	38880.000
x		56.017%	0.461	188.300	193.200	0.000	107200.000	39250.000	38530.000
σ		2.090%	0.060	3.724	3.578	0.000	1270.000	638.200	414.100
%RSD		3.732	12.920	1.978	1.852	0.000	1.185	1.626	1.075

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	1446.000	9436.000	0.000	7460.000	216100.000	217700.000	58.398%	0.764
2	12:44:45	1468.000	9483.000	0.000	7496.000	217900.000	219000.000	56.851%	0.553
3	12:45:28	1487.000	9477.000	0.000	7429.000	217700.000	221500.000	56.458%	0.633
x		1467.000	9465.000	0.000	7461.000	217300.000	219400.000	57.236%	0.650
σ		20.810	25.360	0.000	33.450	1017.000	1951.000	1.025%	0.107
%RSD		1.419	0.268	0.000	0.448	0.468	0.889	1.792	16.390

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	-0.075	0.210	5.834	1669.000	1236.000	1791.000	17.110	45.130
2	12:44:45	-0.090	0.224	5.975	1691.000	1256.000	1795.000	17.400	44.570
3	12:45:28	-0.189	0.185	6.177	1664.000	1240.000	1786.000	16.900	43.910
x		-0.118	0.206	5.995	1674.000	1244.000	1791.000	17.140	44.540
σ		0.062	0.020	0.172	14.330	10.920	4.265	0.254	0.612
%RSD		52.260	9.500	2.875	0.856	0.878	0.238	1.479	1.374

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	1.344	1.636	61.070	60.480	0.462	0.127	0.058	1.020
2	12:44:45	1.266	1.623	60.950	60.590	0.581	0.115	-0.035	1.305
3	12:45:28	1.263	1.507	60.900	60.480	0.355	0.148	-0.023	0.612
x		1.291	1.589	60.970	60.510	0.466	0.130	-0.000	0.979
σ		0.046	0.071	0.089	0.061	0.113	0.017	0.051	0.348
%RSD		3.580	4.463	0.146	0.101	24.220	12.820	47680.000	35.580

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	0.000	1722.000	69.648%	0.076	0.079	63.465%	-0.042	0.403
2	12:44:45	0.000	1722.000	69.387%	0.101	0.095	63.255%	-0.037	1.007
3	12:45:28	0.000	1723.000	68.991%	0.102	0.111	62.506%	-0.035	1.440
x		0.000	1722.000	69.342%	0.093	0.095	63.075%	-0.038	0.950
σ		0.000	0.416	0.331%	0.015	0.016	0.504%	0.003	0.521
%RSD		0.000	0.024	0.477	15.940	16.750	0.799	8.826	54.810

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	-0.035	0.089	0.098	70.733%	0.108	0.048	0.035	26.240
2	12:44:45	-0.036	0.054	0.085	70.805%	0.124	0.055	0.053	26.350
3	12:45:28	-0.033	0.005	0.056	70.585%	0.134	0.032	0.038	26.290
x		-0.035	0.050	0.080	70.708%	0.122	0.045	0.042	26.290
σ		0.002	0.042	0.022	0.112%	0.013	0.012	0.009	0.054
%RSD		5.194	85.100	27.110	0.159	10.760	25.970	22.380	0.207

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:44:02	26.420	80.971%	82.307%	0.117	0.120	0.284	80.285%
2	12:44:45	26.640	82.275%	83.572%	0.116	0.126	0.287	80.451%
3	12:45:28	26.170	81.994%	83.917%	0.122	0.124	0.279	80.431%
x		26.410	81.747%	83.265%	0.118	0.123	0.283	80.389%
σ		0.237	0.687%	0.848%	0.003	0.004	0.004	0.091%
%RSD		0.896	0.840	1.018	2.763	2.855	1.587	0.113

180-26887-H-2-A 11/13/2013 12:48:05 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	55.619%	0.313	175.600	180.900	0.000	103000.000	37380.000	37290.000
2	12:49:31	54.054%	0.258	183.600	183.700	0.000	103600.000	38340.000	37540.000
3	12:50:14	52.002%	0.208	176.800	179.200	0.000	103800.000	38200.000	37610.000
x		53.892%	0.260	178.700	181.200	0.000	103400.000	37970.000	37480.000
σ		1.814%	0.053	4.331	2.258	0.000	410.700	519.000	170.100
%RSD		3.367	20.230	2.424	1.246	0.000	0.397	1.367	0.454
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	439.900	8893.000	0.000	7155.000	207800.000	211600.000	57.161%	0.692
2	12:49:31	441.600	8997.000	0.000	7189.000	209300.000	212400.000	55.487%	0.822
3	12:50:14	441.000	8980.000	0.000	7221.000	209600.000	212600.000	55.643%	0.805
x		440.800	8957.000	0.000	7188.000	208900.000	212200.000	56.097%	0.773
σ		0.844	55.760	0.000	33.180	976.200	511.900	0.925%	0.071
%RSD		0.191	0.623	0.000	0.462	0.467	0.241	1.649	9.137
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	0.040	0.158	4.899	1577.000	554.200	1091.000	16.070	42.600
2	12:49:31	-0.009	0.145	5.015	1582.000	556.200	1090.000	16.260	42.670
3	12:50:14	-0.027	0.114	5.052	1572.000	549.400	1070.000	15.830	41.480
x		0.001	0.139	4.989	1577.000	553.300	1083.000	16.050	42.250
σ		0.035	0.022	0.079	4.986	3.525	12.010	0.213	0.666
%RSD		3093.000	16.020	1.592	0.316	0.637	1.108	1.325	1.576
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	1.264	1.694	59.940	58.920	0.193	0.126	-0.156	0.384
2	12:49:31	1.350	1.704	60.480	59.830	0.321	0.108	-0.189	0.701
3	12:50:14	1.272	1.602	60.470	59.750	0.160	0.114	0.012	0.486
x		1.296	1.667	60.300	59.500	0.225	0.116	-0.111	0.524
σ		0.047	0.056	0.306	0.503	0.085	0.009	0.107	0.162
%RSD		3.658	3.368	0.507	0.845	38.020	8.041	96.750	30.880
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	0.000	1650.000	68.514%	0.117	0.106	62.613%	-0.049	0.563
2	12:49:31	0.000	1646.000	68.829%	0.102	0.097	62.639%	-0.043	1.276
3	12:50:14	0.000	1660.000	67.925%	0.108	0.093	62.055%	-0.035	1.161
x		0.000	1652.000	68.422%	0.109	0.099	62.436%	-0.042	1.000
σ		0.000	7.285	0.459%	0.008	0.006	0.330%	0.007	0.383
%RSD		0.000	0.441	0.671	6.995	6.365	0.529	16.700	38.310
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:48:48	-0.041	0.062	0.105	69.317%	0.089	0.020	0.038	25.330
2	12:49:31	-0.042	0.039	0.057	69.622%	0.079	0.028	0.041	25.500
3	12:50:14	-0.036	0.017	0.069	69.993%	0.072	0.026	0.035	24.950
x		-0.040	0.039	0.077	69.644%	0.080	0.025	0.038	25.260
σ		0.003	0.022	0.025	0.339%	0.009	0.004	0.003	0.286
%RSD		8.795	57.630	32.130	0.486	10.900	17.040	7.791	1.132
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	12:48:48	25.190	79.827%	81.280%	0.117	0.119	0.118	79.754%	
2	12:49:31	25.040	81.207%	82.904%	0.109	0.119	0.112	80.734%	
3	12:50:14	24.900	82.096%	83.165%	0.103	0.109	0.113	81.210%	
x		25.040	81.043%	82.450%	0.110	0.116	0.114	80.566%	
σ		0.142	1.143%	1.022%	0.007	0.006	0.003	0.742%	
%RSD		0.567	1.411	1.239	6.371	5.243	2.425	0.921	

180-26887-H-3-A 11/13/2013 12:52:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	21.173%	0.220	337.000	349.100	0.000	3576000.000	523300.000	507400.000
2	12:54:17	21.555%	0.066	330.400	344.400	0.000	3497000.000	530700.000	512800.000
3	12:55:00	21.611%	0.065	330.100	338.400	0.000	3473000.000	534200.000	516900.000
x		21.446%	0.117	332.500	344.000	0.000	3515000.000	529400.000	512400.000
σ		0.238%	0.089	3.899	5.337	0.000	53540.000	5589.000	4782.000
%RSD		1.111	76.140	1.173	1.552	0.000	1.523	1.056	0.933
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	35.670	4100.000	0.000	68140.000	1756000.000	1622000.000	33.189%	6.879
2	12:54:17	36.710	4156.000	0.000	69000.000	1778000.000	1642000.000	34.234%	6.676
3	12:55:00	36.160	4218.000	0.000	69920.000	1798000.000	1661000.000	34.773%	7.249
x		36.180	4158.000	0.000	69020.000	1777000.000	1642000.000	34.065%	6.935
σ		0.517	58.910	0.000	889.400	21240.000	19420.000	0.805%	0.290
%RSD		1.429	1.417	0.000	1.289	1.195	1.183	2.364	4.189
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	-0.730	0.618	21.450	179.600	1931.000	6123.000	1.241	-11.770
2	12:54:17	-0.729	0.623	21.520	181.000	1956.000	6125.000	1.239	-11.910
3	12:55:00	-0.283	0.637	21.150	181.900	1983.000	6228.000	1.282	-11.940
x		-0.581	0.626	21.370	180.800	1956.000	6159.000	1.254	-11.870
σ		0.258	0.010	0.197	1.171	26.050	60.180	0.024	0.088
%RSD		44.360	1.586	0.921	0.647	1.332	0.977	1.935	0.742
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	193.200	9.417	15.200	3.287	51.770	-3.966	11.700	198.000
2	12:54:17	233.800	9.427	15.590	5.076	52.510	-3.933	12.800	197.600
3	12:55:00	241.500	9.456	15.490	2.840	51.600	-3.848	12.530	197.500
x		222.800	9.433	15.430	3.734	51.960	-3.916	12.350	197.700
σ		25.980	0.020	0.203	1.183	0.486	0.061	0.575	0.255
%RSD		11.660	0.215	1.317	31.690	0.935	1.560	4.653	0.129
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	0.000	79900.000	38.940%	0.924	0.273	29.745%	0.049	7.037
2	12:54:17	0.000	80680.000	40.646%	1.013	0.304	31.286%	0.028	6.881
3	12:55:00	0.000	81990.000	41.241%	0.970	0.278	32.080%	0.046	6.937
x		0.000	80850.000	40.275%	0.969	0.285	31.037%	0.041	6.951
σ		0.000	1053.000	1.194%	0.044	0.017	1.187%	0.011	0.079
%RSD		0.000	1.302	2.966	4.570	5.881	3.825	27.830	1.134
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:53:34	-0.012	-0.359	-0.344	36.153%	0.712	0.292	0.925	92890.000
2	12:54:17	-0.021	-0.366	-0.320	37.720%	0.679	0.256	0.999	93800.000
3	12:55:00	0.002	-0.361	-0.331	38.863%	0.540	0.274	0.991	94550.000
x		-0.010	-0.362	-0.332	37.579%	0.644	0.274	0.972	93740.000
σ		0.011	0.004	0.012	1.361%	0.091	0.018	0.040	831.200
%RSD		109.200	1.074	3.612	3.621	14.150	6.607	4.155	0.887
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	12:53:34	92300.000	41.367%	41.995%	0.002	0.002	0.658	33.806%	
2	12:54:17	93500.000	43.551%	44.137%	0.001	0.006	0.647	35.145%	
3	12:55:00	93850.000	44.713%	45.111%	0.007	0.002	0.651	35.980%	
x		93210.000	43.210%	43.748%	0.003	0.003	0.652	34.977%	
σ		811.900	1.699%	1.594%	0.003	0.002	0.005	1.097%	
%RSD		0.871	3.932	3.644	88.050	70.370	0.839	3.135	

180-26887-I-3-A 11/13/2013 12:57:37 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	21.599%	0.183	332.700	351.900	0.000	3398000.000	554500.000	536200.000
2	12:59:03	20.923%	0.209	332.200	346.700	0.000	3480000.000	566200.000	545500.000
3	12:59:46	19.660%	0.106	339.700	357.100	0.000	3645000.000	586100.000	562700.000
x		20.727%	0.166	334.800	351.900	0.000	3508000.000	568900.000	548100.000
σ		0.984%	0.054	4.241	5.221	0.000	126100.000	15960.000	13440.000
%RSD		4.749	32.200	1.266	1.484	0.000	3.595	2.806	2.452

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	3.892	3843.000	0.000	71460.000	1813000.000	1674000.000	37.311%	5.258
2	12:59:03	3.654	3863.000	0.000	72410.000	1840000.000	1697000.000	37.066%	5.173
3	12:59:46	4.061	3956.000	0.000	73510.000	1861000.000	1710000.000	36.750%	4.844
x		3.869	3887.000	0.000	72460.000	1838000.000	1694000.000	37.042%	5.092
σ		0.204	60.240	0.000	1024.000	23730.000	17940.000	0.282%	0.219
%RSD		5.287	1.550	0.000	1.413	1.291	1.059	0.760	4.296

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	-0.823	0.525	22.490	142.300	35.320	4321.000	1.239	-11.970
2	12:59:03	-0.602	0.441	20.730	141.200	30.930	4137.000	1.251	-12.430
3	12:59:46	-0.790	0.435	20.610	141.500	29.500	4046.000	1.230	-12.450
x		-0.739	0.467	21.280	141.700	31.920	4168.000	1.240	-12.280
σ		0.119	0.050	1.052	0.534	3.035	140.200	0.010	0.272
%RSD		16.120	10.760	4.946	0.377	9.507	3.364	0.841	2.210

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	190.300	9.292	23.050	3.153	52.170	-3.884	11.120	197.800
2	12:59:03	196.800	9.328	22.860	6.123	51.200	-3.752	11.050	190.700
3	12:59:46	197.700	9.191	23.440	3.548	48.780	-3.495	10.610	185.000
x		194.900	9.270	23.120	4.275	50.720	-3.710	10.930	191.200
σ		4.033	0.071	0.299	1.613	1.742	0.198	0.273	6.418
%RSD		2.069	0.770	1.295	37.720	3.436	5.339	2.499	3.357

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	0.000	82210.000	44.236%	0.874	0.224	34.745%	0.001	7.564
2	12:59:03	0.000	81870.000	45.107%	0.826	0.219	35.390%	0.010	4.805
3	12:59:46	0.000	82880.000	45.074%	0.776	0.241	35.665%	0.011	5.586
x		0.000	82320.000	44.806%	0.825	0.228	35.266%	0.007	5.985
σ		0.000	514.000	0.494%	0.049	0.012	0.472%	0.005	1.422
%RSD		0.000	0.624	1.102	5.921	5.123	1.339	71.220	23.760

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	-0.031	-0.362	-0.328	41.220%	0.443	0.232	0.950	95870.000
2	12:59:03	-0.037	-0.179	-0.197	42.176%	0.405	0.207	0.928	95800.000
3	12:59:46	-0.036	-0.270	-0.234	42.919%	0.330	0.186	0.914	95720.000
x		-0.035	-0.270	-0.253	42.105%	0.393	0.208	0.931	95800.000
σ		0.003	0.092	0.068	0.852%	0.057	0.023	0.018	76.630
%RSD		8.966	33.940	26.750	2.023	14.640	11.070	1.928	0.080

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:58:20	95310.000	46.345%	46.855%	0.005	0.002	0.048	37.924%
2	12:59:03	95310.000	48.096%	48.474%	0.001	0.004	0.051	38.693%
3	12:59:46	95240.000	49.175%	49.521%	0.002	0.001	0.045	39.953%
x		95290.000	47.872%	48.284%	0.003	0.002	0.048	38.857%
σ		37.850	1.428%	1.343%	0.002	0.002	0.003	1.024%
%RSD		0.040	2.983	2.782	76.720	74.400	5.497	2.636

180-26978-A-2-B 11/13/2013 1:05:45 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	64.172%	1.069	20.080	20.550	0.000	2235.000	9585.000	9471.000
2	13:07:11	63.371%	1.034	19.200	19.050	0.000	2196.000	9554.000	9386.000
3	13:07:54	62.756%	1.055	18.690	18.850	0.000	2220.000	9618.000	9537.000
x		63.433%	1.052	19.320	19.480	0.000	2217.000	9586.000	9465.000
σ		0.710%	0.018	0.705	0.927	0.000	19.360	31.980	75.590
%RSD		1.120	1.666	3.648	4.760	0.000	0.873	0.334	0.799

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	4850.000	9115.000	0.000	1368.000	5009.000	4811.000	73.452%	0.773
2	13:07:11	4761.000	8968.000	0.000	1361.000	4933.000	4849.000	73.010%	0.783
3	13:07:54	4876.000	9094.000	0.000	1374.000	5106.000	4903.000	72.500%	0.777
x		4829.000	9059.000	0.000	1367.000	5016.000	4854.000	72.987%	0.778
σ		60.390	79.900	0.000	6.822	86.350	46.560	0.476%	0.005
%RSD		1.251	0.882	0.000	0.499	1.721	0.959	0.652	0.683

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	-0.041	0.549	3.704	1690.000	147.000	163.600	61.180	92.880
2	13:07:11	0.004	0.536	4.058	1703.000	148.600	159.600	60.280	90.300
3	13:07:54	0.000	0.549	4.460	1701.000	147.600	163.800	61.260	90.640
x		-0.012	0.545	4.074	1698.000	147.700	162.300	60.910	91.270
σ		0.025	0.008	0.378	7.238	0.833	2.336	0.541	1.400
%RSD		206.700	1.417	9.285	0.426	0.564	1.439	0.889	1.533

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	107.500	105.400	329.100	331.900	0.337	0.051	1.577	1.048
2	13:07:11	105.700	104.800	328.400	329.300	0.329	0.059	1.743	0.774
3	13:07:54	106.100	104.700	328.000	332.700	0.141	0.078	1.680	0.700
x		106.500	105.000	328.500	331.300	0.269	0.062	1.667	0.841
σ		0.947	0.368	0.524	1.789	0.111	0.014	0.084	0.183
%RSD		0.889	0.351	0.160	0.540	41.210	22.850	5.015	21.770

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	0.000	31.700	85.076%	0.037	0.040	80.616%	-0.048	1.002
2	13:07:11	0.000	31.580	85.726%	0.055	0.053	80.400%	-0.041	1.568
3	13:07:54	0.000	31.740	86.707%	0.039	0.031	80.704%	-0.036	1.923
x		0.000	31.670	85.836%	0.043	0.041	80.573%	-0.042	1.498
σ		0.000	0.083	0.821%	0.010	0.011	0.156%	0.006	0.465
%RSD		0.000	0.263	0.957	22.570	27.040	0.194	13.470	31.020

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	-0.042	2.839	2.837	82.873%	-0.047	0.155	0.179	52.770
2	13:07:11	-0.036	2.778	2.830	83.925%	-0.030	0.176	0.173	53.100
3	13:07:54	-0.040	2.924	2.743	84.914%	-0.039	0.169	0.165	53.570
x		-0.039	2.847	2.803	83.904%	-0.039	0.167	0.172	53.150
σ		0.003	0.073	0.052	1.021%	0.008	0.011	0.007	0.403
%RSD		8.375	2.570	1.871	1.217	21.580	6.347	3.996	0.759

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:06:28	52.930	91.421%	91.759%	0.081	0.079	0.939	97.460%
2	13:07:11	53.140	94.012%	94.906%	0.079	0.079	0.948	99.585%
3	13:07:54	53.870	93.993%	94.978%	0.079	0.081	0.957	100.005%
x		53.310	93.142%	93.881%	0.080	0.080	0.948	99.017%
σ		0.489	1.491%	1.838%	0.001	0.001	0.009	1.364%
%RSD		0.917	1.600	1.958	1.431	1.269	0.953	1.378

180-26978-A-3-B 11/13/2013 1:10:32 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	66.541%	8.791	33.950	34.790	0.000	2634.000	32070.000	31810.000
2	13:11:58	64.617%	8.823	34.910	34.810	0.000	2620.000	32210.000	31700.000
3	13:12:41	63.625%	8.741	36.600	34.720	0.000	2639.000	33130.000	32570.000
x		64.928%	8.785	35.150	34.770	0.000	2631.000	32470.000	32030.000
σ		1.483%	0.041	1.338	0.047	0.000	9.954	577.600	474.600
%RSD		2.284	0.472	3.807	0.134	0.000	0.378	1.779	1.482

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	79930.000	29000.000	0.000	2290.000	38540.000	40220.000	74.712%	1.899
2	13:11:58	81050.000	29160.000	0.000	2262.000	38590.000	39890.000	76.610%	1.757
3	13:12:41	81850.000	29330.000	0.000	2297.000	38940.000	40540.000	74.772%	1.555
x		80940.000	29160.000	0.000	2283.000	38690.000	40220.000	75.365%	1.737
σ		961.800	164.400	0.000	18.170	219.200	328.200	1.079%	0.173
%RSD		1.188	0.564	0.000	0.796	0.567	0.816	1.432	9.944

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	-0.108	12.540	4.692	7758.000	9423.000	8896.000	337.000	644.100
2	13:11:58	-0.108	12.200	4.695	7558.000	9122.000	8663.000	321.100	616.400
3	13:12:41	-0.244	12.100	4.957	7664.000	9340.000	8847.000	332.100	633.100
x		-0.153	12.280	4.781	7660.000	9295.000	8802.000	330.000	631.200
σ		0.078	0.229	0.152	100.100	155.400	122.700	8.134	13.990
%RSD		51.200	1.865	3.184	1.307	1.672	1.395	2.465	2.217

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	1085.000	1105.000	2223.000	2044.000	-0.268	0.127	0.776	-0.587
2	13:11:58	1050.000	1053.000	2189.000	2024.000	-0.320	0.128	0.498	-0.691
3	13:12:41	1060.000	1097.000	2228.000	2054.000	-0.054	0.111	0.633	-0.335
x		1065.000	1085.000	2213.000	2041.000	-0.214	0.122	0.636	-0.537
σ		17.960	27.790	21.140	15.480	0.141	0.010	0.139	0.183
%RSD		1.687	2.562	0.955	0.758	66.050	7.975	21.880	34.100

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	0.000	60.480	212.901%	0.047	0.042	79.071%	-0.024	-5.013
2	13:11:58	0.000	60.640	216.158%	0.052	0.046	79.327%	-0.024	-4.578
3	13:12:41	0.000	60.760	217.771%	0.034	0.043	79.517%	-0.022	-2.306
x		0.000	60.630	215.610%	0.044	0.044	79.305%	-0.023	-3.966
σ		0.000	0.140	2.481%	0.009	0.002	0.224%	0.001	1.454
%RSD		0.000	0.231	1.151	19.940	4.236	0.282	4.232	36.660

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	-0.018	27.130	27.110	81.815%	-0.011	0.243	0.237	13.600
2	13:11:58	-0.022	27.270	27.270	82.959%	-0.007	0.225	0.228	13.680
3	13:12:41	-0.021	27.080	26.600	84.161%	-0.019	0.228	0.223	13.600
x		-0.020	27.160	26.990	82.978%	-0.012	0.232	0.229	13.620
σ		0.002	0.098	0.351	1.173%	0.006	0.010	0.007	0.046
%RSD		10.750	0.362	1.302	1.413	50.410	4.238	3.102	0.339

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:11:15	13.800	94.019%	97.984%	0.461	0.460	1.064	91.777%
2	13:11:58	13.770	97.276%	101.590%	0.451	0.463	1.072	93.852%
3	13:12:41	13.610	98.581%	102.820%	0.464	0.474	1.079	94.526%
x		13.730	96.625%	100.798%	0.459	0.466	1.072	93.385%
σ		0.100	2.349%	2.513%	0.007	0.007	0.008	1.433%
%RSD		0.731	2.432	2.493	1.490	1.539	0.722	1.534

180-26978-A-4-B 11/13/2013 1:15:19 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	67.090%	1.702	18.460	17.810	0.000	3164.000	12630.000	12470.000
2	13:16:45	65.985%	1.816	18.510	18.070	0.000	3267.000	12790.000	12580.000
3	13:17:28	67.405%	1.701	19.550	17.450	0.000	3166.000	12630.000	12440.000
x		66.827%	1.740	18.840	17.780	0.000	3199.000	12680.000	12500.000
σ		0.746%	0.066	0.616	0.311	0.000	58.670	91.480	70.470
%RSD		1.116	3.796	3.271	1.750	0.000	1.834	0.721	0.564
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	5625.000	9693.000	0.000	1633.000	9873.000	9314.000	77.095%	0.930
2	13:16:45	5645.000	9720.000	0.000	1636.000	9951.000	9335.000	77.082%	0.779
3	13:17:28	5558.000	9559.000	0.000	1609.000	9833.000	9380.000	77.797%	1.716
x		5609.000	9658.000	0.000	1626.000	9886.000	9343.000	77.325%	1.142
σ		45.740	86.130	0.000	15.090	60.030	33.760	0.409%	0.503
%RSD		0.816	0.892	0.000	0.928	0.607	0.361	0.529	44.050
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	-0.037	0.680	7.583	3067.000	129.200	158.400	88.210	120.600
2	13:16:45	-0.126	0.704	8.580	3054.000	125.600	152.600	86.500	119.600
3	13:17:28	-0.114	0.705	8.967	3045.000	122.100	151.000	85.750	117.400
x		-0.092	0.696	8.377	3056.000	125.600	154.000	86.820	119.200
σ		0.048	0.014	0.714	11.150	3.549	3.902	1.261	1.680
%RSD		52.390	2.062	8.528	0.365	2.825	2.533	1.452	1.410
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	103.600	102.600	406.600	407.900	0.122	0.136	0.931	0.426
2	13:16:45	101.400	102.500	408.200	406.300	-0.109	0.164	0.660	0.008
3	13:17:28	102.700	101.900	405.800	405.400	0.141	0.147	0.679	0.012
x		102.600	102.300	406.800	406.500	0.052	0.149	0.757	0.149
σ		1.103	0.359	1.217	1.296	0.139	0.014	0.152	0.240
%RSD		1.075	0.351	0.299	0.319	269.900	9.379	20.040	161.700
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	0.000	50.860	97.230%	0.051	0.037	83.111%	-0.048	1.540
2	13:16:45	0.000	50.770	99.137%	0.046	0.035	83.696%	-0.046	1.052
3	13:17:28	0.000	51.010	99.563%	0.049	0.032	84.278%	-0.034	1.847
x		0.000	50.880	98.643%	0.049	0.035	83.695%	-0.042	1.480
σ		0.000	0.119	1.242%	0.003	0.002	0.583%	0.007	0.401
%RSD		0.000	0.234	1.259	5.182	6.428	0.697	17.680	27.100
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:16:02	-0.044	4.262	4.345	86.052%	-0.009	0.187	0.175	47.500
2	13:16:45	-0.039	4.222	4.306	87.572%	-0.007	0.181	0.177	48.200
3	13:17:28	-0.038	4.373	4.246	87.875%	-0.002	0.192	0.198	48.230
x		-0.040	4.286	4.299	87.167%	-0.006	0.187	0.183	47.980
σ		0.003	0.078	0.050	0.977%	0.004	0.006	0.013	0.414
%RSD		7.655	1.823	1.157	1.121	57.800	3.055	7.110	0.863
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	13:16:02	47.800	95.663%	96.844%	0.031	0.036	0.689	100.343%	
2	13:16:45	48.240	97.645%	98.666%	0.032	0.035	0.698	101.649%	
3	13:17:28	48.350	97.354%	99.074%	0.035	0.035	0.698	101.851%	
x		48.130	96.887%	98.194%	0.033	0.035	0.695	101.281%	
σ		0.292	1.070%	1.187%	0.002	0.001	0.005	0.818%	
%RSD		0.607	1.105	1.209	6.636	1.515	0.753	0.808	

180-26978-A-4-B SD@5 11/13/2013 1:20:06 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	75.901%	0.377	5.940	6.520	0.000	673.600	2362.000	2340.000
2	13:21:32	71.100%	0.348	7.133	6.911	0.000	669.800	2392.000	2369.000
3	13:22:15	70.758%	0.298	6.055	6.501	0.000	673.600	2394.000	2387.000
x		72.587%	0.341	6.376	6.644	0.000	672.300	2383.000	2365.000
σ		2.876%	0.040	0.658	0.232	0.000	2.182	17.580	24.050
%RSD		3.962	11.720	10.320	3.487	0.000	0.325	0.738	1.017

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	1088.000	1901.000	0.000	308.900	2016.000	1885.000	80.230%	0.162
2	13:21:32	1097.000	1927.000	0.000	306.400	2014.000	1873.000	80.924%	0.330
3	13:22:15	1115.000	1930.000	0.000	309.400	2039.000	1890.000	80.039%	0.200
x		1100.000	1919.000	0.000	308.200	2023.000	1882.000	80.398%	0.231
σ		13.630	16.060	0.000	1.640	13.800	8.548	0.465%	0.088
%RSD		1.239	0.837	0.000	0.532	0.682	0.454	0.579	38.160

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	0.046	0.166	2.504	635.900	25.850	29.800	18.770	25.920
2	13:21:32	0.032	0.170	2.546	625.800	24.410	29.510	18.060	25.570
3	13:22:15	0.080	0.169	2.431	638.100	24.470	29.300	18.600	25.850
x		0.053	0.168	2.494	633.300	24.910	29.540	18.480	25.780
σ		0.025	0.002	0.059	6.552	0.812	0.246	0.369	0.188
%RSD		47.190	1.109	2.352	1.035	3.258	0.834	1.998	0.729

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	23.120	22.160	85.960	86.640	-0.017	0.045	0.614	-0.175
2	13:21:32	22.690	21.820	84.680	85.390	0.065	0.035	0.598	0.127
3	13:22:15	22.990	22.300	87.110	87.610	-0.022	0.044	0.679	-0.079
x		22.930	22.090	85.920	86.550	0.009	0.041	0.631	-0.042
σ		0.221	0.246	1.212	1.115	0.049	0.005	0.043	0.155
%RSD		0.962	1.114	1.411	1.288	551.100	12.750	6.832	364.700

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	0.000	11.620	87.421%	0.018	0.015	87.565%	-0.047	1.653
2	13:21:32	0.000	11.830	88.118%	0.043	0.023	87.851%	-0.050	1.394
3	13:22:15	0.000	11.840	87.498%	0.033	0.020	86.836%	-0.042	1.639
x		0.000	11.760	87.679%	0.032	0.019	87.417%	-0.046	1.562
σ		0.000	0.123	0.382%	0.012	0.004	0.523%	0.004	0.146
%RSD		0.000	1.049	0.436	39.220	19.560	0.599	9.230	9.345

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	-0.047	0.714	0.723	88.606%	0.014	0.024	0.037	9.513
2	13:21:32	-0.046	0.782	0.799	90.000%	0.025	0.038	0.042	9.854
3	13:22:15	-0.042	0.724	0.798	89.191%	0.013	0.026	0.038	9.709
x		-0.045	0.740	0.773	89.266%	0.017	0.029	0.039	9.692
σ		0.002	0.037	0.044	0.700%	0.006	0.008	0.003	0.171
%RSD		5.243	5.022	5.632	0.784	37.790	25.720	7.167	1.765

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:20:49	9.610	93.943%	94.492%	0.007	0.007	0.151	100.476%
2	13:21:32	9.712	97.518%	97.633%	0.007	0.007	0.151	102.674%
3	13:22:15	9.742	97.346%	97.294%	0.006	0.006	0.157	101.811%
x		9.688	96.269%	96.473%	0.007	0.007	0.153	101.654%
σ		0.069	2.016%	1.724%	0.001	0.001	0.003	1.108%
%RSD		0.716	2.094	1.787	10.290	8.908	2.086	1.090

CCV 993939 11/13/2013 1:24:53 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	71.005%	107.300	104.400	101.500	0.000	54040.000	53910.000	53190.000
2	13:26:19	70.607%	107.100	100.400	100.700	0.000	52900.000	53460.000	52970.000
3	13:27:02	68.635%	106.700	105.000	101.200	0.000	54410.000	54600.000	54400.000
x		70.083%	107.028%	103.246%	101.144%	0.000	107.569%	107.982%	107.044%
σ		1.269%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.811	0.316	2.409	0.430	0.000	1.461	1.059	1.439

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	507.200	5285.000	0.000	51740.000	50720.000	52690.000	76.059%	99.570
2	13:26:19	517.200	5310.000	0.000	53000.000	50860.000	52760.000	73.847%	101.300
3	13:27:02	523.900	5330.000	0.000	52690.000	51070.000	52770.000	72.656%	101.300
x		103.222%	106.168%	0.000	104.952%	101.762%	105.478%	74.187%	100.727%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.727%	n/a
%RSD		1.632	0.428	0.000	1.252	0.349	0.083	2.328	0.993

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	100.700	101.200	2.292	521.500	26410.000	26120.000	101.300	102.800
2	13:26:19	102.400	101.200	2.689	528.100	26520.000	26540.000	102.600	103.100
3	13:27:02	101.400	100.700	3.292	525.400	26420.000	26290.000	101.900	103.500
x		101.509%	101.013%	2.758	105.003%	105.804%	105.270%	101.928%	103.174%
σ		n/a	n/a	0.503	n/a	n/a	n/a	n/a	n/a
%RSD		0.838	0.269	18.260	0.634	0.239	0.811	0.617	0.340

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	105.400	103.700	107.000	105.900	105.700	-0.464	109.400	109.900
2	13:26:19	105.900	104.900	108.700	107.900	106.100	-0.433	111.500	110.000
3	13:27:02	105.000	105.400	107.700	107.000	104.900	-0.413	109.700	109.900
x		105.412%	104.643%	107.811%	106.917%	105.585%	-0.437	110.211%	109.907%
σ		n/a	n/a	n/a	n/a	n/a	0.026	n/a	n/a
%RSD		0.454	0.849	0.782	0.966	0.590	5.900	1.047	0.036

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	0.000	104.000	77.765%	102.200	102.600	77.767%	103.000	3.752
2	13:26:19	0.000	104.700	76.678%	103.000	104.500	76.275%	103.600	3.019
3	13:27:02	0.000	104.600	75.920%	103.900	104.900	75.723%	103.300	4.823
x		0.000	104.438%	76.788%	103.055%	103.999%	76.588%	103.273%	3.865
σ		0.000	n/a	0.928%	n/a	n/a	1.058%	n/a	0.907
%RSD		0.000	0.386	1.208	0.830	1.171	1.381	0.285	23.470

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	104.200	105.800	106.600	80.545%	101.500	101.700	101.700	103.300
2	13:26:19	104.500	106.400	106.800	80.181%	101.900	102.500	102.100	103.700
3	13:27:02	103.500	106.900	105.900	79.598%	101.800	102.600	102.200	103.100
x		104.050%	106.365%	106.439%	80.108%	101.728%	102.282%	102.004%	103.359%
σ		n/a	n/a	n/a	0.478%	n/a	n/a	n/a	n/a
%RSD		0.494	0.541	0.452	0.596	0.208	0.508	0.281	0.291

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:25:37	103.500	86.842%	87.566%	98.730	99.640	100.600	88.320%
2	13:26:19	103.800	87.347%	88.059%	100.500	102.100	102.700	87.450%
3	13:27:02	102.400	86.914%	87.933%	101.000	102.000	103.200	87.159%
x		103.260%	87.034%	87.853%	100.064%	101.235%	102.157%	87.643%
σ		n/a	0.273%	0.256%	n/a	n/a	n/a	0.604%
%RSD		0.716	0.314	0.291	1.182	1.369	1.354	0.690

CCB3 11/13/2013 1:33:04 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	85.548%	0.073	2.604	3.274	0.000	32.550	0.706	0.433
2	13:34:30	84.830%	0.006	2.985	3.224	0.000	31.410	0.389	0.330
3	13:35:13	86.205%	-0.004	2.301	2.887	0.000	30.250	0.419	0.385
x		85.528%	0.025	2.630	3.128	0.000	31.400	0.505	0.383
σ		0.688%	0.042	0.343	0.211	0.000	1.149	0.175	0.052
%RSD		0.804	168.300	13.030	6.731	0.000	3.658	34.640	13.490
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	0.092	-0.347	0.000	6.385	-2.474	0.629	88.159%	0.009
2	13:34:30	0.118	-0.154	0.000	5.939	2.269	0.054	88.229%	0.014
3	13:35:13	0.062	-0.125	0.000	4.491	-2.019	0.326	89.079%	0.032
x		0.091	-0.209	0.000	5.605	-0.741	0.337	88.489%	0.018
σ		0.028	0.121	0.000	0.990	2.617	0.287	0.512%	0.012
%RSD		30.660	57.880	0.000	17.670	353.100	85.410	0.579	67.090
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	-0.010	-0.005	0.095	0.030	0.898	1.694	0.001	0.004
2	13:34:30	-0.005	0.012	0.076	0.028	0.881	1.206	0.000	0.008
3	13:35:13	-0.001	0.016	0.098	0.035	-0.163	0.450	0.001	0.005
x		-0.005	0.007	0.090	0.031	0.539	1.117	0.001	0.006
σ		0.005	0.011	0.012	0.004	0.608	0.626	0.001	0.002
%RSD		83.460	151.900	13.340	12.040	112.900	56.110	97.790	36.810
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	0.702	0.009	0.019	0.055	0.006	0.003	0.391	0.006
2	13:34:30	0.690	0.017	0.066	0.013	-0.051	0.008	0.363	-0.160
3	13:35:13	0.636	0.015	0.123	-0.018	0.000	0.001	0.263	-0.004
x		0.676	0.014	0.070	0.016	-0.015	0.004	0.339	-0.053
σ		0.035	0.004	0.052	0.037	0.031	0.003	0.068	0.093
%RSD		5.223	30.710	74.890	224.900	208.500	89.630	19.990	176.400
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	0.000	0.002	88.896%	0.112	0.102	93.379%	-0.041	0.848
2	13:34:30	0.000	0.001	91.091%	0.098	0.093	94.197%	-0.042	0.907
3	13:35:13	0.000	0.001	91.591%	0.068	0.094	94.661%	-0.039	0.732
x		0.000	0.001	90.526%	0.092	0.096	94.079%	-0.041	0.829
σ		0.000	0.001	1.434%	0.022	0.005	0.649%	0.001	0.089
%RSD		0.000	53.310	1.584	24.020	4.724	0.690	3.614	10.740
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:33:47	-0.044	-0.065	-0.042	93.423%	0.022	0.013	0.013	-0.006
2	13:34:30	-0.035	-0.067	-0.048	95.031%	0.005	0.013	0.013	-0.008
3	13:35:13	-0.033	-0.057	-0.039	95.735%	0.001	0.007	0.005	-0.008
x		-0.037	-0.063	-0.043	94.730%	0.010	0.011	0.010	-0.007
σ		0.006	0.005	0.005	1.185%	0.011	0.004	0.005	0.001
%RSD		15.250	8.531	11.050	1.251	117.800	33.290	43.750	14.920
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	13:33:47	0.004	96.506%	97.516%	0.004	0.004	0.017	102.332%	
2	13:34:30	0.003	99.180%	99.535%	0.004	0.003	0.016	103.349%	
3	13:35:13	0.004	99.640%	100.405%	0.005	0.003	0.013	104.163%	
x		0.004	98.442%	99.152%	0.004	0.003	0.015	103.281%	
σ		0.000	1.693%	1.482%	0.001	0.001	0.002	0.918%	
%RSD		10.110	1.719	1.495	13.400	22.840	11.560	0.889	

180-26978-A-5-B 11/13/2013 1:37:53 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	67.384%	0.514	11.960	12.240	0.000	2339.000	5050.000	5316.000
2	13:39:19	64.704%	0.652	12.000	12.500	0.000	2348.000	5093.000	5332.000
3	13:40:02	64.776%	0.673	10.940	12.140	0.000	2362.000	4889.000	5393.000
x		65.621%	0.613	11.630	12.290	0.000	2350.000	5011.000	5347.000
σ		1.527%	0.086	0.602	0.188	0.000	11.870	107.400	40.720
%RSD		2.327	14.020	5.173	1.530	0.000	0.505	2.143	0.761

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	1815.000	7055.000	0.000	1067.000	4947.000	4738.000	70.149%	0.569
2	13:39:19	1815.000	7007.000	0.000	1052.000	4921.000	4724.000	69.899%	0.583
3	13:40:02	1825.000	7092.000	0.000	1083.000	5053.000	4854.000	70.418%	0.518
x		1819.000	7052.000	0.000	1067.000	4973.000	4772.000	70.155%	0.557
σ		5.870	42.530	0.000	15.600	69.940	71.500	0.259%	0.034
%RSD		0.323	0.603	0.000	1.462	1.406	1.498	0.370	6.193

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	-0.104	0.288	5.114	1262.000	49.430	71.700	36.430	51.350
2	13:39:19	0.084	0.326	5.503	1244.000	48.680	65.900	36.550	50.350
3	13:40:02	0.101	0.326	5.919	1263.000	48.620	64.290	36.260	50.160
x		0.027	0.313	5.512	1256.000	48.910	67.300	36.410	50.620
σ		0.114	0.022	0.403	10.600	0.453	3.897	0.146	0.643
%RSD		419.400	7.002	7.302	0.844	0.926	5.791	0.401	1.270

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	42.900	42.270	172.900	175.300	-0.076	0.101	0.155	-0.044
2	13:39:19	42.080	42.040	172.000	173.900	0.094	0.099	0.112	0.149
3	13:40:02	42.100	42.140	173.500	175.500	0.067	0.112	0.110	-0.004
x		42.360	42.150	172.800	174.900	0.029	0.104	0.125	0.034
σ		0.469	0.115	0.763	0.879	0.091	0.007	0.026	0.102
%RSD		1.106	0.274	0.441	0.503	320.200	6.776	20.420	301.900

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	0.000	27.300	80.281%	0.042	0.068	76.331%	-0.047	1.110
2	13:39:19	0.000	27.520	80.402%	0.073	0.056	76.244%	-0.043	1.815
3	13:40:02	0.000	27.880	80.483%	0.046	0.056	76.327%	-0.044	1.087
x		0.000	27.570	80.389%	0.054	0.060	76.301%	-0.045	1.337
σ		0.000	0.293	0.102%	0.017	0.007	0.049%	0.002	0.414
%RSD		0.000	1.064	0.126	31.620	11.090	0.064	4.527	30.930

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	-0.041	1.624	1.645	78.720%	0.018	0.237	0.239	26.360
2	13:39:19	-0.043	1.610	1.636	80.239%	0.006	0.219	0.215	25.920
3	13:40:02	-0.041	1.581	1.713	79.449%	0.000	0.241	0.237	26.940
x		-0.042	1.605	1.665	79.469%	0.008	0.232	0.231	26.410
σ		0.001	0.022	0.042	0.760%	0.009	0.012	0.013	0.515
%RSD		3.465	1.378	2.527	0.956	113.000	5.177	5.839	1.951

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:38:36	26.390	86.537%	87.605%	0.012	0.014	0.292	93.554%
2	13:39:19	26.170	88.730%	89.543%	0.014	0.014	0.279	94.394%
3	13:40:02	26.860	88.417%	89.843%	0.011	0.015	0.295	94.113%
x		26.470	87.895%	88.997%	0.012	0.014	0.289	94.020%
σ		0.349	1.186%	1.215%	0.001	0.000	0.009	0.427%
%RSD		1.317	1.349	1.365	11.670	1.247	3.014	0.454

180-26978-A-6-B 11/13/2013 1:42:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	68.705%	0.467	11.010	11.170	0.000	2258.000	3659.000	3629.000
2	13:44:07	65.114%	0.327	10.140	11.480	0.000	2300.000	3776.000	3738.000
3	13:44:50	65.682%	0.403	11.050	10.840	0.000	2285.000	3724.000	3716.000
x		66.500%	0.399	10.730	11.170	0.000	2281.000	3720.000	3694.000
σ		1.930%	0.070	0.512	0.322	0.000	21.170	59.050	57.300
%RSD		2.903	17.530	4.777	2.883	0.000	0.928	1.588	1.551
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	732.000	6327.000	0.000	950.900	3872.000	3767.000	70.705%	0.456
2	13:44:07	767.000	6577.000	0.000	960.100	3890.000	3805.000	70.282%	0.678
3	13:44:50	750.500	6489.000	0.000	948.000	3898.000	3762.000	70.903%	0.605
x		749.800	6464.000	0.000	953.000	3887.000	3778.000	70.630%	0.580
σ		17.500	126.700	0.000	6.315	13.210	23.790	0.317%	0.114
%RSD		2.334	1.960	0.000	0.663	0.340	0.630	0.449	19.600
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	0.115	0.336	7.058	782.200	50.750	65.180	21.820	32.930
2	13:44:07	-0.105	0.319	7.522	784.200	51.700	66.060	21.990	32.730
3	13:44:50	0.051	0.324	7.601	787.400	51.520	65.800	22.010	32.260
x		0.020	0.326	7.394	784.600	51.320	65.680	21.940	32.640
σ		0.113	0.009	0.293	2.595	0.502	0.452	0.103	0.345
%RSD		556.000	2.710	3.963	0.331	0.977	0.688	0.469	1.058
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	26.030	25.740	112.400	113.200	0.046	0.112	0.072	0.080
2	13:44:07	26.540	26.310	116.100	114.900	0.138	0.121	-0.075	-0.029
3	13:44:50	26.280	26.040	113.100	114.300	0.103	0.123	0.035	0.028
x		26.280	26.030	113.900	114.200	0.096	0.119	0.011	0.026
σ		0.254	0.285	1.975	0.875	0.047	0.006	0.077	0.054
%RSD		0.965	1.094	1.735	0.767	48.640	4.990	729.600	207.100
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	0.000	24.060	77.851%	0.048	0.035	75.943%	-0.050	1.625
2	13:44:07	0.000	24.190	78.159%	0.043	0.057	76.704%	-0.043	1.301
3	13:44:50	0.000	24.250	79.050%	0.035	0.052	77.034%	-0.043	0.971
x		0.000	24.170	78.353%	0.042	0.048	76.560%	-0.045	1.299
σ		0.000	0.094	0.622%	0.006	0.011	0.560%	0.004	0.327
%RSD		0.000	0.387	0.794	15.000	23.740	0.731	9.096	25.170
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:43:24	-0.044	1.066	1.044	78.877%	0.010	0.174	0.214	61.530
2	13:44:07	-0.041	1.038	1.052	80.344%	-0.004	0.162	0.203	60.510
3	13:44:50	-0.044	1.059	1.059	80.687%	-0.011	0.169	0.194	61.510
x		-0.043	1.054	1.051	79.969%	-0.002	0.168	0.203	61.180
σ		0.002	0.015	0.007	0.961%	0.011	0.006	0.010	0.583
%RSD		3.546	1.394	0.710	1.202	664.400	3.765	4.878	0.952
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	13:43:24	61.160	86.740%	87.475%	0.008	0.008	0.169	93.073%	
2	13:44:07	61.110	88.681%	89.111%	0.007	0.009	0.176	94.099%	
3	13:44:50	61.800	88.879%	90.045%	0.013	0.010	0.177	94.825%	
x		61.360	88.100%	88.877%	0.010	0.009	0.174	93.999%	
σ		0.386	1.182%	1.301%	0.003	0.001	0.004	0.880%	
%RSD		0.629	1.342	1.464	35.010	14.810	2.589	0.937	

180-26978-A-7-B 11/13/2013 1:47:29 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	65.224%	0.317	9.926	10.020	0.000	2021.000	3281.000	3278.000
2	13:48:55	65.603%	0.310	10.250	10.610	0.000	2018.000	3328.000	3296.000
3	13:49:38	65.128%	0.260	9.881	10.100	0.000	2048.000	3348.000	3326.000
x		65.318%	0.296	10.020	10.240	0.000	2029.000	3319.000	3300.000
σ		0.251%	0.031	0.202	0.317	0.000	16.730	34.530	24.160
%RSD		0.384	10.590	2.016	3.091	0.000	0.825	1.040	0.732

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	352.400	5692.000	0.000	874.800	4293.000	4111.000	70.339%	0.385
2	13:48:55	353.200	5686.000	0.000	866.700	4327.000	4144.000	70.338%	0.403
3	13:49:38	351.600	5726.000	0.000	870.900	4281.000	4111.000	70.098%	0.423
x		352.400	5701.000	0.000	870.800	4300.000	4122.000	70.258%	0.404
σ		0.794	21.540	0.000	4.059	23.770	19.350	0.138%	0.019
%RSD		0.225	0.378	0.000	0.466	0.553	0.469	0.197	4.713

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	0.118	0.244	7.155	575.900	86.490	97.650	15.500	25.280
2	13:48:55	0.045	0.241	7.396	582.900	85.620	100.800	15.460	25.010
3	13:49:38	-0.008	0.251	7.579	579.700	85.220	98.410	15.740	25.460
x		0.052	0.245	7.377	579.500	85.780	98.940	15.560	25.250
σ		0.063	0.005	0.213	3.508	0.652	1.626	0.152	0.230
%RSD		122.100	2.180	2.885	0.605	0.760	1.643	0.973	0.910

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	19.710	19.490	85.570	86.050	0.087	0.114	0.102	0.566
2	13:48:55	19.750	19.180	86.910	87.730	0.157	0.110	0.075	0.251
3	13:49:38	19.900	19.540	87.410	88.390	-0.011	0.135	0.103	0.063
x		19.790	19.400	86.630	87.390	0.078	0.120	0.093	0.293
σ		0.101	0.191	0.954	1.205	0.084	0.013	0.016	0.254
%RSD		0.510	0.985	1.102	1.378	108.500	11.200	17.090	86.780

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	0.000	24.070	77.076%	0.029	0.038	77.065%	-0.053	1.554
2	13:48:55	0.000	24.110	77.752%	0.033	0.042	76.958%	-0.045	1.257
3	13:49:38	0.000	24.030	77.962%	0.040	0.014	77.389%	-0.045	1.471
x		0.000	24.070	77.596%	0.034	0.031	77.137%	-0.048	1.428
σ		0.000	0.038	0.463%	0.005	0.015	0.225%	0.005	0.153
%RSD		0.000	0.158	0.597	15.310	49.170	0.291	9.498	10.730

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	-0.042	0.667	0.739	79.776%	-0.049	0.174	0.174	60.540
2	13:48:55	-0.046	0.721	0.737	80.409%	-0.039	0.172	0.165	60.620
3	13:49:38	-0.043	0.697	0.758	80.538%	-0.045	0.181	0.173	61.330
x		-0.044	0.695	0.745	80.241%	-0.045	0.176	0.171	60.830
σ		0.002	0.027	0.011	0.408%	0.005	0.004	0.005	0.434
%RSD		3.705	3.937	1.534	0.508	11.400	2.451	3.188	0.714

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:48:12	60.710	87.565%	88.286%	0.008	0.007	0.307	93.750%
2	13:48:55	60.930	89.072%	90.286%	0.007	0.009	0.317	95.313%
3	13:49:38	61.260	89.294%	90.625%	0.007	0.008	0.323	94.691%
x		60.970	88.644%	89.733%	0.007	0.008	0.316	94.584%
σ		0.277	0.941%	1.264%	0.001	0.001	0.008	0.787%
%RSD		0.455	1.061	1.409	9.489	11.730	2.577	0.832

180-26855-C-3-A 11/13/2013 1:52:17 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	62.470%	0.041	234.700	233.800	0.000	102600.000	20150.000	19860.000
2	13:53:43	58.981%	0.002	242.500	238.300	0.000	102500.000	20420.000	20080.000
3	13:54:25	57.116%	0.011	245.100	241.000	0.000	106300.000	21380.000	21150.000
x		59.522%	0.018	240.800	237.700	0.000	103800.000	20650.000	20360.000
σ		2.718%	0.021	5.414	3.619	0.000	2148.000	643.200	688.500
%RSD		4.566	113.500	2.249	1.522	0.000	2.069	3.115	3.381

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	399.200	5235.000	0.000	11850.000	95940.000	98960.000	67.135%	12.440
2	13:53:43	403.700	5254.000	0.000	11930.000	96490.000	99180.000	65.861%	9.122
3	13:54:25	424.000	5555.000	0.000	12900.000	106100.000	110200.000	57.954%	11.250
x		409.000	5348.000	0.000	12230.000	99500.000	102800.000	63.650%	10.940
σ		13.230	179.300	0.000	581.500	5701.000	6446.000	4.974%	1.682
%RSD		3.235	3.352	0.000	4.756	5.729	6.271	7.814	15.380

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	1.331	3.473	3.516	340.100	705.900	955.200	1.024	3.766
2	13:53:43	1.296	3.435	3.904	338.000	705.800	957.700	1.030	3.705
3	13:54:25	1.357	3.710	4.645	368.600	770.900	1020.000	1.085	3.931
x		1.328	3.539	4.021	348.900	727.600	977.500	1.046	3.801
σ		0.031	0.149	0.574	17.090	37.530	36.530	0.034	0.117
%RSD		2.308	4.210	14.260	4.898	5.158	3.737	3.202	3.079

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	75.250	74.870	435.700	441.900	1.067	0.047	0.626	1.818
2	13:53:43	73.890	74.250	438.200	436.500	0.968	0.072	0.776	1.457
3	13:54:25	79.060	77.930	462.600	465.700	1.136	0.058	0.729	1.981
x		76.070	75.680	445.500	448.000	1.057	0.059	0.710	1.752
σ		2.677	1.974	14.820	15.500	0.084	0.013	0.077	0.268
%RSD		3.519	2.609	3.327	3.460	7.992	21.400	10.850	15.300

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	0.000	336.400	70.497%	2.276	2.392	68.959%	0.464	1.400
2	13:53:43	0.000	339.700	70.421%	2.279	2.324	68.560%	0.482	1.651
3	13:54:25	0.000	339.700	69.319%	2.276	2.351	67.296%	0.503	1.321
x		0.000	338.600	70.079%	2.277	2.356	68.272%	0.483	1.457
σ		0.000	1.913	0.659%	0.002	0.034	0.868%	0.020	0.172
%RSD		0.000	0.565	0.941	0.067	1.464	1.272	4.089	11.810

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	0.483	0.117	0.134	74.109%	1.099	0.623	0.609	99.590
2	13:53:43	0.501	0.074	0.112	73.538%	1.127	0.615	0.620	101.100
3	13:54:25	0.478	0.104	0.128	72.897%	1.090	0.612	0.632	100.600
x		0.487	0.098	0.125	73.514%	1.105	0.617	0.621	100.400
σ		0.012	0.022	0.011	0.606%	0.019	0.005	0.012	0.757
%RSD		2.430	22.290	9.152	0.825	1.736	0.857	1.915	0.753

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:53:00	99.740	83.263%	84.364%	0.009	0.009	2.622	84.404%
2	13:53:43	100.000	83.645%	85.135%	0.012	0.011	2.653	84.702%
3	13:54:25	101.100	84.298%	85.656%	0.014	0.010	2.708	85.127%
x		100.300	83.736%	85.052%	0.012	0.010	2.661	84.744%
σ		0.707	0.523%	0.650%	0.003	0.001	0.043	0.364%
%RSD		0.705	0.625	0.764	21.780	9.563	1.625	0.429

180-26855-C-4-A 11/13/2013 1:57:02 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	61.030%	0.007	229.000	232.100	0.000	97320.000	20250.000	20070.000
2	13:58:28	58.448%	-0.014	234.800	235.400	0.000	99290.000	20570.000	20290.000
3	13:59:11	56.928%	-0.020	233.700	235.800	0.000	95830.000	19950.000	19600.000
x		58.802%	-0.009	232.500	234.400	0.000	97480.000	20260.000	19990.000
σ		2.074%	0.014	3.068	2.030	0.000	1733.000	313.300	349.800
%RSD		3.527	152.700	1.319	0.866	0.000	1.778	1.547	1.750

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	34.050	4958.000	0.000	13310.000	101300.000	104500.000	58.673%	4.903
2	13:58:28	35.300	4963.000	0.000	13280.000	101800.000	105400.000	56.765%	4.378
3	13:59:11	33.570	4725.000	0.000	12310.000	94130.000	97200.000	61.914%	4.156
x		34.310	4882.000	0.000	12970.000	99070.000	102400.000	59.117%	4.479
σ		0.895	135.800	0.000	572.100	4290.000	4500.000	2.603%	0.383
%RSD		2.610	2.782	0.000	4.412	4.330	4.396	4.404	8.559

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	0.445	0.988	5.345	104.100	123.200	413.400	0.379	3.534
2	13:58:28	0.384	0.926	5.899	106.500	122.100	408.300	0.397	3.638
3	13:59:11	0.384	0.875	5.689	96.660	110.300	378.700	0.360	3.467
x		0.404	0.930	5.644	102.400	118.500	400.100	0.379	3.546
σ		0.035	0.056	0.280	5.142	7.120	18.720	0.019	0.086
%RSD		8.679	6.076	4.958	5.020	6.006	4.679	4.909	2.435

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	13.460	13.250	107.100	107.000	0.477	0.098	0.323	1.014
2	13:58:28	13.240	12.820	107.500	107.600	0.745	0.091	0.299	1.030
3	13:59:11	12.550	12.310	101.400	101.800	0.561	0.107	0.095	1.051
x		13.080	12.800	105.300	105.500	0.595	0.099	0.239	1.031
σ		0.472	0.470	3.379	3.228	0.137	0.008	0.125	0.019
%RSD		3.606	3.674	3.207	3.061	23.070	7.834	52.340	1.795

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	0.000	332.700	68.350%	1.892	1.904	66.790%	0.153	1.513
2	13:58:28	0.000	330.700	68.039%	1.904	1.885	66.368%	0.147	1.397
3	13:59:11	0.000	331.400	66.997%	1.914	2.023	65.160%	0.148	1.224
x		0.000	331.600	67.795%	1.903	1.938	66.106%	0.149	1.378
σ		0.000	1.009	0.709%	0.011	0.075	0.846%	0.003	0.145
%RSD		0.000	0.304	1.045	0.583	3.851	1.280	2.103	10.560

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	0.150	-0.096	-0.056	71.941%	0.195	0.252	0.262	55.340
2	13:58:28	0.152	-0.066	-0.035	71.451%	0.177	0.261	0.278	55.880
3	13:59:11	0.155	-0.065	-0.042	70.611%	0.219	0.270	0.275	55.590
x		0.152	-0.076	-0.044	71.334%	0.197	0.261	0.272	55.600
σ		0.002	0.018	0.011	0.673%	0.021	0.009	0.008	0.272
%RSD		1.502	23.360	23.780	0.943	10.580	3.493	3.083	0.489

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:57:45	55.270	81.435%	82.633%	0.002	0.001	0.329	82.633%
2	13:58:28	55.600	81.792%	83.536%	0.004	0.002	0.340	82.806%
3	13:59:11	55.560	81.637%	83.195%	0.004	0.001	0.339	82.646%
x		55.480	81.621%	83.122%	0.003	0.001	0.336	82.695%
σ		0.181	0.179%	0.456%	0.001	0.001	0.006	0.097%
%RSD		0.327	0.219	0.549	24.170	38.230	1.770	0.117

MB 180-89482/1-A 11/13/2013 2:05:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	64.353%	0.035	4.828	4.254	0.000	42.970	9.707	9.554
2	14:07:17	61.818%	-0.021	4.990	4.271	0.000	42.980	8.962	9.749
3	14:08:00	61.401%	0.004	4.170	3.955	0.000	41.470	9.793	9.502
x		62.524%	0.006	4.662	4.160	0.000	42.470	9.487	9.602
σ		1.597%	0.028	0.434	0.177	0.000	0.867	0.457	0.130
%RSD		2.555	487.200	9.309	4.267	0.000	2.040	4.819	1.352

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	4.224	3.425	0.000	18.130	44.920	35.950	63.259%	0.057
2	14:07:17	4.356	3.333	0.000	16.950	34.680	37.550	64.006%	0.042
3	14:08:00	4.434	3.071	0.000	16.500	33.360	35.430	64.048%	0.048
x		4.338	3.276	0.000	17.190	37.650	36.310	63.771%	0.049
σ		0.106	0.184	0.000	0.842	6.331	1.104	0.444%	0.008
%RSD		2.441	5.608	0.000	4.895	16.810	3.042	0.696	15.360

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	-0.180	1.296	11.620	0.174	12.720	16.330	0.009	0.460
2	14:07:17	-0.267	1.233	11.730	0.153	11.890	16.220	0.007	0.484
3	14:08:00	0.051	1.246	10.930	0.162	11.810	15.430	0.006	0.420
x		-0.132	1.258	11.420	0.163	12.140	16.000	0.007	0.455
σ		0.164	0.033	0.433	0.011	0.503	0.494	0.002	0.032
%RSD		124.600	2.653	3.793	6.459	4.143	3.091	22.690	7.130

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	0.799	0.532	1.875	1.756	0.559	0.139	-0.280	2.124
2	14:07:17	0.781	0.609	1.749	1.834	0.249	0.174	-0.276	1.638
3	14:08:00	0.782	0.458	1.770	1.864	0.188	0.187	-0.244	0.922
x		0.788	0.533	1.798	1.818	0.332	0.167	-0.267	1.561
σ		0.010	0.075	0.067	0.056	0.199	0.025	0.020	0.604
%RSD		1.220	14.130	3.746	3.068	59.900	15.010	7.320	38.700

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	0.000	0.086	68.487%	0.073	0.073	69.796%	-0.048	1.262
2	14:07:17	0.000	0.095	69.481%	0.064	0.077	70.803%	-0.049	0.832
3	14:08:00	0.000	0.102	68.883%	0.067	0.080	70.876%	-0.045	0.716
x		0.000	0.095	68.950%	0.068	0.077	70.492%	-0.047	0.937
σ		0.000	0.008	0.500%	0.005	0.004	0.604%	0.002	0.288
%RSD		0.000	8.521	0.726	6.688	5.168	0.856	4.650	30.710

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	-0.042	-0.096	-0.095	73.379%	6.959	-0.003	0.014	0.222
2	14:07:17	-0.036	-0.069	-0.065	74.126%	7.043	0.003	0.002	0.302
3	14:08:00	-0.040	-0.059	-0.076	74.533%	7.119	0.008	0.014	0.297
x		-0.039	-0.075	-0.079	74.013%	7.040	0.003	0.010	0.274
σ		0.003	0.019	0.015	0.585%	0.080	0.005	0.007	0.045
%RSD		7.978	25.460	19.280	0.791	1.140	188.200	69.870	16.380

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:06:34	0.275	82.520%	83.786%	-0.001	-0.001	0.064	88.593%
2	14:07:17	0.265	84.425%	85.381%	-0.001	0.000	0.063	89.895%
3	14:08:00	0.287	84.355%	86.139%	-0.000	-0.001	0.065	90.391%
x		0.276	83.767%	85.102%	-0.001	-0.000	0.064	89.627%
σ		0.011	1.080%	1.201%	0.000	0.000	0.001	0.929%
%RSD		4.081	1.290	1.411	51.010	116.900	1.066	1.036

PB 180-89081/4-B 11/13/2013 2:10:38 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	58.993%	-0.011	5.042	4.788	0.000	127.600	58.950	55.990
2	14:12:04	56.871%	-0.019	5.288	5.221	0.000	125.000	57.580	57.110
3	14:12:47	56.943%	-0.096	5.030	5.075	0.000	123.400	61.000	57.480
x		57.602%	-0.042	5.120	5.028	0.000	125.300	59.180	56.860
σ		1.205%	0.047	0.146	0.220	0.000	2.145	1.719	0.779
%RSD		2.092	112.500	2.843	4.383	0.000	1.712	2.905	1.369

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	7.705	25.700	0.000	49.240	189.700	205.600	57.762%	0.477
2	14:12:04	7.610	25.460	0.000	46.410	210.600	207.600	57.481%	0.353
3	14:12:47	7.851	26.850	0.000	45.700	210.800	212.700	56.604%	0.435
x		7.722	26.000	0.000	47.120	203.700	208.600	57.282%	0.422
σ		0.122	0.744	0.000	1.877	12.120	3.684	0.604%	0.063
%RSD		1.574	2.863	0.000	3.984	5.949	1.766	1.054	14.960

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	-1.131	1.233	38.970	0.251	7.840	11.020	0.006	0.686
2	14:12:04	-0.565	1.169	36.390	0.274	6.388	9.903	0.007	0.619
3	14:12:47	-0.597	1.150	36.570	0.265	5.988	10.430	0.012	0.689
x		-0.764	1.184	37.310	0.263	6.739	10.450	0.008	0.665
σ		0.318	0.044	1.440	0.012	0.975	0.559	0.003	0.039
%RSD		41.620	3.693	3.858	4.425	14.460	5.346	40.450	5.911

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	1.156	0.994	3.951	3.874	0.260	0.644	-0.386	0.200
2	14:12:04	1.072	0.928	3.832	3.966	-0.019	0.661	-0.313	-0.049
3	14:12:47	1.160	0.961	3.903	4.061	-0.262	0.674	-0.496	0.034
x		1.129	0.961	3.895	3.967	-0.007	0.659	-0.398	0.062
σ		0.050	0.033	0.060	0.093	0.261	0.015	0.092	0.127
%RSD		4.400	3.452	1.536	2.350	3615.000	2.281	23.170	206.200

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	0.000	0.531	68.831%	0.131	0.129	69.053%	-0.052	0.679
2	14:12:04	0.000	0.535	68.767%	0.129	0.115	69.124%	-0.042	1.843
3	14:12:47	0.000	0.543	68.834%	0.116	0.107	68.662%	-0.039	1.067
x		0.000	0.536	68.811%	0.125	0.117	68.946%	-0.044	1.196
σ		0.000	0.006	0.038%	0.008	0.011	0.249%	0.007	0.593
%RSD		0.000	1.090	0.055	6.452	9.633	0.361	15.320	49.570

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	-0.041	-0.054	-0.091	73.609%	24.050	0.099	0.106	1.143
2	14:12:04	-0.040	-0.144	-0.150	73.747%	23.550	0.087	0.116	1.216
3	14:12:47	-0.034	-0.086	-0.132	74.041%	23.700	0.082	0.078	1.188
x		-0.038	-0.094	-0.124	73.799%	23.760	0.089	0.100	1.182
σ		0.004	0.045	0.030	0.220%	0.258	0.008	0.020	0.037
%RSD		9.468	48.140	24.150	0.299	1.087	9.494	19.890	3.104

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:11:21	1.194	85.677%	87.301%	-0.000	0.001	0.124	88.839%
2	14:12:04	1.119	86.617%	88.869%	0.002	0.000	0.118	90.446%
3	14:12:47	1.140	86.496%	88.995%	-0.000	0.000	0.115	90.773%
x		1.151	86.264%	88.388%	0.000	0.000	0.119	90.019%
σ		0.038	0.511%	0.943%	0.001	0.000	0.004	1.035%
%RSD		3.334	0.593	1.067	320.600	104.400	3.652	1.150

LCS 180-89482/2-A 11/13/2013 2:15:24 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	58.012%	46.890	905.100	896.600	0.000	51250.000	54140.000	53020.000
2	14:16:50	57.146%	46.890	902.000	903.400	0.000	51690.000	55350.000	54060.000
3	14:17:33	56.422%	47.290	911.900	905.000	0.000	49870.000	52890.000	51840.000
x		57.193%	47.030	906.300	901.700	0.000	50940.000	54130.000	52980.000
σ		0.796%	0.232	5.073	4.460	0.000	953.500	1234.000	1109.000
%RSD		1.392	0.492	0.560	0.495	0.000	1.872	2.280	2.094

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	2146.000	5692.000	0.000	50920.000	52550.000	54220.000	56.617%	1000.000
2	14:16:50	2154.000	5721.000	0.000	51300.000	54010.000	55000.000	57.460%	994.900
3	14:17:33	2050.000	5364.000	0.000	47000.000	48660.000	50030.000	64.477%	913.300
x		2117.000	5592.000	0.000	49740.000	51740.000	53080.000	59.518%	969.500
σ		58.140	198.100	0.000	2382.000	2767.000	2674.000	4.315%	48.680
%RSD		2.747	3.543	0.000	4.790	5.348	5.038	7.250	5.022

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	524.000	199.300	52.100	513.200	1074.000	1194.000	494.200	477.600
2	14:16:50	520.200	198.900	54.030	510.300	1075.000	1173.000	487.300	471.900
3	14:17:33	474.100	181.500	49.040	462.700	966.600	1073.000	450.700	435.900
x		506.100	193.200	51.720	495.400	1038.000	1147.000	477.400	461.800
σ		27.760	10.170	2.519	28.330	62.080	64.440	23.390	22.620
%RSD		5.486	5.262	4.869	5.719	5.979	5.619	4.900	4.897

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	239.100	240.600	457.500	450.500	33.240	0.971	8.195	8.169
2	14:16:50	237.500	240.900	452.700	452.700	33.350	0.989	8.172	8.143
3	14:17:33	222.500	225.900	428.300	426.500	32.150	0.986	7.746	8.678
x		233.100	235.800	446.100	443.200	32.910	0.982	8.038	8.330
σ		9.191	8.621	15.660	14.550	0.663	0.010	0.253	0.302
%RSD		3.944	3.656	3.511	3.283	2.013	1.006	3.144	3.622

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	0.000	983.000	67.166%	934.600	988.100	64.731%	48.490	12.580
2	14:16:50	0.000	984.700	68.796%	948.700	994.400	66.284%	48.430	11.900
3	14:17:33	0.000	992.600	69.682%	948.500	996.500	66.623%	48.430	14.740
x		0.000	986.800	68.548%	943.900	993.000	65.879%	48.450	13.070
σ		0.000	5.159	1.276%	8.093	4.409	1.009%	0.036	1.484
%RSD		0.000	0.523	1.862	0.857	0.444	1.531	0.074	11.350

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	48.300	47.060	40.070	70.248%	1960.000	440.500	438.500	1373.000
2	14:16:50	48.010	48.170	40.070	71.986%	1967.000	443.000	444.600	1229.000
3	14:17:33	48.310	46.500	39.490	73.000%	1967.000	446.000	447.600	1306.000
x		48.210	47.240	39.880	71.745%	1964.000	443.200	443.600	1303.000
σ		0.171	0.853	0.333	1.392%	4.319	2.775	4.632	72.030
%RSD		0.354	1.806	0.835	1.940	0.220	0.626	1.044	5.528

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:16:07	1951.000	82.989%	84.650%	48.180	49.060	20.310	80.308%
2	14:16:50	1961.000	85.728%	87.446%	48.500	49.640	20.430	83.052%
3	14:17:33	1959.000	86.681%	88.922%	48.640	49.800	20.330	84.478%
x		1957.000	85.133%	87.006%	48.440	49.500	20.360	82.613%
σ		5.537	1.916%	2.170%	0.239	0.392	0.066	2.119%
%RSD		0.283	2.251	2.494	0.493	0.792	0.326	2.565

LCSD 180-89482/3-A 11/13/2013 2:20:10 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	61.553%	45.770	901.800	920.300	0.000	51490.000	54320.000	53700.000
2	14:21:36	59.157%	47.130	927.300	918.400	0.000	51740.000	54870.000	53870.000
3	14:22:19	58.325%	47.300	936.500	940.300	0.000	52500.000	55040.000	54850.000
x		59.678%	46.730	921.800	926.300	0.000	51910.000	54740.000	54140.000
σ		1.676%	0.840	17.990	12.150	0.000	524.200	376.900	621.300
%RSD		2.808	1.797	1.951	1.311	0.000	1.010	0.689	1.147
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	2167.000	5684.000	0.000	51560.000	53830.000	55150.000	58.982%	1018.000
2	14:21:36	2151.000	5628.000	0.000	50500.000	53400.000	55290.000	60.044%	1013.000
3	14:22:19	2185.000	5653.000	0.000	51890.000	54000.000	55660.000	59.469%	998.100
x		2168.000	5655.000	0.000	51320.000	53740.000	55370.000	59.498%	1010.000
σ		16.660	27.630	0.000	723.200	311.900	265.200	0.532%	10.520
%RSD		0.769	0.489	0.000	1.409	0.580	0.479	0.893	1.042
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	530.700	203.300	49.360	510.400	1094.000	1208.000	499.600	486.200
2	14:21:36	524.500	198.500	50.670	510.000	1084.000	1186.000	491.600	470.500
3	14:22:19	521.900	202.400	48.580	507.400	1079.000	1184.000	492.200	474.200
x		525.700	201.400	49.540	509.300	1086.000	1193.000	494.500	477.000
σ		4.496	2.547	1.058	1.609	7.846	13.590	4.455	8.196
%RSD		0.855	1.265	2.136	0.316	0.723	1.139	0.901	1.718
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	244.900	246.500	450.300	452.100	33.450	0.929	8.210	8.840
2	14:21:36	239.300	244.000	444.100	442.900	32.900	0.948	7.824	8.536
3	14:22:19	240.000	243.200	449.400	446.300	32.990	0.964	7.815	7.910
x		241.400	244.600	447.900	447.100	33.120	0.947	7.950	8.429
σ		3.036	1.716	3.310	4.682	0.294	0.017	0.226	0.474
%RSD		1.257	0.701	0.739	1.047	0.887	1.839	2.838	5.624
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	0.000	988.000	69.561%	957.400	1004.000	67.279%	48.750	10.820
2	14:21:36	0.000	992.500	70.349%	957.800	1003.000	67.103%	48.790	13.990
3	14:22:19	0.000	995.600	70.678%	950.600	1001.000	67.729%	48.680	10.600
x		0.000	992.000	70.196%	955.300	1003.000	67.370%	48.740	11.800
σ		0.000	3.857	0.574%	4.027	1.912	0.323%	0.055	1.897
%RSD		0.000	0.389	0.818	0.422	0.191	0.479	0.112	16.070
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:20:53	48.250	47.090	40.090	72.626%	1975.000	443.200	443.300	1073.000
2	14:21:36	48.920	46.820	40.160	73.460%	1973.000	447.100	445.700	995.300
3	14:22:19	48.340	46.910	39.700	73.560%	1983.000	447.300	448.900	960.000
x		48.500	46.940	39.980	73.215%	1977.000	445.800	446.000	1009.000
σ		0.360	0.135	0.252	0.513%	5.438	2.299	2.809	57.860
%RSD		0.741	0.287	0.631	0.701	0.275	0.516	0.630	5.731
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	14:20:53	1961.000	85.069%	86.777%	48.680	49.700	20.610	81.774%	
2	14:21:36	1963.000	86.974%	88.668%	49.470	50.310	20.820	82.745%	
3	14:22:19	1970.000	87.550%	89.674%	49.620	50.680	20.730	83.616%	
x		1965.000	86.531%	88.373%	49.260	50.230	20.720	82.712%	
σ		4.757	1.298%	1.471%	0.504	0.497	0.103	0.921%	
%RSD		0.242	1.500	1.664	1.024	0.989	0.500	1.114	

180-26836-A-1-C 11/13/2013 2:28:18 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	62.654%	-0.020	15.230	16.630	0.000	8632.000	1516.000	1494.000
2	14:29:44	60.917%	0.021	14.130	15.240	0.000	9025.000	1624.000	1605.000
3	14:30:27	61.252%	-0.039	13.040	13.370	0.000	8479.000	1536.000	1533.000
x		61.608%	-0.012	14.140	15.080	0.000	8712.000	1559.000	1544.000
σ		0.921%	0.031	1.094	1.633	0.000	281.400	57.060	56.380
%RSD		1.496	248.700	7.736	10.830	0.000	3.231	3.661	3.652
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	51.680	138.100	0.000	14100.000	6466.000	6180.000	65.128%	20.460
2	14:29:44	54.130	146.800	0.000	15420.000	7137.000	6798.000	58.824%	21.720
3	14:30:27	53.040	139.300	0.000	14390.000	6414.000	6339.000	64.632%	19.710
x		52.950	141.400	0.000	14640.000	6672.000	6439.000	62.861%	20.630
σ		1.229	4.726	0.000	694.200	403.100	321.100	3.506%	1.018
%RSD		2.321	3.343	0.000	4.742	6.042	4.986	5.577	4.933
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	0.238	0.706	32.950	15.290	650.000	648.500	7.999	0.714
2	14:29:44	-0.485	0.748	36.120	16.360	701.200	694.000	8.569	0.768
3	14:30:27	-0.389	0.600	32.140	15.410	640.500	643.800	7.964	0.674
x		-0.212	0.685	33.730	15.680	663.900	662.100	8.178	0.719
σ		0.393	0.076	2.103	0.585	32.620	27.720	0.340	0.047
%RSD		185.200	11.130	6.233	3.727	4.914	4.187	4.151	6.554
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	18.170	18.260	168.300	170.400	3.539	0.615	3.754	4.325
2	14:29:44	19.170	18.960	178.800	178.700	3.792	0.605	3.830	4.345
3	14:30:27	17.840	18.030	169.800	171.700	3.363	0.631	3.608	4.255
x		18.390	18.420	172.300	173.600	3.564	0.617	3.731	4.308
σ		0.692	0.486	5.695	4.420	0.216	0.013	0.113	0.047
%RSD		3.762	2.637	3.305	2.546	6.045	2.176	3.032	1.099
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	0.000	16.380	68.529%	1.275	1.262	68.719%	-0.001	1.188
2	14:29:44	0.000	16.230	69.987%	1.116	1.106	69.619%	0.009	1.523
3	14:30:27	0.000	16.250	70.376%	1.100	1.074	69.748%	0.008	1.944
x		0.000	16.290	69.631%	1.164	1.147	69.362%	0.005	1.551
σ		0.000	0.080	0.974%	0.097	0.100	0.561%	0.005	0.379
%RSD		0.000	0.491	1.399	8.311	8.744	0.809	98.360	24.420
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:29:01	0.001	2.687	2.653	72.851%	21.480	0.659	0.660	3.828
2	14:29:44	0.004	2.711	2.631	73.940%	21.370	0.576	0.618	4.011
3	14:30:27	0.014	2.697	2.626	74.673%	21.300	0.494	0.486	3.883
x		0.006	2.698	2.637	73.821%	21.390	0.576	0.588	3.907
σ		0.007	0.012	0.014	0.917%	0.093	0.082	0.091	0.094
%RSD		117.800	0.457	0.542	1.242	0.436	14.310	15.410	2.400
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	14:29:01	3.846	83.350%	85.141%	0.085	0.084	0.353	85.505%	
2	14:29:44	3.836	86.020%	87.670%	0.089	0.081	0.352	87.312%	
3	14:30:27	3.812	86.912%	88.394%	0.075	0.078	0.352	88.354%	
x		3.831	85.428%	87.068%	0.083	0.081	0.353	87.057%	
σ		0.017	1.854%	1.708%	0.007	0.003	0.001	1.442%	
%RSD		0.454	2.170	1.961	8.583	3.492	0.190	1.656	

CCV 993939 11/13/2013 2:33:05 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	76.697%	104.600	103.400	101.900	0.000	52230.000	52100.000	51750.000
2	14:34:31	74.906%	106.200	102.700	102.100	0.000	52300.000	53080.000	52450.000
3	14:35:14	74.834%	106.800	103.000	106.200	0.000	52550.000	53050.000	52760.000
x		75.479%	105.852%	103.016%	103.428%	0.000	104.720%	105.488%	104.637%
σ		1.055%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.398	1.050	0.311	2.333	0.000	0.322	1.055	0.991

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	502.100	5246.000	0.000	52260.000	51100.000	52350.000	74.719%	102.500
2	14:34:31	513.400	5264.000	0.000	51970.000	52000.000	52270.000	75.234%	102.400
3	14:35:14	506.700	5257.000	0.000	51980.000	51700.000	52320.000	75.179%	102.100
x		101.481%	105.111%	0.000	104.141%	103.206%	104.630%	75.044%	102.336%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.283%	n/a
%RSD		1.121	0.177	0.000	0.322	0.887	0.080	0.377	0.173

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	103.300	102.500	4.025	520.000	26220.000	25940.000	103.700	104.000
2	14:34:31	103.200	102.000	2.479	515.900	25650.000	25730.000	103.200	104.000
3	14:35:14	101.500	102.300	3.141	513.100	25840.000	25570.000	100.800	102.400
x		102.667%	102.253%	3.215	103.270%	103.614%	102.981%	102.547%	103.473%
σ		n/a	n/a	0.776	n/a	n/a	n/a	n/a	n/a
%RSD		0.982	0.211	24.130	0.673	1.129	0.713	1.526	0.863

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	105.700	104.100	106.500	107.500	104.600	-0.346	106.900	105.600
2	14:34:31	105.400	104.900	105.400	104.900	103.800	-0.421	106.000	106.100
3	14:35:14	104.500	104.600	104.900	105.400	104.200	-0.483	105.300	106.900
x		105.192%	104.542%	105.598%	105.939%	104.198%	-0.417	106.049%	106.176%
σ		n/a	n/a	n/a	n/a	n/a	0.069	n/a	n/a
%RSD		0.568	0.380	0.786	1.278	0.350	16.440	0.728	0.632

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	0.000	101.300	78.043%	101.500	103.000	74.299%	105.300	4.542
2	14:34:31	0.000	101.100	78.515%	103.400	105.000	74.564%	105.300	1.524
3	14:35:14	0.000	100.600	79.488%	103.000	104.700	74.878%	105.900	4.019
x		0.000	101.007%	78.682%	102.633%	104.222%	74.581%	105.502%	3.362
σ		0.000	n/a	0.737%	n/a	n/a	0.290%	n/a	1.613
%RSD		0.000	0.361	0.937	0.962	1.032	0.389	0.332	47.990

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	105.800	106.100	107.000	77.162%	102.100	102.400	102.000	103.500
2	14:34:31	106.000	105.900	106.900	78.205%	101.600	102.500	101.800	103.100
3	14:35:14	105.800	106.900	107.100	78.000%	102.400	103.800	102.400	104.000
x		105.855%	106.320%	106.989%	77.789%	102.043%	102.906%	102.071%	103.532%
σ		n/a	n/a	n/a	0.552%	n/a	n/a	n/a	n/a
%RSD		0.092	0.492	0.065	0.710	0.373	0.734	0.282	0.452

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:33:48	103.800	81.442%	82.039%	101.900	103.300	104.400	79.520%
2	14:34:31	104.300	83.420%	83.923%	102.700	104.000	105.100	80.602%
3	14:35:14	104.400	83.943%	85.063%	103.300	104.700	105.700	81.313%
x		104.135%	82.935%	83.675%	102.618%	104.002%	105.077%	80.479%
σ		n/a	1.319%	1.527%	n/a	n/a	n/a	0.903%
%RSD		0.299	1.591	1.825	0.708	0.678	0.618	1.122

CCB4 11/13/2013 2:41:15 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	98.475%	-0.028	4.151	4.188	0.000	6.979	0.462	0.578
2	14:42:41	94.587%	-0.073	3.936	3.969	0.000	7.144	0.365	0.543
3	14:43:24	93.770%	-0.050	4.073	3.828	0.000	6.726	0.304	0.513
x		95.611%	-0.050	4.053	3.995	0.000	6.950	0.377	0.545
σ		2.514%	0.023	0.109	0.181	0.000	0.211	0.080	0.033
%RSD		2.629	45.260	2.695	4.543	0.000	3.030	21.150	5.964

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	0.133	-0.295	0.000	0.269	0.093	-1.099	93.987%	0.008
2	14:42:41	0.187	0.266	0.000	-0.523	0.525	-1.393	94.438%	0.003
3	14:43:24	0.142	-0.214	0.000	-0.349	-0.783	-0.425	93.880%	0.013
x		0.154	-0.081	0.000	-0.201	-0.055	-0.972	94.102%	0.008
σ		0.029	0.303	0.000	0.416	0.666	0.496	0.296%	0.005
%RSD		18.800	375.700	0.000	206.800	1206.000	51.060	0.315	59.700

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	0.027	0.026	0.147	0.033	4.343	2.067	0.001	0.010
2	14:42:41	0.024	0.017	0.172	0.029	2.467	0.803	0.003	0.006
3	14:43:24	0.011	0.019	0.156	0.037	2.168	1.340	0.000	-0.001
x		0.021	0.021	0.158	0.033	2.993	1.403	0.001	0.005
σ		0.009	0.005	0.013	0.004	1.179	0.634	0.001	0.006
%RSD		42.520	23.540	7.959	12.680	39.380	45.210	105.400	108.200

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	0.102	-0.007	-0.019	0.008	0.032	-0.001	-0.005	0.245
2	14:42:41	0.106	-0.001	0.094	0.052	0.046	-0.001	0.092	0.142
3	14:43:24	0.107	-0.014	0.069	0.055	0.038	-0.001	0.094	0.130
x		0.105	-0.007	0.048	0.038	0.038	-0.001	0.060	0.172
σ		0.002	0.006	0.060	0.026	0.007	0.000	0.057	0.063
%RSD		2.262	90.940	124.000	68.510	18.900	7.566	94.120	36.590

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	0.000	0.012	91.487%	0.127	0.143	94.563%	-0.051	0.157
2	14:42:41	0.000	0.005	93.740%	0.118	0.124	95.398%	-0.047	0.879
3	14:43:24	0.000	0.011	94.217%	0.089	0.100	95.630%	-0.043	0.371
x		0.000	0.009	93.148%	0.111	0.122	95.197%	-0.047	0.469
σ		0.000	0.004	1.458%	0.020	0.022	0.561%	0.004	0.371
%RSD		0.000	39.370	1.565	17.930	17.830	0.589	8.335	79.100

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	-0.044	-0.008	-0.002	93.003%	-0.021	0.089	0.078	0.005
2	14:42:41	-0.043	-0.065	-0.047	95.077%	-0.021	0.071	0.077	-0.002
3	14:43:24	-0.041	-0.027	-0.015	95.254%	-0.040	0.070	0.080	0.006
x		-0.043	-0.033	-0.021	94.445%	-0.027	0.077	0.078	0.003
σ		0.001	0.029	0.023	1.252%	0.011	0.011	0.001	0.004
%RSD		3.253	88.400	108.200	1.326	40.620	13.850	1.899	128.100

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:41:58	0.017	92.724%	92.379%	0.019	0.021	0.015	97.084%
2	14:42:41	0.002	95.900%	95.586%	0.017	0.018	0.018	97.824%
3	14:43:24	0.013	96.785%	96.436%	0.016	0.018	0.016	98.391%
x		0.011	95.136%	94.800%	0.017	0.019	0.017	97.767%
σ		0.008	2.135%	2.140%	0.001	0.002	0.002	0.655%
%RSD		73.380	2.245	2.257	8.033	9.927	11.270	0.670

180-26836-A-3-C 11/13/2013 2:46:05 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	70.778%	-0.014	6.494	7.043	0.000	8622.000	1473.000	1453.000
2	14:47:31	67.215%	-0.033	6.699	6.661	0.000	8712.000	1498.000	1478.000
3	14:48:13	64.167%	-0.011	6.806	6.610	0.000	8762.000	1519.000	1496.000
x		67.387%	-0.019	6.666	6.771	0.000	8699.000	1497.000	1476.000
σ		3.309%	0.012	0.158	0.237	0.000	70.840	22.880	21.390
%RSD		4.910	62.650	2.374	3.500	0.000	0.814	1.529	1.449

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	81.550	135.400	0.000	13850.000	7660.000	7351.000	70.460%	20.500
2	14:47:31	87.620	133.800	0.000	13600.000	7609.000	7307.000	68.714%	20.820
3	14:48:13	85.680	135.300	0.000	13710.000	7766.000	7368.000	69.021%	20.060
x		84.950	134.800	0.000	13720.000	7678.000	7342.000	69.398%	20.460
σ		3.101	0.895	0.000	124.700	80.010	31.380	0.932%	0.380
%RSD		3.651	0.664	0.000	0.909	1.042	0.427	1.343	1.858

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	0.156	0.563	29.520	7.855	819.400	814.000	10.620	0.682
2	14:47:31	-0.620	0.517	29.010	7.809	794.600	799.600	10.300	0.784
3	14:48:13	-0.091	0.538	28.600	7.721	786.400	780.000	10.270	0.710
x		-0.185	0.539	29.040	7.795	800.100	797.900	10.400	0.725
σ		0.397	0.023	0.458	0.068	17.190	17.090	0.194	0.053
%RSD		214.200	4.236	1.577	0.872	2.148	2.141	1.866	7.284

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	16.830	17.170	193.100	195.100	6.695	0.533	5.322	5.744
2	14:47:31	16.440	16.370	194.800	195.900	6.563	0.544	5.287	5.974
3	14:48:13	16.110	16.710	191.900	191.200	6.783	0.492	5.489	5.856
x		16.460	16.750	193.300	194.100	6.680	0.523	5.366	5.858
σ		0.364	0.399	1.450	2.521	0.111	0.027	0.108	0.115
%RSD		2.211	2.380	0.750	1.299	1.662	5.242	2.003	1.958

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	0.000	11.430	74.382%	1.392	1.356	73.717%	0.003	1.766
2	14:47:31	0.000	11.540	74.152%	1.424	1.422	73.335%	0.001	1.457
3	14:48:13	0.000	11.430	74.328%	1.351	1.351	73.262%	-0.001	1.748
x		0.000	11.470	74.287%	1.389	1.377	73.438%	0.001	1.657
σ		0.000	0.062	0.120%	0.036	0.040	0.245%	0.002	0.173
%RSD		0.000	0.543	0.162	2.622	2.893	0.333	173.500	10.470

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	0.009	3.807	4.014	77.801%	22.170	0.203	0.204	3.976
2	14:47:31	0.004	3.987	3.885	78.253%	21.920	0.178	0.175	3.928
3	14:48:13	-0.004	3.925	3.988	78.334%	22.140	0.163	0.146	3.897
x		0.003	3.906	3.962	78.129%	22.080	0.181	0.175	3.934
σ		0.007	0.092	0.068	0.287%	0.136	0.021	0.029	0.040
%RSD		242.800	2.344	1.720	0.367	0.614	11.310	16.530	1.009

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:46:47	3.739	86.667%	88.134%	0.060	0.059	0.368	86.865%
2	14:47:31	3.835	88.381%	90.033%	0.067	0.061	0.366	88.843%
3	14:48:13	3.947	89.230%	90.662%	0.060	0.056	0.357	89.666%
x		3.840	88.093%	89.609%	0.062	0.059	0.363	88.458%
σ		0.104	1.305%	1.316%	0.004	0.003	0.006	1.440%
%RSD		2.703	1.482	1.469	6.823	4.526	1.666	1.628

180-26836-A-4-C 11/13/2013 2:50:52 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	65.379%	0.017	7.316	7.050	0.000	7846.000	1847.000	1833.000
2	14:52:18	61.608%	-0.011	6.282	7.316	0.000	8298.000	1964.000	1958.000
3	14:53:01	61.172%	0.042	7.026	6.857	0.000	7975.000	1879.000	1839.000
x		62.720%	0.016	6.875	7.074	0.000	8040.000	1896.000	1877.000
σ		2.314%	0.026	0.533	0.231	0.000	232.800	60.250	70.500
%RSD		3.689	164.300	7.760	3.261	0.000	2.896	3.177	3.756

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	427.600	402.400	0.000	14930.000	6766.000	6421.000	68.449%	41.720
2	14:52:18	455.700	434.600	0.000	16420.000	7435.000	7178.000	61.072%	45.710
3	14:53:01	426.100	400.900	0.000	14760.000	6657.000	6413.000	67.557%	41.270
x		436.500	412.600	0.000	15370.000	6953.000	6670.000	65.693%	42.900
σ		16.690	19.050	0.000	915.600	421.300	439.200	4.026%	2.442
%RSD		3.823	4.616	0.000	5.957	6.059	6.585	6.129	5.692

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	0.817	1.402	30.220	29.450	1756.000	1721.000	13.110	3.197
2	14:52:18	0.505	1.513	33.490	32.000	1899.000	1854.000	13.820	3.350
3	14:53:01	1.569	1.332	28.670	28.760	1716.000	1699.000	12.780	2.974
x		0.964	1.416	30.790	30.070	1790.000	1758.000	13.240	3.174
σ		0.547	0.091	2.458	1.705	96.010	84.190	0.532	0.189
%RSD		56.750	6.436	7.984	5.670	5.363	4.789	4.022	5.962

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	116.200	116.000	245.100	245.700	143.800	0.554	5.784	6.458
2	14:52:18	121.400	123.600	257.900	260.800	148.700	0.554	5.863	6.358
3	14:53:01	113.100	115.600	242.600	243.500	141.400	0.545	5.547	5.822
x		116.900	118.400	248.500	250.000	144.600	0.551	5.732	6.213
σ		4.191	4.514	8.186	9.419	3.697	0.005	0.165	0.342
%RSD		3.584	3.813	3.294	3.768	2.556	0.895	2.870	5.507

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	0.000	35.790	73.609%	5.671	5.698	73.114%	0.378	1.105
2	14:52:18	0.000	36.200	73.401%	5.674	5.763	71.727%	0.364	1.465
3	14:53:01	0.000	35.970	72.938%	5.747	5.746	71.434%	0.384	1.146
x		0.000	35.980	73.316%	5.697	5.736	72.092%	0.376	1.239
σ		0.000	0.203	0.343%	0.043	0.034	0.897%	0.010	0.198
%RSD		0.000	0.563	0.468	0.756	0.588	1.244	2.750	15.950

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	0.388	4.196	4.275	77.059%	23.650	4.235	4.167	12.320
2	14:52:18	0.385	4.209	4.182	76.834%	23.630	4.255	4.253	12.270
3	14:53:01	0.396	4.114	4.191	77.262%	23.440	4.202	4.182	12.100
x		0.390	4.173	4.216	77.051%	23.570	4.230	4.201	12.230
σ		0.005	0.052	0.051	0.214%	0.114	0.027	0.046	0.114
%RSD		1.362	1.241	1.211	0.278	0.483	0.635	1.101	0.934

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:51:35	12.020	87.976%	88.991%	0.320	0.316	9.781	88.216%
2	14:52:18	12.350	88.885%	90.424%	0.313	0.322	9.887	89.620%
3	14:53:01	12.180	89.288%	91.037%	0.316	0.318	9.835	90.978%
x		12.190	88.716%	90.151%	0.316	0.318	9.834	89.605%
σ		0.165	0.672%	1.050%	0.003	0.003	0.053	1.381%
%RSD		1.350	0.758	1.165	1.068	0.950	0.536	1.541

180-26836-A-4-C SD@5 11/13/2013 2:55:40 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	77.879%	-0.036	3.059	3.444	0.000	1582.000	357.500	357.600
2	14:57:06	74.228%	-0.075	3.227	2.951	0.000	1596.000	368.300	367.900
3	14:57:49	72.566%	-0.036	2.346	2.715	0.000	1598.000	371.200	366.400
x		74.891%	-0.049	2.877	3.037	0.000	1592.000	365.700	364.000
σ		2.718%	0.023	0.468	0.372	0.000	8.995	7.215	5.536
%RSD		3.629	46.300	16.250	12.250	0.000	0.565	1.973	1.521

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	85.500	80.070	0.000	3092.000	1400.000	1291.000	74.652%	8.431
2	14:57:06	87.920	82.440	0.000	3076.000	1357.000	1294.000	74.181%	8.291
3	14:57:49	85.990	82.780	0.000	3038.000	1346.000	1296.000	74.976%	8.800
x		86.470	81.760	0.000	3068.000	1368.000	1294.000	74.603%	8.508
σ		1.279	1.476	0.000	27.780	28.400	2.393	0.400%	0.263
%RSD		1.479	1.806	0.000	0.905	2.076	0.185	0.536	3.089

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	0.160	0.365	7.436	6.005	374.200	359.200	2.803	0.772
2	14:57:06	0.148	0.326	7.216	6.006	374.900	362.900	2.750	0.601
3	14:57:49	0.258	0.289	7.000	6.004	365.600	354.500	2.749	0.641
x		0.189	0.327	7.217	6.005	371.500	358.900	2.767	0.671
σ		0.060	0.038	0.218	0.001	5.169	4.211	0.031	0.089
%RSD		31.730	11.530	3.018	0.012	1.391	1.173	1.126	13.300

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	25.290	25.680	54.880	54.910	32.190	0.118	1.114	1.292
2	14:57:06	25.300	25.560	55.550	55.270	31.690	0.117	1.152	1.079
3	14:57:49	25.100	25.080	54.350	54.920	31.650	0.121	1.125	1.397
x		25.230	25.440	54.930	55.030	31.840	0.118	1.130	1.256
σ		0.116	0.315	0.601	0.209	0.303	0.002	0.020	0.162
%RSD		0.458	1.237	1.094	0.380	0.952	1.644	1.735	12.910

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	0.000	7.165	77.249%	1.162	1.094	78.882%	0.046	1.937
2	14:57:06	0.000	7.288	77.176%	1.166	1.175	79.125%	0.035	1.311
3	14:57:49	0.000	7.247	77.988%	1.131	1.139	79.226%	0.043	1.272
x		0.000	7.233	77.471%	1.153	1.136	79.078%	0.041	1.506
σ		0.000	0.062	0.449%	0.019	0.040	0.177%	0.006	0.373
%RSD		0.000	0.859	0.580	1.643	3.535	0.223	13.360	24.770

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	0.037	0.748	0.811	79.692%	4.559	0.907	0.903	2.484
2	14:57:06	0.046	0.785	0.820	80.730%	4.688	0.873	0.925	2.420
3	14:57:49	0.045	0.825	0.863	81.253%	4.630	0.880	0.933	2.529
x		0.043	0.786	0.831	80.558%	4.626	0.887	0.921	2.478
σ		0.005	0.039	0.028	0.795%	0.065	0.018	0.016	0.055
%RSD		11.270	4.911	3.386	0.987	1.399	2.004	1.704	2.209

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:56:23	2.530	85.186%	85.822%	0.064	0.066	1.933	87.774%
2	14:57:06	2.470	87.319%	87.932%	0.066	0.068	1.917	89.616%
3	14:57:49	2.540	87.895%	88.507%	0.065	0.067	1.930	90.471%
x		2.513	86.800%	87.420%	0.065	0.067	1.927	89.287%
σ		0.038	1.427%	1.413%	0.001	0.001	0.009	1.378%
%RSD		1.502	1.644	1.617	0.970	1.205	0.461	1.543

180-26836-A-4-C PDS 11/13/2013 3:00:27 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	64.427%	50.210	997.400	1008.000	0.000	57870.000	54680.000	54120.000
2	15:01:53	61.568%	51.490	1035.000	1036.000	0.000	61480.000	57950.000	57250.000
3	15:02:36	60.537%	51.640	1038.000	1047.000	0.000	61680.000	59430.000	58460.000
x		62.177%	51.110	1024.000	1030.000	0.000	60340.000	57350.000	56610.000
σ		2.015%	0.783	22.740	20.480	0.000	2145.000	2429.000	2241.000
%RSD		3.241	1.532	2.221	1.988	0.000	3.555	4.235	3.959

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	2645.000	10420.000	0.000	63140.000	57150.000	58500.000	65.852%	1015.000
2	15:01:53	2806.000	10940.000	0.000	68440.000	63050.000	64660.000	60.136%	1104.000
3	15:02:36	2869.000	11040.000	0.000	68700.000	62830.000	64630.000	59.885%	1106.000
x		2773.000	10800.000	0.000	66760.000	61010.000	62600.000	61.958%	1075.000
σ		115.600	334.000	0.000	3139.000	3345.000	3551.000	3.375%	52.090
%RSD		4.169	3.093	0.000	4.702	5.483	5.673	5.447	4.845

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	535.300	207.600	47.400	556.800	2764.000	2858.000	540.500	508.200
2	15:01:53	586.400	221.900	48.080	589.800	2922.000	3006.000	571.000	535.600
3	15:02:36	585.200	221.600	50.070	589.800	2904.000	3011.000	568.300	533.700
x		569.000	217.000	48.520	578.800	2864.000	2958.000	559.900	525.800
σ		29.170	8.137	1.386	19.060	86.580	86.890	16.850	15.320
%RSD		5.127	3.749	2.857	3.293	3.023	2.937	3.010	2.914

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	363.200	369.400	712.100	720.300	180.300	0.816	15.390	15.220
2	15:01:53	382.900	385.100	750.100	752.300	183.500	0.843	15.510	16.240
3	15:02:36	380.100	384.900	748.800	744.300	183.500	0.849	15.050	16.570
x		375.400	379.800	737.000	739.000	182.400	0.836	15.320	16.010
σ		10.640	9.030	21.610	16.620	1.836	0.018	0.242	0.705
%RSD		2.835	2.378	2.932	2.250	1.007	2.137	1.577	4.402

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	0.000	1132.000	69.367%	1012.000	1057.000	66.941%	53.890	12.220
2	15:01:53	0.000	1131.000	70.483%	1020.000	1058.000	67.738%	54.160	11.280
3	15:02:36	0.000	1134.000	70.420%	1014.000	1061.000	67.478%	54.670	12.640
x		0.000	1132.000	70.090%	1015.000	1059.000	67.386%	54.240	12.050
σ		0.000	1.438	0.627%	3.878	2.315	0.406%	0.395	0.696
%RSD		0.000	0.127	0.895	0.382	0.219	0.603	0.728	5.774

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	53.970	57.910	49.870	71.639%	2075.000	478.000	478.100	650.100
2	15:01:53	53.680	56.710	50.250	73.065%	2067.000	477.000	479.400	404.800
3	15:02:36	53.420	57.380	49.610	72.868%	2085.000	481.300	481.400	425.600
x		53.690	57.330	49.910	72.524%	2076.000	478.800	479.700	493.500
σ		0.274	0.599	0.320	0.773%	8.989	2.274	1.669	136.000
%RSD		0.510	1.045	0.641	1.066	0.433	0.475	0.348	27.560

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:01:10	2186.000	83.036%	84.334%	54.790	55.640	32.020	79.560%
2	15:01:53	2185.000	84.281%	86.585%	54.670	55.600	32.050	81.872%
3	15:02:36	2185.000	85.011%	87.213%	55.310	56.310	32.320	81.774%
x		2185.000	84.110%	86.044%	54.920	55.850	32.130	81.069%
σ		0.312	0.999%	1.514%	0.337	0.397	0.168	1.308%
%RSD		0.014	1.187	1.759	0.613	0.711	0.522	1.613

MB 180-89486/1-A 11/13/2013 3:09:18 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	93.807%	-0.039	6.596	6.422	0.000	16.670	8.787	8.739
2	15:10:44	91.565%	-0.064	6.244	5.836	0.000	16.120	9.620	8.611
3	15:11:27	94.521%	-0.110	5.779	5.456	0.000	16.350	8.774	8.723
x		93.298%	-0.071	6.206	5.905	0.000	16.380	9.060	8.691
σ		1.543%	0.036	0.410	0.487	0.000	0.275	0.485	0.070
%RSD		1.653	50.120	6.607	8.247	0.000	1.681	5.350	0.803
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	2.130	2.708	0.000	4.000	35.570	33.620	86.437%	0.091
2	15:10:44	2.198	3.068	0.000	4.051	34.330	34.310	87.193%	0.064
3	15:11:27	2.293	2.817	0.000	3.990	35.410	33.140	86.771%	0.025
x		2.207	2.864	0.000	4.014	35.110	33.690	86.800%	0.060
σ		0.082	0.185	0.000	0.033	0.672	0.586	0.379%	0.033
%RSD		3.719	6.446	0.000	0.821	1.915	1.740	0.437	54.650
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	-0.026	0.065	0.415	0.084	8.455	7.777	0.005	0.070
2	15:10:44	-0.022	0.100	0.355	0.093	9.730	6.876	0.005	0.112
3	15:11:27	0.013	0.086	0.301	0.088	9.139	7.084	0.005	0.095
x		-0.012	0.084	0.357	0.088	9.108	7.246	0.005	0.092
σ		0.021	0.017	0.057	0.004	0.638	0.472	0.000	0.021
%RSD		177.800	20.810	15.950	4.823	7.005	6.509	6.767	23.160
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	0.304	0.200	0.848	0.773	0.096	-0.003	-0.102	0.343
2	15:10:44	0.278	0.225	0.780	0.811	-0.025	0.011	-0.075	-0.198
3	15:11:27	0.252	0.230	0.768	0.832	0.000	0.007	0.083	-0.078
x		0.278	0.218	0.799	0.805	0.024	0.005	-0.031	0.022
σ		0.026	0.016	0.043	0.030	0.064	0.007	0.100	0.284
%RSD		9.518	7.451	5.387	3.717	267.200	142.900	320.100	1277.000
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	0.000	0.095	84.415%	0.190	0.191	86.718%	-0.050	0.342
2	15:10:44	0.000	0.089	86.256%	0.182	0.177	87.389%	-0.051	0.237
3	15:11:27	0.000	0.086	85.642%	0.182	0.147	87.899%	-0.047	0.251
x		0.000	0.090	85.438%	0.185	0.172	87.335%	-0.049	0.276
σ		0.000	0.004	0.937%	0.005	0.023	0.592%	0.002	0.057
%RSD		0.000	4.750	1.097	2.593	13.130	0.678	4.631	20.570
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:10:01	-0.050	-0.024	0.004	85.346%	4.497	0.194	0.184	0.223
2	15:10:44	-0.046	-0.015	-0.025	87.327%	4.397	0.180	0.183	0.227
3	15:11:27	-0.045	-0.014	-0.028	87.755%	4.545	0.151	0.150	0.240
x		-0.047	-0.018	-0.016	86.809%	4.480	0.175	0.172	0.230
σ		0.002	0.005	0.018	1.285%	0.076	0.022	0.019	0.009
%RSD		4.701	29.270	108.800	1.480	1.690	12.640	11.120	3.865
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	15:10:01	0.226	86.783%	86.292%	0.019	0.018	0.036	90.175%	
2	15:10:44	0.223	89.035%	88.955%	0.017	0.017	0.039	89.711%	
3	15:11:27	0.221	88.750%	89.251%	0.015	0.017	0.041	89.173%	
x		0.223	88.189%	88.166%	0.017	0.017	0.039	89.687%	
σ		0.003	1.227%	1.630%	0.002	0.001	0.003	0.501%	
%RSD		1.183	1.391	1.848	11.390	4.972	6.671	0.559	

PB 180-89081/4-C 11/13/2013 3:14:06 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	97.151%	-0.052	6.397	6.150	0.000	89.610	51.630	51.240
2	15:15:32	95.117%	-0.039	5.737	6.109	0.000	88.800	51.990	51.880
3	15:16:15	93.174%	-0.061	6.163	6.063	0.000	89.580	53.910	51.940
x		95.147%	-0.051	6.099	6.107	0.000	89.330	52.510	51.690
σ		1.989%	0.011	0.335	0.043	0.000	0.458	1.228	0.388
%RSD		2.090	21.620	5.493	0.711	0.000	0.513	2.339	0.750
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	7.676	15.930	0.000	36.850	184.300	184.400	90.906%	0.273
2	15:15:32	8.146	16.610	0.000	36.320	187.100	178.400	90.527%	0.169
3	15:16:15	7.656	15.800	0.000	35.620	191.500	183.300	91.409%	0.195
x		7.826	16.120	0.000	36.270	187.700	182.000	90.947%	0.212
σ		0.277	0.435	0.000	0.615	3.611	3.211	0.443%	0.054
%RSD		3.541	2.699	0.000	1.695	1.924	1.764	0.487	25.450
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	-0.005	0.296	0.271	0.277	9.414	8.120	0.014	0.426
2	15:15:32	0.001	0.283	0.233	0.288	9.226	6.994	0.016	0.479
3	15:16:15	0.009	0.292	0.229	0.280	8.739	7.127	0.015	0.526
x		0.002	0.290	0.245	0.282	9.126	7.414	0.015	0.477
σ		0.007	0.007	0.023	0.006	0.348	0.615	0.001	0.050
%RSD		409.900	2.441	9.522	1.979	3.818	8.297	7.298	10.490
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	0.955	0.958	3.673	3.974	-0.052	0.011	-0.203	-0.178
2	15:15:32	0.919	0.894	3.638	3.675	0.092	-0.004	-0.032	0.257
3	15:16:15	0.978	0.884	3.770	3.661	-0.047	0.010	0.000	-0.199
x		0.951	0.912	3.694	3.770	-0.003	0.006	-0.078	-0.040
σ		0.030	0.040	0.068	0.177	0.082	0.009	0.109	0.258
%RSD		3.107	4.395	1.851	4.688	3075.000	149.400	139.200	642.400
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	0.000	0.506	88.107%	0.174	0.152	89.635%	-0.052	0.054
2	15:15:32	0.000	0.514	89.509%	0.157	0.154	90.868%	-0.050	0.540
3	15:16:15	0.000	0.512	89.665%	0.128	0.119	90.220%	-0.052	0.627
x		0.000	0.510	89.094%	0.153	0.142	90.241%	-0.051	0.407
σ		0.000	0.004	0.858%	0.023	0.020	0.617%	0.001	0.309
%RSD		0.000	0.851	0.963	15.200	14.150	0.684	2.094	75.780
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:14:49	-0.052	0.002	-0.058	89.013%	20.870	0.179	0.162	1.056
2	15:15:32	-0.047	-0.039	-0.096	90.036%	21.100	0.119	0.129	1.050
3	15:16:15	-0.050	-0.044	-0.073	90.297%	21.330	0.105	0.122	1.100
x		-0.050	-0.027	-0.076	89.782%	21.100	0.134	0.138	1.069
σ		0.003	0.025	0.019	0.678%	0.226	0.039	0.021	0.027
%RSD		5.642	94.690	25.520	0.755	1.070	29.140	15.450	2.549
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	15:14:49	1.104	89.972%	90.317%	0.019	0.015	0.090	89.262%	
2	15:15:32	1.083	91.588%	91.882%	0.015	0.014	0.086	89.958%	
3	15:16:15	1.100	93.327%	93.937%	0.011	0.014	0.095	90.384%	
x		1.096	91.629%	92.045%	0.015	0.014	0.090	89.868%	
σ		0.011	1.678%	1.815%	0.004	0.001	0.004	0.566%	
%RSD		1.017	1.832	1.972	25.550	5.822	4.551	0.630	

LCS 180-89486/2-A 11/13/2013 3:18:53 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	89.379%	44.290	866.200	842.300	0.000	46930.000	46510.000	46150.000
2	15:20:19	85.100%	44.270	857.200	837.600	0.000	47740.000	47860.000	47520.000
3	15:21:02	81.726%	43.630	863.700	841.300	0.000	48170.000	48050.000	47300.000
x		85.402%	44.060	862.400	840.400	0.000	47610.000	47470.000	46990.000
σ		3.836%	0.376	4.638	2.485	0.000	628.100	839.900	736.800
%RSD		4.492	0.854	0.538	0.296	0.000	1.319	1.769	1.568

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	1896.000	5414.000	0.000	48380.000	48890.000	48590.000	80.134%	939.800
2	15:20:19	1934.000	5467.000	0.000	48130.000	48500.000	49180.000	78.995%	941.000
3	15:21:02	1925.000	5466.000	0.000	47970.000	48640.000	48540.000	79.022%	926.500
x		1918.000	5449.000	0.000	48160.000	48680.000	48770.000	79.384%	935.800
σ		19.920	30.070	0.000	209.800	196.900	357.100	0.650%	8.032
%RSD		1.039	0.552	0.000	0.436	0.405	0.732	0.818	0.858

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	531.500	206.000	4.251	491.400	1216.000	1354.000	507.200	496.100
2	15:20:19	532.500	203.400	4.851	487.200	1203.000	1328.000	503.000	492.100
3	15:21:02	524.500	201.000	3.640	486.800	1209.000	1332.000	502.000	489.000
x		529.500	203.500	4.247	488.400	1210.000	1338.000	504.100	492.400
σ		4.381	2.468	0.605	2.567	6.604	13.840	2.714	3.567
%RSD		0.827	1.213	14.250	0.526	0.546	1.035	0.538	0.724

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	254.800	254.800	437.500	437.900	33.980	-0.041	7.913	8.861
2	15:20:19	252.100	256.700	439.800	441.000	34.400	-0.026	8.101	8.628
3	15:21:02	248.100	250.500	436.000	437.700	33.950	-0.027	8.188	8.629
x		251.600	254.000	437.800	438.900	34.110	-0.031	8.067	8.706
σ		3.360	3.175	1.899	1.870	0.248	0.008	0.141	0.134
%RSD		1.335	1.250	0.434	0.426	0.727	26.810	1.743	1.543

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	0.000	1035.000	71.997%	996.400	1014.000	75.475%	47.760	14.820
2	15:20:19	0.000	1025.000	72.598%	993.400	1018.000	76.045%	46.960	13.020
3	15:21:02	0.000	1043.000	71.936%	991.300	1018.000	75.836%	46.900	14.740
x		0.000	1034.000	72.177%	993.700	1017.000	75.785%	47.210	14.190
σ		0.000	8.655	0.366%	2.564	2.416	0.288%	0.483	1.018
%RSD		0.000	0.837	0.507	0.258	0.238	0.380	1.023	7.170

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	47.840	45.220	40.050	76.764%	1929.000	437.700	435.000	925.000
2	15:20:19	47.100	44.700	39.430	77.798%	1947.000	437.000	436.200	1231.000
3	15:21:02	47.410	45.730	39.440	78.295%	1944.000	435.900	434.700	916.600
x		47.450	45.220	39.640	77.619%	1940.000	436.900	435.300	1024.000
σ		0.372	0.514	0.354	0.781%	9.621	0.897	0.807	178.900
%RSD		0.784	1.136	0.893	1.006	0.496	0.205	0.185	17.470

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:19:36	1967.000	81.080%	81.306%	48.070	49.130	19.970	74.747%
2	15:20:19	1970.000	82.854%	83.173%	48.580	49.630	20.240	75.805%
3	15:21:02	1970.000	83.770%	84.431%	48.930	49.440	20.300	77.234%
x		1969.000	82.568%	82.970%	48.530	49.400	20.170	75.929%
σ		1.637	1.368%	1.572%	0.435	0.250	0.177	1.248%
%RSD		0.083	1.656	1.895	0.896	0.507	0.879	1.644

LCSD 180-89486/3-A 11/13/2013 3:23:39 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	82.669%	44.290	843.900	853.500	0.000	47760.000	47880.000	47920.000
2	15:25:05	81.390%	44.340	854.800	830.500	0.000	48080.000	48040.000	47970.000
3	15:25:48	81.139%	43.670	858.900	859.600	0.000	48810.000	48520.000	48270.000
x		81.733%	44.100	852.500	847.900	0.000	48210.000	48140.000	48050.000
σ		0.820%	0.375	7.774	15.320	0.000	539.300	332.400	189.900
%RSD		1.003	0.850	0.912	1.806	0.000	1.118	0.690	0.395
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	1941.000	5501.000	0.000	48400.000	49640.000	49670.000	76.166%	958.100
2	15:25:05	1965.000	5497.000	0.000	48680.000	49740.000	50170.000	74.875%	969.000
3	15:25:48	1957.000	5552.000	0.000	49010.000	49570.000	49830.000	75.826%	968.500
x		1954.000	5516.000	0.000	48700.000	49650.000	49890.000	75.622%	965.200
σ		12.280	30.740	0.000	307.500	81.720	257.100	0.669%	6.110
%RSD		0.628	0.557	0.000	0.631	0.165	0.515	0.885	0.633
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	519.400	201.100	3.628	493.800	1064.000	1208.000	519.000	503.000
2	15:25:05	521.200	200.100	6.217	502.100	1061.000	1206.000	513.500	494.800
3	15:25:48	516.200	198.500	6.927	495.600	1050.000	1188.000	508.600	494.000
x		519.000	199.900	5.591	497.200	1058.000	1201.000	513.700	497.300
σ		2.525	1.293	1.737	4.403	7.029	10.800	5.222	4.961
%RSD		0.487	0.647	31.060	0.886	0.664	0.899	1.017	0.998
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	257.000	259.300	447.200	447.000	34.890	-0.044	8.275	8.950
2	15:25:05	256.200	258.500	451.100	447.500	34.740	-0.038	8.495	8.627
3	15:25:48	252.800	253.400	443.800	443.300	34.520	-0.047	8.188	9.236
x		255.300	257.100	447.300	445.900	34.720	-0.043	8.319	8.938
σ		2.253	3.205	3.643	2.277	0.184	0.004	0.158	0.305
%RSD		0.883	1.247	0.815	0.511	0.531	10.080	1.903	3.410
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	0.000	1031.000	70.952%	980.400	996.600	74.434%	47.340	12.950
2	15:25:05	0.000	1033.000	71.316%	988.000	1006.000	74.769%	47.090	12.510
3	15:25:48	0.000	1031.000	71.791%	982.600	1003.000	75.150%	46.910	14.890
x		0.000	1032.000	71.353%	983.700	1002.000	74.784%	47.110	13.450
σ		0.000	1.187	0.421%	3.919	4.821	0.358%	0.215	1.267
%RSD		0.000	0.115	0.590	0.398	0.481	0.479	0.456	9.419
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:24:22	47.230	45.930	39.550	77.336%	1914.000	431.500	430.800	1305.000
2	15:25:05	47.190	44.800	38.930	77.605%	1923.000	434.400	431.900	987.000
3	15:25:48	47.210	45.510	39.410	77.973%	1920.000	435.500	434.200	1034.000
x		47.210	45.420	39.300	77.638%	1919.000	433.800	432.300	1108.000
σ		0.019	0.570	0.322	0.320%	4.648	2.072	1.757	171.600
%RSD		0.041	1.254	0.820	0.412	0.242	0.478	0.406	15.480
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	15:24:22	1941.000	81.668%	81.644%	48.010	48.610	19.690	75.697%	
2	15:25:05	1951.000	83.055%	83.261%	48.280	49.130	19.890	76.867%	
3	15:25:48	1944.000	83.163%	83.579%	48.230	49.290	19.900	77.384%	
x		1945.000	82.629%	82.828%	48.170	49.010	19.830	76.649%	
σ		5.394	0.834%	1.038%	0.144	0.358	0.116	0.865%	
%RSD		0.277	1.009	1.253	0.300	0.730	0.586	1.128	

180-26836-A-1-D 11/13/2013 3:31:46 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	85.495%	-0.070	14.440	14.810	0.000	8322.000	1344.000	1344.000
2	15:33:12	83.890%	-0.049	14.470	14.050	0.000	8312.000	1372.000	1361.000
3	15:33:55	84.906%	-0.013	13.690	12.790	0.000	8236.000	1366.000	1365.000
x		84.764%	-0.044	14.200	13.880	0.000	8290.000	1361.000	1357.000
σ		0.812%	0.029	0.444	1.019	0.000	47.240	14.610	11.390
%RSD		0.958	65.260	3.124	7.344	0.000	0.570	1.074	0.840

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	63.870	152.100	0.000	14850.000	5781.000	5415.000	79.233%	17.300
2	15:33:12	64.360	154.800	0.000	14750.000	5742.000	5504.000	78.309%	17.620
3	15:33:55	63.860	149.300	0.000	14670.000	5793.000	5520.000	79.144%	16.970
x		64.030	152.000	0.000	14760.000	5772.000	5480.000	78.895%	17.300
σ		0.286	2.737	0.000	93.070	26.460	56.570	0.510%	0.326
%RSD		0.446	1.800	0.000	0.631	0.459	1.032	0.646	1.884

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	-0.024	-0.190	0.536	13.020	642.500	632.300	7.727	0.592
2	15:33:12	-0.046	-0.246	0.548	13.030	642.100	634.500	7.507	0.702
3	15:33:55	-0.026	-0.187	0.526	12.950	644.400	647.300	7.673	0.584
x		-0.032	-0.207	0.537	13.000	643.000	638.000	7.636	0.626
σ		0.012	0.033	0.011	0.043	1.227	8.109	0.115	0.066
%RSD		38.200	15.930	2.040	0.333	0.191	1.271	1.499	10.530

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	11.090	11.110	153.300	154.400	3.486	-0.024	3.168	3.700
2	15:33:12	11.120	10.980	155.100	156.200	3.236	-0.011	3.240	3.638
3	15:33:55	11.120	11.120	155.400	156.100	3.234	-0.014	3.540	3.519
x		11.110	11.070	154.600	155.600	3.319	-0.017	3.316	3.619
σ		0.017	0.077	1.165	1.013	0.145	0.007	0.197	0.092
%RSD		0.157	0.698	0.753	0.651	4.366	41.280	5.948	2.551

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	0.000	13.940	78.205%	1.169	1.120	78.509%	-0.011	-0.235
2	15:33:12	0.000	14.090	79.087%	1.133	1.144	79.318%	-0.016	0.505
3	15:33:55	0.000	14.220	79.525%	1.133	1.060	79.850%	-0.013	1.413
x		0.000	14.080	78.939%	1.145	1.108	79.226%	-0.014	0.561
σ		0.000	0.138	0.672%	0.021	0.043	0.675%	0.002	0.825
%RSD		0.000	0.978	0.852	1.825	3.895	0.852	18.210	147.100

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	-0.005	2.528	2.606	79.323%	17.630	0.094	0.127	3.624
2	15:33:12	-0.010	2.618	2.553	80.868%	17.130	0.107	0.113	3.746
3	15:33:55	-0.010	2.430	2.463	81.549%	16.780	0.088	0.089	3.863
x		-0.008	2.525	2.541	80.580%	17.180	0.096	0.109	3.744
σ		0.003	0.094	0.072	1.141%	0.429	0.009	0.019	0.119
%RSD		38.320	3.728	2.839	1.415	2.499	9.723	17.660	3.187

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:32:29	3.812	83.007%	83.550%	0.017	0.018	0.364	82.001%
2	15:33:12	3.686	85.401%	86.177%	0.019	0.022	0.359	82.931%
3	15:33:55	3.759	86.212%	86.885%	0.020	0.022	0.371	83.578%
x		3.752	84.874%	85.537%	0.019	0.021	0.365	82.837%
σ		0.063	1.667%	1.757%	0.002	0.002	0.006	0.793%
%RSD		1.686	1.964	2.054	8.647	10.850	1.587	0.957

180-26836-A-3-D 11/13/2013 3:36:32 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	86.020%	-0.074	9.303	9.963	0.000	8708.000	1433.000	1413.000
2	15:37:58	79.122%	-0.058	9.657	10.040	0.000	8746.000	1449.000	1458.000
3	15:38:41	78.817%	-0.084	8.891	8.825	0.000	8554.000	1426.000	1459.000
x		81.320%	-0.072	9.284	9.609	0.000	8669.000	1436.000	1444.000
σ		4.074%	0.013	0.383	0.680	0.000	101.900	11.720	26.080
%RSD		5.009	17.890	4.129	7.077	0.000	1.175	0.816	1.806
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	122.600	163.900	0.000	14110.000	7635.000	7251.000	78.755%	17.780
2	15:37:58	137.500	180.400	0.000	14090.000	7715.000	7337.000	78.743%	16.880
3	15:38:41	129.400	171.400	0.000	14150.000	7852.000	7424.000	78.593%	17.770
x		129.800	171.900	0.000	14110.000	7734.000	7337.000	78.697%	17.480
σ		7.442	8.240	0.000	32.410	109.900	86.180	0.090%	0.517
%RSD		5.733	4.793	0.000	0.230	1.421	1.175	0.114	2.960
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	-0.009	-0.217	0.611	9.700	848.400	851.200	11.300	0.660
2	15:37:58	0.029	-0.192	0.530	9.571	842.800	844.600	10.900	0.581
3	15:38:41	0.014	-0.166	0.506	9.687	845.000	841.800	10.860	0.664
x		0.011	-0.192	0.549	9.653	845.400	845.900	11.020	0.635
σ		0.019	0.026	0.055	0.071	2.830	4.855	0.246	0.047
%RSD		166.700	13.370	10.030	0.733	0.335	0.574	2.232	7.386
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	20.360	19.990	186.800	188.200	6.610	-0.001	5.413	5.572
2	15:37:58	19.830	19.970	183.500	186.500	6.648	-0.023	5.170	5.105
3	15:38:41	19.810	19.530	185.000	186.600	6.643	-0.025	5.212	5.514
x		20.000	19.830	185.100	187.100	6.634	-0.016	5.265	5.397
σ		0.314	0.259	1.667	0.927	0.021	0.013	0.130	0.254
%RSD		1.568	1.305	0.901	0.496	0.310	82.390	2.468	4.708
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	0.000	11.110	79.256%	1.384	1.354	79.612%	-0.012	0.286
2	15:37:58	0.000	11.380	80.603%	1.315	1.345	80.184%	-0.010	1.025
3	15:38:41	0.000	11.310	80.866%	1.356	1.367	80.401%	-0.002	1.030
x		0.000	11.260	80.241%	1.352	1.355	80.066%	-0.008	0.780
σ		0.000	0.142	0.863%	0.035	0.012	0.408%	0.006	0.428
%RSD		0.000	1.257	1.076	2.571	0.849	0.509	70.560	54.880
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:37:14	-0.007	3.893	3.977	81.165%	15.430	0.070	0.065	4.037
2	15:37:58	0.002	3.716	3.818	82.513%	15.450	0.068	0.060	4.101
3	15:38:41	-0.010	3.705	3.780	83.593%	15.400	0.056	0.057	4.198
x		-0.005	3.771	3.858	82.424%	15.430	0.065	0.061	4.112
σ		0.006	0.105	0.104	1.217%	0.026	0.007	0.004	0.081
%RSD		128.200	2.795	2.706	1.476	0.169	11.450	6.741	1.971
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	15:37:14	4.103	84.716%	84.868%	0.050	0.044	0.397	82.257%	
2	15:37:58	4.022	87.507%	88.038%	0.045	0.046	0.409	84.741%	
3	15:38:41	4.052	88.215%	88.914%	0.051	0.046	0.398	85.584%	
x		4.059	86.813%	87.273%	0.048	0.045	0.401	84.194%	
σ		0.041	1.850%	2.129%	0.003	0.001	0.007	1.730%	
%RSD		1.007	2.131	2.439	6.781	1.741	1.659	2.054	

CCV 993939 11/13/2013 3:41:19 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	86.822%	101.500	97.860	95.980	0.000	51280.000	50500.000	49790.000
2	15:42:45	85.253%	101.000	98.100	97.260	0.000	51400.000	51220.000	51120.000
3	15:43:28	83.070%	106.200	99.710	98.860	0.000	52000.000	51180.000	51070.000
x		85.048%	102.913%	98.557%	97.365%	0.000	103.117%	101.925%	101.316%
σ		1.884%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.215	2.775	1.021	1.482	0.000	0.745	0.794	1.484

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	485.600	5065.000	0.000	52170.000	51950.000	52580.000	77.051%	104.100
2	15:42:45	505.000	5182.000	0.000	52510.000	52490.000	53290.000	77.263%	102.800
3	15:43:28	507.900	5208.000	0.000	53470.000	52920.000	52900.000	77.649%	103.200
x		99.906%	103.041%	0.000	105.427%	104.909%	105.851%	77.321%	103.348%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.303%	n/a
%RSD		2.427	1.479	0.000	1.277	0.927	0.672	0.392	0.653

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	105.100	105.500	3.207	526.000	26660.000	26480.000	106.100	107.900
2	15:42:45	104.400	104.900	3.723	531.900	26570.000	26170.000	105.300	104.800
3	15:43:28	104.400	105.700	2.240	520.700	26300.000	26070.000	104.800	106.300
x		104.613%	105.354%	3.057	105.245%	106.034%	104.951%	105.412%	106.315%
σ		n/a	n/a	0.752	n/a	n/a	n/a	n/a	n/a
%RSD		0.363	0.434	24.620	1.071	0.715	0.826	0.642	1.439

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	108.300	108.100	107.300	107.800	106.600	-0.500	109.100	108.700
2	15:42:45	107.600	108.000	107.900	107.200	105.000	-0.391	107.800	106.800
3	15:43:28	106.600	106.200	106.700	107.500	105.900	-0.397	107.800	107.700
x		107.512%	107.446%	107.312%	107.498%	105.813%	-0.429	108.210%	107.742%
σ		n/a	n/a	n/a	n/a	n/a	0.062	n/a	n/a
%RSD		0.788	0.968	0.556	0.270	0.745	14.330	0.699	0.912

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	0.000	101.600	79.092%	102.200	103.200	75.422%	106.200	2.615
2	15:42:45	0.000	101.900	79.634%	103.800	105.200	76.122%	105.500	4.639
3	15:43:28	0.000	102.000	79.938%	104.200	106.000	75.717%	106.700	3.627
x		0.000	101.865%	79.554%	103.398%	104.793%	75.754%	106.153%	3.627
σ		0.000	n/a	0.428%	n/a	n/a	0.351%	n/a	1.012
%RSD		0.000	0.211	0.538	1.048	1.401	0.464	0.584	27.900

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	106.200	106.800	106.400	77.826%	102.100	101.700	101.700	104.700
2	15:42:45	105.900	106.700	106.700	78.492%	103.000	102.300	101.700	103.900
3	15:43:28	107.100	107.200	106.900	78.251%	102.700	102.700	101.900	104.500
x		106.416%	106.881%	106.679%	78.190%	102.597%	102.251%	101.765%	104.369%
σ		n/a	n/a	n/a	0.337%	n/a	n/a	n/a	n/a
%RSD		0.611	0.246	0.257	0.431	0.476	0.482	0.123	0.430

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:42:02	105.300	80.834%	81.221%	102.000	103.200	104.000	78.213%
2	15:42:45	104.900	81.436%	81.883%	102.400	104.400	105.500	78.503%
3	15:43:28	105.200	82.784%	82.733%	103.400	105.000	106.200	78.386%
x		105.128%	81.685%	81.946%	102.599%	104.197%	105.222%	78.367%
σ		n/a	0.998%	0.758%	n/a	n/a	n/a	0.146%
%RSD		0.172	1.222	0.925	0.675	0.862	1.074	0.186

CCB5 11/13/2013 3:49:29 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	104.024%	-0.044	3.806	3.249	0.000	5.634	0.881	0.799
2	15:50:55	102.688%	-0.108	2.902	3.341	0.000	5.443	0.771	0.676
3	15:51:38	101.826%	-0.075	3.001	3.033	0.000	5.328	0.417	0.740
x		102.846%	-0.075	3.236	3.208	0.000	5.468	0.690	0.738
σ		1.107%	0.032	0.496	0.158	0.000	0.154	0.243	0.061
%RSD		1.077	42.570	15.330	4.925	0.000	2.823	35.190	8.306
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	0.221	-0.400	0.000	1.881	-1.744	-0.272	96.589%	-0.030
2	15:50:55	0.116	-0.220	0.000	0.535	-0.030	0.232	96.901%	0.028
3	15:51:38	0.130	-0.192	0.000	0.849	1.712	-0.466	96.547%	-0.003
x		0.156	-0.271	0.000	1.088	-0.021	-0.169	96.679%	-0.002
σ		0.057	0.113	0.000	0.704	1.728	0.361	0.193%	0.029
%RSD		36.820	41.660	0.000	64.720	8428.000	213.800	0.200	1724.000
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	0.014	0.010	0.016	0.022	5.339	2.342	0.002	0.013
2	15:50:55	-0.022	-0.004	0.072	0.019	3.399	1.611	0.002	-0.004
3	15:51:38	-0.004	0.006	0.032	0.018	3.237	0.761	0.001	-0.005
x		-0.004	0.004	0.040	0.020	3.992	1.571	0.001	0.001
σ		0.018	0.007	0.029	0.002	1.170	0.791	0.001	0.010
%RSD		470.600	191.000	71.610	9.571	29.310	50.340	51.620	778.700
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	0.069	-0.002	0.067	0.098	0.065	-0.006	0.128	0.300
2	15:50:55	0.081	-0.003	0.077	0.086	-0.008	0.002	0.221	-0.024
3	15:51:38	0.077	-0.002	0.130	0.144	0.014	-0.001	0.079	0.023
x		0.076	-0.002	0.091	0.109	0.024	-0.001	0.142	0.100
σ		0.006	0.000	0.034	0.030	0.037	0.004	0.072	0.175
%RSD		8.082	19.540	36.720	27.810	156.800	270.100	50.740	175.700
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	0.000	0.012	93.193%	0.143	0.153	95.359%	-0.049	-0.031
2	15:50:55	0.000	0.012	93.930%	0.136	0.126	96.896%	-0.047	0.512
3	15:51:38	0.000	0.012	95.627%	0.117	0.114	97.254%	-0.043	0.516
x		0.000	0.012	94.250%	0.132	0.131	96.503%	-0.046	0.332
σ		0.000	0.000	1.248%	0.014	0.020	1.007%	0.003	0.315
%RSD		0.000	1.334	1.325	10.400	14.910	1.044	6.720	94.750
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:12	-0.041	0.003	0.005	93.790%	0.123	0.020	0.021	0.010
2	15:50:55	-0.040	-0.034	-0.023	94.941%	0.108	0.018	0.021	0.012
3	15:51:38	-0.038	-0.037	-0.025	95.979%	0.077	0.014	0.025	0.015
x		-0.040	-0.023	-0.014	94.903%	0.103	0.018	0.022	0.013
σ		0.002	0.023	0.016	1.095%	0.023	0.003	0.002	0.003
%RSD		5.000	100.100	114.500	1.154	22.690	17.050	9.011	20.520
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	15:50:12	0.013	91.456%	91.521%	0.004	0.006	0.000	94.006%	
2	15:50:55	0.012	94.573%	94.080%	0.004	0.003	0.000	94.872%	
3	15:51:38	0.021	95.127%	94.505%	0.005	0.005	0.002	95.091%	
x		0.015	93.718%	93.369%	0.004	0.005	0.001	94.656%	
σ		0.005	1.979%	1.614%	0.000	0.001	0.001	0.574%	
%RSD		32.920	2.112	1.729	7.047	28.730	109.600	0.606	

180-26836-A-4-D 11/13/2013 3:54:19 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	92.628%	-0.034	6.908	6.590	0.000	7167.000	1622.000	1632.000
2	15:55:44	90.065%	-0.002	6.699	6.866	0.000	7170.000	1627.000	1640.000
3	15:56:27	85.870%	-0.095	6.045	6.853	0.000	7395.000	1693.000	1700.000
x		89.521%	-0.044	6.551	6.770	0.000	7244.000	1647.000	1657.000
σ		3.412%	0.047	0.450	0.156	0.000	130.700	39.730	37.220
%RSD		3.811	107.900	6.868	2.297	0.000	1.804	2.412	2.246

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	360.500	303.100	0.000	14590.000	6470.000	6190.000	85.466%	41.250
2	15:55:44	359.400	304.200	0.000	14290.000	6614.000	6123.000	84.295%	40.320
3	15:56:27	369.700	308.300	0.000	14580.000	6610.000	6276.000	83.324%	40.400
x		363.200	305.200	0.000	14490.000	6565.000	6196.000	84.361%	40.660
σ		5.644	2.720	0.000	166.000	82.160	77.020	1.073%	0.517
%RSD		1.554	0.891	0.000	1.146	1.252	1.243	1.271	1.272

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	1.692	0.387	0.440	29.720	1769.000	1739.000	12.340	3.462
2	15:55:44	1.671	0.415	0.429	29.860	1756.000	1741.000	12.460	3.455
3	15:56:27	1.652	0.403	0.534	30.240	1787.000	1752.000	12.390	3.582
x		1.672	0.402	0.468	29.940	1771.000	1744.000	12.400	3.500
σ		0.020	0.014	0.057	0.266	15.600	7.124	0.063	0.071
%RSD		1.212	3.553	12.250	0.887	0.881	0.408	0.511	2.034

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	120.100	121.100	227.700	228.700	128.700	-0.029	5.731	5.701
2	15:55:44	119.600	120.000	226.700	229.000	128.500	-0.018	5.623	5.885
3	15:56:27	120.300	120.500	227.700	230.800	127.500	-0.023	5.550	6.092
x		120.000	120.500	227.400	229.500	128.200	-0.023	5.635	5.892
σ		0.399	0.551	0.589	1.169	0.646	0.005	0.091	0.196
%RSD		0.333	0.457	0.259	0.509	0.504	21.570	1.616	3.324

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	0.000	37.260	83.355%	3.781	3.722	83.781%	0.387	0.616
2	15:55:44	0.000	37.350	84.215%	3.633	3.635	84.093%	0.373	1.131
3	15:56:27	0.000	37.230	85.351%	3.771	3.702	84.891%	0.374	0.864
x		0.000	37.280	84.307%	3.728	3.686	84.255%	0.378	0.870
σ		0.000	0.063	1.001%	0.082	0.046	0.572%	0.008	0.258
%RSD		0.000	0.168	1.187	2.210	1.235	0.679	2.014	29.590

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	0.380	3.800	3.898	84.635%	14.750	3.315	3.283	13.710
2	15:55:44	0.380	3.797	3.819	85.873%	14.900	3.338	3.329	14.230
3	15:56:27	0.369	3.972	3.803	86.137%	14.810	3.393	3.347	13.960
x		0.376	3.856	3.840	85.549%	14.820	3.349	3.320	13.970
σ		0.006	0.100	0.050	0.802%	0.079	0.040	0.033	0.257
%RSD		1.642	2.601	1.313	0.937	0.530	1.203	1.002	1.841

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:01	14.230	87.343%	87.679%	0.309	0.330	10.060	85.100%
2	15:55:44	13.920	90.104%	89.694%	0.331	0.322	10.250	86.481%
3	15:56:27	13.830	90.143%	90.300%	0.315	0.324	10.230	87.329%
x		13.990	89.197%	89.224%	0.318	0.326	10.180	86.303%
σ		0.209	1.606%	1.372%	0.011	0.004	0.102	1.125%
%RSD		1.491	1.800	1.538	3.577	1.323	1.006	1.304

180-26836-A-4-D SD@5 11/13/2013 3:59:05 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	90.950%	-0.076	3.513	3.136	0.000	1487.000	335.100	335.300
2	16:00:31	89.754%	-0.094	2.847	2.727	0.000	1456.000	338.000	331.700
3	16:01:14	90.989%	-0.047	2.615	2.573	0.000	1436.000	329.300	331.000
x		90.564%	-0.073	2.991	2.812	0.000	1460.000	334.100	332.700
σ		0.702%	0.024	0.466	0.291	0.000	25.870	4.393	2.290
%RSD		0.775	32.730	15.570	10.340	0.000	1.772	1.315	0.689

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	75.880	62.260	0.000	2976.000	1288.000	1263.000	87.847%	9.067
2	16:00:31	72.920	61.130	0.000	2956.000	1254.000	1259.000	86.658%	8.503
3	16:01:14	72.840	59.540	0.000	2916.000	1307.000	1246.000	86.840%	8.087
x		73.880	60.980	0.000	2949.000	1283.000	1256.000	87.115%	8.552
σ		1.732	1.369	0.000	30.770	26.760	9.319	0.640%	0.492
%RSD		2.345	2.245	0.000	1.043	2.086	0.742	0.735	5.750

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	0.263	0.048	0.140	5.893	366.400	350.400	2.461	0.710
2	16:00:31	0.302	0.080	0.083	5.967	367.500	347.800	2.409	0.630
3	16:01:14	0.282	0.075	0.097	5.980	361.600	351.900	2.485	0.668
x		0.282	0.068	0.107	5.946	365.200	350.000	2.451	0.669
σ		0.020	0.017	0.030	0.047	3.151	2.098	0.039	0.040
%RSD		6.942	25.340	27.950	0.790	0.863	0.599	1.591	5.948

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	25.540	24.900	51.920	52.140	28.350	-0.003	1.429	1.199
2	16:00:31	25.020	24.850	51.500	51.560	28.600	-0.003	1.405	1.519
3	16:01:14	25.030	24.580	51.900	51.820	28.270	0.005	1.188	1.086
x		25.200	24.780	51.770	51.840	28.400	-0.000	1.341	1.268
σ		0.295	0.170	0.236	0.293	0.171	0.004	0.133	0.225
%RSD		1.172	0.686	0.456	0.565	0.600	1170.000	9.929	17.720

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	0.000	7.398	87.350%	0.715	0.787	88.101%	0.024	0.954
2	16:00:31	0.000	7.326	87.757%	0.787	0.746	88.684%	0.028	1.073
3	16:01:14	0.000	7.346	88.108%	0.703	0.745	88.906%	0.033	1.229
x		0.000	7.356	87.738%	0.735	0.759	88.564%	0.029	1.085
σ		0.000	0.037	0.380%	0.045	0.024	0.416%	0.004	0.138
%RSD		0.000	0.504	0.433	6.154	3.213	0.469	15.060	12.690

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	0.024	0.731	0.771	88.661%	2.896	0.672	0.691	2.670
2	16:00:31	0.036	0.750	0.778	89.140%	2.851	0.678	0.702	2.656
3	16:01:14	0.025	0.699	0.754	90.140%	2.955	0.722	0.701	2.553
x		0.029	0.727	0.768	89.314%	2.900	0.691	0.698	2.626
σ		0.006	0.026	0.013	0.755%	0.052	0.028	0.006	0.064
%RSD		22.730	3.551	1.649	0.845	1.799	3.983	0.854	2.433

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:59:48	2.486	89.273%	88.455%	0.056	0.062	1.951	89.798%
2	16:00:31	2.653	90.030%	90.788%	0.059	0.059	1.967	90.802%
3	16:01:14	2.517	91.189%	91.479%	0.058	0.059	1.975	91.339%
x		2.552	90.164%	90.241%	0.058	0.060	1.964	90.646%
σ		0.089	0.965%	1.585%	0.001	0.001	0.012	0.782%
%RSD		3.479	1.071	1.756	2.187	2.395	0.630	0.863

180-26836-A-4-D PDS 11/13/2013 4:03:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	81.331%	48.750	958.100	953.000	0.000	58960.000	52930.000	52670.000
2	16:05:17	80.237%	48.830	959.300	930.800	0.000	58950.000	54270.000	53520.000
3	16:06:00	79.065%	48.890	973.600	953.900	0.000	59650.000	53780.000	53570.000
x		80.211%	48.820	963.700	945.900	0.000	59190.000	53660.000	53250.000
σ		1.133%	0.067	8.657	13.090	0.000	400.500	676.400	506.500
%RSD		1.413	0.138	0.898	1.384	0.000	0.677	1.261	0.951

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	2397.000	10280.000	0.000	65190.000	57310.000	57970.000	79.891%	1036.000
2	16:05:17	2420.000	10260.000	0.000	65550.000	59080.000	58960.000	77.869%	1050.000
3	16:06:00	2450.000	10380.000	0.000	65050.000	58100.000	58800.000	77.455%	1043.000
x		2423.000	10310.000	0.000	65260.000	58160.000	58580.000	78.405%	1043.000
σ		26.560	66.540	0.000	256.300	885.800	531.900	1.304%	6.719
%RSD		1.096	0.646	0.000	0.393	1.523	0.908	1.663	0.644

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	539.600	207.300	7.747	544.600	2762.000	2883.000	542.200	518.600
2	16:05:17	550.600	210.500	6.372	546.800	2736.000	2862.000	542.000	521.200
3	16:06:00	543.100	208.300	6.374	553.300	2767.000	2868.000	543.700	523.000
x		544.400	208.700	6.831	548.200	2755.000	2871.000	542.600	520.900
σ		5.611	1.644	0.793	4.532	16.750	11.040	0.946	2.231
%RSD		1.031	0.787	11.610	0.827	0.608	0.385	0.174	0.428

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	372.500	378.000	675.700	676.700	160.900	-0.051	14.490	13.930
2	16:05:17	373.500	374.900	683.400	682.900	161.600	-0.047	14.320	14.560
3	16:06:00	377.700	374.900	684.100	684.300	161.100	-0.058	14.610	15.000
x		374.600	375.900	681.100	681.300	161.200	-0.052	14.470	14.500
σ		2.750	1.797	4.671	4.054	0.362	0.006	0.146	0.533
%RSD		0.734	0.478	0.686	0.595	0.225	10.660	1.012	3.677

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	0.000	1071.000	78.098%	1041.000	1066.000	75.474%	51.950	15.530
2	16:05:17	0.000	1069.000	78.325%	1045.000	1083.000	75.791%	52.130	14.250
3	16:06:00	0.000	1082.000	77.504%	1023.000	1080.000	75.071%	52.250	11.690
x		0.000	1074.000	77.976%	1036.000	1076.000	75.446%	52.110	13.820
σ		0.000	6.983	0.424%	11.760	8.891	0.361%	0.151	1.959
%RSD		0.000	0.650	0.543	1.135	0.826	0.478	0.289	14.170

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	52.050	52.960	47.330	78.029%	2083.000	477.800	476.300	923.100
2	16:05:17	52.180	53.540	47.120	77.952%	2098.000	485.700	482.800	519.600
3	16:06:00	52.370	53.350	47.480	77.916%	2085.000	484.700	482.300	319.400
x		52.200	53.280	47.310	77.965%	2089.000	482.700	480.400	587.400
σ		0.162	0.299	0.181	0.058%	8.335	4.277	3.628	307.500
%RSD		0.310	0.561	0.383	0.074	0.399	0.886	0.755	52.350

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:04:34	2149.000	81.906%	81.960%	52.850	53.540	31.400	76.776%
2	16:05:17	2148.000	83.827%	84.248%	53.450	54.180	31.880	77.504%
3	16:06:00	2150.000	83.598%	84.007%	53.490	54.380	31.950	77.581%
x		2149.000	83.110%	83.405%	53.260	54.030	31.740	77.287%
σ		1.058	1.049%	1.257%	0.360	0.441	0.297	0.445%
%RSD		0.049	1.262	1.507	0.675	0.817	0.936	0.575

MB 180-89487/1-A 11/13/2013 4:12:42 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	82.550%	-0.093	6.345	6.652	0.000	21.220	8.972	9.241
2	16:14:08	79.988%	-0.100	5.915	5.902	0.000	21.760	9.513	8.817
3	16:14:52	79.698%	-0.056	5.350	5.767	0.000	21.110	9.398	8.557
x		80.746%	-0.083	5.870	6.107	0.000	21.360	9.295	8.872
σ		1.570%	0.024	0.499	0.476	0.000	0.351	0.285	0.345
%RSD		1.944	28.950	8.505	7.801	0.000	1.642	3.066	3.891

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	5.292	5.101	0.000	13.040	27.900	33.570	78.619%	0.102
2	16:14:08	5.444	5.900	0.000	12.800	46.270	33.110	78.170%	0.147
3	16:14:52	5.457	5.167	0.000	11.360	41.840	32.560	78.490%	0.064
x		5.398	5.389	0.000	12.400	38.670	33.080	78.426%	0.104
σ		0.092	0.444	0.000	0.907	9.586	0.502	0.231%	0.042
%RSD		1.699	8.232	0.000	7.312	24.790	1.519	0.294	40.010

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	0.001	0.592	6.547	0.265	27.430	27.440	0.017	0.322
2	16:14:08	-0.035	0.589	6.662	0.261	25.880	27.290	0.018	0.321
3	16:14:52	0.107	0.604	6.332	0.254	26.380	26.230	0.020	0.355
x		0.024	0.595	6.514	0.260	26.560	26.990	0.018	0.333
σ		0.074	0.008	0.168	0.005	0.791	0.660	0.001	0.020
%RSD		303.500	1.302	2.576	1.994	2.978	2.445	6.430	5.941

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	1.004	0.858	1.092	1.187	-0.050	0.138	-0.150	-0.198
2	16:14:08	0.929	0.867	1.098	1.197	0.048	0.126	-0.133	0.265
3	16:14:52	0.918	0.872	0.991	0.980	0.015	0.125	-0.181	-0.054
x		0.950	0.866	1.060	1.121	0.005	0.130	-0.155	0.004
σ		0.047	0.007	0.060	0.122	0.050	0.007	0.024	0.237
%RSD		4.922	0.813	5.643	10.910	1094.000	5.559	15.780	5587.000

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	0.000	0.088	80.729%	0.353	0.364	81.600%	-0.052	0.057
2	16:14:08	0.000	0.095	80.891%	0.383	0.372	81.938%	-0.050	1.200
3	16:14:52	0.000	0.099	80.639%	0.309	0.319	81.381%	-0.055	1.078
x		0.000	0.094	80.753%	0.348	0.352	81.640%	-0.052	0.778
σ		0.000	0.005	0.128%	0.037	0.029	0.281%	0.003	0.627
%RSD		0.000	5.581	0.158	10.590	8.245	0.344	4.906	80.600

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	-0.045	-0.007	-0.035	83.434%	6.010	0.339	0.322	0.275
2	16:14:08	-0.044	-0.094	-0.097	84.363%	5.847	0.277	0.299	0.331
3	16:14:52	-0.043	-0.083	-0.075	83.587%	5.668	0.233	0.237	0.310
x		-0.044	-0.061	-0.069	83.795%	5.842	0.283	0.286	0.305
σ		0.001	0.047	0.031	0.498%	0.171	0.053	0.044	0.029
%RSD		2.037	77.350	45.620	0.595	2.922	18.890	15.410	9.341

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:13:26	0.308	87.261%	87.694%	0.002	0.001	0.104	88.977%
2	16:14:08	0.299	88.896%	89.203%	0.001	0.001	0.100	90.277%
3	16:14:52	0.268	88.799%	89.337%	0.002	0.001	0.100	90.617%
x		0.291	88.318%	88.745%	0.002	0.001	0.101	89.957%
σ		0.021	0.917%	0.912%	0.001	0.000	0.002	0.866%
%RSD		7.186	1.038	1.028	46.470	24.180	2.314	0.962

MB 180-89489/1-A 11/13/2013 4:17:30 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	90.089%	-0.094	4.277	4.226	0.000	12.900	6.623	6.484
2	16:19:00	86.553%	-0.100	4.483	4.097	0.000	13.590	6.086	6.272
3	16:19:43	86.904%	-0.025	4.018	3.869	0.000	12.790	6.540	6.022
x		87.849%	-0.073	4.259	4.064	0.000	13.090	6.417	6.259
σ		1.948%	0.041	0.233	0.180	0.000	0.435	0.289	0.231
%RSD		2.218	56.580	5.474	4.440	0.000	3.319	4.508	3.697

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	2.319	3.129	0.000	6.307	24.660	20.570	84.578%	0.028
2	16:19:00	2.496	3.399	0.000	6.052	23.320	23.010	84.303%	0.054
3	16:19:43	2.347	3.073	0.000	6.169	24.690	21.650	84.647%	0.058
x		2.388	3.200	0.000	6.176	24.220	21.740	84.509%	0.047
σ		0.095	0.174	0.000	0.128	0.782	1.222	0.182%	0.016
%RSD		3.989	5.443	0.000	2.070	3.228	5.622	0.215	35.010

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	0.004	0.144	0.177	0.175	12.370	11.300	0.011	0.236
2	16:19:00	0.005	0.140	0.152	0.176	12.060	10.980	0.009	0.259
3	16:19:43	0.006	0.129	0.125	0.165	11.320	10.380	0.008	0.231
x		0.005	0.138	0.151	0.172	11.920	10.890	0.009	0.242
σ		0.001	0.008	0.026	0.006	0.537	0.467	0.001	0.015
%RSD		22.780	5.651	16.970	3.300	4.504	4.294	11.800	6.179

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	1.317	1.205	1.237	1.406	0.011	0.004	0.091	0.034
2	16:19:00	1.384	1.286	1.363	1.366	0.065	-0.004	-0.059	0.232
3	16:19:43	1.363	1.302	1.295	1.374	0.045	-0.002	-0.194	0.095
x		1.355	1.265	1.298	1.382	0.040	-0.001	-0.054	0.120
σ		0.035	0.052	0.063	0.022	0.028	0.004	0.143	0.101
%RSD		2.551	4.114	4.858	1.568	68.410	620.300	262.900	84.160

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	0.000	0.068	84.082%	0.108	0.096	85.418%	-0.050	0.496
2	16:19:00	0.000	0.070	85.437%	0.084	0.083	86.404%	-0.051	0.610
3	16:19:43	0.000	0.066	85.859%	0.102	0.088	86.371%	-0.054	0.785
x		0.000	0.068	85.126%	0.098	0.089	86.065%	-0.052	0.630
σ		0.000	0.002	0.928%	0.012	0.007	0.560%	0.002	0.145
%RSD		0.000	3.457	1.090	12.640	7.323	0.651	3.221	23.090

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	-0.051	-0.034	-0.038	85.699%	4.462	0.112	0.095	0.210
2	16:19:00	-0.050	-0.046	-0.037	87.142%	4.407	0.077	0.098	0.191
3	16:19:43	-0.051	-0.060	-0.052	88.072%	4.429	0.072	0.084	0.200
x		-0.051	-0.047	-0.042	86.971%	4.433	0.087	0.092	0.200
σ		0.001	0.013	0.008	1.195%	0.027	0.022	0.008	0.010
%RSD		1.114	27.780	19.870	1.374	0.617	24.920	8.169	4.845

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:18:12	0.215	88.340%	88.017%	0.001	0.001	0.073	90.045%
2	16:19:00	0.209	90.525%	90.244%	0.002	0.002	0.073	91.878%
3	16:19:43	0.198	91.136%	91.332%	0.001	0.001	0.069	91.883%
x		0.207	90.000%	89.864%	0.001	0.001	0.072	91.269%
σ		0.008	1.470%	1.690%	0.001	0.001	0.003	1.060%
%RSD		4.096	1.633	1.881	53.800	56.080	3.529	1.161

LCS 180-89487/2-A 11/13/2013 4:27:35 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	64.781%	46.630	903.900	900.900	0.000	49670.000	51450.000	51050.000
2	16:29:01	62.768%	46.340	934.100	922.300	0.000	50200.000	52780.000	51860.000
3	16:29:44	62.233%	47.230	927.000	921.600	0.000	49910.000	52570.000	51040.000
x		63.260%	46.730	921.700	914.900	0.000	49920.000	52260.000	51320.000
σ		1.344%	0.455	15.790	12.190	0.000	263.500	714.000	470.000
%RSD		2.124	0.973	1.713	1.332	0.000	0.528	1.366	0.916

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	2029.000	5228.000	0.000	46740.000	48700.000	49640.000	68.681%	939.000
2	16:29:01	2053.000	5226.000	0.000	46860.000	49380.000	50440.000	67.672%	946.100
3	16:29:44	2018.000	5199.000	0.000	47160.000	49240.000	49990.000	68.009%	945.000
x		2033.000	5218.000	0.000	46920.000	49110.000	50020.000	68.120%	943.300
σ		17.780	16.170	0.000	215.300	358.500	399.900	0.513%	3.826
%RSD		0.875	0.310	0.000	0.459	0.730	0.799	0.754	0.406

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	489.200	188.600	40.390	478.700	1064.000	1195.000	474.900	465.400
2	16:29:01	493.100	190.400	40.390	478.800	1058.000	1176.000	479.800	471.700
3	16:29:44	483.600	187.500	39.690	479.900	1061.000	1171.000	467.000	464.400
x		488.600	188.800	40.160	479.100	1061.000	1181.000	473.900	467.100
σ		4.770	1.479	0.405	0.633	2.936	12.560	6.471	3.946
%RSD		0.976	0.783	1.008	0.132	0.277	1.064	1.366	0.845

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	244.700	249.400	445.100	447.000	34.040	0.853	8.511	9.121
2	16:29:01	245.100	249.900	447.500	448.700	34.170	0.860	8.057	9.140
3	16:29:44	241.700	247.600	446.200	446.600	34.730	0.824	8.339	8.634
x		243.800	249.000	446.300	447.400	34.310	0.846	8.303	8.965
σ		1.888	1.218	1.181	1.074	0.364	0.019	0.229	0.287
%RSD		0.774	0.489	0.265	0.240	1.062	2.289	2.759	3.200

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	0.000	1061.000	66.661%	1010.000	1029.000	68.217%	49.840	14.380
2	16:29:01	0.000	1046.000	66.917%	1009.000	1022.000	67.932%	48.810	11.550
3	16:29:44	0.000	1055.000	66.980%	1004.000	1026.000	68.654%	49.120	13.120
x		0.000	1054.000	66.853%	1008.000	1026.000	68.268%	49.260	13.020
σ		0.000	7.466	0.169%	3.517	3.587	0.364%	0.529	1.421
%RSD		0.000	0.708	0.253	0.349	0.350	0.533	1.074	10.920

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	49.340	47.310	41.290	73.600%	1964.000	450.000	450.000	1286.000
2	16:29:01	48.780	47.890	40.810	74.509%	1953.000	447.500	447.700	1027.000
3	16:29:44	49.180	47.380	41.090	73.932%	1961.000	449.600	451.500	971.200
x		49.100	47.530	41.060	74.014%	1959.000	449.000	449.700	1095.000
σ		0.291	0.317	0.241	0.460%	5.965	1.371	1.935	167.900
%RSD		0.594	0.666	0.586	0.621	0.304	0.305	0.430	15.340

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:28:18	1961.000	85.194%	86.502%	49.080	50.200	20.720	80.810%
2	16:29:01	1952.000	86.123%	87.591%	49.600	50.850	20.870	81.115%
3	16:29:44	1956.000	85.077%	87.338%	49.690	50.960	21.020	80.781%
x		1957.000	85.465%	87.144%	49.460	50.670	20.870	80.902%
σ		4.297	0.573%	0.570%	0.329	0.413	0.150	0.185%
%RSD		0.220	0.671	0.654	0.665	0.815	0.720	0.229

LCS 180-89489/2-A 11/13/2013 4:32:23 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	83.134%	44.710	873.500	850.000	0.000	47290.000	46800.000	46820.000
2	16:33:49	78.781%	44.640	871.100	849.300	0.000	46540.000	47500.000	47680.000
3	16:34:32	78.508%	43.470	867.200	858.900	0.000	47320.000	47650.000	47220.000
x		80.141%	44.270	870.600	852.700	0.000	47050.000	47320.000	47240.000
σ		2.595%	0.698	3.191	5.388	0.000	441.900	455.100	432.300
%RSD		3.239	1.576	0.366	0.632	0.000	0.939	0.962	0.915

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	1917.000	5924.000	0.000	47670.000	48200.000	47850.000	76.336%	937.600
2	16:33:49	1933.000	5929.000	0.000	47210.000	47740.000	47990.000	75.026%	937.400
3	16:34:32	1924.000	5934.000	0.000	47310.000	47820.000	48220.000	75.344%	934.900
x		1925.000	5929.000	0.000	47400.000	47920.000	48020.000	75.569%	936.600
σ		8.327	4.722	0.000	239.100	246.200	184.100	0.684%	1.492
%RSD		0.433	0.080	0.000	0.504	0.514	0.383	0.905	0.159

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	497.500	194.500	6.849	482.000	1108.000	1247.000	502.700	492.800
2	16:33:49	501.200	194.100	6.544	482.300	1093.000	1229.000	492.700	489.000
3	16:34:32	501.300	193.500	7.578	482.900	1074.000	1226.000	491.500	481.800
x		500.000	194.000	6.990	482.400	1092.000	1234.000	495.600	487.900
σ		2.199	0.465	0.531	0.461	17.110	11.060	6.176	5.590
%RSD		0.440	0.240	7.603	0.096	1.567	0.896	1.246	1.146

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	252.700	253.400	439.400	439.600	34.270	-0.010	8.061	8.417
2	16:33:49	249.500	250.900	439.800	440.900	33.990	-0.023	8.158	9.343
3	16:34:32	246.100	250.200	434.800	438.500	34.090	-0.042	8.106	9.148
x		249.400	251.500	438.000	439.700	34.110	-0.025	8.109	8.969
σ		3.299	1.705	2.780	1.233	0.141	0.016	0.048	0.488
%RSD		1.323	0.678	0.635	0.280	0.413	63.790	0.597	5.443

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	0.000	1032.000	69.025%	992.800	1002.000	72.137%	47.570	15.230
2	16:33:49	0.000	1025.000	68.998%	990.900	1006.000	72.326%	46.780	15.750
3	16:34:32	0.000	1019.000	69.866%	984.600	1005.000	72.328%	47.370	14.270
x		0.000	1025.000	69.296%	989.500	1004.000	72.264%	47.240	15.080
σ		0.000	6.502	0.493%	4.282	1.971	0.110%	0.410	0.752
%RSD		0.000	0.634	0.712	0.433	0.196	0.152	0.869	4.984

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	47.530	45.040	40.000	74.706%	1915.000	435.300	431.800	1415.000
2	16:33:49	47.300	44.810	40.070	74.989%	1918.000	435.900	433.900	1458.000
3	16:34:32	47.270	44.750	40.280	75.748%	1901.000	432.900	431.000	1215.000
x		47.370	44.870	40.120	75.148%	1911.000	434.700	432.200	1363.000
σ		0.139	0.155	0.146	0.539%	8.762	1.552	1.522	129.600
%RSD		0.293	0.345	0.364	0.717	0.458	0.357	0.352	9.514

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:33:06	1933.000	78.753%	79.654%	48.680	49.710	20.140	72.639%
2	16:33:49	1939.000	80.408%	81.106%	48.910	49.730	20.270	74.122%
3	16:34:32	1929.000	81.280%	81.881%	48.850	49.440	20.130	75.096%
x		1934.000	80.147%	80.880%	48.810	49.630	20.180	73.953%
σ		5.129	1.284%	1.130%	0.118	0.161	0.077	1.237%
%RSD		0.265	1.602	1.398	0.242	0.324	0.383	1.673

180-26373-C-2-B 11/13/2013 4:40:31 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	63.109%	2.913	128.500	129.100	0.000	50270.000	38760.000	38810.000
2	16:41:57	57.818%	3.329	130.500	127.600	0.000	51560.000	40390.000	39590.000
3	16:42:40	55.831%	2.958	129.600	132.300	0.000	51500.000	40940.000	40040.000
x		58.919%	3.067	129.600	129.700	0.000	51110.000	40030.000	39480.000
σ		3.762%	0.228	1.013	2.394	0.000	730.900	1131.000	622.000
%RSD		6.385	7.443	0.782	1.847	0.000	1.430	2.826	1.575
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	59080.000	3039.000	0.000	14480.000	131300.000	134400.000	61.755%	2477.000
2	16:41:57	59530.000	2993.000	0.000	14420.000	133500.000	134800.000	59.553%	2505.000
3	16:42:40	60650.000	3039.000	0.000	14230.000	132300.000	135900.000	59.556%	2499.000
x		59750.000	3024.000	0.000	14380.000	132400.000	135000.000	60.288%	2493.000
σ		809.300	26.630	0.000	128.000	1126.000	800.400	1.270%	14.730
%RSD		1.354	0.881	0.000	0.890	0.850	0.593	2.107	0.591
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	179.100	143.100	30.850	1394.000	119700.000	119800.000	43.120	80.370
2	16:41:57	176.800	141.800	31.960	1417.000	119900.000	120800.000	42.800	80.310
3	16:42:40	176.300	140.700	30.280	1396.000	117100.000	119300.000	42.100	78.400
x		177.400	141.900	31.030	1402.000	118900.000	120000.000	42.670	79.690
σ		1.473	1.202	0.858	12.550	1541.000	727.500	0.524	1.120
%RSD		0.830	0.848	2.764	0.895	1.296	0.606	1.227	1.405
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	61.200	62.450	530.400	533.100	34.870	1.085	1.772	3.646
2	16:41:57	61.590	62.600	534.700	539.900	36.260	1.080	1.502	4.433
3	16:42:40	60.440	62.270	532.600	536.000	35.760	1.066	1.744	3.440
x		61.080	62.440	532.600	536.300	35.630	1.077	1.672	3.840
σ		0.584	0.165	2.182	3.444	0.701	0.010	0.148	0.524
%RSD		0.956	0.264	0.410	0.642	1.968	0.899	8.875	13.650
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	0.000	454.300	0.000	4.661	4.742	64.610%	0.352	-5.920
2	16:41:57	0.000	464.000	0.000	4.424	4.365	64.258%	0.343	-6.182
3	16:42:40	0.000	461.700	0.000	4.286	4.263	64.355%	0.354	-5.934
x		0.000	460.000	0.000	4.457	4.456	64.408%	0.349	-6.012
σ		0.000	5.029	0.000	0.190	0.252	0.182%	0.006	0.148
%RSD		0.000	1.093	0.000	4.260	5.661	0.282	1.655	2.458
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:41:14	0.314	1.781	1.450	70.092%	32.130	0.912	0.900	161.100
2	16:41:57	0.324	1.706	1.496	70.810%	30.540	0.835	0.913	161.100
3	16:42:40	0.307	1.793	1.510	71.672%	29.710	0.814	0.878	161.400
x		0.315	1.760	1.485	70.858%	30.790	0.853	0.897	161.200
σ		0.009	0.047	0.032	0.792%	1.230	0.052	0.018	0.154
%RSD		2.760	2.683	2.127	1.117	3.996	6.057	1.982	0.095
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	16:41:14	157.700	82.961%	83.615%	0.958	0.952	92.480	73.733%	
2	16:41:57	158.600	84.865%	85.975%	0.965	0.950	92.950	76.019%	
3	16:42:40	159.400	86.872%	87.835%	0.947	0.971	93.170	77.666%	
x		158.600	84.899%	85.809%	0.957	0.958	92.870	75.806%	
σ		0.865	1.956%	2.115%	0.009	0.011	0.352	1.975%	
%RSD		0.545	2.304	2.464	0.941	1.188	0.379	2.606	

180-26373-C-3-B 11/13/2013 4:45:19 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	61.129%	4.281	170.200	172.300	0.000	71910.000	74120.000	72970.000
2	16:46:45	59.072%	4.284	168.500	169.500	0.000	72230.000	74970.000	73280.000
3	16:47:28	59.096%	4.024	162.100	167.800	0.000	72080.000	74760.000	73320.000
x		59.766%	4.196	166.900	169.900	0.000	72070.000	74620.000	73190.000
σ		1.181%	0.149	4.283	2.303	0.000	158.500	442.000	193.000
%RSD		1.976	3.556	2.565	1.356	0.000	0.220	0.592	0.264
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	99620.000	3032.000	0.000	19750.000	101000.000	103400.000	71.873%	4452.000
2	16:46:45	101700.000	3037.000	0.000	19740.000	101400.000	103200.000	70.749%	4435.000
3	16:47:28	99380.000	3063.000	0.000	19570.000	100700.000	102200.000	71.499%	4346.000
x		100200.000	3044.000	0.000	19690.000	101000.000	102900.000	71.374%	4411.000
σ		1262.000	16.800	0.000	99.030	355.700	654.800	0.572%	56.840
%RSD		1.259	0.552	0.000	0.503	0.352	0.636	0.801	1.289
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	265.200	220.200	38.740	1818.000	166400.000	170500.000	57.050	136.600
2	16:46:45	261.600	217.700	38.910	1813.000	165200.000	169100.000	56.970	137.100
3	16:47:28	256.000	213.700	38.250	1756.000	161100.000	164900.000	55.920	134.300
x		260.900	217.200	38.630	1795.000	164200.000	168200.000	56.650	136.000
σ		4.613	3.283	0.341	34.540	2794.000	2883.000	0.631	1.468
%RSD		1.768	1.512	0.884	1.924	1.701	1.715	1.114	1.079
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	70.640	73.250	477.000	481.300	46.840	1.174	2.517	6.066
2	16:46:45	70.290	72.180	480.100	481.000	45.990	1.246	2.716	5.885
3	16:47:28	69.140	71.520	474.500	476.400	45.770	1.202	2.683	5.768
x		70.020	72.320	477.200	479.600	46.200	1.207	2.638	5.906
σ		0.783	0.873	2.840	2.778	0.566	0.036	0.107	0.150
%RSD		1.118	1.208	0.595	0.579	1.225	2.979	4.035	2.542
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	0.000	366.100	0.000	6.498	6.439	68.428%	0.600	-13.110
2	16:46:45	0.000	369.500	0.000	6.501	6.490	67.724%	0.612	-10.810
3	16:47:28	0.000	365.900	0.000	6.564	6.412	68.008%	0.619	-12.460
x		0.000	367.200	0.000	6.521	6.447	68.054%	0.610	-12.120
σ		0.000	2.009	0.000	0.037	0.039	0.354%	0.009	1.184
%RSD		0.000	0.547	0.000	0.570	0.609	0.520	1.518	9.764
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:46:02	0.554	2.200	1.674	73.329%	33.470	0.693	0.732	440.300
2	16:46:45	0.527	1.969	1.631	73.991%	33.460	0.679	0.738	436.700
3	16:47:28	0.552	2.136	1.673	74.087%	33.320	0.662	0.701	429.300
x		0.544	2.102	1.659	73.802%	33.420	0.678	0.724	435.400
σ		0.015	0.120	0.024	0.412%	0.085	0.015	0.020	5.593
%RSD		2.740	5.694	1.456	0.559	0.253	2.254	2.710	1.284
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	16:46:02	438.100	88.644%	88.732%	1.389	1.450	91.390	74.289%	
2	16:46:45	434.200	90.235%	90.774%	1.405	1.448	91.080	76.051%	
3	16:47:28	427.500	91.118%	91.072%	1.420	1.423	90.460	76.769%	
x		433.200	89.999%	90.193%	1.405	1.440	90.980	75.703%	
σ		5.370	1.254%	1.273%	0.015	0.015	0.472	1.276%	
%RSD		1.239	1.393	1.412	1.095	1.029	0.519	1.686	

180-26373-A-4-G 11/13/2013 4:50:07 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	70.189%	2.961	141.200	140.700	0.000	41190.000	28820.000	28050.000
2	16:51:33	66.235%	3.252	138.900	141.600	0.000	41000.000	29190.000	28590.000
3	16:52:16	64.184%	3.036	141.000	140.900	0.000	41090.000	29370.000	28630.000
x		66.869%	3.083	140.400	141.000	0.000	41090.000	29130.000	28420.000
σ		3.052%	0.151	1.264	0.455	0.000	92.730	282.300	323.800
%RSD		4.564	4.898	0.901	0.323	0.000	0.226	0.969	1.139
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	51860.000	2662.000	0.000	16190.000	31750.000	32370.000	80.858%	3209.000
2	16:51:33	52240.000	2565.000	0.000	16330.000	31990.000	32340.000	79.554%	3239.000
3	16:52:16	52360.000	2633.000	0.000	16190.000	31880.000	32590.000	79.411%	3221.000
x		52160.000	2620.000	0.000	16240.000	31870.000	32430.000	79.941%	3223.000
σ		262.300	49.480	0.000	79.310	116.300	134.800	0.798%	15.340
%RSD		0.503	1.889	0.000	0.488	0.365	0.415	0.998	0.476
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	159.300	180.200	40.010	958.200	133100.000	134500.000	31.440	170.300
2	16:51:33	160.300	182.400	37.280	957.200	132700.000	134800.000	31.020	168.400
3	16:52:16	160.100	178.400	35.900	944.600	130100.000	132500.000	31.330	171.000
x		159.900	180.300	37.730	953.300	132000.000	133900.000	31.260	169.900
σ		0.541	1.990	2.091	7.598	1629.000	1247.000	0.215	1.322
%RSD		0.338	1.103	5.542	0.797	1.235	0.931	0.688	0.778
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	83.740	86.090	288.200	289.300	47.740	0.858	1.835	3.331
2	16:51:33	84.380	87.320	288.300	291.700	47.620	0.876	1.996	3.171
3	16:52:16	84.480	85.960	287.800	291.200	47.960	0.841	1.994	3.588
x		84.200	86.460	288.100	290.700	47.770	0.858	1.942	3.363
σ		0.405	0.750	0.314	1.228	0.173	0.018	0.093	0.210
%RSD		0.480	0.867	0.109	0.422	0.363	2.073	4.783	6.251
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	0.000	180.200	0.000	13.920	13.910	77.058%	0.411	-7.890
2	16:51:33	0.000	178.300	0.000	14.060	13.780	76.609%	0.406	-7.081
3	16:52:16	0.000	181.100	0.000	13.910	13.900	76.995%	0.403	-7.678
x		0.000	179.900	0.000	13.960	13.870	76.887%	0.406	-7.550
σ		0.000	1.418	0.000	0.087	0.072	0.243%	0.004	0.420
%RSD		0.000	0.788	0.000	0.620	0.519	0.316	1.010	5.557
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:50	0.386	1.928	1.552	81.083%	29.920	1.024	1.016	161.800
2	16:51:33	0.406	1.775	1.428	81.624%	29.760	1.027	1.015	162.200
3	16:52:16	0.392	1.881	1.512	81.217%	30.150	1.005	1.022	161.300
x		0.395	1.861	1.497	81.308%	29.940	1.019	1.018	161.800
σ		0.011	0.079	0.063	0.282%	0.194	0.012	0.004	0.472
%RSD		2.679	4.230	4.206	0.347	0.647	1.184	0.380	0.292
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	16:50:50	161.200	92.178%	92.041%	0.792	0.808	76.540	80.222%	
2	16:51:33	160.800	93.589%	94.186%	0.782	0.823	76.870	82.256%	
3	16:52:16	161.400	94.676%	95.295%	0.805	0.811	76.890	82.986%	
x		161.200	93.481%	93.841%	0.793	0.814	76.770	81.822%	
σ		0.324	1.253%	1.654%	0.011	0.008	0.200	1.432%	
%RSD		0.201	1.340	1.763	1.435	0.980	0.260	1.750	

CCV 993939 11/13/2013 4:54:54 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	84.936%	105.500	104.100	104.200	0.000	50930.000	50970.000	50730.000
2	16:56:31	80.854%	105.400	101.100	103.600	0.000	50990.000	51400.000	51360.000
3	16:57:14	81.819%	105.400	103.300	104.000	0.000	50710.000	50760.000	50930.000
x		82.536%	105.456%	102.845%	103.951%	0.000	101.752%	102.082%	102.015%
σ		2.133%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.585	0.078	1.497	0.289	0.000	0.295	0.635	0.629
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	491.400	5261.000	0.000	52150.000	51320.000	51560.000	79.262%	104.700
2	16:56:31	513.000	5211.000	0.000	51640.000	52200.000	52030.000	77.371%	104.800
3	16:57:14	511.000	5164.000	0.000	51680.000	52000.000	51940.000	76.075%	103.500
x		101.027%	104.238%	0.000	103.653%	103.681%	103.687%	77.570%	104.342%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.603%	n/a
%RSD		2.364	0.929	0.000	0.550	0.892	0.475	2.066	0.688
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	105.600	105.100	2.462	507.500	25690.000	25480.000	106.100	107.000
2	16:56:31	103.700	103.200	2.711	508.800	25810.000	25700.000	103.100	104.000
3	16:57:14	104.700	104.000	2.600	507.700	25820.000	25620.000	102.700	105.800
x		104.673%	104.131%	2.591	101.600%	103.094%	102.403%	103.939%	105.590%
σ		n/a	n/a	0.125	n/a	n/a	n/a	n/a	n/a
%RSD		0.876	0.916	4.813	0.141	0.288	0.441	1.777	1.441
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	108.800	108.600	106.000	106.100	106.100	-0.351	107.200	107.100
2	16:56:31	107.000	106.800	106.000	106.800	105.800	-0.421	106.600	106.800
3	16:57:14	107.000	106.300	106.400	105.500	105.100	-0.404	106.100	106.600
x		107.572%	107.213%	106.162%	106.134%	105.672%	-0.392	106.619%	106.811%
σ		n/a	n/a	n/a	n/a	n/a	0.036	n/a	n/a
%RSD		0.957	1.111	0.212	0.618	0.488	9.264	0.508	0.249
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	0.000	101.100	79.162%	102.600	104.500	74.470%	107.000	2.890
2	16:56:31	0.000	100.200	78.431%	103.700	105.200	73.159%	107.500	-0.509
3	16:57:14	0.000	100.400	78.344%	103.600	104.800	72.925%	107.000	3.252
x		0.000	100.560%	78.646%	103.308%	104.839%	73.518%	107.148%	1.878
σ		0.000	n/a	0.449%	n/a	n/a	0.832%	n/a	2.075
%RSD		0.000	0.500	0.571	0.582	0.326	1.132	0.279	110.500
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:55:48	107.800	107.100	106.500	76.366%	101.500	101.700	101.200	105.500
2	16:56:31	107.100	107.000	107.300	75.258%	102.500	102.700	102.400	106.600
3	16:57:14	108.200	106.800	106.900	75.007%	103.000	102.900	102.600	104.400
x		107.702%	106.972%	106.894%	75.543%	102.341%	102.429%	102.074%	105.491%
σ		n/a	n/a	n/a	0.723%	n/a	n/a	n/a	n/a
%RSD		0.481	0.122	0.391	0.958	0.747	0.629	0.741	1.056
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	16:55:48	105.200	78.014%	78.148%	103.800	105.500	106.100	73.701%	
2	16:56:31	105.300	77.934%	78.579%	104.200	105.900	106.900	73.732%	
3	16:57:14	105.700	78.062%	78.295%	104.200	106.200	106.900	73.777%	
x		105.427%	78.003%	78.341%	104.093%	105.886%	106.629%	73.737%	
σ		n/a	0.065%	0.219%	n/a	n/a	n/a	0.038%	
%RSD		0.231	0.083	0.279	0.240	0.334	0.443	0.051	

CCB6 11/13/2013 5:03:15 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	101.056%	-0.053	4.734	4.663	0.000	2.542	0.492	0.670
2	17:04:41	100.362%	-0.078	4.151	4.435	0.000	2.643	0.787	0.617
3	17:05:24	101.029%	-0.073	4.078	4.321	0.000	2.396	0.538	0.615
x		100.816%	-0.068	4.321	4.473	0.000	2.527	0.606	0.634
σ		0.393%	0.014	0.360	0.174	0.000	0.125	0.159	0.031
%RSD		0.390	19.930	8.329	3.900	0.000	4.925	26.190	4.918

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	0.303	0.316	0.000	1.786	4.150	0.278	93.041%	0.065
2	17:04:41	0.271	0.577	0.000	1.297	-1.236	0.641	93.834%	0.059
3	17:05:24	0.288	0.546	0.000	0.970	0.492	0.527	94.863%	0.030
x		0.287	0.479	0.000	1.351	1.135	0.482	93.912%	0.051
σ		0.016	0.143	0.000	0.410	2.750	0.186	0.914%	0.019
%RSD		5.700	29.730	0.000	30.380	242.200	38.560	0.973	36.150

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	-0.011	0.002	0.242	0.044	6.188	2.811	0.001	0.017
2	17:04:41	-0.009	0.017	0.199	0.038	5.022	1.460	0.001	0.017
3	17:05:24	0.002	0.020	0.201	0.034	4.455	2.219	0.001	-0.001
x		-0.006	0.013	0.214	0.039	5.222	2.163	0.001	0.011
σ		0.007	0.010	0.025	0.005	0.884	0.677	0.000	0.010
%RSD		112.300	74.600	11.470	13.030	16.930	31.300	24.930	92.090

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	0.034	-0.001	0.527	0.587	0.075	-0.003	0.172	0.219
2	17:04:41	0.039	-0.002	0.505	0.482	0.132	-0.011	0.193	0.525
3	17:05:24	0.054	0.006	0.533	0.473	0.052	-0.002	0.101	0.202
x		0.042	0.001	0.521	0.514	0.087	-0.005	0.156	0.316
σ		0.010	0.004	0.014	0.063	0.041	0.005	0.048	0.182
%RSD		24.410	531.700	2.758	12.250	47.260	85.290	30.950	57.660

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	0.000	0.010	88.856%	0.136	0.158	91.008%	-0.051	0.357
2	17:04:41	0.000	0.009	90.134%	0.102	0.114	92.766%	-0.046	0.106
3	17:05:24	0.000	0.009	91.742%	0.103	0.099	93.342%	-0.046	0.388
x		0.000	0.010	90.244%	0.114	0.123	92.372%	-0.048	0.283
σ		0.000	0.001	1.446%	0.020	0.031	1.216%	0.003	0.155
%RSD		0.000	7.429	1.602	17.140	24.890	1.316	5.987	54.560

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	-0.044	-0.021	-0.016	88.415%	0.047	0.041	0.056	0.005
2	17:04:41	-0.040	-0.004	0.001	90.925%	0.019	0.044	0.046	0.003
3	17:05:24	-0.045	-0.023	-0.015	90.673%	0.005	0.048	0.040	0.006
x		-0.043	-0.016	-0.010	90.005%	0.024	0.044	0.048	0.005
σ		0.003	0.010	0.009	1.382%	0.021	0.004	0.008	0.002
%RSD		6.675	63.180	96.970	1.536	89.630	8.747	16.800	33.300

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:03:58	0.013	85.366%	84.983%	0.011	0.009	0.024	86.755%
2	17:04:41	0.002	87.828%	87.188%	0.010	0.011	0.020	87.989%
3	17:05:24	0.016	89.227%	88.493%	0.010	0.010	0.019	88.553%
x		0.010	87.474%	86.888%	0.010	0.010	0.021	87.766%
σ		0.007	1.955%	1.774%	0.001	0.001	0.003	0.920%
%RSD		70.580	2.235	2.042	6.467	6.333	12.220	1.048

180-26373-C-1-D 11/13/2013 5:08:03 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	64.100%	2.143	92.640	97.560	0.000	51360.000	50890.000	50610.000
2	17:09:29	59.504%	2.377	96.260	96.110	0.000	51810.000	52360.000	51230.000
3	17:10:12	57.742%	2.466	97.970	98.880	0.000	54280.000	54700.000	53870.000
x		60.449%	2.329	95.620	97.520	0.000	52480.000	52650.000	51900.000
σ		3.282%	0.167	2.724	1.387	0.000	1573.000	1923.000	1732.000
%RSD		5.430	7.162	2.848	1.423	0.000	2.998	3.652	3.336
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	46140.000	2257.000	0.000	10070.000	107000.000	107500.000	71.101%	2352.000
2	17:09:29	47080.000	2264.000	0.000	10230.000	107100.000	109900.000	68.962%	2337.000
3	17:10:12	48770.000	2376.000	0.000	10850.000	116500.000	118300.000	61.929%	2564.000
x		47330.000	2299.000	0.000	10380.000	110200.000	111900.000	67.330%	2418.000
σ		1332.000	67.000	0.000	413.600	5471.000	5664.000	4.799%	127.100
%RSD		2.814	2.914	0.000	3.984	4.965	5.060	7.127	5.256
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	129.900	110.600	30.650	1539.000	98530.000	98160.000	43.120	73.890
2	17:09:29	132.400	111.100	26.750	1509.000	96210.000	97250.000	42.690	71.650
3	17:10:12	139.400	118.100	32.550	1660.000	104800.000	105400.000	45.580	78.020
x		133.900	113.300	29.980	1569.000	99850.000	100300.000	43.800	74.520
σ		4.898	4.215	2.956	79.550	4448.000	4488.000	1.560	3.231
%RSD		3.658	3.721	9.860	5.069	4.455	4.476	3.561	4.335
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	21.980	23.270	283.600	283.900	29.920	1.092	1.431	3.884
2	17:09:29	21.890	22.850	281.900	282.300	29.170	1.095	1.499	2.962
3	17:10:12	23.490	24.990	301.800	302.600	32.330	1.085	1.273	3.570
x		22.450	23.700	289.100	289.600	30.470	1.090	1.401	3.472
σ		0.896	1.138	11.010	11.290	1.654	0.005	0.116	0.469
%RSD		3.991	4.801	3.809	3.900	5.429	0.448	8.286	13.500
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	0.000	341.000	0.000	2.410	2.495	69.152%	0.142	-6.541
2	17:09:29	0.000	343.100	0.000	2.408	2.424	68.752%	0.119	-6.100
3	17:10:12	0.000	353.700	0.000	2.348	2.508	67.370%	0.110	-5.603
x		0.000	345.900	0.000	2.388	2.476	68.424%	0.124	-6.081
σ		0.000	6.848	0.000	0.035	0.045	0.935%	0.017	0.469
%RSD		0.000	1.980	0.000	1.481	1.822	1.366	13.370	7.721
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:08:46	0.103	0.757	0.536	74.136%	27.060	0.404	0.459	68.680
2	17:09:29	0.121	0.711	0.465	74.105%	26.950	0.430	0.416	69.020
3	17:10:12	0.105	0.652	0.453	73.417%	26.970	0.407	0.409	69.290
x		0.110	0.706	0.485	73.886%	26.990	0.414	0.428	69.000
σ		0.010	0.053	0.045	0.407%	0.060	0.014	0.027	0.303
%RSD		9.007	7.442	9.263	0.550	0.224	3.459	6.271	0.439
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	17:08:46	68.730	88.325%	88.160%	0.873	0.875	41.270	76.097%	
2	17:09:29	68.720	89.665%	90.300%	0.857	0.894	41.420	78.110%	
3	17:10:12	69.350	89.754%	90.413%	0.891	0.916	41.660	78.222%	
x		68.930	89.248%	89.624%	0.874	0.895	41.450	77.476%	
σ		0.362	0.801%	1.269%	0.017	0.021	0.197	1.196%	
%RSD		0.525	0.897	1.416	1.923	2.303	0.475	1.543	

180-26373-C-1-D SD@5 11/13/2013 5:12:50 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	83.541%	0.535	22.830	22.800	0.000	10070.000	9875.000	9729.000
2	17:14:16	82.547%	0.369	22.600	21.770	0.000	9944.000	9894.000	9871.000
3	17:14:59	79.364%	0.417	22.220	22.090	0.000	10050.000	10070.000	9990.000
x		81.817%	0.441	22.550	22.220	0.000	10020.000	9946.000	9863.000
σ		2.182%	0.085	0.306	0.528	0.000	67.790	107.700	130.800
%RSD		2.666	19.370	1.357	2.375	0.000	0.676	1.083	1.326

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	8993.000	448.600	0.000	2088.000	21460.000	21930.000	83.515%	477.000
2	17:14:16	9107.000	446.400	0.000	2065.000	21560.000	22180.000	83.053%	479.500
3	17:14:59	9259.000	458.800	0.000	2082.000	21560.000	21950.000	83.262%	480.900
x		9120.000	451.300	0.000	2078.000	21530.000	22020.000	83.277%	479.100
σ		133.700	6.578	0.000	11.800	56.890	139.200	0.231%	2.003
%RSD		1.466	1.458	0.000	0.568	0.264	0.632	0.278	0.418

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	26.840	23.170	7.231	310.500	19890.000	19630.000	8.622	14.990
2	17:14:16	26.350	22.540	6.787	304.700	19640.000	19530.000	8.555	15.170
3	17:14:59	27.190	23.030	6.838	308.200	19820.000	19800.000	8.792	14.970
x		26.790	22.910	6.952	307.800	19790.000	19650.000	8.656	15.040
σ		0.422	0.332	0.243	2.934	128.800	133.200	0.122	0.111
%RSD		1.575	1.451	3.492	0.953	0.651	0.678	1.412	0.740

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	4.714	4.826	60.530	60.530	5.954	0.169	-0.032	0.265
2	17:14:16	4.566	4.683	59.740	59.600	5.830	0.161	0.115	0.209
3	17:14:59	4.635	4.733	60.770	60.760	5.960	0.159	0.252	0.194
x		4.638	4.748	60.350	60.300	5.914	0.163	0.111	0.223
σ		0.074	0.073	0.540	0.617	0.074	0.006	0.142	0.037
%RSD		1.591	1.529	0.895	1.023	1.243	3.414	127.500	16.780

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	0.000	55.140	96.000%	0.435	0.468	83.620%	-0.017	-0.612
2	17:14:16	0.000	54.900	97.683%	0.414	0.483	83.873%	-0.019	-0.762
3	17:14:59	0.000	55.230	97.691%	0.447	0.443	84.567%	-0.020	-0.388
x		0.000	55.090	97.125%	0.432	0.465	84.020%	-0.019	-0.587
σ		0.000	0.171	0.974%	0.017	0.021	0.490%	0.002	0.188
%RSD		0.000	0.310	1.003	3.837	4.430	0.584	9.686	32.010

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	-0.023	0.098	0.064	84.405%	5.342	0.089	0.085	14.570
2	17:14:16	-0.019	0.095	0.070	85.826%	5.242	0.077	0.087	14.380
3	17:14:59	-0.024	0.082	0.038	86.715%	5.312	0.079	0.075	14.420
x		-0.022	0.091	0.057	85.649%	5.299	0.082	0.082	14.460
σ		0.003	0.008	0.017	1.165%	0.052	0.006	0.006	0.098
%RSD		12.160	9.125	29.720	1.360	0.975	7.698	7.762	0.677

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:13:33	14.390	87.744%	87.507%	0.169	0.170	7.977	83.984%
2	17:14:16	14.410	90.790%	91.229%	0.180	0.175	7.986	86.717%
3	17:14:59	14.220	92.241%	92.227%	0.175	0.177	8.037	87.927%
x		14.340	90.258%	90.321%	0.175	0.174	8.000	86.209%
σ		0.105	2.296%	2.488%	0.005	0.004	0.032	2.020%
%RSD		0.732	2.543	2.754	3.021	2.122	0.403	2.343

180-26373-C-1-E MS 11/13/2013 5:17:37 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	52.711%	47.490	1015.000	1011.000	0.000	102500.000	110700.000	108600.000
2	17:19:03	50.579%	48.770	1024.000	1016.000	0.000	103600.000	112100.000	108900.000
3	17:19:46	49.500%	48.430	1021.000	1008.000	0.000	103300.000	112600.000	110200.000
x		50.930%	48.230	1020.000	1012.000	0.000	103200.000	111800.000	109200.000
σ		1.634%	0.661	4.300	4.012	0.000	570.100	1012.000	852.900
%RSD		3.209	1.370	0.422	0.397	0.000	0.553	0.905	0.781

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	67030.000	6883.000	0.000	64440.000	219600.000	224000.000	55.864%	4747.000
2	17:19:03	67540.000	6877.000	0.000	63690.000	219300.000	223700.000	53.843%	4738.000
3	17:19:46	67730.000	6889.000	0.000	64290.000	220900.000	225300.000	53.168%	4757.000
x		67430.000	6883.000	0.000	64140.000	219900.000	224300.000	54.292%	4747.000
σ		358.100	6.003	0.000	396.400	831.300	833.600	1.403%	9.405
%RSD		0.531	0.087	0.000	0.618	0.378	0.372	2.584	0.198

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	689.400	334.200	45.550	2189.000	110900.000	110600.000	528.000	544.800
2	17:19:03	689.200	333.800	46.480	2212.000	111700.000	112400.000	526.100	542.600
3	17:19:46	683.800	335.000	49.180	2220.000	111600.000	112400.000	532.800	541.400
x		687.500	334.300	47.070	2207.000	111400.000	111800.000	529.000	542.900
σ		3.149	0.645	1.883	15.750	405.000	1045.000	3.479	1.726
%RSD		0.458	0.193	3.999	0.714	0.363	0.935	0.658	0.318

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	256.300	260.500	724.000	725.700	63.060	1.788	9.438	11.670
2	17:19:03	254.100	261.000	727.100	733.800	62.810	1.852	9.355	12.180
3	17:19:46	255.800	260.800	730.600	735.700	64.430	1.769	9.223	12.360
x		255.400	260.800	727.200	731.800	63.430	1.803	9.338	12.070
σ		1.157	0.229	3.344	5.293	0.876	0.044	0.109	0.358
%RSD		0.453	0.088	0.460	0.723	1.381	2.414	1.162	2.969

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	0.000	1652.000	0.000	1014.000	1036.000	58.863%	47.830	-1.417
2	17:19:03	0.000	1664.000	0.000	1020.000	1043.000	57.996%	48.150	-1.161
3	17:19:46	0.000	1662.000	0.000	1017.000	1042.000	57.661%	47.840	-2.801
x		0.000	1659.000	0.000	1017.000	1040.000	58.173%	47.940	-1.793
σ		0.000	6.576	0.000	3.056	3.897	0.620%	0.179	0.882
%RSD		0.000	0.396	0.000	0.301	0.375	1.067	0.374	49.220

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	47.360	46.840	40.770	64.773%	1929.000	359.700	359.300	1304.000
2	17:19:03	47.770	47.970	40.260	64.625%	1948.000	363.100	362.500	1607.000
3	17:19:46	47.290	48.090	39.800	64.686%	1934.000	361.500	360.300	1346.000
x		47.480	47.630	40.280	64.694%	1937.000	361.500	360.700	1419.000
σ		0.261	0.689	0.481	0.074%	9.786	1.680	1.675	164.300
%RSD		0.549	1.446	1.195	0.115	0.505	0.465	0.464	11.580

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:20	2005.000	80.893%	81.976%	50.040	51.420	63.950	69.072%
2	17:19:03	1999.000	82.325%	83.251%	51.000	52.380	64.940	69.704%
3	17:19:46	1987.000	82.612%	83.816%	50.940	52.200	64.470	70.423%
x		1997.000	81.943%	83.014%	50.660	52.000	64.450	69.733%
σ		9.354	0.921%	0.942%	0.537	0.510	0.492	0.676%
%RSD		0.468	1.124	1.135	1.060	0.981	0.764	0.969

180-26373-C-1-F MSD 11/13/2013 5:22:23 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	51.533%	49.860	1031.000	1043.000	0.000	103000.000	108600.000	107900.000
2	17:23:49	50.365%	49.110	1022.000	1021.000	0.000	105700.000	112100.000	108800.000
3	17:24:32	49.956%	48.020	1023.000	1020.000	0.000	103200.000	111300.000	108100.000
x		50.618%	49.000	1025.000	1028.000	0.000	103900.000	110700.000	108300.000
σ		0.818%	0.926	5.153	13.130	0.000	1529.000	1839.000	496.200
%RSD		1.617	1.891	0.502	1.277	0.000	1.471	1.662	0.458

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	64970.000	6834.000	0.000	64470.000	161600.000	165600.000	56.854%	4432.000
2	17:23:49	65180.000	6796.000	0.000	64460.000	162900.000	165500.000	55.604%	4430.000
3	17:24:32	65700.000	6886.000	0.000	64180.000	163200.000	165500.000	55.205%	4427.000
x		65280.000	6839.000	0.000	64370.000	162600.000	165500.000	55.888%	4430.000
σ		375.700	45.430	0.000	167.700	837.200	72.330	0.860%	2.286
%RSD		0.576	0.664	0.000	0.261	0.515	0.044	1.540	0.052

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	683.200	328.500	43.290	2165.000	104900.000	105900.000	530.300	544.000
2	17:23:49	671.200	319.900	38.850	2144.000	103500.000	104600.000	528.300	543.800
3	17:24:32	673.300	324.500	44.450	2166.000	104700.000	106700.000	536.800	549.200
x		675.900	324.300	42.200	2159.000	104400.000	105700.000	531.800	545.700
σ		6.430	4.317	2.956	12.560	738.600	1037.000	4.407	3.047
%RSD		0.951	1.331	7.006	0.582	0.708	0.981	0.829	0.558

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	254.500	262.700	714.000	717.000	61.940	1.369	9.352	12.120
2	17:23:49	255.600	261.800	719.300	719.700	62.080	1.428	9.438	11.240
3	17:24:32	256.900	263.200	724.200	724.200	62.140	1.383	9.684	11.850
x		255.700	262.600	719.200	720.300	62.050	1.393	9.491	11.740
σ		1.214	0.722	5.142	3.641	0.105	0.031	0.173	0.452
%RSD		0.475	0.275	0.715	0.505	0.169	2.215	1.819	3.854

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	0.000	1411.000	0.000	1020.000	1039.000	60.036%	48.220	-0.127
2	17:23:49	0.000	1428.000	0.000	1026.000	1050.000	59.709%	48.410	-0.096
3	17:24:32	0.000	1437.000	0.000	1031.000	1052.000	59.067%	48.360	2.558
x		0.000	1425.000	0.000	1026.000	1047.000	59.604%	48.330	0.778
σ		0.000	12.850	0.000	5.201	6.817	0.493%	0.100	1.541
%RSD		0.000	0.901	0.000	0.507	0.651	0.827	0.207	198.100

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	47.940	47.960	40.560	66.014%	1947.000	368.600	367.000	1654.000
2	17:23:49	47.630	47.860	40.970	66.039%	1954.000	370.800	369.600	1527.000
3	17:24:32	48.010	47.690	39.990	65.767%	1960.000	372.600	372.200	1617.000
x		47.860	47.840	40.510	65.940%	1954.000	370.700	369.600	1599.000
σ		0.201	0.135	0.490	0.150%	6.254	1.992	2.619	65.260
%RSD		0.421	0.282	1.209	0.228	0.320	0.537	0.709	4.080

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:06	2013.000	81.823%	83.151%	51.010	52.230	62.100	70.077%
2	17:23:49	2016.000	83.856%	84.492%	51.300	52.480	62.250	71.915%
3	17:24:32	2024.000	84.080%	84.836%	51.420	52.980	62.610	71.693%
x		2018.000	83.253%	84.160%	51.250	52.560	62.320	71.229%
σ		5.757	1.243%	0.890%	0.212	0.381	0.261	1.003%
%RSD		0.285	1.493	1.057	0.414	0.725	0.419	1.408

180-26373-C-1-G 11/13/2013 5:30:30 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	84.891%	1.642	85.640	85.960	0.000	47840.000	42480.000	42490.000
2	17:31:56	81.187%	1.735	84.140	83.900	0.000	47660.000	43430.000	42920.000
3	17:32:39	79.579%	1.695	83.190	82.970	0.000	48050.000	43540.000	43220.000
x		81.885%	1.691	84.330	84.280	0.000	47850.000	43150.000	42870.000
σ		2.724%	0.047	1.235	1.530	0.000	196.600	585.200	367.400
%RSD		3.326	2.772	1.465	1.815	0.000	0.411	1.356	0.857
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	37140.000	1507.000	0.000	8782.000	105200.000	105500.000	83.366%	1456.000
2	17:31:56	37620.000	1545.000	0.000	8716.000	105500.000	105700.000	81.133%	1460.000
3	17:32:39	37460.000	1449.000	0.000	8672.000	104900.000	105900.000	80.518%	1450.000
x		37410.000	1500.000	0.000	8723.000	105200.000	105700.000	81.673%	1455.000
σ		243.900	48.240	0.000	55.470	313.400	162.800	1.499%	5.188
%RSD		0.652	3.215	0.000	0.636	0.298	0.154	1.835	0.356
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	103.900	95.590	3.090	1342.000	78320.000	78370.000	39.800	70.940
2	17:31:56	103.900	95.150	3.305	1361.000	78680.000	78800.000	40.120	70.520
3	17:32:39	102.000	94.860	3.551	1354.000	78670.000	78580.000	39.470	69.920
x		103.300	95.200	3.315	1352.000	78550.000	78590.000	39.800	70.460
σ		1.108	0.365	0.231	9.907	206.700	213.000	0.326	0.512
%RSD		1.073	0.383	6.957	0.733	0.263	0.271	0.820	0.727
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	21.640	22.280	243.800	242.700	25.920	0.100	1.470	3.665
2	17:31:56	21.620	22.050	244.700	245.500	25.670	0.086	1.324	3.713
3	17:32:39	21.620	22.460	243.900	244.700	25.660	0.092	1.258	3.498
x		21.630	22.260	244.200	244.300	25.750	0.093	1.350	3.625
σ		0.015	0.204	0.489	1.411	0.149	0.007	0.109	0.113
%RSD		0.067	0.918	0.200	0.578	0.578	7.598	8.036	3.109
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	0.000	331.100	0.000	2.297	2.296	76.967%	0.106	-7.856
2	17:31:56	0.000	335.300	0.000	2.224	2.226	76.317%	0.102	-6.591
3	17:32:39	0.000	338.200	0.000	2.189	2.188	75.458%	0.090	-5.444
x		0.000	334.800	0.000	2.237	2.237	76.247%	0.099	-6.630
σ		0.000	3.554	0.000	0.055	0.055	0.757%	0.008	1.207
%RSD		0.000	1.061	0.000	2.469	2.457	0.993	8.006	18.200
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:31:13	0.077	0.817	0.574	78.068%	24.280	0.530	0.505	61.250
2	17:31:56	0.071	0.731	0.496	78.108%	24.640	0.436	0.460	60.940
3	17:32:39	0.091	0.643	0.423	78.519%	24.680	0.372	0.363	60.280
x		0.080	0.730	0.497	78.232%	24.530	0.446	0.443	60.830
σ		0.011	0.087	0.076	0.249%	0.219	0.079	0.072	0.496
%RSD		13.190	11.870	15.190	0.319	0.891	17.810	16.370	0.815
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	17:31:13	60.980	82.943%	82.671%	0.872	0.873	36.220	71.465%	
2	17:31:56	60.690	84.692%	84.115%	0.867	0.882	36.640	73.159%	
3	17:32:39	60.080	85.686%	85.238%	0.871	0.853	36.930	73.122%	
x		60.580	84.441%	84.008%	0.870	0.869	36.600	72.582%	
σ		0.458	1.388%	1.287%	0.002	0.015	0.356	0.968%	
%RSD		0.755	1.644	1.532	0.277	1.697	0.974	1.333	

180-26373-C-1-G SD@5 11/13/2013 5:35:17 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	98.070%	0.238	23.580	23.020	0.000	9486.000	8654.000	8571.000
2	17:36:43	97.273%	0.339	22.010	22.310	0.000	9403.000	8657.000	8611.000
3	17:37:26	96.979%	0.252	21.700	22.170	0.000	9553.000	8661.000	8538.000
x		97.441%	0.276	22.430	22.500	0.000	9481.000	8657.000	8573.000
σ		0.564%	0.055	1.008	0.455	0.000	75.080	3.425	36.670
%RSD		0.579	19.790	4.495	2.024	0.000	0.792	0.040	0.428

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	7382.000	290.300	0.000	1780.000	21500.000	21520.000	93.607%	292.500
2	17:36:43	7518.000	292.900	0.000	1772.000	21320.000	21450.000	92.907%	293.900
3	17:37:26	7487.000	297.900	0.000	1764.000	20970.000	21330.000	93.799%	294.300
x		7462.000	293.700	0.000	1772.000	21260.000	21440.000	93.438%	293.600
σ		71.460	3.863	0.000	7.940	270.300	96.290	0.469%	0.930
%RSD		0.958	1.315	0.000	0.448	1.271	0.449	0.502	0.317

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	20.510	18.920	0.835	265.000	15730.000	15420.000	7.921	14.250
2	17:36:43	20.770	19.360	0.566	267.600	15680.000	15560.000	7.856	14.330
3	17:37:26	20.830	19.090	0.655	268.200	15820.000	15720.000	8.014	14.310
x		20.700	19.120	0.685	266.900	15740.000	15570.000	7.930	14.300
σ		0.170	0.222	0.137	1.661	66.630	150.900	0.079	0.039
%RSD		0.823	1.163	20.060	0.622	0.423	0.969	1.002	0.274

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	4.527	4.400	53.890	54.280	5.253	0.032	0.211	0.085
2	17:36:43	4.556	4.468	53.860	54.200	5.354	0.026	0.196	0.288
3	17:37:26	4.595	4.494	54.980	54.470	5.267	0.032	0.232	0.296
x		4.559	4.454	54.240	54.320	5.291	0.030	0.213	0.223
σ		0.034	0.048	0.637	0.140	0.055	0.004	0.018	0.120
%RSD		0.747	1.087	1.175	0.258	1.031	11.670	8.346	53.630

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	0.000	57.440	98.472%	0.465	0.460	87.829%	-0.021	-1.062
2	17:36:43	0.000	57.280	101.531%	0.470	0.453	89.202%	-0.020	-0.851
3	17:37:26	0.000	57.330	102.280%	0.448	0.459	89.953%	-0.030	-0.580
x		0.000	57.350	100.761%	0.461	0.457	88.995%	-0.024	-0.831
σ		0.000	0.079	2.018%	0.012	0.004	1.077%	0.005	0.242
%RSD		0.000	0.139	2.002	2.556	0.862	1.211	22.280	29.120

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	-0.019	0.128	0.102	86.639%	5.081	0.134	0.145	12.440
2	17:36:43	-0.026	0.115	0.065	89.151%	4.972	0.133	0.142	12.630
3	17:37:26	-0.022	0.096	0.067	90.105%	4.990	0.108	0.106	12.460
x		-0.022	0.113	0.078	88.632%	5.014	0.125	0.131	12.510
σ		0.004	0.016	0.021	1.790%	0.058	0.015	0.022	0.104
%RSD		17.600	14.140	26.660	2.020	1.165	11.650	16.760	0.829

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:00	12.690	85.190%	85.246%	0.198	0.194	6.993	81.310%
2	17:36:43	12.730	88.470%	87.111%	0.195	0.191	7.150	82.629%
3	17:37:26	12.650	89.060%	88.945%	0.173	0.186	7.096	83.788%
x		12.690	87.573%	87.101%	0.189	0.190	7.080	82.575%
σ		0.039	2.085%	1.850%	0.013	0.004	0.080	1.240%
%RSD		0.303	2.381	2.123	6.991	2.161	1.125	1.502

180-26373-C-1-H MS 11/13/2013 5:40:04 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	73.316%	48.740	980.800	965.000	0.000	100200.000	97800.000	97000.000
2	17:41:31	71.260%	46.030	941.900	928.300	0.000	98560.000	98080.000	96750.000
3	17:42:14	67.930%	47.580	979.000	959.100	0.000	100000.000	98990.000	98090.000
x		70.835%	47.450	967.200	950.800	0.000	99600.000	98290.000	97280.000
σ		2.718%	1.359	21.960	19.740	0.000	904.200	622.500	711.800
%RSD		3.837	2.865	2.270	2.076	0.000	0.908	0.633	0.732

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	57500.000	7059.000	0.000	61210.000	150100.000	150200.000	73.691%	3543.000
2	17:41:31	56810.000	6678.000	0.000	60620.000	151900.000	151800.000	70.984%	3513.000
3	17:42:14	57620.000	6761.000	0.000	60910.000	150100.000	151600.000	69.909%	3543.000
x		57310.000	6832.000	0.000	60910.000	150700.000	151200.000	71.528%	3533.000
σ		435.200	200.300	0.000	296.600	1048.000	879.500	1.949%	17.540
%RSD		0.759	2.932	0.000	0.487	0.696	0.582	2.725	0.496

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	649.600	316.500	8.523	2038.000	94840.000	94840.000	539.200	559.400
2	17:41:31	641.000	310.900	10.680	2039.000	94530.000	94750.000	536.500	554.000
3	17:42:14	643.300	313.200	7.643	2021.000	93910.000	94490.000	529.700	544.600
x		644.600	313.500	8.947	2033.000	94430.000	94700.000	535.200	552.700
σ		4.488	2.799	1.561	9.805	472.400	183.900	4.883	7.478
%RSD		0.696	0.893	17.440	0.482	0.500	0.194	0.912	1.353

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	265.600	266.900	691.500	692.700	61.200	0.041	9.304	12.110
2	17:41:31	259.900	260.400	692.700	699.700	60.800	0.048	8.987	12.550
3	17:42:14	259.400	261.300	696.000	699.500	60.440	0.078	8.927	11.210
x		261.600	262.900	693.400	697.300	60.810	0.056	9.073	11.960
σ		3.408	3.501	2.324	3.993	0.378	0.020	0.203	0.683
%RSD		1.303	1.332	0.335	0.573	0.622	35.430	2.235	5.707

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	0.000	1339.000	0.000	990.300	1016.000	66.034%	42.810	-3.052
2	17:41:31	0.000	1355.000	0.000	995.600	1024.000	64.562%	42.580	-1.630
3	17:42:14	0.000	1352.000	0.000	1002.000	1027.000	63.788%	43.060	-2.632
x		0.000	1349.000	0.000	995.900	1022.000	64.795%	42.820	-2.438
σ		0.000	8.117	0.000	5.791	5.338	1.141%	0.242	0.731
%RSD		0.000	0.602	0.000	0.582	0.522	1.760	0.564	29.980

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	42.620	47.100	41.260	69.577%	1917.000	330.700	329.200	1799.000
2	17:41:31	42.420	47.140	40.910	68.645%	1914.000	334.000	331.600	1281.000
3	17:42:14	42.130	46.690	40.860	68.590%	1925.000	332.500	331.600	1059.000
x		42.390	46.980	41.010	68.938%	1919.000	332.400	330.800	1380.000
σ		0.245	0.246	0.221	0.555%	5.353	1.663	1.362	379.500
%RSD		0.579	0.524	0.539	0.805	0.279	0.500	0.412	27.510

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:40:48	2034.000	77.198%	77.112%	50.540	51.410	61.340	65.487%
2	17:41:31	2030.000	78.083%	78.013%	51.270	52.120	62.060	65.742%
3	17:42:14	2019.000	77.881%	77.899%	51.120	52.330	62.120	65.766%
x		2028.000	77.721%	77.675%	50.970	51.950	61.840	65.665%
σ		7.686	0.464%	0.491%	0.387	0.483	0.433	0.155%
%RSD		0.379	0.597	0.632	0.759	0.929	0.701	0.236

180-26373-C-1-I MSD 11/13/2013 5:44:53 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	71.829%	48.050	944.200	949.700	0.000	99070.000	97920.000	98420.000
2	17:46:19	68.755%	48.880	965.900	967.000	0.000	101800.000	99780.000	98730.000
3	17:47:02	66.790%	47.310	964.100	962.900	0.000	101600.000	100900.000	101400.000
x		69.125%	48.080	958.100	959.900	0.000	100800.000	99520.000	99530.000
σ		2.540%	0.789	12.010	9.008	0.000	1522.000	1484.000	1663.000
%RSD		3.675	1.641	1.254	0.938	0.000	1.510	1.491	1.671
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	55380.000	6121.000	0.000	63570.000	167600.000	168300.000	64.120%	3522.000
2	17:46:19	55050.000	6145.000	0.000	62610.000	166000.000	166500.000	63.812%	3513.000
3	17:47:02	56300.000	6074.000	0.000	62450.000	166800.000	166300.000	63.345%	3526.000
x		55580.000	6113.000	0.000	62880.000	166800.000	167000.000	63.759%	3520.000
σ		649.000	36.110	0.000	607.400	826.300	1085.000	0.391%	6.965
%RSD		1.168	0.591	0.000	0.966	0.495	0.650	0.613	0.198
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	675.000	324.700	8.730	1978.000	95880.000	96240.000	561.100	580.800
2	17:46:19	665.600	321.300	11.020	1994.000	96140.000	95430.000	551.900	570.600
3	17:47:02	673.600	325.600	9.113	1991.000	95650.000	95470.000	546.300	568.000
x		671.400	323.900	9.621	1988.000	95890.000	95710.000	553.100	573.100
σ		5.086	2.236	1.227	8.586	243.600	456.300	7.478	6.755
%RSD		0.757	0.690	12.750	0.432	0.254	0.477	1.352	1.179
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	271.300	273.500	714.200	716.700	62.400	0.066	9.316	11.990
2	17:46:19	269.100	269.500	711.800	709.400	62.160	0.043	9.474	11.970
3	17:47:02	268.300	270.400	713.000	711.000	61.670	0.045	9.320	11.580
x		269.600	271.100	713.000	712.400	62.080	0.051	9.370	11.850
σ		1.520	2.107	1.196	3.863	0.375	0.012	0.090	0.229
%RSD		0.564	0.777	0.168	0.542	0.604	23.860	0.963	1.935
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	0.000	1360.000	0.000	970.600	992.400	64.191%	39.830	0.660
2	17:46:19	0.000	1369.000	0.000	976.100	994.800	64.131%	39.810	0.415
3	17:47:02	0.000	1378.000	0.000	982.000	1002.000	63.650%	39.890	1.565
x		0.000	1369.000	0.000	976.200	996.200	63.991%	39.840	0.880
σ		0.000	8.940	0.000	5.716	4.721	0.297%	0.039	0.606
%RSD		0.000	0.653	0.000	0.586	0.474	0.463	0.099	68.890
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:45:36	39.860	45.750	40.390	66.894%	1857.000	326.000	323.700	1681.000
2	17:46:19	39.320	45.350	39.740	67.887%	1857.000	324.600	323.200	1838.000
3	17:47:02	39.580	45.410	40.120	68.092%	1864.000	325.000	323.600	1766.000
x		39.580	45.500	40.080	67.625%	1859.000	325.200	323.500	1762.000
σ		0.266	0.217	0.323	0.641%	4.339	0.716	0.266	78.670
%RSD		0.672	0.478	0.806	0.947	0.233	0.220	0.082	4.465
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	17:45:36	1964.000	75.795%	75.622%	49.200	50.000	58.710	64.196%	
2	17:46:19	1961.000	76.836%	76.862%	49.730	50.760	59.660	65.118%	
3	17:47:02	1960.000	77.236%	77.823%	49.490	50.530	59.500	66.104%	
x		1962.000	76.622%	76.769%	49.470	50.430	59.290	65.139%	
σ		1.906	0.744%	1.103%	0.265	0.389	0.508	0.954%	
%RSD		0.097	0.971	1.437	0.535	0.772	0.857	1.464	

180-26373-C-2-C 11/13/2013 5:53:01 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	80.039%	2.664	108.700	110.100	0.000	49070.000	34320.000	34220.000
2	17:54:27	76.161%	2.815	110.800	110.600	0.000	50650.000	34790.000	34640.000
3	17:55:10	74.309%	2.509	107.100	108.000	0.000	50250.000	35220.000	34800.000
x		76.836%	2.663	108.900	109.600	0.000	49990.000	34780.000	34550.000
σ		2.924%	0.153	1.839	1.369	0.000	824.200	448.200	301.700
%RSD		3.806	5.749	1.689	1.249	0.000	1.649	1.289	0.873
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	47650.000	1623.000	0.000	12870.000	121600.000	120800.000	78.750%	1488.000
2	17:54:27	47760.000	1567.000	0.000	12460.000	118600.000	119300.000	77.381%	1477.000
3	17:55:10	48130.000	1600.000	0.000	12480.000	120400.000	120800.000	76.329%	1477.000
x		47850.000	1597.000	0.000	12600.000	120200.000	120300.000	77.487%	1481.000
σ		251.400	28.040	0.000	229.000	1495.000	844.100	1.214%	6.581
%RSD		0.525	1.756	0.000	1.817	1.243	0.702	1.567	0.445
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	143.900	116.500	4.171	1275.000	103400.000	103600.000	40.150	69.570
2	17:54:27	141.400	114.400	4.516	1272.000	102800.000	102800.000	39.730	67.710
3	17:55:10	141.700	114.800	2.894	1270.000	102500.000	103200.000	39.950	68.070
x		142.300	115.200	3.860	1272.000	102900.000	103200.000	39.940	68.450
σ		1.342	1.095	0.854	2.660	488.700	370.500	0.213	0.987
%RSD		0.943	0.950	22.120	0.209	0.475	0.359	0.534	1.442
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	50.150	51.010	392.100	396.200	30.660	0.052	1.558	3.606
2	17:54:27	49.780	50.340	392.200	396.300	30.200	0.062	1.605	3.457
3	17:55:10	49.810	50.320	394.800	395.000	30.570	0.051	1.622	3.771
x		49.910	50.560	393.000	395.900	30.480	0.055	1.595	3.611
σ		0.204	0.389	1.504	0.733	0.240	0.006	0.033	0.157
%RSD		0.408	0.770	0.383	0.185	0.788	10.840	2.077	4.341
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	0.000	404.200	0.000	3.887	3.823	73.069%	0.329	-7.621
2	17:54:27	0.000	411.400	0.000	3.606	3.731	71.853%	0.331	-7.555
3	17:55:10	0.000	412.200	0.000	3.561	3.550	71.233%	0.332	-6.693
x		0.000	409.300	0.000	3.685	3.701	72.051%	0.331	-7.290
σ		0.000	4.381	0.000	0.177	0.139	0.934%	0.002	0.518
%RSD		0.000	1.070	0.000	4.797	3.746	1.297	0.540	7.104
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:53:44	0.295	1.561	1.313	74.486%	27.730	0.215	0.210	113.800
2	17:54:27	0.289	1.569	1.334	74.867%	27.170	0.202	0.207	113.500
3	17:55:10	0.291	1.551	1.259	75.251%	26.660	0.204	0.211	113.300
x		0.292	1.561	1.302	74.868%	27.180	0.207	0.209	113.500
σ		0.003	0.009	0.039	0.382%	0.535	0.007	0.002	0.224
%RSD		0.968	0.584	2.994	0.511	1.968	3.282	0.854	0.197
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	17:53:44	115.000	79.973%	80.096%	0.857	0.878	80.120	70.774%	
2	17:54:27	114.200	81.582%	81.864%	0.857	0.875	80.950	72.054%	
3	17:55:10	113.600	83.188%	83.029%	0.847	0.884	81.150	72.835%	
x		114.200	81.581%	81.663%	0.854	0.879	80.740	71.888%	
σ		0.713	1.608%	1.477%	0.006	0.005	0.547	1.041%	
%RSD		0.624	1.971	1.808	0.651	0.516	0.678	1.448	

180-26373-C-3-C 11/13/2013 5:57:49 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	75.360%	3.559	142.200	138.100	0.000	60940.000	65150.000	64620.000
2	17:59:15	72.029%	3.583	141.000	142.600	0.000	61600.000	65850.000	65440.000
3	17:59:58	70.970%	3.783	138.500	138.400	0.000	61670.000	66900.000	65320.000
x		72.786%	3.642	140.600	139.700	0.000	61400.000	65960.000	65130.000
σ		2.291%	0.123	1.863	2.555	0.000	402.200	879.900	438.200
%RSD		3.147	3.366	1.325	1.829	0.000	0.655	1.334	0.673
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	83320.000	723.900	0.000	17970.000	74510.000	73980.000	79.283%	2861.000
2	17:59:15	84600.000	777.300	0.000	18070.000	74990.000	75070.000	77.059%	2897.000
3	17:59:58	84630.000	640.100	0.000	17790.000	74480.000	74490.000	77.524%	2875.000
x		84190.000	713.800	0.000	17950.000	74660.000	74510.000	77.956%	2878.000
σ		746.400	69.160	0.000	142.600	286.300	542.700	1.173%	18.410
%RSD		0.887	9.689	0.000	0.795	0.384	0.728	1.505	0.640
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	222.600	192.600	6.339	1590.000	144200.000	146000.000	55.000	133.000
2	17:59:15	225.600	195.900	6.437	1618.000	146500.000	147800.000	55.780	133.800
3	17:59:58	221.700	192.100	6.870	1596.000	143600.000	145400.000	54.550	130.500
x		223.300	193.500	6.549	1601.000	144800.000	146400.000	55.110	132.400
σ		2.027	2.079	0.283	14.750	1550.000	1284.000	0.622	1.680
%RSD		0.908	1.074	4.315	0.921	1.071	0.877	1.129	1.268
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	69.070	69.600	422.300	424.200	41.210	0.105	2.533	5.594
2	17:59:15	69.170	69.700	426.600	430.900	40.830	0.090	2.701	5.874
3	17:59:58	67.910	69.270	424.700	423.900	40.630	0.102	2.813	5.751
x		68.720	69.520	424.500	426.300	40.890	0.099	2.682	5.740
σ		0.698	0.225	2.159	3.988	0.294	0.008	0.141	0.140
%RSD		1.016	0.323	0.509	0.936	0.719	8.072	5.245	2.445
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	0.000	270.200	0.000	5.535	5.539	70.962%	0.539	-12.370
2	17:59:15	0.000	274.600	0.000	5.625	5.499	71.261%	0.563	-12.880
3	17:59:58	0.000	270.100	0.000	5.570	5.644	71.433%	0.533	-10.990
x		0.000	271.600	0.000	5.577	5.561	71.218%	0.545	-12.080
σ		0.000	2.549	0.000	0.045	0.075	0.239%	0.016	0.977
%RSD		0.000	0.938	0.000	0.810	1.343	0.335	2.933	8.088
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:58:32	0.490	1.982	1.618	73.883%	23.270	0.151	0.167	172.500
2	17:59:15	0.470	2.007	1.667	74.591%	23.100	0.153	0.159	171.900
3	17:59:58	0.472	1.942	1.599	74.776%	23.100	0.157	0.155	171.600
x		0.477	1.977	1.628	74.417%	23.160	0.154	0.160	172.000
σ		0.011	0.032	0.035	0.471%	0.098	0.003	0.006	0.438
%RSD		2.387	1.642	2.151	0.633	0.423	1.936	3.732	0.254
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	17:58:32	173.400	82.783%	82.232%	1.296	1.313	83.740	69.568%	
2	17:59:15	171.300	84.907%	84.600%	1.280	1.311	84.120	70.990%	
3	17:59:58	172.100	85.475%	85.496%	1.307	1.300	84.200	71.814%	
x		172.300	84.388%	84.109%	1.295	1.308	84.020	70.791%	
σ		1.092	1.419%	1.686%	0.014	0.007	0.249	1.136%	
%RSD		0.634	1.681	2.005	1.046	0.540	0.297	1.605	

CCV 993939 11/13/2013 6:02:37 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	76.733%	108.200	106.000	106.300	0.000	52330.000	51950.000	51790.000
2	18:04:03	76.187%	105.000	105.100	101.900	0.000	50910.000	51850.000	51570.000
3	18:04:46	74.418%	106.400	104.600	103.300	0.000	51610.000	52120.000	52010.000
x		75.779%	106.529%	105.245%	103.834%	0.000	103.229%	103.939%	103.581%
σ		1.210%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.596	1.496	0.694	2.136	0.000	1.376	0.261	0.425

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	523.000	5256.000	0.000	52420.000	52540.000	52600.000	74.124%	104.300
2	18:04:03	516.600	5168.000	0.000	52010.000	52030.000	52050.000	73.022%	104.400
3	18:04:46	505.200	5205.000	0.000	51790.000	51970.000	52370.000	72.428%	103.300
x		102.985%	104.195%	0.000	104.139%	104.362%	104.682%	73.191%	104.005%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.861%	n/a
%RSD		1.744	0.844	0.000	0.615	0.600	0.532	1.176	0.608

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	103.600	104.000	2.731	512.300	25900.000	25500.000	103.700	104.700
2	18:04:03	103.200	102.900	3.473	514.800	25780.000	25660.000	102.800	104.600
3	18:04:46	102.400	102.600	3.225	514.200	25770.000	25600.000	103.500	104.900
x		103.073%	103.194%	3.143	102.757%	103.258%	102.334%	103.357%	104.745%
σ		n/a	n/a	0.378	n/a	n/a	n/a	n/a	n/a
%RSD		0.586	0.705	12.020	0.253	0.277	0.316	0.469	0.156

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	105.800	105.400	106.900	105.600	105.900	-0.526	105.800	107.100
2	18:04:03	105.600	106.700	106.500	106.800	105.500	-0.442	106.400	106.300
3	18:04:46	106.000	104.700	106.900	105.800	104.800	-0.395	105.700	104.900
x		105.796%	105.581%	106.749%	106.062%	105.397%	-0.454	105.981%	106.076%
σ		n/a	n/a	n/a	n/a	n/a	0.066	n/a	n/a
%RSD		0.222	0.969	0.225	0.619	0.542	14.630	0.389	1.069

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	0.000	100.400	76.265%	101.200	103.100	71.599%	106.100	1.943
2	18:04:03	0.000	100.700	75.657%	102.800	104.500	71.308%	105.900	0.892
3	18:04:46	0.000	100.500	75.457%	104.300	105.900	70.550%	107.000	1.374
x		0.000	100.563%	75.793%	102.798%	104.476%	71.152%	106.321%	1.403
σ		0.000	n/a	0.421%	n/a	n/a	0.542%	n/a	0.526
%RSD		0.000	0.164	0.555	1.530	1.360	0.761	0.584	37.490

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	106.300	106.700	106.100	74.136%	101.900	101.500	101.500	104.800
2	18:04:03	106.600	105.700	106.700	74.197%	101.700	101.900	101.500	103.200
3	18:04:46	106.000	106.200	106.400	73.756%	101.300	102.200	101.900	104.200
x		106.295%	106.181%	106.443%	74.029%	101.621%	101.856%	101.635%	104.047%
σ		n/a	n/a	n/a	0.239%	n/a	n/a	n/a	n/a
%RSD		0.267	0.438	0.283	0.323	0.287	0.320	0.208	0.789

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:03:20	103.900	76.997%	77.357%	102.000	103.700	104.600	73.905%
2	18:04:03	103.700	77.695%	78.358%	103.100	105.400	105.800	74.184%
3	18:04:46	103.500	78.128%	78.021%	103.100	104.600	105.900	74.109%
x		103.727%	77.607%	77.912%	102.705%	104.557%	105.416%	74.066%
σ		n/a	0.571%	0.510%	n/a	n/a	n/a	0.144%
%RSD		0.190	0.736	0.654	0.628	0.821	0.686	0.195

CCB7 11/13/2013 6:10:47 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	93.905%	-0.065	4.992	4.967	0.000	6.011	0.977	1.178
2	18:12:13	92.372%	-0.085	4.852	4.814	0.000	5.570	0.993	0.882
3	18:12:56	93.421%	-0.080	4.416	4.688	0.000	5.512	0.880	0.759
x		93.233%	-0.077	4.753	4.823	0.000	5.698	0.950	0.940
σ		0.784%	0.010	0.300	0.140	0.000	0.272	0.061	0.215
%RSD		0.841	13.490	6.321	2.893	0.000	4.782	6.409	22.890

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	0.969	0.110	0.000	3.421	0.763	0.188	89.388%	0.066
2	18:12:13	0.386	0.206	0.000	3.216	1.258	1.213	88.947%	0.008
3	18:12:56	0.421	0.438	0.000	3.328	3.071	0.435	89.732%	0.027
x		0.592	0.251	0.000	3.322	1.697	0.612	89.356%	0.034
σ		0.327	0.169	0.000	0.103	1.215	0.535	0.394%	0.029
%RSD		55.190	67.030	0.000	3.088	71.560	87.430	0.440	87.560

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	-0.000	0.006	0.043	0.024	2.893	2.861	0.004	0.005
2	18:12:13	-0.004	0.003	0.032	0.030	2.229	1.595	-0.001	0.014
3	18:12:56	-0.003	-0.004	0.041	0.028	3.110	0.973	0.002	0.002
x		-0.002	0.002	0.039	0.027	2.744	1.810	0.002	0.007
σ		0.002	0.005	0.006	0.003	0.459	0.962	0.002	0.006
%RSD		76.820	330.300	14.960	11.710	16.730	53.160	140.200	85.420

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	0.093	0.008	0.402	0.564	0.008	0.000	0.024	0.101
2	18:12:13	0.060	0.006	0.563	0.625	0.024	-0.001	0.045	0.062
3	18:12:56	0.062	0.017	0.526	0.582	-0.007	0.001	0.125	0.026
x		0.072	0.010	0.497	0.590	0.008	0.000	0.065	0.063
σ		0.019	0.006	0.084	0.032	0.016	0.001	0.053	0.037
%RSD		25.870	55.030	16.960	5.346	190.400	3949.000	82.260	59.250

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	0.000	0.009	86.748%	0.165	0.128	88.552%	-0.051	0.351
2	18:12:13	0.000	0.012	88.270%	0.122	0.129	90.012%	-0.049	0.145
3	18:12:56	0.000	0.009	89.291%	0.100	0.110	90.389%	-0.049	0.428
x		0.000	0.010	88.103%	0.129	0.123	89.651%	-0.050	0.308
σ		0.000	0.002	1.280%	0.033	0.011	0.970%	0.001	0.146
%RSD		0.000	20.580	1.453	25.320	8.689	1.082	2.454	47.520

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	-0.047	-0.023	-0.011	87.115%	0.100	0.009	0.023	0.007
2	18:12:13	-0.044	-0.009	-0.005	88.914%	0.121	0.018	0.019	0.005
3	18:12:56	-0.046	-0.030	-0.022	89.712%	0.093	0.006	0.012	0.003
x		-0.046	-0.021	-0.013	88.580%	0.105	0.011	0.018	0.005
σ		0.001	0.011	0.009	1.330%	0.014	0.006	0.006	0.002
%RSD		2.774	50.830	70.760	1.502	13.760	54.700	30.980	41.790

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:11:30	0.019	86.853%	86.333%	0.007	0.009	0.004	89.321%
2	18:12:13	0.012	88.778%	88.889%	0.008	0.009	0.003	89.935%
3	18:12:56	0.012	90.003%	90.171%	0.005	0.008	0.003	90.525%
x		0.014	88.545%	88.464%	0.007	0.008	0.004	89.927%
σ		0.004	1.588%	1.954%	0.002	0.001	0.001	0.602%
%RSD		25.870	1.794	2.209	25.720	7.952	19.590	0.669

CRI 1011230 11/13/2013 6:15:37 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	96.500%	1.009	9.037	8.450	0.000	95.820	102.000	103.100
2	18:17:03	94.277%	1.001	9.322	8.717	0.000	95.260	101.000	102.300
3	18:17:46	92.539%	0.869	9.125	8.826	0.000	95.200	104.300	104.600
x		94.438%	95.956%	183.229%	173.288%	0.000	95.426%	102.423%	103.313%
σ		1.986%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.103	8.210	1.597	2.234	0.000	0.358	1.624	1.152

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	30.810	523.400	0.000	104.500	105.100	102.800	88.126%	4.883
2	18:17:03	30.760	518.100	0.000	101.500	103.700	101.300	88.592%	5.134
3	18:17:46	31.170	523.700	0.000	102.300	89.640	99.680	88.676%	5.290
x		103.057%	104.342%	0.000	102.755%	99.500%	101.282%	88.465%	102.043%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.297%	n/a
%RSD		0.722	0.608	0.000	1.482	8.606	1.552	0.335	4.025

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	1.054	2.113	0.032	5.074	54.170	53.540	0.535	1.121
2	18:17:03	1.021	2.146	0.011	5.059	52.750	51.090	0.494	1.078
3	18:17:46	0.947	2.024	0.205	5.068	52.350	52.400	0.529	1.041
x		100.745%	104.724%	0.082	1013.423%	106.176%	104.686%	103.901%	107.996%
σ		n/a	n/a	0.106	n/a	n/a	n/a	n/a	n/a
%RSD		5.456	3.008	129.100	0.155	1.798	2.341	4.257	3.683

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	2.420	2.248	5.387	5.606	1.105	-0.011	5.162	4.940
2	18:17:03	2.324	2.371	5.639	5.671	1.127	-0.013	5.332	5.329
3	18:17:46	2.414	2.220	5.703	5.760	1.283	-0.028	5.290	5.143
x		119.311%	114.002%	111.524%	113.577%	117.192%	-0.017	105.223%	102.750%
σ		n/a	n/a	n/a	n/a	n/a	0.009	n/a	n/a
%RSD		2.248	3.520	2.990	1.364	8.261	51.110	1.688	3.782

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	0.000	4.784	88.767%	4.806	4.738	86.852%	1.095	0.324
2	18:17:03	0.000	4.797	89.132%	4.723	4.925	87.153%	1.055	0.989
3	18:17:46	0.000	4.878	89.314%	4.757	4.829	87.378%	1.050	0.933
x		0.000	96.393%	89.071%	95.244%	96.610%	87.128%	106.644%	0.749
σ		0.000	n/a	0.278%	n/a	n/a	0.264%	n/a	0.369
%RSD		0.000	1.065	0.313	0.879	1.944	0.303	2.297	49.260

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	1.090	1.077	1.040	85.720%	5.371	1.969	1.983	10.330
2	18:17:03	1.110	0.883	0.962	87.237%	5.326	1.980	1.963	10.510
3	18:17:46	1.104	1.034	0.981	87.397%	5.486	1.970	1.977	10.190
x		110.126%	99.843%	99.441%	86.785%	107.879%	98.659%	98.718%	103.431%
σ		n/a	n/a	n/a	0.925%	n/a	n/a	n/a	n/a
%RSD		0.939	10.190	4.128	1.066	1.530	0.310	0.527	1.560

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:16:20	10.460	84.484%	84.230%	0.946	0.990	0.983	86.563%
2	18:17:03	10.240	86.410%	85.743%	0.960	1.000	0.990	87.065%
3	18:17:46	10.130	86.710%	86.540%	0.978	0.982	1.006	87.334%
x		102.777%	85.868%	85.504%	96.101%	99.084%	99.310%	86.987%
σ		n/a	1.208%	1.173%	n/a	n/a	n/a	0.392%
%RSD		1.621	1.407	1.372	1.691	0.917	1.213	0.450

MB 180-89540/1-A 11/13/2013 6:25:14 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	91.317%	-0.080	3.147	3.092	0.000	13.980	6.153	6.061
2	18:26:40	89.481%	-0.061	2.786	3.003	0.000	12.970	5.779	6.214
3	18:27:23	86.724%	-0.042	3.391	2.827	0.000	11.720	5.287	5.375
x		89.174%	-0.061	3.108	2.974	0.000	12.890	5.740	5.883
σ		2.312%	0.019	0.304	0.135	0.000	1.132	0.434	0.447
%RSD		2.592	30.850	9.786	4.549	0.000	8.778	7.564	7.594
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	1.322	2.920	0.000	15.450	28.550	21.110	87.332%	0.030
2	18:26:40	1.343	2.898	0.000	13.390	20.090	18.950	86.922%	0.050
3	18:27:23	1.255	2.798	0.000	12.870	20.670	20.360	86.703%	0.105
x		1.307	2.872	0.000	13.900	23.110	20.140	86.986%	0.062
σ		0.046	0.065	0.000	1.368	4.726	1.094	0.319%	0.039
%RSD		3.521	2.256	0.000	9.842	20.450	5.430	0.367	63.330
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	-0.001	0.224	4.386	0.132	8.115	6.094	0.000	0.130
2	18:26:40	0.069	0.211	4.042	0.128	6.344	3.937	0.002	0.090
3	18:27:23	-0.059	0.164	3.980	0.109	5.011	4.407	-0.000	0.092
x		0.003	0.200	4.136	0.123	6.490	4.812	0.001	0.104
σ		0.064	0.031	0.219	0.012	1.557	1.134	0.001	0.022
%RSD		2226.000	15.740	5.282	9.742	24.000	23.570	149.000	21.520
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	0.373	0.417	1.334	1.302	-0.010	0.084	-0.019	0.259
2	18:26:40	0.400	0.303	1.296	1.273	-0.013	0.085	0.122	0.202
3	18:27:23	0.342	0.342	1.114	1.064	0.033	0.074	0.071	0.094
x		0.371	0.354	1.248	1.213	0.003	0.081	0.058	0.185
σ		0.029	0.058	0.117	0.130	0.026	0.006	0.071	0.083
%RSD		7.816	16.300	9.404	10.690	782.100	7.344	123.700	45.120
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	0.000	0.062	85.795%	0.075	0.074	87.394%	-0.055	0.793
2	18:26:40	0.000	0.053	87.207%	0.084	0.070	87.931%	-0.051	0.742
3	18:27:23	0.000	0.054	86.985%	0.069	0.067	88.502%	-0.049	0.740
x		0.000	0.056	86.662%	0.076	0.070	87.942%	-0.052	0.758
σ		0.000	0.005	0.759%	0.007	0.003	0.554%	0.003	0.030
%RSD		0.000	8.517	0.876	9.820	4.880	0.630	5.397	3.937
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:25:57	-0.051	-0.058	-0.046	87.370%	3.321	0.007	0.006	0.159
2	18:26:40	-0.045	-0.056	-0.033	88.133%	3.077	0.005	0.005	0.121
3	18:27:23	-0.048	-0.057	-0.054	88.103%	2.908	0.016	0.009	0.145
x		-0.048	-0.057	-0.044	87.868%	3.102	0.009	0.007	0.141
σ		0.003	0.001	0.011	0.432%	0.207	0.006	0.002	0.019
%RSD		6.326	1.243	23.640	0.491	6.690	61.990	33.210	13.410
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	18:25:57	0.145	87.622%	87.802%	0.005	0.005	0.063	88.926%	
2	18:26:40	0.144	90.143%	90.021%	0.007	0.004	0.054	90.216%	
3	18:27:23	0.144	91.205%	91.020%	0.006	0.005	0.051	90.693%	
x		0.145	89.657%	89.614%	0.006	0.005	0.056	89.945%	
σ		0.001	1.840%	1.647%	0.001	0.000	0.007	0.914%	
%RSD		0.414	2.053	1.838	21.200	7.937	11.970	1.016	

MB 180-89541/1-A 11/13/2013 6:30:01 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	100.485%	-0.102	2.685	2.856	0.000	9.116	5.311	5.390
2	18:31:27	98.534%	-0.087	2.473	2.595	0.000	8.981	4.976	5.126
3	18:32:10	99.084%	-0.070	2.660	2.306	0.000	8.274	4.858	4.738
x		99.368%	-0.087	2.606	2.586	0.000	8.790	5.048	5.085
σ		1.006%	0.016	0.116	0.275	0.000	0.452	0.235	0.328
%RSD		1.012	18.130	4.451	10.630	0.000	5.143	4.653	6.447

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	1.259	2.208	0.000	8.988	21.790	21.120	92.291%	0.033
2	18:31:27	1.171	2.281	0.000	7.683	21.110	18.860	91.525%	0.058
3	18:32:10	1.104	1.849	0.000	6.502	25.610	17.140	93.127%	0.046
x		1.178	2.113	0.000	7.725	22.840	19.040	92.314%	0.046
σ		0.078	0.231	0.000	1.243	2.427	1.994	0.801%	0.012
%RSD		6.598	10.940	0.000	16.100	10.630	10.470	0.868	26.690

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	0.004	0.069	0.106	0.097	9.342	6.217	0.001	0.072
2	18:31:27	0.000	0.067	0.103	0.077	8.963	6.154	0.002	0.060
3	18:32:10	-0.001	0.071	0.098	0.077	7.383	4.340	0.001	0.036
x		0.001	0.069	0.102	0.084	8.563	5.570	0.002	0.056
σ		0.003	0.002	0.004	0.012	1.039	1.066	0.001	0.018
%RSD		238.300	2.713	4.111	13.900	12.130	19.140	56.850	32.290

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	0.313	0.275	1.213	1.121	0.023	-0.000	-0.051	0.119
2	18:31:27	0.302	0.246	1.226	1.332	-0.023	0.005	0.089	-0.113
3	18:32:10	0.287	0.268	1.191	1.062	-0.050	0.007	0.086	-0.150
x		0.301	0.263	1.210	1.172	-0.017	0.004	0.041	-0.048
σ		0.013	0.015	0.018	0.142	0.037	0.004	0.080	0.145
%RSD		4.215	5.770	1.481	12.100	221.400	88.910	195.100	303.800

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	0.000	0.053	89.016%	0.104	0.104	90.723%	-0.049	0.138
2	18:31:27	0.000	0.055	90.564%	0.102	0.127	92.302%	-0.053	0.706
3	18:32:10	0.000	0.045	90.973%	0.076	0.080	93.070%	-0.046	0.334
x		0.000	0.051	90.184%	0.094	0.103	92.032%	-0.049	0.393
σ		0.000	0.005	1.032%	0.015	0.023	1.197%	0.004	0.289
%RSD		0.000	10.210	1.144	16.400	22.620	1.300	7.469	73.590

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	-0.052	-0.006	-0.014	89.197%	3.358	0.006	0.009	0.129
2	18:31:27	-0.045	-0.051	-0.045	91.342%	3.159	0.005	0.012	0.127
3	18:32:10	-0.042	-0.020	-0.021	90.732%	3.066	0.010	0.005	0.136
x		-0.046	-0.026	-0.027	90.423%	3.194	0.007	0.009	0.131
σ		0.005	0.023	0.017	1.105%	0.149	0.003	0.004	0.005
%RSD		11.230	89.690	62.900	1.222	4.678	37.290	41.970	3.717

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:30:44	0.149	87.396%	87.800%	0.004	0.005	0.038	87.907%
2	18:31:27	0.147	89.647%	89.445%	0.006	0.007	0.032	89.576%
3	18:32:10	0.149	90.910%	90.234%	0.003	0.004	0.029	89.495%
x		0.148	89.318%	89.160%	0.004	0.005	0.033	88.993%
σ		0.001	1.780%	1.242%	0.001	0.001	0.005	0.941%
%RSD		0.476	1.993	1.393	32.670	26.530	14.720	1.058

LCS 180-89540/2-A 11/13/2013 6:34:49 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	67.056%	43.890	828.700	834.400	0.000	47630.000	49430.000	48960.000
2	18:36:15	62.032%	45.640	863.900	859.600	0.000	48400.000	51270.000	50820.000
3	18:36:58	60.117%	44.670	869.700	852.600	0.000	46830.000	49840.000	48770.000
x		63.069%	44.730	854.100	848.900	0.000	47620.000	50180.000	49510.000
σ		3.584%	0.877	22.220	13.030	0.000	783.300	965.800	1130.000
%RSD		5.682	1.961	2.602	1.535	0.000	1.645	1.925	2.283

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	1974.000	5376.000	0.000	48550.000	51410.000	52040.000	61.235%	990.100
2	18:36:15	2045.000	5476.000	0.000	48910.000	52140.000	52670.000	60.055%	987.800
3	18:36:58	1946.000	5219.000	0.000	45140.000	47530.000	48580.000	64.120%	925.200
x		1988.000	5357.000	0.000	47530.000	50360.000	51100.000	61.803%	967.700
σ		51.270	129.700	0.000	2083.000	2478.000	2200.000	2.091%	36.850
%RSD		2.579	2.420	0.000	4.381	4.919	4.305	3.384	3.808

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	510.500	198.000	45.770	489.600	1047.000	1172.000	485.000	480.700
2	18:36:15	509.600	198.000	43.600	484.600	1047.000	1148.000	483.100	475.400
3	18:36:58	478.800	183.700	42.490	459.800	968.300	1068.000	452.600	447.600
x		499.600	193.200	43.950	478.000	1021.000	1130.000	473.500	467.900
σ		18.010	8.232	1.666	15.980	45.620	54.320	18.190	17.780
%RSD		3.605	4.260	3.791	3.342	4.468	4.809	3.842	3.800

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	245.000	244.800	448.500	450.500	35.160	0.830	8.783	9.087
2	18:36:15	240.100	242.900	451.000	451.700	34.980	0.868	8.382	9.321
3	18:36:58	229.400	236.200	432.800	433.800	33.310	0.896	8.312	8.815
x		238.200	241.300	444.100	445.300	34.480	0.864	8.492	9.075
σ		7.986	4.515	9.872	10.010	1.020	0.033	0.254	0.253
%RSD		3.353	1.871	2.223	2.249	2.959	3.851	2.994	2.788

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	0.000	995.900	65.936%	961.000	981.000	66.377%	47.820	14.540
2	18:36:15	0.000	999.000	65.175%	956.100	979.500	65.712%	47.900	12.430
3	18:36:58	0.000	994.100	64.707%	967.300	983.300	65.352%	48.020	11.110
x		0.000	996.300	65.273%	961.400	981.300	65.813%	47.920	12.700
σ		0.000	2.458	0.620%	5.616	1.937	0.520%	0.099	1.732
%RSD		0.000	0.247	0.950	0.584	0.197	0.790	0.207	13.640

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	47.680	46.650	41.320	70.413%	1891.000	419.100	418.800	1402.000
2	18:36:15	48.060	45.940	40.530	70.438%	1893.000	424.100	424.400	1621.000
3	18:36:58	47.910	46.690	40.890	70.242%	1886.000	429.200	429.400	1698.000
x		47.880	46.430	40.910	70.364%	1890.000	424.100	424.200	1574.000
σ		0.192	0.426	0.393	0.107%	3.763	5.023	5.291	153.600
%RSD		0.401	0.918	0.960	0.152	0.199	1.184	1.247	9.759

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:35:32	1896.000	79.532%	81.129%	47.630	48.410	19.980	74.906%
2	18:36:15	1899.000	80.941%	81.886%	47.820	49.080	20.100	76.719%
3	18:36:58	1897.000	81.099%	82.592%	48.170	49.160	20.100	76.721%
x		1897.000	80.524%	81.869%	47.870	48.880	20.060	76.116%
σ		1.803	0.863%	0.732%	0.274	0.411	0.068	1.047%
%RSD		0.095	1.071	0.894	0.573	0.840	0.338	1.376

LCS 180-89541/2-A 11/13/2013 6:39:36 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	60.974%	-0.174	5.815	5.264	0.000	5.975	3.922	3.442
2	18:41:02	57.781%	-0.117	4.453	4.246	0.000	3.791	0.152	0.156
3	18:41:45	64.251%	-0.154	4.527	3.910	0.000	2.828	-0.202	-0.208
x		61.002%	-0.148	4.931	4.473	0.000	4.198	1.291	1.130
σ		3.235%	0.029	0.766	0.705	0.000	1.612	2.286	2.010
%RSD		5.303	19.490	15.530	15.760	0.000	38.400	177.100	177.900
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	0.461	14.970	0.000	-7.278	1.258	0.355	91.396%	0.076
2	18:41:02	-0.254	2.402	0.000	-11.180	-2.080	-2.402	94.939%	-0.007
3	18:41:45	-0.300	1.101	0.000	-12.340	-2.514	-2.790	92.621%	-0.037
x		-0.031	6.159	0.000	-10.270	-1.112	-1.612	92.985%	0.011
σ		0.427	7.662	0.000	2.652	2.064	1.715	1.800%	0.059
%RSD		1381.000	124.400	0.000	25.830	185.600	106.400	1.936	554.300
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	0.025	-0.025	0.409	0.041	-19.700	-6.253	0.031	0.040
2	18:41:02	0.009	-0.048	0.333	0.022	-21.580	-6.570	-0.001	-0.005
3	18:41:45	-0.034	-0.056	0.304	0.020	-21.570	-6.952	-0.001	-0.011
x		0.000	-0.043	0.349	0.028	-20.950	-6.591	0.010	0.008
σ		0.030	0.016	0.054	0.011	1.082	0.350	0.019	0.028
%RSD		7369.000	37.660	15.510	41.350	5.166	5.307	192.000	338.700
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	-0.007	-0.003	-0.041	-0.036	0.623	-0.053	-0.108	2.240
2	18:41:02	-0.018	-0.021	-0.174	-0.104	0.629	-0.057	-0.089	2.249
3	18:41:45	-0.026	-0.028	-0.230	-0.183	0.665	-0.061	0.006	2.368
x		-0.017	-0.017	-0.149	-0.107	0.639	-0.057	-0.064	2.286
σ		0.010	0.013	0.097	0.074	0.023	0.004	0.061	0.072
%RSD		58.180	73.740	65.340	68.620	3.591	7.689	95.560	3.130
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	0.000	0.078	103.398%	0.488	0.498	100.214%	-0.054	2.913
2	18:41:02	0.000	0.006	106.109%	0.280	0.274	101.028%	-0.056	3.203
3	18:41:45	0.000	0.000	107.878%	0.168	0.188	106.351%	-0.057	3.432
x		0.000	0.028	105.795%	0.312	0.320	102.531%	-0.056	3.183
σ		0.000	0.043	2.257%	0.162	0.160	3.334%	0.001	0.260
%RSD		0.000	153.600	2.133	52.060	50.050	3.251	2.509	8.176
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:40:19	-0.048	-0.219	-0.155	102.385%	0.203	1.186	1.188	0.117
2	18:41:02	-0.053	-0.243	-0.171	100.158%	0.092	0.819	0.799	-0.003
3	18:41:45	-0.050	-0.266	-0.187	116.419%	0.017	0.534	0.529	-0.013
x		-0.050	-0.243	-0.171	106.321%	0.104	0.846	0.839	0.034
σ		0.003	0.023	0.016	8.816%	0.093	0.327	0.331	0.072
%RSD		5.042	9.520	9.248	8.292	89.720	38.620	39.440	215.200
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	18:40:19	0.145	127.851%	130.652%	0.043	0.044	0.019	121.727%	
2	18:41:02	0.002	127.565%	130.617%	0.008	0.006	0.019	129.677%	
3	18:41:45	-0.006	133.051%	135.873%	0.001	0.002	0.019	133.535%	
x		0.047	129.489%	132.381%	0.017	0.017	0.019	128.313%	
σ		0.085	3.088%	3.025%	0.023	0.023	0.000	6.021%	
%RSD		181.500	2.385	2.285	130.600	135.200	1.359	4.693	

180-26373-A-4-H 11/13/2013 6:44:24 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	80.677%	2.474	112.900	114.900	0.000	41640.000	26700.000	26560.000
2	18:45:49	75.820%	2.824	116.800	118.700	0.000	42440.000	27320.000	27170.000
3	18:46:32	77.443%	2.457	113.100	113.000	0.000	41050.000	26890.000	26680.000
x		77.980%	2.585	114.300	115.500	0.000	41710.000	26970.000	26800.000
σ		2.473%	0.207	2.197	2.901	0.000	698.400	318.100	324.800
%RSD		3.171	8.010	1.923	2.512	0.000	1.675	1.179	1.212
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	44760.000	1805.000	0.000	15380.000	32690.000	32890.000	80.371%	1845.000
2	18:45:49	45830.000	1871.000	0.000	15390.000	32700.000	33250.000	80.084%	1865.000
3	18:46:32	44700.000	1809.000	0.000	15480.000	32820.000	33010.000	78.872%	1867.000
x		45090.000	1828.000	0.000	15420.000	32740.000	33050.000	79.775%	1859.000
σ		634.800	36.600	0.000	55.700	75.630	184.000	0.796%	12.190
%RSD		1.408	2.002	0.000	0.361	0.231	0.557	0.997	0.656
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	155.400	176.500	8.412	942.400	136200.000	136100.000	32.730	179.900
2	18:45:49	157.800	177.200	4.276	932.400	136000.000	136200.000	32.580	177.900
3	18:46:32	157.300	178.900	5.818	948.500	138200.000	137100.000	33.080	179.900
x		156.800	177.500	6.169	941.100	136800.000	136400.000	32.800	179.200
σ		1.251	1.230	2.090	8.132	1238.000	557.700	0.255	1.165
%RSD		0.798	0.693	33.880	0.864	0.905	0.409	0.777	0.650
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	90.690	90.160	293.100	295.500	43.620	0.040	2.370	4.107
2	18:45:49	90.030	90.350	293.000	294.600	43.620	0.030	2.053	4.129
3	18:46:32	90.230	92.220	297.900	298.000	43.260	0.045	2.002	4.214
x		90.310	90.910	294.700	296.000	43.500	0.038	2.142	4.150
σ		0.340	1.138	2.774	1.743	0.211	0.008	0.200	0.056
%RSD		0.376	1.252	0.941	0.589	0.485	19.810	9.322	1.358
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	0.000	177.300	0.000	11.600	11.460	74.550%	0.416	-7.626
2	18:45:49	0.000	178.600	0.000	11.720	11.630	74.712%	0.427	-8.076
3	18:46:32	0.000	179.800	0.000	11.490	11.310	74.179%	0.427	-7.166
x		0.000	178.500	0.000	11.600	11.470	74.480%	0.423	-7.623
σ		0.000	1.260	0.000	0.116	0.158	0.274%	0.006	0.455
%RSD		0.000	0.706	0.000	0.997	1.376	0.367	1.490	5.970
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:45:07	0.355	1.843	1.569	76.886%	24.580	2.429	2.435	156.400
2	18:45:49	0.378	1.951	1.591	77.393%	24.580	1.764	1.784	157.400
3	18:46:32	0.364	1.726	1.531	77.451%	24.300	1.374	1.357	157.400
x		0.366	1.840	1.564	77.243%	24.490	1.856	1.859	157.100
σ		0.011	0.113	0.030	0.311%	0.160	0.533	0.543	0.561
%RSD		3.120	6.120	1.940	0.402	0.652	28.750	29.220	0.357
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	18:45:07	158.300	82.507%	82.421%	0.795	0.838	74.680	74.845%	
2	18:45:49	157.800	84.365%	84.563%	0.817	0.826	76.110	75.035%	
3	18:46:32	156.900	84.525%	84.437%	0.783	0.833	76.390	74.963%	
x		157.700	83.799%	83.807%	0.798	0.832	75.730	74.948%	
σ		0.708	1.122%	1.202%	0.017	0.006	0.920	0.096%	
%RSD		0.449	1.339	1.434	2.137	0.772	1.215	0.128	

180-26887-I-3-A @10 11/13/2013 6:49:10 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	72.540%	-0.055	37.890	39.860	0.000	852100.000	35180.000	34740.000
2	18:50:36	71.442%	-0.082	36.170	39.360	0.000	868600.000	35890.000	35330.000
3	18:51:19	70.474%	-0.014	36.530	39.520	0.000	862900.000	36310.000	35920.000
x		71.485%	-0.050	36.860	39.580	0.000	861200.000	35790.000	35330.000
σ		1.034%	0.034	0.905	0.255	0.000	8396.000	575.000	594.000
%RSD		1.446	68.330	2.456	0.643	0.000	0.975	1.607	1.681
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	3.061	316.700	0.000	5518.000	133200.000	134700.000	73.008%	0.441
2	18:50:36	1.796	315.900	0.000	5412.000	132800.000	133400.000	74.080%	0.294
3	18:51:19	1.580	324.000	0.000	5452.000	131800.000	133300.000	75.059%	0.341
x		2.146	318.900	0.000	5460.000	132600.000	133800.000	74.049%	0.359
σ		0.800	4.497	0.000	53.580	743.400	747.300	1.026%	0.075
%RSD		37.280	1.410	0.000	0.981	0.561	0.559	1.385	21.040
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	-0.109	0.081	2.469	13.950	19.430	479.300	0.132	-0.597
2	18:50:36	-0.086	0.057	2.404	13.930	12.460	449.000	0.127	-0.638
3	18:51:19	-0.047	0.064	2.423	13.670	11.100	444.100	0.117	-0.662
x		-0.081	0.067	2.432	13.850	14.330	457.500	0.125	-0.633
σ		0.031	0.012	0.034	0.159	4.471	19.060	0.008	0.033
%RSD		39.010	18.480	1.388	1.146	31.200	4.165	6.288	5.196
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	3.839	1.621	3.667	-1.365	5.421	-0.479	0.156	21.350
2	18:50:36	5.119	1.600	3.572	-0.548	5.369	-0.470	0.420	20.600
3	18:51:19	6.233	1.575	3.507	-2.513	5.166	-0.453	0.934	20.240
x		5.064	1.599	3.582	-1.475	5.319	-0.468	0.503	20.730
σ		1.198	0.023	0.081	0.987	0.135	0.014	0.396	0.565
%RSD		23.660	1.429	2.253	66.930	2.531	2.897	78.610	2.725
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	0.000	7454.000	71.446%	0.192	0.137	65.144%	-0.051	-0.274
2	18:50:36	0.000	7440.000	73.497%	0.173	0.112	66.124%	-0.053	0.799
3	18:51:19	0.000	7481.000	74.329%	0.196	0.095	67.429%	-0.052	0.746
x		0.000	7458.000	73.091%	0.187	0.115	66.233%	-0.052	0.424
σ		0.000	20.900	1.484%	0.012	0.021	1.146%	0.001	0.605
%RSD		0.000	0.280	2.030	6.422	18.560	1.731	1.503	142.600
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:49:53	-0.054	0.026	0.009	68.599%	0.118	0.289	0.268	8663.000
2	18:50:36	-0.046	-0.061	-0.045	70.828%	0.105	0.240	0.250	8695.000
3	18:51:19	-0.047	-0.050	-0.041	72.103%	0.081	0.225	0.208	8692.000
x		-0.049	-0.028	-0.026	70.510%	0.102	0.251	0.242	8683.000
σ		0.004	0.047	0.030	1.774%	0.019	0.034	0.031	17.810
%RSD		8.935	168.400	115.300	2.515	18.300	13.350	12.670	0.205
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	18:49:53	8653.000	72.366%	72.659%	0.016	0.015	0.019	63.132%	
2	18:50:36	8644.000	75.611%	76.174%	0.016	0.017	0.016	65.491%	
3	18:51:19	8625.000	77.530%	77.820%	0.015	0.012	0.015	66.768%	
x		8641.000	75.169%	75.551%	0.016	0.015	0.017	65.130%	
σ		14.440	2.610%	2.636%	0.001	0.002	0.002	1.844%	
%RSD		0.167	3.472	3.489	3.558	15.890	11.470	2.832	

CCV 993939 11/13/2013 6:58:44 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	78.898%	107.200	102.400	99.340	0.000	50120.000	51320.000	51720.000
2	19:00:10	76.594%	105.900	100.600	101.900	0.000	51450.000	52190.000	51410.000
3	19:00:53	77.840%	106.200	102.200	98.460	0.000	51110.000	51670.000	52060.000
x		77.777%	106.442%	101.705%	99.892%	0.000	101.791%	103.454%	103.463%
σ		1.153%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.483	0.644	0.987	1.780	0.000	1.359	0.852	0.624

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	515.800	5236.000	0.000	52460.000	51870.000	52360.000	75.508%	103.100
2	19:00:10	516.700	5250.000	0.000	52830.000	52260.000	52660.000	74.833%	104.400
3	19:00:53	506.000	5229.000	0.000	51840.000	51950.000	52510.000	74.770%	102.500
x		102.568%	104.762%	0.000	104.757%	104.050%	105.022%	75.037%	103.324%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.409%	n/a
%RSD		1.150	0.200	0.000	0.954	0.399	0.277	0.545	0.927

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	102.800	102.900	3.634	504.400	25670.000	25370.000	100.700	101.800
2	19:00:10	104.800	104.600	2.818	512.300	25890.000	25700.000	103.300	104.900
3	19:00:53	103.000	103.000	3.650	510.500	25970.000	25690.000	103.200	104.500
x		103.528%	103.516%	3.367	101.813%	103.379%	102.344%	102.433%	103.758%
σ		n/a	n/a	0.476	n/a	n/a	n/a	n/a	n/a
%RSD		1.068	0.924	14.120	0.816	0.614	0.746	1.444	1.615

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	105.300	104.700	104.600	105.100	104.000	-0.401	106.600	105.800
2	19:00:10	108.100	106.300	107.100	108.000	105.300	-0.436	105.500	107.000
3	19:00:53	106.200	105.600	106.000	106.200	103.400	-0.312	105.700	104.800
x		106.538%	105.527%	105.909%	106.425%	104.234%	-0.383	105.904%	105.880%
σ		n/a	n/a	n/a	n/a	n/a	0.064	n/a	n/a
%RSD		1.338	0.765	1.165	1.349	0.952	16.760	0.563	1.019

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	0.000	98.970	78.030%	100.700	103.000	72.398%	106.400	5.268
2	19:00:10	0.000	100.300	78.281%	101.700	103.400	73.449%	105.200	4.013
3	19:00:53	0.000	99.240	78.815%	103.300	104.800	73.290%	106.600	2.512
x		0.000	99.507%	78.375%	101.882%	103.726%	73.046%	106.091%	3.931
σ		0.000	n/a	0.401%	n/a	n/a	0.567%	n/a	1.380
%RSD		0.000	0.721	0.511	1.285	0.907	0.776	0.691	35.100

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	106.700	106.000	106.000	75.268%	100.600	101.800	101.200	103.200
2	19:00:10	106.400	105.900	106.400	75.918%	101.600	102.200	101.800	103.000
3	19:00:53	106.500	106.900	107.200	75.795%	102.100	102.700	102.400	105.600
x		106.516%	106.290%	106.527%	75.660%	101.451%	102.231%	101.821%	103.907%
σ		n/a	n/a	n/a	0.345%	n/a	n/a	n/a	n/a
%RSD		0.162	0.534	0.618	0.456	0.759	0.425	0.581	1.427

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:59:27	104.000	78.005%	78.444%	100.900	102.100	103.400	75.637%
2	19:00:10	103.600	79.693%	79.555%	102.400	103.500	104.600	76.235%
3	19:00:53	104.400	80.412%	80.926%	101.900	103.400	105.000	76.823%
x		104.014%	79.370%	79.642%	101.734%	103.007%	104.350%	76.232%
σ		n/a	1.236%	1.243%	n/a	n/a	n/a	0.593%
%RSD		0.359	1.557	1.561	0.729	0.730	0.807	0.778

CCB8 11/13/2013 7:08:20 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	100.440%	-0.058	2.736	2.654	0.000	8.871	1.124	1.175
2	19:09:46	98.318%	-0.084	2.036	2.628	0.000	8.679	1.172	0.986
3	19:10:29	96.464%	-0.091	2.740	2.588	0.000	8.848	1.274	1.112
x		98.407%	-0.078	2.504	2.624	0.000	8.799	1.190	1.091
σ		1.989%	0.018	0.405	0.033	0.000	0.105	0.076	0.097
%RSD		2.021	22.790	16.180	1.255	0.000	1.190	6.428	8.853

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	0.637	-0.204	0.000	5.315	-0.326	0.705	93.207%	0.065
2	19:09:46	0.609	0.372	0.000	5.025	-0.792	0.714	93.935%	0.027
3	19:10:29	0.644	0.086	0.000	4.428	-0.339	1.264	93.773%	0.022
x		0.630	0.085	0.000	4.923	-0.486	0.894	93.638%	0.038
σ		0.018	0.288	0.000	0.452	0.265	0.320	0.383%	0.023
%RSD		2.916	340.500	0.000	9.182	54.630	35.760	0.409	61.580

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	0.003	0.018	0.055	0.037	5.432	2.092	-0.001	0.020
2	19:09:46	0.009	0.027	0.047	0.037	4.819	1.110	0.003	0.006
3	19:10:29	-0.002	0.006	0.057	0.030	4.289	1.679	0.002	0.008
x		0.004	0.017	0.053	0.035	4.847	1.627	0.002	0.011
σ		0.006	0.011	0.005	0.004	0.572	0.493	0.002	0.008
%RSD		152.000	63.490	9.808	11.020	11.800	30.310	145.400	67.840

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	0.172	0.016	0.506	0.775	0.010	0.002	0.285	-0.036
2	19:09:46	0.164	0.006	0.577	0.652	-0.011	0.002	0.384	0.028
3	19:10:29	0.166	-0.004	0.631	0.719	0.041	-0.003	0.148	0.251
x		0.167	0.006	0.571	0.716	0.014	0.000	0.273	0.081
σ		0.004	0.010	0.063	0.061	0.026	0.003	0.118	0.151
%RSD		2.310	159.300	10.950	8.573	193.800	770.700	43.430	186.100

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	0.000	0.013	90.414%	0.112	0.084	91.669%	-0.051	0.984
2	19:09:46	0.000	0.012	91.806%	0.106	0.087	94.010%	-0.047	0.646
3	19:10:29	0.000	0.011	91.920%	0.094	0.090	93.669%	-0.048	0.418
x		0.000	0.012	91.380%	0.104	0.087	93.116%	-0.049	0.683
σ		0.000	0.001	0.838%	0.009	0.003	1.264%	0.002	0.284
%RSD		0.000	12.210	0.917	8.676	3.596	1.358	4.397	41.650

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	-0.050	-0.069	-0.047	90.913%	-0.009	0.065	0.070	0.004
2	19:09:46	-0.044	-0.042	-0.028	92.375%	-0.029	0.072	0.077	0.006
3	19:10:29	-0.046	-0.030	-0.015	92.265%	-0.027	0.060	0.061	0.009
x		-0.047	-0.047	-0.030	91.851%	-0.021	0.065	0.070	0.006
σ		0.003	0.020	0.016	0.814%	0.011	0.006	0.008	0.002
%RSD		5.796	43.110	52.560	0.886	51.370	9.692	11.340	34.810

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:03	0.019	89.321%	88.930%	0.009	0.008	0.012	90.914%
2	19:09:46	0.013	90.949%	90.348%	0.011	0.010	0.012	91.264%
3	19:10:29	0.012	91.839%	90.900%	0.010	0.007	0.010	90.630%
x		0.015	90.703%	90.059%	0.010	0.008	0.011	90.936%
σ		0.004	1.277%	1.016%	0.001	0.001	0.001	0.317%
%RSD		25.050	1.408	1.128	6.777	15.190	10.890	0.349

180-26700-A-1-H 11/13/2013 7:13:10 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	55.458%	16.510	192.200	186.600	0.000	2567.000	152400.000	150600.000
2	19:14:36	52.295%	16.640	189.700	189.800	0.000	2570.000	154500.000	152700.000
3	19:15:19	50.962%	16.310	184.000	183.200	0.000	2500.000	152400.000	150400.000
x		52.905%	16.490	188.700	186.600	0.000	2546.000	153100.000	151200.000
σ		2.309%	0.166	4.209	3.293	0.000	39.370	1228.000	1292.000
%RSD		4.365	1.007	2.231	1.765	0.000	1.547	0.802	0.855
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	131600.000	6393.000	0.000	7411.000	668900.000	633400.000	56.527%	3109.000
2	19:14:36	133900.000	6312.000	0.000	7302.000	667100.000	628500.000	54.715%	3071.000
3	19:15:19	132700.000	6260.000	0.000	7245.000	661000.000	632400.000	53.305%	3085.000
x		132700.000	6322.000	0.000	7319.000	665700.000	631400.000	54.849%	3088.000
σ		1129.000	66.810	0.000	84.110	4133.000	2595.000	1.615%	19.410
%RSD		0.850	1.057	0.000	1.149	0.621	0.411	2.945	0.628
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	496.600	935.500	30.190	51470.000	306000.000	314900.000	39.050	90.530
2	19:14:36	490.900	926.300	26.530	50910.000	302000.000	311300.000	38.710	89.050
3	19:15:19	493.000	923.500	27.480	49920.000	299300.000	308000.000	38.460	87.020
x		493.500	928.400	28.070	50770.000	302400.000	311400.000	38.740	88.870
σ		2.881	6.282	1.899	784.200	3408.000	3452.000	0.298	1.763
%RSD		0.584	0.677	6.765	1.545	1.127	1.109	0.769	1.984
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	199.800	203.900	2074.000	2091.000	51.130	1.826	6.546	9.532
2	19:14:36	199.600	202.900	2064.000	2082.000	51.090	1.932	6.003	8.750
3	19:15:19	198.400	200.000	2066.000	2091.000	50.580	1.960	6.339	8.948
x		199.200	202.300	2068.000	2088.000	50.930	1.906	6.296	9.077
σ		0.777	2.018	5.312	5.189	0.305	0.071	0.274	0.406
%RSD		0.390	0.998	0.257	0.249	0.599	3.726	4.355	4.477
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	0.000	932.100	0.000	11.510	11.290	57.327%	0.737	-19.250
2	19:14:36	0.000	927.100	0.000	11.360	11.280	56.219%	0.706	-20.110
3	19:15:19	0.000	928.700	0.000	11.500	11.000	54.985%	0.711	-17.130
x		0.000	929.300	0.000	11.460	11.190	56.177%	0.718	-18.830
σ		0.000	2.554	0.000	0.082	0.163	1.172%	0.017	1.536
%RSD		0.000	0.275	0.000	0.718	1.456	2.086	2.315	8.156
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:13:53	0.591	9.461	8.351	62.995%	158.100	2.590	2.612	1185.000
2	19:14:36	0.575	9.403	8.258	62.585%	157.700	2.731	2.617	1180.000
3	19:15:19	0.586	9.139	8.112	61.228%	158.300	2.656	2.615	1179.000
x		0.584	9.334	8.240	62.270%	158.100	2.659	2.614	1181.000
σ		0.008	0.172	0.121	0.925%	0.287	0.070	0.003	2.796
%RSD		1.404	1.839	1.462	1.485	0.181	2.649	0.099	0.237
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	19:13:53	1177.000	72.048%	72.314%	0.763	0.743	784.000	62.691%	
2	19:14:36	1181.000	72.096%	72.722%	0.741	0.760	789.700	63.099%	
3	19:15:19	1181.000	71.501%	72.211%	0.757	0.774	787.300	62.761%	
x		1180.000	71.882%	72.416%	0.754	0.759	787.000	62.850%	
σ		2.254	0.331%	0.270%	0.012	0.015	2.849	0.218%	
%RSD		0.191	0.460	0.373	1.541	1.998	0.362	0.347	

180-26700-A-2-F 11/13/2013 7:17:59 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	73.281%	2.548	13.610	12.500	0.000	310.600	6606.000	6505.000
2	19:19:24	68.008%	2.408	13.250	12.860	0.000	332.500	6648.000	6566.000
3	19:20:08	66.463%	2.270	12.650	12.710	0.000	328.900	6653.000	6487.000
x		69.251%	2.409	13.170	12.690	0.000	324.000	6636.000	6519.000
σ		3.574%	0.139	0.484	0.183	0.000	11.720	25.530	41.590
%RSD		5.162	5.768	3.675	1.438	0.000	3.619	0.385	0.638

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	27200.000	2413.000	0.000	3865.000	7558.000	7173.000	79.616%	292.100
2	19:19:24	27490.000	2414.000	0.000	3909.000	7620.000	7289.000	74.831%	289.800
3	19:20:08	27080.000	2403.000	0.000	3871.000	7754.000	7339.000	71.851%	292.700
x		27260.000	2410.000	0.000	3882.000	7644.000	7267.000	75.432%	291.500
σ		210.900	6.279	0.000	23.920	100.300	85.060	3.917%	1.546
%RSD		0.773	0.261	0.000	0.616	1.312	1.170	5.193	0.530

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	56.580	47.180	23.200	42780.000	127500.000	127700.000	32.080	125.500
2	19:19:24	57.870	47.710	21.600	43030.000	127200.000	127700.000	31.990	122.800
3	19:20:08	57.110	47.790	22.170	43350.000	127300.000	128400.000	31.980	123.600
x		57.180	47.560	22.320	43060.000	127300.000	128000.000	32.020	124.000
σ		0.648	0.331	0.811	285.400	137.000	397.100	0.057	1.353
%RSD		1.134	0.696	3.631	0.663	0.108	0.310	0.178	1.092

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	86.980	87.480	225.500	227.000	38.980	0.538	1.140	2.598
2	19:19:24	85.640	85.910	227.400	229.700	39.420	0.492	0.889	2.529
3	19:20:08	85.790	86.040	228.800	231.900	38.900	0.523	0.789	2.409
x		86.140	86.480	227.200	229.500	39.100	0.518	0.939	2.512
σ		0.733	0.869	1.651	2.456	0.280	0.024	0.181	0.096
%RSD		0.851	1.005	0.727	1.070	0.716	4.573	19.280	3.818

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	0.000	48.460	0.000	4.439	4.329	76.902%	0.060	-5.949
2	19:19:24	0.000	49.410	0.000	4.392	4.400	73.085%	0.070	-5.414
3	19:20:08	0.000	48.930	0.000	4.597	4.319	71.034%	0.057	-5.851
x		0.000	48.930	0.000	4.476	4.349	73.674%	0.063	-5.738
σ		0.000	0.476	0.000	0.107	0.044	2.978%	0.007	0.285
%RSD		0.000	0.974	0.000	2.397	1.011	4.043	11.090	4.959

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	0.029	2.102	1.951	78.577%	24.790	1.159	1.194	298.600
2	19:19:24	0.029	2.138	1.959	75.318%	24.450	1.137	1.140	298.000
3	19:20:08	0.025	2.144	1.991	73.360%	24.700	1.185	1.151	299.200
x		0.027	2.128	1.967	75.752%	24.650	1.161	1.161	298.600
σ		0.002	0.023	0.021	2.636%	0.177	0.024	0.029	0.601
%RSD		7.706	1.061	1.052	3.479	0.720	2.075	2.488	0.201

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:18:41	298.500	87.625%	86.957%	0.490	0.509	63.930	77.212%
2	19:19:24	298.800	85.377%	85.272%	0.488	0.509	64.210	76.088%
3	19:20:08	298.100	83.388%	83.265%	0.503	0.510	64.650	74.495%
x		298.500	85.464%	85.165%	0.494	0.509	64.260	75.932%
σ		0.349	2.120%	1.848%	0.008	0.000	0.361	1.366%
%RSD		0.117	2.480	2.170	1.662	0.086	0.561	1.798

180-26700-B-3-I 11/13/2013 7:22:46 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	67.821%	6.801	25.000	24.610	0.000	874.000	17960.000	17710.000
2	19:24:12	67.592%	6.475	25.010	25.200	0.000	883.600	18310.000	17860.000
3	19:24:55	67.378%	6.555	26.470	24.540	0.000	877.700	18100.000	18020.000
x		67.597%	6.610	25.490	24.790	0.000	878.400	18120.000	17860.000
σ		0.222%	0.170	0.845	0.364	0.000	4.858	179.900	155.200
%RSD		0.328	2.569	3.313	1.469	0.000	0.553	0.993	0.869
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	52850.000	4104.000	0.000	5336.000	36740.000	37350.000	72.252%	480.700
2	19:24:12	53150.000	4115.000	0.000	5383.000	36970.000	37510.000	73.810%	484.200
3	19:24:55	54040.000	4103.000	0.000	5411.000	37450.000	37940.000	74.459%	481.800
x		53350.000	4107.000	0.000	5377.000	37050.000	37600.000	73.507%	482.200
σ		618.500	6.590	0.000	37.760	363.600	305.100	1.134%	1.772
%RSD		1.159	0.160	0.000	0.702	0.981	0.812	1.543	0.367
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	119.700	98.450	25.950	9850.000	282200.000	294500.000	81.320	154.300
2	19:24:12	119.300	97.140	24.550	9806.000	281700.000	291200.000	81.360	153.000
3	19:24:55	120.900	98.410	25.520	9724.000	281200.000	291600.000	80.980	152.800
x		119.900	98.000	25.340	9793.000	281700.000	292400.000	81.220	153.400
σ		0.829	0.745	0.719	64.370	539.000	1832.000	0.207	0.804
%RSD		0.691	0.760	2.836	0.657	0.191	0.626	0.255	0.524
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	149.800	149.700	402.800	407.000	84.280	0.669	1.703	3.219
2	19:24:12	149.300	153.200	401.500	405.000	84.460	0.658	1.899	3.936
3	19:24:55	149.200	151.300	401.600	405.400	85.020	0.664	1.602	4.021
x		149.400	151.400	402.000	405.800	84.590	0.664	1.735	3.725
σ		0.329	1.755	0.746	1.016	0.381	0.005	0.151	0.441
%RSD		0.220	1.159	0.186	0.250	0.451	0.796	8.687	11.830
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	0.000	170.400	0.000	11.140	10.770	66.782%	0.128	-10.850
2	19:24:12	0.000	170.800	0.000	10.870	10.890	68.745%	0.144	-7.998
3	19:24:55	0.000	171.500	0.000	10.890	10.810	69.701%	0.141	-9.957
x		0.000	170.900	0.000	10.970	10.820	68.410%	0.138	-9.602
σ		0.000	0.540	0.000	0.153	0.062	1.488%	0.008	1.459
%RSD		0.000	0.316	0.000	1.398	0.570	2.175	5.990	15.190
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:23:29	0.068	1.981	1.678	69.049%	25.750	2.388	2.319	627.900
2	19:24:12	0.079	1.747	1.478	71.780%	26.080	2.391	2.379	629.600
3	19:24:55	0.069	1.885	1.571	72.410%	26.060	2.401	2.362	630.900
x		0.072	1.871	1.576	71.080%	25.960	2.393	2.353	629.500
σ		0.006	0.118	0.100	1.787%	0.188	0.007	0.031	1.508
%RSD		7.930	6.292	6.365	2.514	0.722	0.295	1.317	0.240
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	19:23:29	626.800	78.718%	78.618%	1.453	1.474	108.600	68.705%	
2	19:24:12	629.900	82.283%	81.857%	1.485	1.509	109.600	70.925%	
3	19:24:55	629.400	82.414%	82.638%	1.450	1.493	108.800	71.684%	
x		628.700	81.138%	81.038%	1.463	1.492	109.000	70.438%	
σ		1.685	2.097%	2.132%	0.019	0.018	0.546	1.548%	
%RSD		0.268	2.585	2.630	1.319	1.177	0.501	2.197	

180-26700-A-4-F 11/13/2013 7:27:33 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	37.708%	79.700	616.600	607.400	0.000	11820.000	604200.000	597600.000
2	19:28:59	34.981%	81.130	630.800	614.700	0.000	11920.000	622300.000	607100.000
3	19:29:42	34.533%	83.280	624.700	620.800	0.000	11880.000	624600.000	608800.000
x		35.741%	81.370	624.000	614.300	0.000	11870.000	617000.000	604500.000
σ		1.718%	1.801	7.100	6.713	0.000	48.730	11160.000	6038.000
%RSD		4.808	2.214	1.138	1.093	0.000	0.410	1.809	0.999

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	335100.000	2505.000	0.000	17800.000	2120000.000	2024000.000	43.298%	4741.000
2	19:28:59	342500.000	2346.000	0.000	17980.000	2156000.000	2045000.000	41.967%	4767.000
3	19:29:42	343900.000	2478.000	0.000	18010.000	2152000.000	2039000.000	41.658%	4789.000
x		340500.000	2443.000	0.000	17930.000	2142000.000	2036000.000	42.308%	4766.000
σ		4725.000	84.740	0.000	113.000	19750.000	10460.000	0.871%	23.840
%RSD		1.388	3.469	0.000	0.630	0.922	0.514	2.059	0.500

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	28.960	165.000	29.480	19850.000	322700.000	337800.000	15.650	9.450
2	19:28:59	29.250	164.600	29.350	19890.000	325200.000	340400.000	15.470	9.692
3	19:29:42	27.370	164.600	32.900	19960.000	325700.000	337500.000	15.440	8.980
x		28.530	164.700	30.580	19900.000	324500.000	338600.000	15.520	9.374
σ		1.013	0.218	2.012	58.860	1649.000	1598.000	0.113	0.362
%RSD		3.551	0.132	6.579	0.296	0.508	0.472	0.727	3.864

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	22.880	26.290	20.850	17.460	6.217	7.970	19.720	24.430
2	19:28:59	22.620	26.160	20.960	17.780	8.898	7.720	19.870	24.640
3	19:29:42	22.420	26.080	20.950	16.620	8.741	7.626	19.550	24.190
x		22.640	26.170	20.920	17.290	7.952	7.772	19.710	24.420
σ		0.231	0.107	0.059	0.598	1.505	0.178	0.161	0.224
%RSD		1.021	0.408	0.282	3.459	18.920	2.292	0.816	0.919

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	0.000	3509.000	0.000	15.020	14.450	38.828%	0.644	-63.830
2	19:28:59	0.000	3546.000	0.000	14.720	14.790	38.603%	0.681	-62.010
3	19:29:42	0.000	3527.000	0.000	14.940	14.820	38.413%	0.654	-57.760
x		0.000	3527.000	0.000	14.890	14.690	38.614%	0.659	-61.200
σ		0.000	18.570	0.000	0.155	0.205	0.208%	0.019	3.117
%RSD		0.000	0.527	0.000	1.041	1.393	0.538	2.907	5.093

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	0.010	4.934	3.092	45.187%	21.350	0.189	0.312	1036.000
2	19:28:59	0.022	4.770	3.003	45.605%	21.430	0.163	0.240	900.400
3	19:29:42	0.004	4.458	2.817	45.443%	21.160	0.178	0.287	967.000
x		0.012	4.721	2.971	45.412%	21.320	0.176	0.280	967.800
σ		0.009	0.242	0.140	0.210%	0.142	0.013	0.036	67.790
%RSD		73.570	5.120	4.722	0.463	0.667	7.370	12.960	7.004

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:28:16	3458.000	57.157%	60.052%	0.027	0.027	3.753	44.251%
2	19:28:59	3432.000	58.841%	61.515%	0.028	0.024	3.759	45.301%
3	19:29:42	3433.000	58.453%	61.458%	0.022	0.025	3.795	45.522%
x		3441.000	58.150%	61.008%	0.026	0.025	3.769	45.025%
σ		14.680	0.882%	0.829%	0.004	0.002	0.022	0.679%
%RSD		0.426	1.516	1.359	13.820	6.318	0.596	1.509

180-26700-A-5-F 11/13/2013 7:32:20 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	39.631%	61.180	608.100	606.300	0.000	7900.000	528100.000	518500.000
2	19:33:46	38.383%	61.200	606.800	589.100	0.000	7952.000	538500.000	525700.000
3	19:34:29	38.892%	61.700	613.000	602.400	0.000	7908.000	529300.000	517200.000
x		38.969%	61.360	609.300	599.300	0.000	7920.000	532000.000	520500.000
σ		0.627%	0.293	3.260	9.012	0.000	27.900	5678.000	4584.000
%RSD		1.610	0.477	0.535	1.504	0.000	0.352	1.067	0.881

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	263700.000	3627.000	0.000	11320.000	1600000.000	1518000.000	44.111%	4779.000
2	19:33:46	266300.000	3646.000	0.000	11280.000	1615000.000	1531000.000	43.646%	4789.000
3	19:34:29	263500.000	3632.000	0.000	11270.000	1614000.000	1520000.000	44.040%	4782.000
x		264500.000	3635.000	0.000	11290.000	1610000.000	1523000.000	43.933%	4784.000
σ		1532.000	9.854	0.000	24.840	8563.000	6874.000	0.251%	5.216
%RSD		0.579	0.271	0.000	0.220	0.532	0.451	0.571	0.109

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	240.800	417.600	40.510	34930.000	438900.000	461100.000	15.950	25.300
2	19:33:46	241.000	417.700	37.770	34960.000	438300.000	458800.000	16.110	25.780
3	19:34:29	236.800	410.800	40.650	34930.000	437900.000	457900.000	16.150	26.060
x		239.500	415.400	39.640	34940.000	438400.000	459300.000	16.070	25.710
σ		2.358	3.924	1.624	19.050	476.400	1657.000	0.105	0.383
%RSD		0.985	0.945	4.096	0.055	0.109	0.361	0.655	1.491

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	35.050	38.490	79.140	77.260	8.188	6.421	11.140	13.990
2	19:33:46	34.740	38.190	80.390	77.620	9.083	6.312	10.590	14.230
3	19:34:29	34.650	38.550	79.240	77.710	9.140	6.507	10.940	14.380
x		34.810	38.410	79.590	77.530	8.804	6.413	10.890	14.200
σ		0.210	0.192	0.694	0.235	0.534	0.098	0.279	0.197
%RSD		0.603	0.500	0.872	0.303	6.063	1.521	2.558	1.385

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	0.000	2388.000	0.000	4.616	4.560	41.406%	0.596	-51.100
2	19:33:46	0.000	2423.000	0.000	4.719	4.394	41.287%	0.586	-49.720
3	19:34:29	0.000	2421.000	0.000	4.633	4.559	41.337%	0.563	-55.900
x		0.000	2411.000	0.000	4.656	4.504	41.343%	0.582	-52.240
σ		0.000	19.480	0.000	0.055	0.095	0.060%	0.017	3.245
%RSD		0.000	0.808	0.000	1.188	2.120	0.144	2.953	6.211

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	0.029	4.089	2.636	47.287%	23.800	0.192	0.290	2368.000
2	19:33:46	0.031	3.994	2.517	47.836%	24.120	0.200	0.305	2306.000
3	19:34:29	0.022	4.384	2.842	47.602%	23.950	0.232	0.302	2313.000
x		0.027	4.155	2.665	47.575%	23.960	0.208	0.299	2329.000
σ		0.005	0.204	0.164	0.276%	0.163	0.021	0.008	33.590
%RSD		17.920	4.901	6.167	0.579	0.679	9.999	2.788	1.442

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:33:03	2349.000	58.385%	60.763%	0.051	0.045	12.940	47.055%
2	19:33:46	2343.000	59.523%	62.293%	0.047	0.044	13.060	47.541%
3	19:34:29	2407.000	59.570%	62.283%	0.045	0.049	12.960	47.377%
x		2367.000	59.159%	61.780%	0.047	0.046	12.990	47.324%
σ		35.330	0.671%	0.881%	0.003	0.003	0.066	0.247%
%RSD		1.493	1.134	1.426	6.406	6.525	0.511	0.522

180-26700-A-6-F 11/13/2013 7:37:07 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	45.414%	26.190	447.500	439.900	0.000	16640.000	324100.000	318700.000
2	19:38:33	43.053%	26.020	452.300	445.000	0.000	16930.000	336400.000	331300.000
3	19:39:16	43.093%	26.240	452.800	452.200	0.000	16750.000	329400.000	325800.000
x		43.853%	26.150	450.900	445.700	0.000	16780.000	330000.000	325300.000
σ		1.352%	0.117	2.883	6.215	0.000	146.200	6184.000	6324.000
%RSD		3.082	0.447	0.639	1.395	0.000	0.871	1.874	1.944
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	155200.000	4832.000	0.000	10170.000	1309000.000	1238000.000	45.936%	6132.000
2	19:38:33	157200.000	4752.000	0.000	10330.000	1323000.000	1253000.000	45.395%	6078.000
3	19:39:16	157600.000	4811.000	0.000	10190.000	1298000.000	1237000.000	46.088%	6049.000
x		156700.000	4798.000	0.000	10230.000	1310000.000	1243000.000	45.806%	6086.000
σ		1269.000	41.320	0.000	89.090	12370.000	8790.000	0.364%	42.510
%RSD		0.810	0.861	0.000	0.871	0.944	0.707	0.795	0.698
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	1407.000	3388.000	88.330	74600.000	511700.000	538500.000	32.020	167.100
2	19:38:33	1385.000	3345.000	85.030	74550.000	508900.000	538200.000	31.470	162.000
3	19:39:16	1390.000	3347.000	76.810	73490.000	505000.000	534700.000	31.650	164.100
x		1394.000	3360.000	83.390	74210.000	508500.000	537100.000	31.720	164.400
σ		11.480	23.980	5.932	625.200	3373.000	2119.000	0.282	2.543
%RSD		0.824	0.714	7.113	0.842	0.663	0.395	0.890	1.547
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	592.900	607.100	1141.000	1151.000	42.160	5.307	11.930	14.670
2	19:38:33	591.600	603.100	1146.000	1151.000	41.230	5.337	11.790	14.690
3	19:39:16	587.500	599.800	1139.000	1145.000	39.360	5.571	11.840	13.770
x		590.700	603.400	1142.000	1149.000	40.920	5.405	11.850	14.380
σ		2.825	3.666	3.735	3.567	1.431	0.144	0.072	0.525
%RSD		0.478	0.608	0.327	0.311	3.496	2.667	0.609	3.653
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	0.000	1508.000	0.000	41.560	41.930	45.162%	1.017	-38.330
2	19:38:33	0.000	1524.000	0.000	42.410	41.980	45.181%	0.994	-39.590
3	19:39:16	0.000	1517.000	0.000	42.240	42.290	45.360%	0.960	-37.540
x		0.000	1517.000	0.000	42.070	42.060	45.234%	0.990	-38.490
σ		0.000	8.238	0.000	0.450	0.196	0.109%	0.029	1.033
%RSD		0.000	0.543	0.000	1.071	0.467	0.242	2.930	2.684
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:37:50	0.597	9.090	7.720	50.171%	100.300	4.108	4.267	1778.000
2	19:38:33	0.608	9.075	7.612	50.747%	101.100	4.247	4.353	1784.000
3	19:39:16	0.603	9.028	7.507	51.343%	100.100	4.282	4.250	1769.000
x		0.603	9.064	7.613	50.754%	100.500	4.212	4.290	1777.000
σ		0.005	0.033	0.107	0.586%	0.559	0.092	0.055	7.650
%RSD		0.892	0.359	1.400	1.156	0.556	2.178	1.291	0.430
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	19:37:50	1771.000	56.241%	57.810%	0.341	0.328	261.700	48.963%	
2	19:38:33	1771.000	58.120%	59.489%	0.352	0.338	264.500	49.775%	
3	19:39:16	1761.000	58.338%	59.628%	0.334	0.356	264.800	50.232%	
x		1767.000	57.566%	58.976%	0.342	0.341	263.700	49.657%	
σ		5.733	1.153%	1.012%	0.009	0.014	1.684	0.643%	
%RSD		0.324	2.003	1.716	2.640	4.168	0.639	1.294	

180-26700-A-7-F 11/13/2013 7:41:54 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	39.713%	3.419	439.200	437.700	0.000	2644.000	238600.000	236500.000
2	19:43:20	38.824%	3.615	441.200	443.500	0.000	2655.000	242600.000	240200.000
3	19:44:03	39.757%	3.428	434.300	431.300	0.000	2573.000	240100.000	237100.000
x		39.431%	3.487	438.200	437.500	0.000	2624.000	240400.000	237900.000
σ		0.526%	0.111	3.518	6.086	0.000	44.410	2042.000	1951.000
%RSD		1.335	3.169	0.803	1.391	0.000	1.692	0.849	0.820

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	69710.000	5616.000	0.000	1550.000	2784000.000	2617000.000	38.794%	18170.000
2	19:43:20	70530.000	5629.000	0.000	1547.000	2787000.000	2633000.000	39.157%	17920.000
3	19:44:03	70150.000	5557.000	0.000	1530.000	2762000.000	2626000.000	39.173%	18110.000
x		70130.000	5601.000	0.000	1542.000	2777000.000	2625000.000	39.041%	18070.000
σ		412.700	38.640	0.000	11.080	13910.000	8086.000	0.214%	126.300
%RSD		0.588	0.690	0.000	0.718	0.501	0.308	0.549	0.699

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	4145.000	12340.000	502.200	317800.000	1588000.000	1991000.000	34.710	182.800
2	19:43:20	4048.000	12240.000	552.400	315300.000	1576000.000	1980000.000	33.860	182.000
3	19:44:03	4070.000	12210.000	588.600	316700.000	1574000.000	1977000.000	33.720	181.100
x		4088.000	12260.000	547.700	316600.000	1579000.000	1983000.000	34.100	182.000
σ		51.050	70.820	43.400	1279.000	7598.000	7344.000	0.535	0.884
%RSD		1.249	0.578	7.924	0.404	0.481	0.370	1.570	0.486

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	592.200	606.200	538.200	532.300	34.280	13.250	4.292	6.269
2	19:43:20	590.600	604.000	535.800	527.000	30.410	13.760	4.089	5.022
3	19:44:03	587.300	598.400	536.900	530.000	31.960	13.550	4.414	5.726
x		590.000	602.900	537.000	529.800	32.220	13.520	4.265	5.672
σ		2.501	4.019	1.209	2.698	1.948	0.255	0.164	0.625
%RSD		0.424	0.667	0.225	0.509	6.046	1.884	3.855	11.020

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	0.000	2008.000	0.000	414.300	410.600	36.444%	0.696	-29.320
2	19:43:20	0.000	2012.000	0.000	411.600	413.000	36.934%	0.747	-27.830
3	19:44:03	0.000	2008.000	0.000	411.200	410.000	37.166%	0.670	-26.820
x		0.000	2009.000	0.000	412.400	411.200	36.848%	0.704	-27.990
σ		0.000	2.168	0.000	1.722	1.589	0.369%	0.039	1.255
%RSD		0.000	0.108	0.000	0.417	0.387	1.000	5.547	4.484

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	0.904	3.700	2.624	40.782%	57.320	3.786	3.807	1111.000
2	19:43:20	0.926	3.625	2.459	41.628%	57.060	3.791	3.883	1108.000
3	19:44:03	0.918	3.604	2.330	41.745%	57.630	3.693	3.795	1111.000
x		0.916	3.643	2.471	41.385%	57.340	3.757	3.828	1110.000
σ		0.011	0.050	0.147	0.526%	0.283	0.055	0.047	2.253
%RSD		1.198	1.385	5.965	1.270	0.493	1.473	1.238	0.203

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:42:37	1113.000	42.033%	42.175%	0.086	0.063	109.700	36.324%
2	19:43:20	1114.000	42.735%	42.990%	0.100	0.060	109.500	37.424%
3	19:44:03	1117.000	43.109%	43.273%	0.099	0.059	110.000	37.382%
x		1115.000	42.626%	42.813%	0.095	0.061	109.700	37.043%
σ		1.898	0.546%	0.570%	0.008	0.002	0.241	0.624%
%RSD		0.170	1.281	1.332	8.140	2.962	0.220	1.683

180-26700-A-8-F 11/13/2013 7:46:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	61.426%	12.460	190.000	189.000	0.000	2824.000	81430.000	80740.000
2	19:48:07	57.373%	12.400	196.800	190.700	0.000	2793.000	82880.000	82510.000
3	19:48:50	56.290%	12.700	200.500	194.000	0.000	2902.000	83730.000	83040.000
x		58.363%	12.520	195.700	191.300	0.000	2840.000	82680.000	82100.000
σ		2.707%	0.156	5.332	2.549	0.000	56.080	1160.000	1206.000
%RSD		4.638	1.246	2.724	1.333	0.000	1.975	1.403	1.469

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	102400.000	9058.000	0.000	10360.000	293100.000	301400.000	57.545%	2542.000
2	19:48:07	104900.000	9035.000	0.000	10210.000	295000.000	300300.000	56.480%	2515.000
3	19:48:50	104400.000	9071.000	0.000	10280.000	291900.000	299200.000	56.172%	2497.000
x		103900.000	9055.000	0.000	10280.000	293300.000	300300.000	56.732%	2518.000
σ		1281.000	18.490	0.000	75.400	1555.000	1090.000	0.721%	22.770
%RSD		1.233	0.204	0.000	0.733	0.530	0.363	1.270	0.904

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	387.900	856.200	32.710	18930.000	501900.000	524000.000	75.070	204.300
2	19:48:07	377.800	841.800	40.110	18680.000	487200.000	523700.000	73.430	196.500
3	19:48:50	381.300	842.000	33.970	18590.000	488200.000	519200.000	74.090	199.600
x		382.300	846.700	35.600	18730.000	492400.000	522300.000	74.200	200.100
σ		5.159	8.214	3.961	176.200	8197.000	2690.000	0.823	3.910
%RSD		1.349	0.970	11.130	0.940	1.665	0.515	1.109	1.954

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	265.700	267.400	4490.000	4437.000	221.200	1.734	9.449	11.330
2	19:48:07	262.700	267.500	4492.000	4287.000	220.600	1.587	9.635	11.710
3	19:48:50	259.500	263.800	4497.000	4385.000	220.500	1.646	9.198	11.320
x		262.600	266.200	4493.000	4370.000	220.800	1.656	9.427	11.450
σ		3.097	2.122	3.587	75.850	0.358	0.074	0.219	0.223
%RSD		1.179	0.797	0.080	1.736	0.162	4.490	2.323	1.948

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	0.000	537.200	0.000	24.730	24.750	58.532%	0.795	-22.510
2	19:48:07	0.000	539.200	0.000	24.910	24.720	57.841%	0.801	-20.490
3	19:48:50	0.000	539.900	0.000	25.140	24.770	57.778%	0.794	-21.000
x		0.000	538.800	0.000	24.930	24.750	58.050%	0.797	-21.330
σ		0.000	1.394	0.000	0.205	0.026	0.418%	0.004	1.049
%RSD		0.000	0.259	0.000	0.821	0.104	0.720	0.528	4.916

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	0.696	4.657	2.513	61.682%	688.200	5.225	5.163	927.900
2	19:48:07	0.682	4.641	2.356	62.049%	688.200	5.286	5.216	934.900
3	19:48:50	0.616	4.532	2.310	61.610%	688.900	5.297	5.200	931.800
x		0.664	4.610	2.393	61.781%	688.400	5.270	5.193	931.500
σ		0.043	0.068	0.106	0.235%	0.390	0.039	0.027	3.500
%RSD		6.421	1.472	4.443	0.381	0.057	0.733	0.523	0.376

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:47:24	931.500	67.508%	67.466%	7.484	7.639	1523.000	60.754%
2	19:48:07	935.000	68.755%	68.876%	7.661	7.805	1527.000	62.066%
3	19:48:50	935.600	68.083%	68.556%	7.691	7.868	1534.000	61.568%
x		934.000	68.115%	68.299%	7.612	7.771	1528.000	61.463%
σ		2.217	0.624%	0.739%	0.112	0.119	5.345	0.662%
%RSD		0.237	0.916	1.082	1.468	1.526	0.350	1.077

180-26370-A-33-E 11/13/2013 7:51:28 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	57.242%	2.872	319.100	324.300	0.000	3106.000	329000.000	327500.000
2	19:52:54	53.831%	2.973	322.000	322.500	0.000	3160.000	337800.000	333900.000
3	19:53:37	52.439%	3.129	326.800	322.200	0.000	3162.000	340100.000	335400.000
x		54.504%	2.991	322.700	323.000	0.000	3143.000	335600.000	332300.000
σ		2.471%	0.130	3.862	1.142	0.000	31.470	5852.000	4202.000
%RSD		4.534	4.341	1.197	0.353	0.000	1.001	1.743	1.265

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	65550.000	3233.000	0.000	5710.000	644200.000	616000.000	53.230%	1485.000
2	19:52:54	67460.000	3267.000	0.000	5799.000	651500.000	619800.000	51.411%	1484.000
3	19:53:37	67150.000	3230.000	0.000	5726.000	650800.000	619700.000	51.475%	1484.000
x		66720.000	3243.000	0.000	5745.000	648800.000	618500.000	52.039%	1484.000
σ		1025.000	20.580	0.000	47.200	3992.000	2179.000	1.033%	0.359
%RSD		1.536	0.634	0.000	0.822	0.615	0.352	1.984	0.024

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	250.200	154.500	33.990	3230.000	245700.000	255000.000	55.750	202.200
2	19:52:54	247.200	152.200	32.240	3247.000	250300.000	256800.000	56.840	203.800
3	19:53:37	248.000	153.200	30.690	3207.000	246000.000	251400.000	54.520	200.100
x		248.400	153.300	32.310	3228.000	247300.000	254400.000	55.700	202.100
σ		1.552	1.157	1.652	19.930	2537.000	2747.000	1.158	1.848
%RSD		0.625	0.755	5.115	0.617	1.026	1.080	2.079	0.915

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	252.100	255.900	9105.000	9104.000	63.250	3.068	2.705	4.367
2	19:52:54	252.000	257.200	9164.000	9174.000	63.280	3.121	2.659	4.397
3	19:53:37	250.400	254.400	9125.000	9113.000	62.770	3.068	2.401	3.890
x		251.500	255.800	9131.000	9130.000	63.100	3.086	2.588	4.218
σ		0.949	1.434	30.240	37.930	0.283	0.031	0.164	0.284
%RSD		0.378	0.560	0.331	0.415	0.449	0.992	6.331	6.740

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	0.000	460.900	0.000	16.190	16.100	53.708%	0.501	-8.458
2	19:52:54	0.000	468.500	0.000	16.200	16.350	53.496%	0.489	-8.439
3	19:53:37	0.000	468.000	0.000	16.450	16.540	53.183%	0.497	-5.949
x		0.000	465.800	0.000	16.280	16.330	53.462%	0.496	-7.615
σ		0.000	4.214	0.000	0.146	0.218	0.264%	0.006	1.443
%RSD		0.000	0.905	0.000	0.897	1.332	0.493	1.243	18.940

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	0.420	9.550	9.044	57.896%	64.120	6.664	6.617	458.700
2	19:52:54	0.427	9.627	8.991	58.222%	63.540	6.726	6.641	460.300
3	19:53:37	0.424	9.501	8.800	58.379%	63.530	6.645	6.702	463.600
x		0.424	9.559	8.945	58.165%	63.730	6.678	6.653	460.900
σ		0.003	0.064	0.128	0.246%	0.338	0.042	0.044	2.517
%RSD		0.721	0.668	1.432	0.423	0.530	0.632	0.656	0.546

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:52:11	461.400	65.214%	65.673%	1.286	1.319	3540.000	56.687%
2	19:52:54	459.600	66.376%	67.044%	1.294	1.321	3577.000	57.822%
3	19:53:37	462.500	66.846%	67.808%	1.285	1.291	3570.000	58.667%
x		461.200	66.145%	66.842%	1.288	1.311	3563.000	57.726%
σ		1.459	0.840%	1.082%	0.005	0.017	19.510	0.994%
%RSD		0.316	1.270	1.618	0.407	1.281	0.548	1.721

180-26370-A-33-E SD@5 11/13/2013 7:56:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	81.094%	0.534	72.190	71.150	0.000	632.400	60820.000	60330.000
2	19:57:41	80.610%	0.570	71.980	71.800	0.000	638.100	61810.000	60240.000
3	19:58:24	79.242%	0.494	72.940	70.970	0.000	633.200	60980.000	60300.000
x		80.316%	0.533	72.370	71.310	0.000	634.600	61200.000	60290.000
σ		0.960%	0.038	0.505	0.436	0.000	3.103	534.900	42.200
%RSD		1.196	7.184	0.698	0.612	0.000	0.489	0.874	0.070
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	12340.000	629.700	0.000	1099.000	110700.000	111600.000	75.009%	273.800
2	19:57:41	12250.000	618.400	0.000	1082.000	109400.000	111000.000	75.938%	273.900
3	19:58:24	12280.000	616.500	0.000	1075.000	109600.000	111500.000	75.541%	274.900
x		12290.000	621.500	0.000	1085.000	109900.000	111400.000	75.496%	274.200
σ		44.580	7.132	0.000	12.660	711.800	319.600	0.466%	0.565
%RSD		0.363	1.148	0.000	1.167	0.648	0.287	0.617	0.206
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	46.280	28.940	6.846	586.600	46850.000	46770.000	10.590	40.680
2	19:57:41	46.470	28.740	6.672	588.300	46470.000	46620.000	10.600	40.230
3	19:58:24	46.740	28.650	6.179	589.000	47000.000	46740.000	10.690	40.190
x		46.500	28.780	6.565	588.000	46770.000	46710.000	10.630	40.370
σ		0.232	0.148	0.346	1.229	274.400	78.440	0.051	0.273
%RSD		0.498	0.515	5.271	0.209	0.587	0.168	0.485	0.677
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	50.450	50.810	1848.000	1858.000	12.230	0.228	0.346	0.657
2	19:57:41	50.290	50.590	1829.000	1843.000	12.080	0.230	0.373	0.324
3	19:58:24	50.820	50.420	1847.000	1858.000	11.940	0.220	0.297	0.686
x		50.520	50.610	1842.000	1853.000	12.080	0.226	0.339	0.556
σ		0.270	0.200	10.880	8.911	0.146	0.005	0.039	0.201
%RSD		0.534	0.394	0.591	0.481	1.211	2.353	11.430	36.190
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	0.000	72.750	82.781%	2.785	2.945	73.040%	0.073	-0.483
2	19:57:41	0.000	72.860	83.060%	2.751	2.867	73.758%	0.060	-0.940
3	19:58:24	0.000	73.290	82.492%	2.853	2.890	73.599%	0.058	0.111
x		0.000	72.970	82.777%	2.797	2.901	73.466%	0.064	-0.438
σ		0.000	0.284	0.284%	0.052	0.040	0.377%	0.008	0.527
%RSD		0.000	0.389	0.343	1.845	1.388	0.514	13.280	120.400
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:56:58	0.063	1.854	1.857	74.723%	12.390	1.389	1.422	91.530
2	19:57:41	0.047	2.000	1.921	74.692%	12.530	1.447	1.413	92.030
3	19:58:24	0.050	1.855	1.855	75.526%	12.430	1.379	1.402	91.970
x		0.053	1.903	1.878	74.980%	12.450	1.405	1.412	91.840
σ		0.009	0.084	0.038	0.473%	0.072	0.037	0.010	0.275
%RSD		16.220	4.407	2.017	0.630	0.582	2.616	0.727	0.299
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	19:56:58	91.150	76.300%	76.460%	0.258	0.255	686.400	69.613%	
2	19:57:41	93.300	78.088%	78.667%	0.253	0.270	687.600	71.228%	
3	19:58:24	91.800	78.322%	78.579%	0.249	0.258	692.800	71.294%	
x		92.080	77.570%	77.902%	0.254	0.261	688.900	70.712%	
σ		1.104	1.106%	1.250%	0.005	0.008	3.388	0.952%	
%RSD		1.198	1.426	1.604	1.796	3.163	0.492	1.346	

CCV 993939 11/13/2013 8:04:24 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	93.837%	108.300	100.800	101.700	0.000	49120.000	48320.000	48440.000
2	20:05:50	92.054%	105.300	103.400	101.300	0.000	49530.000	48750.000	49090.000
3	20:06:32	90.851%	105.900	102.300	102.400	0.000	49770.000	49230.000	49550.000
x		92.247%	106.462%	102.198%	101.812%	0.000	98.946%	97.542%	98.055%
σ		1.502%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.628	1.484	1.264	0.548	0.000	0.663	0.931	1.134
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	495.600	5204.000	0.000	51360.000	49640.000	48800.000	85.345%	101.600
2	20:05:50	500.800	5207.000	0.000	50910.000	49650.000	49360.000	85.135%	99.420
3	20:06:32	506.100	5197.000	0.000	50380.000	49470.000	49680.000	84.512%	99.220
x		100.167%	104.056%	0.000	101.770%	99.176%	98.560%	84.998%	100.096%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.433%	n/a
%RSD		1.051	0.101	0.000	0.962	0.207	0.905	0.510	1.344
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	102.000	100.500	2.981	489.100	24860.000	24710.000	103.900	108.100
2	20:05:50	101.700	100.000	3.016	484.200	24470.000	24650.000	102.600	105.100
3	20:06:32	100.900	101.000	2.339	485.900	24540.000	24470.000	103.200	105.800
x		101.515%	100.501%	2.779	97.276%	98.484%	98.433%	103.229%	106.359%
σ		n/a	n/a	0.381	n/a	n/a	n/a	n/a	n/a
%RSD		0.596	0.464	13.720	0.509	0.854	0.517	0.622	1.483
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	109.600	108.900	103.300	102.200	103.500	-0.378	103.300	102.000
2	20:05:50	108.300	107.200	100.700	101.000	103.000	-0.392	102.600	101.600
3	20:06:32	107.100	107.100	101.200	100.300	102.900	-0.401	102.500	103.600
x		108.326%	107.725%	101.732%	101.125%	103.115%	-0.390	102.795%	102.396%
σ		n/a	n/a	n/a	n/a	n/a	0.011	n/a	n/a
%RSD		1.154	0.965	1.354	0.945	0.344	2.891	0.397	1.051
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	0.000	95.700	80.855%	100.100	102.000	74.038%	107.600	2.209
2	20:05:50	0.000	96.220	80.802%	101.500	103.600	73.564%	107.300	1.938
3	20:06:32	0.000	95.860	81.457%	101.600	103.700	74.034%	106.700	3.777
x		0.000	95.925%	81.038%	101.055%	103.085%	73.879%	107.199%	2.642
σ		0.000	n/a	0.364%	n/a	n/a	0.273%	n/a	0.993
%RSD		0.000	0.277	0.449	0.828	0.905	0.369	0.420	37.580
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:05:07	108.000	105.500	106.300	73.082%	101.200	101.100	99.950	105.700
2	20:05:50	107.800	104.500	106.000	73.539%	101.000	100.700	100.600	104.300
3	20:06:32	108.300	105.600	105.700	74.015%	101.800	101.300	100.000	106.100
x		108.038%	105.207%	106.022%	73.545%	101.330%	101.047%	100.179%	105.353%
σ		n/a	n/a	n/a	0.466%	n/a	n/a	n/a	n/a
%RSD		0.267	0.606	0.273	0.634	0.417	0.277	0.328	0.859
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:05:07	104.900	71.902%	71.272%	100.800	102.100	102.700	67.967%	
2	20:05:50	106.100	72.616%	72.109%	102.000	103.800	104.800	67.749%	
3	20:06:32	106.000	72.857%	73.088%	102.900	104.300	105.200	67.869%	
x		105.652%	72.458%	72.156%	101.908%	103.420%	104.235%	67.861%	
σ		n/a	0.497%	0.909%	n/a	n/a	n/a	0.109%	
%RSD		0.634	0.686	1.260	1.028	1.101	1.294	0.161	

CCB9 11/13/2013 8:12:34 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	118.020%	-0.056	3.212	3.610	0.000	0.013	1.272	1.287
2	20:13:59	115.894%	-0.097	3.169	3.460	0.000	-0.050	1.214	1.095
3	20:14:42	115.300%	-0.138	3.722	3.459	0.000	-0.103	1.380	1.163
x		116.405%	-0.097	3.368	3.509	0.000	-0.047	1.289	1.182
σ		1.430%	0.041	0.308	0.087	0.000	0.058	0.084	0.098
%RSD		1.229	42.040	9.130	2.479	0.000	124.900	6.530	8.253

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	0.591	1.430	0.000	0.689	3.179	1.104	99.543%	0.078
2	20:13:59	0.621	1.347	0.000	0.130	2.664	1.360	101.184%	0.092
3	20:14:42	0.664	1.313	0.000	0.151	-0.160	0.942	99.890%	0.029
x		0.625	1.364	0.000	0.324	1.894	1.135	100.206%	0.066
σ		0.037	0.060	0.000	0.317	1.798	0.210	0.865%	0.033
%RSD		5.894	4.414	0.000	97.850	94.900	18.550	0.863	49.670

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	0.005	0.038	0.170	0.087	12.970	4.397	0.003	0.013
2	20:13:59	0.005	0.027	0.165	0.075	10.830	3.601	0.001	0.004
3	20:14:42	0.007	0.028	0.147	0.078	9.835	2.919	0.003	0.010
x		0.006	0.031	0.161	0.080	11.210	3.639	0.003	0.009
σ		0.001	0.006	0.012	0.006	1.605	0.740	0.001	0.004
%RSD		20.670	20.940	7.422	7.704	14.310	20.320	44.060	47.150

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	0.009	-0.005	0.649	0.643	0.104	-0.007	0.316	0.529
2	20:13:59	0.010	0.009	0.718	0.682	0.023	0.000	0.236	0.130
3	20:14:42	0.002	0.016	0.664	0.746	0.070	-0.004	0.271	0.278
x		0.007	0.007	0.677	0.691	0.066	-0.004	0.274	0.313
σ		0.004	0.011	0.036	0.052	0.041	0.004	0.040	0.202
%RSD		64.650	158.700	5.301	7.526	62.000	105.900	14.570	64.500

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	0.000	0.015	91.444%	0.150	0.174	93.502%	-0.050	0.496
2	20:13:59	0.000	0.016	92.654%	0.129	0.146	94.517%	-0.046	0.524
3	20:14:42	0.000	0.017	93.444%	0.123	0.123	94.901%	-0.047	0.068
x		0.000	0.016	92.514%	0.134	0.148	94.307%	-0.048	0.363
σ		0.000	0.001	1.007%	0.014	0.026	0.723%	0.002	0.256
%RSD		0.000	4.506	1.089	10.670	17.410	0.767	3.874	70.500

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	-0.051	-0.029	-0.015	89.136%	0.006	0.015	0.021	0.019
2	20:13:59	-0.044	-0.031	-0.025	90.784%	-0.021	0.018	0.027	0.020
3	20:14:42	-0.043	0.000	0.005	91.549%	-0.019	0.022	0.024	0.025
x		-0.046	-0.020	-0.012	90.490%	-0.012	0.018	0.024	0.021
σ		0.004	0.017	0.015	1.233%	0.015	0.003	0.003	0.003
%RSD		9.786	88.750	128.000	1.363	129.600	17.720	12.590	13.750

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:13:16	0.019	83.283%	81.869%	0.011	0.008	0.048	82.222%
2	20:13:59	0.017	84.236%	83.813%	0.010	0.009	0.048	82.485%
3	20:14:42	0.031	85.475%	84.093%	0.006	0.010	0.043	82.718%
x		0.022	84.331%	83.258%	0.009	0.009	0.047	82.475%
σ		0.007	1.099%	1.211%	0.002	0.001	0.003	0.248%
%RSD		33.240	1.303	1.455	26.420	8.101	5.995	0.301

180-26370-A-33-F MS 11/13/2013 8:17:23 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	52.260%	45.610	1362.000	1340.000	0.000	54600.000	548700.000	544300.000
2	20:18:49	48.928%	46.320	1391.000	1358.000	0.000	54400.000	562000.000	552000.000
3	20:19:32	48.050%	45.410	1372.000	1371.000	0.000	55120.000	564200.000	554000.000
x		49.746%	45.780	1375.000	1356.000	0.000	54710.000	558300.000	550100.000
σ		2.221%	0.480	14.460	15.260	0.000	372.800	8404.000	5164.000
%RSD		4.464	1.049	1.052	1.125	0.000	0.681	1.505	0.939

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	99630.000	9401.000	0.000	61180.000	1178000.000	1116000.000	49.822%	3919.000
2	20:18:49	99470.000	9336.000	0.000	61670.000	1192000.000	1134000.000	48.338%	3892.000
3	20:19:32	99710.000	9251.000	0.000	60430.000	1189000.000	1139000.000	47.863%	3861.000
x		99600.000	9329.000	0.000	61090.000	1186000.000	1130000.000	48.674%	3891.000
σ		122.800	75.450	0.000	626.800	7518.000	12150.000	1.022%	29.190
%RSD		0.123	0.809	0.000	1.026	0.634	1.076	2.100	0.750

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	1044.000	491.300	44.680	8474.000	396400.000	412500.000	517.900	735.400
2	20:18:49	1015.000	482.700	45.890	8400.000	390100.000	406200.000	561.400	724.100
3	20:19:32	1010.000	481.800	46.100	8274.000	386000.000	403200.000	560.400	718.900
x		1023.000	485.200	45.560	8382.000	390800.000	407300.000	546.600	726.100
σ		18.450	5.253	0.766	100.900	5249.000	4781.000	24.830	8.427
%RSD		1.804	1.082	1.681	1.204	1.343	1.174	4.543	1.161

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	551.900	560.500	11350.000	11350.000	132.000	5.295	11.100	13.010
2	20:18:49	548.000	561.000	11390.000	11460.000	133.400	5.203	10.760	13.040
3	20:19:32	551.600	562.200	11360.000	11380.000	133.500	5.407	11.080	13.450
x		550.500	561.200	11360.000	11400.000	133.000	5.302	10.980	13.170
σ		2.180	0.885	24.390	56.130	0.821	0.102	0.192	0.243
%RSD		0.396	0.158	0.215	0.493	0.617	1.929	1.752	1.844

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	0.000	1906.000	0.000	1066.000	1084.000	48.168%	45.690	0.393
2	20:18:49	0.000	1930.000	0.000	1082.000	1082.000	47.708%	45.940	-0.644
3	20:19:32	0.000	1930.000	0.000	1079.000	1081.000	47.413%	46.020	-3.048
x		0.000	1922.000	0.000	1076.000	1082.000	47.763%	45.890	-1.100
σ		0.000	13.820	0.000	8.680	1.538	0.380%	0.172	1.765
%RSD		0.000	0.719	0.000	0.807	0.142	0.797	0.374	160.500

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	45.200	53.550	47.260	52.920%	1883.000	348.900	349.000	2139.000
2	20:18:49	45.390	54.320	47.150	53.066%	1889.000	354.500	352.800	2244.000
3	20:19:32	45.520	53.910	47.270	53.141%	1886.000	353.900	356.200	2266.000
x		45.370	53.930	47.220	53.042%	1886.000	352.500	352.700	2216.000
σ		0.163	0.382	0.067	0.112%	3.336	3.075	3.616	67.830
%RSD		0.358	0.709	0.143	0.211	0.177	0.872	1.025	3.061

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:18:06	2623.000	58.313%	58.562%	53.400	54.310	2755.000	49.152%
2	20:18:49	2620.000	59.603%	60.259%	54.080	55.270	2777.000	50.186%
3	20:19:32	2607.000	59.864%	60.521%	54.060	55.680	2779.000	50.571%
x		2617.000	59.260%	59.781%	53.850	55.090	2770.000	49.969%
σ		8.449	0.831%	1.063%	0.392	0.705	13.510	0.734%
%RSD		0.323	1.402	1.779	0.727	1.280	0.488	1.468

180-26370-A-33-G MSD 11/13/2013 8:22:11 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	51.981%	48.370	1220.000	1220.000	0.000	53350.000	354200.000	351200.000
2	20:23:37	49.498%	49.370	1214.000	1205.000	0.000	53040.000	354100.000	352700.000
3	20:24:20	49.279%	48.020	1238.000	1223.000	0.000	53470.000	360800.000	354400.000
x		50.253%	48.590	1224.000	1216.000	0.000	53290.000	356400.000	352800.000
σ		1.500%	0.705	12.390	9.617	0.000	225.300	3841.000	1571.000
%RSD		2.986	1.450	1.012	0.791	0.000	0.423	1.078	0.445
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	123900.000	8900.000	0.000	59720.000	651700.000	616500.000	50.105%	3404.000
2	20:23:37	122300.000	8655.000	0.000	58580.000	644700.000	614300.000	49.773%	3371.000
3	20:24:20	124200.000	8653.000	0.000	58850.000	646700.000	618300.000	49.397%	3354.000
x		123500.000	8736.000	0.000	59050.000	647700.000	616400.000	49.758%	3376.000
σ		1017.000	142.100	0.000	593.500	3614.000	1998.000	0.354%	25.110
%RSD		0.823	1.627	0.000	1.005	0.558	0.324	0.711	0.744
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	852.800	384.300	46.330	6283.000	478100.000	504600.000	527.800	700.900
2	20:23:37	836.300	379.800	44.910	6221.000	472700.000	494100.000	538.700	685.100
3	20:24:20	828.800	376.900	43.830	6174.000	471500.000	494800.000	522.900	691.500
x		839.300	380.300	45.020	6226.000	474100.000	497900.000	529.800	692.500
σ		12.260	3.738	1.251	54.310	3493.000	5865.000	8.080	7.954
%RSD		1.460	0.983	2.778	0.872	0.737	1.178	1.525	1.149
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	454.600	462.300	10100.000	10140.000	104.200	3.569	10.790	13.270
2	20:23:37	448.200	458.900	10010.000	10120.000	104.200	3.523	11.060	13.270
3	20:24:20	450.300	458.400	10010.000	10060.000	102.800	3.580	11.260	12.920
x		451.000	459.900	10040.000	10110.000	103.800	3.557	11.040	13.150
σ		3.240	2.146	55.380	45.400	0.789	0.030	0.238	0.204
%RSD		0.718	0.467	0.552	0.449	0.760	0.848	2.159	1.554
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	0.000	1623.000	0.000	1056.000	1057.000	50.415%	46.920	-1.705
2	20:23:37	0.000	1635.000	0.000	1069.000	1065.000	49.766%	46.810	-5.172
3	20:24:20	0.000	1634.000	0.000	1060.000	1061.000	49.798%	46.700	-2.737
x		0.000	1631.000	0.000	1062.000	1061.000	49.993%	46.810	-3.205
σ		0.000	6.607	0.000	6.603	3.631	0.366%	0.108	1.780
%RSD		0.000	0.405	0.000	0.622	0.342	0.731	0.231	55.560
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:54	46.430	56.780	49.840	54.592%	2026.000	341.800	340.200	1218.000
2	20:23:37	46.360	57.140	49.870	55.004%	2015.000	342.600	341.200	1359.000
3	20:24:20	46.150	57.070	50.170	55.491%	2005.000	342.700	341.600	1465.000
x		46.320	57.000	49.960	55.029%	2015.000	342.400	341.000	1347.000
σ		0.144	0.192	0.182	0.450%	10.070	0.493	0.759	123.800
%RSD		0.311	0.337	0.364	0.818	0.500	0.144	0.223	9.189
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:22:54	2661.000	61.948%	62.224%	52.300	53.610	4288.000	52.866%	
2	20:23:37	2639.000	63.584%	63.641%	52.700	53.950	4284.000	54.217%	
3	20:24:20	2640.000	63.570%	64.067%	53.150	54.480	4313.000	54.352%	
x		2646.000	63.034%	63.311%	52.720	54.020	4295.000	53.812%	
σ		12.430	0.940%	0.965%	0.425	0.438	15.880	0.822%	
%RSD		0.470	1.492	1.523	0.806	0.811	0.370	1.528	

180-26370-B-34-G 11/13/2013 8:27:00 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	56.248%	5.502	76.190	77.770	0.000	769.300	171200.000	169500.000
2	20:28:26	52.003%	5.827	74.730	73.240	0.000	798.700	178900.000	176100.000
3	20:29:09	52.886%	5.514	71.780	71.880	0.000	787.900	174700.000	174400.000
x		53.712%	5.614	74.230	74.300	0.000	785.300	174900.000	173400.000
σ		2.240%	0.184	2.243	3.087	0.000	14.840	3844.000	3436.000
%RSD		4.170	3.283	3.021	4.155	0.000	1.890	2.197	1.982

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	91370.000	2804.000	0.000	12510.000	413800.000	398900.000	53.245%	1431.000
2	20:28:26	94760.000	2823.000	0.000	12750.000	397300.000	402500.000	51.607%	1428.000
3	20:29:09	94040.000	2829.000	0.000	12580.000	422800.000	406600.000	51.838%	1430.000
x		93390.000	2819.000	0.000	12610.000	411300.000	402700.000	52.230%	1430.000
σ		1785.000	13.180	0.000	122.300	12890.000	3870.000	0.887%	1.607
%RSD		1.911	0.468	0.000	0.970	3.134	0.961	1.698	0.112

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	238.500	145.400	29.860	5295.000	234600.000	237800.000	134.000	186.800
2	20:28:26	238.300	143.800	29.330	5308.000	233700.000	237700.000	131.100	184.700
3	20:29:09	237.900	144.800	29.430	5309.000	234700.000	238000.000	132.600	186.000
x		238.200	144.700	29.540	5304.000	234400.000	237800.000	132.600	185.800
σ		0.311	0.828	0.281	7.641	576.600	152.800	1.464	1.068
%RSD		0.131	0.572	0.950	0.144	0.246	0.064	1.104	0.575

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	274.200	278.400	1628.000	1633.000	129.200	2.109	2.763	4.760
2	20:28:26	269.400	276.100	1643.000	1655.000	129.800	2.188	2.502	4.583
3	20:29:09	270.700	275.600	1635.000	1647.000	129.800	2.181	2.910	4.851
x		271.400	276.700	1635.000	1645.000	129.600	2.159	2.725	4.731
σ		2.502	1.485	7.359	10.980	0.322	0.044	0.206	0.136
%RSD		0.922	0.537	0.450	0.667	0.249	2.022	7.579	2.875

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	0.000	443.500	0.000	37.040	37.250	54.750%	0.493	-6.599
2	20:28:26	0.000	446.900	0.000	36.720	37.000	54.434%	0.492	-5.342
3	20:29:09	0.000	443.000	0.000	36.350	36.380	54.584%	0.511	-6.424
x		0.000	444.500	0.000	36.700	36.880	54.589%	0.499	-6.122
σ		0.000	2.095	0.000	0.341	0.445	0.158%	0.011	0.681
%RSD		0.000	0.471	0.000	0.929	1.207	0.289	2.182	11.120

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	0.432	5.324	4.957	59.873%	41.440	7.009	6.918	779.400
2	20:28:26	0.467	5.126	4.902	59.426%	40.890	6.412	6.382	787.200
3	20:29:09	0.450	5.409	4.840	59.918%	40.390	6.143	6.219	789.600
x		0.450	5.286	4.900	59.739%	40.910	6.521	6.506	785.400
σ		0.017	0.145	0.059	0.272%	0.525	0.443	0.366	5.321
%RSD		3.873	2.747	1.197	0.456	1.284	6.796	5.622	0.677

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:27:43	777.300	69.503%	69.706%	3.220	3.279	559.900	60.455%
2	20:28:26	783.800	70.495%	70.968%	3.241	3.316	548.100	61.612%
3	20:29:09	782.600	70.362%	70.981%	3.236	3.283	526.600	61.704%
x		781.300	70.120%	70.552%	3.232	3.293	544.900	61.257%
σ		3.492	0.539%	0.732%	0.011	0.020	16.890	0.696%
%RSD		0.447	0.768	1.038	0.343	0.621	3.100	1.136

180-26370-B-35-A 11/13/2013 8:31:48 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	70.281%	9.572	90.760	89.380	0.000	768.900	40630.000	40120.000
2	20:33:14	70.388%	8.823	87.210	88.020	0.000	765.600	40340.000	39480.000
3	20:33:57	67.345%	9.376	87.750	90.340	0.000	787.000	42000.000	41290.000
x		69.338%	9.257	88.570	89.240	0.000	773.900	40990.000	40300.000
σ		1.727%	0.389	1.910	1.162	0.000	11.500	881.900	918.600
%RSD		2.490	4.197	2.157	1.302	0.000	1.486	2.151	2.280
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	144900.000	3569.000	0.000	11470.000	52960.000	53290.000	78.606%	1013.000
2	20:33:14	142900.000	3496.000	0.000	11250.000	52710.000	53050.000	78.223%	1012.000
3	20:33:57	148000.000	3631.000	0.000	11370.000	53470.000	54000.000	77.684%	1004.000
x		145300.000	3565.000	0.000	11360.000	53050.000	53440.000	78.171%	1010.000
σ		2558.000	67.780	0.000	110.500	384.300	493.300	0.464%	4.692
%RSD		1.760	1.901	0.000	0.973	0.724	0.923	0.593	0.465
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	332.500	182.700	35.610	4662.000	219700.000	225300.000	80.290	181.600
2	20:33:14	326.500	179.700	36.220	4592.000	222900.000	226000.000	78.750	181.300
3	20:33:57	338.800	180.700	34.980	4603.000	220900.000	226100.000	78.750	178.700
x		332.600	181.100	35.600	4619.000	221100.000	225800.000	79.260	180.500
σ		6.176	1.531	0.621	37.880	1609.000	458.400	0.886	1.584
%RSD		1.857	0.845	1.743	0.820	0.727	0.203	1.118	0.877
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	186.100	189.400	740.700	748.100	88.570	1.031	8.307	10.990
2	20:33:14	185.100	188.300	747.300	752.100	87.690	1.076	8.375	10.650
3	20:33:57	187.200	189.600	752.200	758.600	89.330	1.100	8.309	10.590
x		186.100	189.100	746.700	752.900	88.530	1.069	8.330	10.740
σ		1.031	0.660	5.783	5.311	0.821	0.035	0.039	0.219
%RSD		0.554	0.349	0.774	0.705	0.927	3.281	0.468	2.040
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	0.000	410.900	0.000	30.070	29.940	70.466%	0.883	-18.680
2	20:33:14	0.000	417.300	0.000	30.130	30.420	70.960%	0.904	-17.930
3	20:33:57	0.000	418.500	0.000	29.890	30.160	70.687%	0.894	-16.200
x		0.000	415.600	0.000	30.030	30.170	70.704%	0.894	-17.600
σ		0.000	4.076	0.000	0.129	0.238	0.247%	0.010	1.271
%RSD		0.000	0.981	0.000	0.430	0.788	0.350	1.171	7.222
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:32:31	0.760	7.627	7.144	73.252%	27.580	2.728	2.728	1566.000
2	20:33:14	0.744	7.666	7.060	74.032%	27.330	2.684	2.636	1580.000
3	20:33:57	0.766	7.399	7.040	74.916%	27.290	2.653	2.659	1529.000
x		0.757	7.564	7.081	74.066%	27.400	2.688	2.674	1558.000
σ		0.011	0.144	0.055	0.833%	0.158	0.038	0.048	25.910
%RSD		1.473	1.909	0.779	1.124	0.577	1.411	1.782	1.663
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:32:31	1561.000	83.116%	82.514%	1.695	1.741	177.500	69.001%	
2	20:33:14	1596.000	85.296%	85.045%	1.719	1.747	179.000	70.560%	
3	20:33:57	1589.000	86.056%	86.131%	1.703	1.795	179.200	71.251%	
x		1582.000	84.823%	84.563%	1.706	1.761	178.600	70.271%	
σ		18.770	1.526%	1.856%	0.012	0.029	0.949	1.152%	
%RSD		1.186	1.799	2.195	0.721	1.670	0.531	1.640	

180-26370-B-36-F 11/13/2013 8:36:36 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	54.872%	1.468	256.400	256.900	0.000	1656.000	985400.000	977600.000
2	20:38:02	52.161%	1.323	262.300	263.300	0.000	1646.000	1002000.000	1000000.000
3	20:38:45	52.653%	1.460	264.200	265.800	0.000	1667.000	1008000.000	993700.000
x		53.229%	1.417	261.000	262.000	0.000	1656.000	998600.000	990600.000
σ		1.444%	0.081	4.045	4.565	0.000	10.470	11810.000	11740.000
%RSD		2.714	5.731	1.550	1.743	0.000	0.632	1.182	1.186

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	14050.000	3427.000	0.000	8092.000	1845000.000	1756000.000	50.924%	104.900
2	20:38:02	14410.000	3530.000	0.000	8109.000	1862000.000	1769000.000	50.717%	102.700
3	20:38:45	14330.000	3478.000	0.000	8069.000	1840000.000	1763000.000	51.434%	102.600
x		14260.000	3478.000	0.000	8090.000	1849000.000	1763000.000	51.025%	103.400
σ		191.200	51.990	0.000	19.960	11530.000	6592.000	0.369%	1.310
%RSD		1.341	1.495	0.000	0.247	0.623	0.374	0.723	1.267

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	36.350	45.420	46.740	892.100	39450.000	46030.000	11.250	17.630
2	20:38:02	35.470	45.530	45.850	887.300	39460.000	45470.000	11.090	16.620
3	20:38:45	36.350	45.730	46.200	880.200	38940.000	44930.000	10.910	16.410
x		36.050	45.560	46.260	886.500	39290.000	45480.000	11.090	16.890
σ		0.509	0.156	0.450	6.028	300.100	546.100	0.169	0.652
%RSD		1.413	0.342	0.973	0.680	0.764	1.201	1.520	3.861

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	20.990	23.890	78.520	79.670	18.780	11.210	1.547	2.966
2	20:38:02	20.580	23.350	78.880	79.960	19.940	11.420	1.638	2.371
3	20:38:45	20.510	23.500	78.510	79.540	16.650	11.580	1.542	3.467
x		20.700	23.580	78.640	79.720	18.460	11.400	1.576	2.935
σ		0.260	0.281	0.210	0.211	1.668	0.187	0.054	0.549
%RSD		1.254	1.191	0.267	0.265	9.036	1.641	3.431	18.690

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	0.000	757.400	0.000	6.782	6.712	47.025%	0.095	-5.940
2	20:38:02	0.000	765.300	0.000	6.905	6.783	47.342%	0.073	-5.431
3	20:38:45	0.000	762.700	0.000	6.697	6.828	47.683%	0.074	-5.890
x		0.000	761.800	0.000	6.795	6.774	47.350%	0.081	-5.753
σ		0.000	4.023	0.000	0.105	0.058	0.329%	0.012	0.281
%RSD		0.000	0.528	0.000	1.544	0.858	0.695	15.280	4.876

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	0.038	0.904	0.717	51.932%	22.860	0.807	0.825	78.030
2	20:38:02	0.037	0.932	0.768	52.715%	22.820	0.833	0.860	78.150
3	20:38:45	0.050	0.948	0.695	52.625%	22.580	0.787	0.878	78.380
x		0.042	0.928	0.727	52.424%	22.750	0.809	0.855	78.180
σ		0.007	0.022	0.038	0.429%	0.153	0.023	0.027	0.178
%RSD		17.210	2.386	5.202	0.818	0.674	2.863	3.205	0.227

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:37:19	77.920	58.275%	59.042%	0.621	0.629	70.290	46.028%
2	20:38:02	78.350	59.256%	60.161%	0.594	0.605	70.610	46.755%
3	20:38:45	78.050	59.675%	60.278%	0.630	0.613	70.540	46.889%
x		78.110	59.069%	59.827%	0.615	0.616	70.480	46.558%
σ		0.217	0.719%	0.682%	0.019	0.013	0.171	0.463%
%RSD		0.278	1.216	1.141	3.041	2.072	0.242	0.995

180-26370-B-37-D 11/13/2013 8:41:24 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	51.341%	2.011	457.900	454.900	0.000	2246.000	610400.000	603600.000
2	20:42:49	48.139%	1.920	451.000	452.500	0.000	2246.000	618900.000	608200.000
3	20:43:33	46.470%	1.869	475.000	459.600	0.000	2285.000	630800.000	623300.000
x		48.650%	1.933	461.300	455.700	0.000	2259.000	620000.000	611700.000
σ		2.475%	0.072	12.350	3.625	0.000	22.710	10240.000	10310.000
%RSD		5.088	3.718	2.677	0.796	0.000	1.005	1.651	1.686
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	33780.000	2484.000	0.000	7002.000	1612000.000	1538000.000	46.305%	1263.000
2	20:42:49	34320.000	2484.000	0.000	7021.000	1622000.000	1551000.000	44.870%	1278.000
3	20:43:33	34770.000	2569.000	0.000	7031.000	1627000.000	1543000.000	45.002%	1258.000
x		34290.000	2513.000	0.000	7018.000	1620000.000	1544000.000	45.392%	1266.000
σ		493.700	49.070	0.000	14.850	7618.000	6541.000	0.793%	10.380
%RSD		1.440	1.953	0.000	0.212	0.470	0.424	1.747	0.820
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	134.200	327.800	43.200	5108.000	524900.000	552000.000	57.030	199.900
2	20:42:49	134.000	331.700	42.280	5099.000	528300.000	555300.000	56.750	197.200
3	20:43:33	133.800	328.700	41.300	5082.000	524400.000	551800.000	55.680	194.400
x		134.000	329.400	42.260	5096.000	525800.000	553000.000	56.490	197.200
σ		0.166	2.037	0.952	13.060	2105.000	1998.000	0.711	2.707
%RSD		0.124	0.619	2.254	0.256	0.400	0.361	1.259	1.373
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	786.600	798.000	2198.000	2215.000	68.100	8.286	6.519	8.355
2	20:42:49	791.300	805.800	2228.000	2250.000	68.650	8.203	6.975	8.385
3	20:43:33	775.000	793.400	2221.000	2245.000	70.540	7.929	6.702	8.082
x		784.300	799.100	2216.000	2237.000	69.100	8.139	6.732	8.274
σ		8.408	6.263	16.000	19.210	1.282	0.187	0.229	0.167
%RSD		1.072	0.784	0.722	0.859	1.855	2.297	3.405	2.017
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	0.000	1348.000	0.000	4179.000	4170.000	44.903%	1.659	37.760
2	20:42:49	0.000	1373.000	0.000	4225.000	4192.000	44.532%	1.656	33.930
3	20:43:33	0.000	1372.000	0.000	4224.000	4227.000	44.158%	1.656	33.670
x		0.000	1364.000	0.000	4209.000	4196.000	44.531%	1.657	35.120
σ		0.000	14.320	0.000	26.070	28.820	0.372%	0.002	2.291
%RSD		0.000	1.050	0.000	0.619	0.687	0.836	0.111	6.522
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:42:06	1.556	11.640	11.340	49.325%	109.100	8.500	8.483	489.300
2	20:42:49	1.563	12.130	11.350	49.798%	108.800	8.611	8.600	493.000
3	20:43:33	1.597	11.770	10.840	50.045%	109.600	8.697	8.761	494.600
x		1.572	11.850	11.180	49.723%	109.200	8.602	8.615	492.300
σ		0.022	0.252	0.296	0.366%	0.421	0.099	0.140	2.719
%RSD		1.404	2.127	2.650	0.736	0.385	1.147	1.623	0.552
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:42:06	492.500	53.289%	53.305%	1.107	1.160	8510.000	44.945%	
2	20:42:49	491.600	54.980%	55.213%	1.118	1.155	8479.000	46.375%	
3	20:43:33	494.600	54.857%	55.538%	1.099	1.166	8501.000	46.506%	
x		492.900	54.375%	54.685%	1.108	1.160	8496.000	45.942%	
σ		1.548	0.942%	1.207%	0.010	0.006	15.970	0.866%	
%RSD		0.314	1.733	2.207	0.873	0.490	0.188	1.885	

180-26370-B-38-D 11/13/2013 8:46:11 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	54.709%	1.374	327.200	324.000	0.000	1732.000	269700.000	267300.000
2	20:47:37	51.342%	1.473	339.700	326.100	0.000	1752.000	277600.000	275500.000
3	20:48:20	51.764%	1.227	330.600	319.500	0.000	1732.000	276100.000	269600.000
x		52.605%	1.358	332.500	323.200	0.000	1739.000	274500.000	270800.000
σ		1.834%	0.124	6.461	3.407	0.000	11.200	4222.000	4256.000
%RSD		3.486	9.117	1.943	1.054	0.000	0.644	1.538	1.572
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	27660.000	2347.000	0.000	4166.000	1199000.000	1146000.000	47.595%	1175.000
2	20:47:37	28260.000	2359.000	0.000	4115.000	1200000.000	1152000.000	46.392%	1174.000
3	20:48:20	27850.000	2312.000	0.000	4126.000	1202000.000	1141000.000	45.759%	1167.000
x		27920.000	2339.000	0.000	4136.000	1200000.000	1146000.000	46.582%	1172.000
σ		308.700	24.360	0.000	26.700	1418.000	5341.000	0.933%	4.720
%RSD		1.106	1.041	0.000	0.645	0.118	0.466	2.002	0.403
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	88.550	571.900	51.800	7205.000	689500.000	746700.000	58.370	276.300
2	20:47:37	83.430	559.200	55.260	7123.000	690700.000	748300.000	58.040	273.500
3	20:48:20	84.230	563.700	52.690	7193.000	693400.000	745800.000	58.060	273.500
x		85.400	564.900	53.250	7174.000	691200.000	746900.000	58.160	274.400
σ		2.753	6.430	1.800	44.330	2003.000	1285.000	0.182	1.640
%RSD		3.224	1.138	3.379	0.618	0.290	0.172	0.314	0.598
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	1355.000	1373.000	3434.000	3467.000	60.610	6.732	3.222	5.040
2	20:47:37	1340.000	1368.000	3442.000	3471.000	59.040	6.633	3.483	5.420
3	20:48:20	1337.000	1355.000	3435.000	3477.000	60.650	6.564	3.325	4.706
x		1344.000	1365.000	3437.000	3472.000	60.100	6.643	3.343	5.055
σ		9.875	9.200	4.690	4.953	0.919	0.085	0.131	0.357
%RSD		0.735	0.674	0.136	0.143	1.530	1.275	3.921	7.071
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	0.000	1053.000	0.000	557.300	557.700	46.709%	1.920	-1.855
2	20:47:37	0.000	1060.000	0.000	559.300	560.300	46.273%	1.981	-2.406
3	20:48:20	0.000	1059.000	0.000	553.500	556.100	46.574%	1.938	-1.310
x		0.000	1057.000	0.000	556.700	558.100	46.519%	1.946	-1.857
σ		0.000	4.227	0.000	2.938	2.135	0.223%	0.031	0.548
%RSD		0.000	0.400	0.000	0.528	0.383	0.480	1.615	29.530
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:46:54	1.914	9.827	9.110	51.025%	150.000	9.282	9.377	653.400
2	20:47:37	1.865	9.691	8.937	51.703%	149.700	9.013	9.220	647.900
3	20:48:20	1.826	9.623	8.782	51.696%	150.100	9.205	9.204	645.100
x		1.868	9.713	8.943	51.475%	149.900	9.167	9.267	648.800
σ		0.044	0.104	0.164	0.390%	0.202	0.138	0.096	4.208
%RSD		2.353	1.072	1.836	0.757	0.135	1.510	1.033	0.648
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:46:54	653.900	55.036%	55.593%	0.660	0.723	13710.000	47.420%	
2	20:47:37	647.300	56.760%	56.952%	0.688	0.728	13790.000	48.421%	
3	20:48:20	644.300	57.118%	57.651%	0.683	0.741	13870.000	48.657%	
x		648.500	56.305%	56.732%	0.677	0.731	13790.000	48.166%	
σ		4.935	1.114%	1.047%	0.015	0.009	79.480	0.657%	
%RSD		0.761	1.978	1.845	2.181	1.294	0.576	1.365	

180-26370-A-39-G 11/13/2013 8:50:58 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	54.747%	6.236	321.100	329.300	0.000	2035.000	237500.000	236600.000
2	20:52:24	51.815%	6.638	325.500	323.600	0.000	2023.000	240400.000	238300.000
3	20:53:06	51.253%	6.512	321.500	326.600	0.000	2049.000	240800.000	237000.000
x		52.605%	6.462	322.700	326.500	0.000	2036.000	239600.000	237300.000
σ		1.876%	0.205	2.398	2.848	0.000	13.180	1787.000	893.600
%RSD		3.566	3.178	0.743	0.872	0.000	0.647	0.746	0.377

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	118900.000	3130.000	0.000	11320.000	432200.000	437900.000	51.289%	818.800
2	20:52:24	118700.000	3117.000	0.000	11170.000	459900.000	437900.000	49.398%	811.900
3	20:53:06	119600.000	3121.000	0.000	11300.000	464500.000	442900.000	49.889%	806.200
x		119100.000	3123.000	0.000	11270.000	452200.000	439500.000	50.192%	812.300
σ		496.500	6.638	0.000	84.560	17480.000	2902.000	0.981%	6.303
%RSD		0.417	0.213	0.000	0.751	3.865	0.660	1.955	0.776

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	278.000	196.500	28.400	7463.000	181200.000	185400.000	68.900	162.900
2	20:52:24	276.300	195.400	28.430	7611.000	184800.000	186300.000	68.000	159.000
3	20:53:06	271.800	192.100	30.030	7431.000	180100.000	182700.000	68.350	159.300
x		275.300	194.700	28.950	7501.000	182000.000	184800.000	68.420	160.400
σ		3.222	2.319	0.931	95.930	2446.000	1866.000	0.455	2.160
%RSD		1.170	1.191	3.215	1.279	1.344	1.010	0.665	1.346

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	136.900	139.900	811.900	811.800	68.980	1.995	5.681	8.627
2	20:52:24	137.800	141.100	824.600	823.500	68.850	2.026	5.850	8.776
3	20:53:06	135.900	138.700	811.700	816.000	69.040	2.035	5.797	8.320
x		136.900	139.900	816.100	817.100	68.960	2.019	5.776	8.574
σ		0.953	1.187	7.383	5.927	0.094	0.021	0.086	0.233
%RSD		0.696	0.849	0.905	0.725	0.136	1.031	1.495	2.712

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	0.000	476.300	0.000	16.650	16.650	52.077%	0.648	-9.212
2	20:52:24	0.000	477.900	0.000	16.070	16.200	51.674%	0.625	-8.527
3	20:53:06	0.000	482.300	0.000	15.790	15.810	51.834%	0.633	-8.164
x		0.000	478.800	0.000	16.170	16.220	51.862%	0.635	-8.635
σ		0.000	3.071	0.000	0.438	0.420	0.203%	0.011	0.532
%RSD		0.000	0.641	0.000	2.708	2.590	0.391	1.779	6.165

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	0.615	6.711	6.321	56.662%	28.400	1.505	1.504	1220.000
2	20:52:24	0.613	6.632	6.330	56.588%	28.600	1.551	1.491	1228.000
3	20:53:06	0.636	6.701	6.318	57.372%	28.220	1.454	1.505	1222.000
x		0.621	6.681	6.323	56.874%	28.410	1.503	1.500	1223.000
σ		0.013	0.043	0.007	0.432%	0.187	0.049	0.008	4.088
%RSD		2.122	0.644	0.104	0.760	0.660	3.233	0.521	0.334

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:51:41	1217.000	66.046%	66.961%	1.535	1.580	214.700	56.961%
2	20:52:24	1221.000	67.431%	68.584%	1.582	1.600	215.900	57.931%
3	20:53:06	1214.000	67.594%	68.815%	1.546	1.629	216.900	57.872%
x		1217.000	67.024%	68.120%	1.554	1.603	215.800	57.588%
σ		3.245	0.850%	1.010%	0.024	0.024	1.096	0.544%
%RSD		0.267	1.269	1.483	1.573	1.527	0.508	0.944

180-26370-A-40-E 11/13/2013 8:55:44 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	58.199%	5.318	294.400	289.400	0.000	1764.000	215300.000	213900.000
2	20:57:10	55.228%	5.533	291.100	289.100	0.000	1768.000	219000.000	216100.000
3	20:57:53	51.580%	6.329	305.700	305.000	0.000	1823.000	222500.000	218100.000
x		55.002%	5.727	297.100	294.500	0.000	1785.000	219000.000	216000.000
σ		3.316%	0.533	7.642	9.116	0.000	32.890	3596.000	2086.000
%RSD		6.028	9.302	2.572	3.096	0.000	1.843	1.642	0.966
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	106800.000	3569.000	0.000	10390.000	421300.000	406800.000	50.649%	912.600
2	20:57:10	109300.000	3627.000	0.000	10480.000	404600.000	412200.000	49.396%	895.500
3	20:57:53	107400.000	3638.000	0.000	10410.000	423200.000	407100.000	48.837%	911.200
x		107800.000	3611.000	0.000	10430.000	416400.000	408700.000	49.627%	906.400
σ		1314.000	36.980	0.000	49.480	10250.000	3053.000	0.928%	9.469
%RSD		1.219	1.024	0.000	0.475	2.463	0.747	1.870	1.045
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	264.200	184.100	34.040	6547.000	170100.000	171600.000	61.500	146.400
2	20:57:10	260.800	181.900	35.110	6541.000	168100.000	169500.000	60.880	145.800
3	20:57:53	259.400	181.000	37.650	6548.000	166600.000	169900.000	61.170	145.600
x		261.500	182.300	35.600	6545.000	168300.000	170300.000	61.180	145.900
σ		2.491	1.568	1.853	3.683	1758.000	1119.000	0.314	0.419
%RSD		0.953	0.860	5.204	0.056	1.045	0.657	0.513	0.287
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	119.400	122.200	784.600	789.700	66.360	2.441	5.118	7.761
2	20:57:10	120.400	122.100	783.100	787.700	66.060	2.339	5.353	7.755
3	20:57:53	119.200	123.500	791.700	796.600	66.450	2.442	5.241	7.595
x		119.600	122.600	786.500	791.300	66.290	2.407	5.237	7.704
σ		0.624	0.784	4.621	4.683	0.206	0.059	0.117	0.094
%RSD		0.521	0.640	0.588	0.592	0.311	2.462	2.239	1.220
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	0.000	425.500	0.000	13.040	13.200	51.970%	0.543	-7.532
2	20:57:10	0.000	426.900	0.000	12.900	13.080	51.938%	0.585	-5.919
3	20:57:53	0.000	423.600	0.000	13.150	12.770	51.487%	0.564	-7.824
x		0.000	425.300	0.000	13.030	13.020	51.798%	0.564	-7.092
σ		0.000	1.675	0.000	0.128	0.222	0.270%	0.021	1.026
%RSD		0.000	0.394	0.000	0.980	1.706	0.521	3.705	14.470
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:56:27	0.527	5.243	5.018	56.588%	28.150	1.268	1.287	1153.000
2	20:57:10	0.526	5.167	5.014	56.382%	28.460	1.278	1.298	1157.000
3	20:57:53	0.547	5.277	4.894	56.966%	28.000	1.274	1.241	1155.000
x		0.534	5.229	4.976	56.646%	28.200	1.273	1.275	1155.000
σ		0.012	0.057	0.070	0.296%	0.234	0.005	0.030	2.368
%RSD		2.244	1.083	1.417	0.523	0.831	0.362	2.382	0.205
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	20:56:27	1148.000	65.382%	65.970%	1.492	1.471	183.800	56.151%	
2	20:57:10	1146.000	66.860%	67.448%	1.468	1.493	183.500	57.870%	
3	20:57:53	1149.000	67.440%	68.322%	1.465	1.496	183.200	58.422%	
x		1148.000	66.560%	67.247%	1.475	1.486	183.500	57.481%	
σ		1.748	1.061%	1.189%	0.015	0.014	0.291	1.184%	
%RSD		0.152	1.594	1.768	1.008	0.911	0.158	2.060	

180-26370-A-41-G 11/13/2013 9:00:31 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	51.857%	2.066	539.100	530.200	0.000	36390.000	221600.000	218600.000
2	21:01:57	50.089%	1.829	522.400	517.200	0.000	36040.000	224700.000	219500.000
3	21:02:40	48.908%	2.008	520.200	527.500	0.000	36890.000	225500.000	221000.000
x		50.285%	1.968	527.200	525.000	0.000	36440.000	223900.000	219700.000
σ		1.484%	0.124	10.350	6.881	0.000	428.200	2059.000	1206.000
%RSD		2.951	6.281	1.963	1.311	0.000	1.175	0.919	0.549

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	63040.000	4085.000	0.000	7959.000	1148000.000	1103000.000	46.091%	1677.000
2	21:01:57	62690.000	3973.000	0.000	8041.000	1160000.000	1110000.000	45.425%	1689.000
3	21:02:40	63480.000	4051.000	0.000	8058.000	1150000.000	1105000.000	45.255%	1687.000
x		63070.000	4036.000	0.000	8019.000	1153000.000	1106000.000	45.590%	1684.000
σ		396.400	57.390	0.000	52.800	6608.000	3372.000	0.442%	6.128
%RSD		0.628	1.422	0.000	0.658	0.573	0.305	0.969	0.364

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	136.400	157.700	36.620	2470.000	145200.000	147200.000	167.300	119.200
2	21:01:57	132.800	154.400	37.930	2455.000	143900.000	148200.000	170.600	118.300
3	21:02:40	132.400	152.900	38.250	2414.000	142500.000	145500.000	168.400	117.100
x		133.900	155.000	37.600	2447.000	143900.000	147000.000	168.700	118.200
σ		2.208	2.429	0.866	29.200	1356.000	1353.000	1.689	1.076
%RSD		1.649	1.567	2.302	1.194	0.942	0.921	1.001	0.911

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	636.300	637.900	1238.000	1247.000	78.940	5.738	3.824	5.086
2	21:01:57	624.600	633.000	1233.000	1241.000	79.180	5.683	3.465	4.808
3	21:02:40	623.700	629.700	1237.000	1246.000	79.140	5.672	3.543	4.907
x		628.200	633.500	1236.000	1245.000	79.090	5.697	3.610	4.934
σ		7.009	4.134	2.323	3.163	0.130	0.035	0.189	0.141
%RSD		1.116	0.652	0.188	0.254	0.164	0.619	5.235	2.852

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	0.000	1097.000	0.000	68.410	68.270	47.911%	0.528	-8.993
2	21:01:57	0.000	1113.000	0.000	69.170	68.990	47.737%	0.514	-5.701
3	21:02:40	0.000	1110.000	0.000	68.990	68.720	47.697%	0.516	-7.367
x		0.000	1107.000	0.000	68.860	68.660	47.781%	0.519	-7.354
σ		0.000	8.501	0.000	0.397	0.361	0.114%	0.008	1.646
%RSD		0.000	0.768	0.000	0.576	0.526	0.238	1.445	22.390

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	0.432	8.230	7.702	53.016%	50.060	3.654	3.677	265.300
2	21:01:57	0.449	8.045	7.480	53.248%	49.630	3.621	3.640	265.800
3	21:02:40	0.443	8.129	7.523	53.227%	50.050	3.639	3.712	262.600
x		0.441	8.135	7.568	53.164%	49.910	3.638	3.676	264.600
σ		0.008	0.092	0.118	0.129%	0.248	0.016	0.036	1.728
%RSD		1.897	1.134	1.555	0.242	0.496	0.444	0.986	0.653

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:01:14	264.300	58.081%	58.445%	1.568	1.600	1421.000	50.906%
2	21:01:57	265.300	58.586%	59.304%	1.631	1.602	1418.000	52.242%
3	21:02:40	262.000	59.330%	59.709%	1.627	1.611	1416.000	52.505%
x		263.900	58.666%	59.153%	1.609	1.604	1418.000	51.885%
σ		1.697	0.628%	0.646%	0.035	0.006	2.613	0.858%
%RSD		0.643	1.070	1.092	2.199	0.368	0.184	1.653

CCV 993939 11/13/2013 9:05:19 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	92.568%	109.200	108.700	106.300	0.000	49770.000	47610.000	47740.000
2	21:06:44	88.505%	109.200	108.700	106.900	0.000	49970.000	49150.000	49220.000
3	21:07:27	89.324%	108.300	106.100	106.900	0.000	49670.000	48160.000	47880.000
x		90.132%	108.900%	107.847%	106.735%	0.000	99.605%	96.612%	96.563%
σ		2.149%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.384	0.457	1.418	0.319	0.000	0.306	1.618	1.689

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	470.900	5105.000	0.000	51190.000	50320.000	49160.000	79.793%	100.600
2	21:06:44	493.700	5192.000	0.000	50830.000	49960.000	49060.000	79.021%	100.200
3	21:07:27	498.900	5164.000	0.000	50410.000	49970.000	49120.000	79.479%	100.400
x		97.572%	103.076%	0.000	101.620%	100.167%	98.233%	79.431%	100.367%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.388%	n/a
%RSD		3.057	0.867	0.000	0.770	0.408	0.103	0.488	0.191

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	104.200	103.400	1.803	485.500	24960.000	24630.000	105.900	107.900
2	21:06:44	102.000	101.600	3.681	489.600	24990.000	24940.000	104.600	108.500
3	21:07:27	101.700	101.900	4.438	485.700	24900.000	24650.000	104.700	106.800
x		102.605%	102.317%	3.307	97.384%	99.811%	98.965%	105.072%	107.747%
σ		n/a	n/a	1.357	n/a	n/a	n/a	n/a	n/a
%RSD		1.349	0.952	41.020	0.471	0.187	0.697	0.678	0.768

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	111.300	111.700	104.400	102.800	105.100	-0.305	105.200	104.000
2	21:06:44	110.100	110.100	103.600	103.500	104.000	-0.327	104.200	103.800
3	21:07:27	109.100	107.600	102.200	102.500	103.900	-0.327	103.700	104.800
x		110.157%	109.813%	103.406%	102.954%	104.346%	-0.319	104.343%	104.174%
σ		n/a	n/a	n/a	n/a	n/a	0.013	n/a	n/a
%RSD		0.966	1.905	1.116	0.490	0.652	3.921	0.718	0.534

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	0.000	97.890	74.104%	101.000	102.600	69.416%	107.000	-0.616
2	21:06:44	0.000	97.080	74.617%	102.600	104.700	69.149%	107.900	5.246
3	21:07:27	0.000	97.570	75.719%	102.000	104.400	69.660%	107.200	5.049
x		0.000	97.517%	74.814%	101.882%	103.922%	69.408%	107.346%	3.226
σ		0.000	n/a	0.825%	n/a	n/a	0.256%	n/a	3.329
%RSD		0.000	0.419	1.103	0.752	1.099	0.368	0.455	103.200

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	108.700	105.600	105.500	68.770%	101.100	101.200	99.950	104.600
2	21:06:44	107.400	104.300	105.700	70.289%	100.200	100.600	99.660	104.300
3	21:07:27	107.500	104.500	104.300	70.703%	100.400	100.000	99.530	104.000
x		107.889%	104.782%	105.148%	69.921%	100.588%	100.606%	99.711%	104.293%
σ		n/a	n/a	n/a	1.018%	n/a	n/a	n/a	n/a
%RSD		0.683	0.683	0.680	1.456	0.467	0.587	0.214	0.276

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:06:01	106.200	66.904%	67.229%	103.100	104.200	104.900	62.301%
2	21:06:44	105.200	69.070%	68.647%	104.100	105.300	106.500	63.661%
3	21:07:27	105.600	69.737%	69.561%	103.800	105.500	106.900	63.924%
x		105.675%	68.570%	68.479%	103.658%	105.000%	106.129%	63.295%
σ		n/a	1.481%	1.175%	n/a	n/a	n/a	0.871%
%RSD		0.477	2.160	1.716	0.459	0.687	0.982	1.376

CCB10 11/13/2013 9:13:29 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	119.504%	-0.080	6.332	6.250	0.000	-1.379	1.962	1.663
2	21:14:55	117.573%	-0.104	5.868	5.854	0.000	-1.378	1.776	1.695
3	21:15:38	118.578%	-0.147	5.873	5.445	0.000	-1.434	1.680	1.444
x		118.551%	-0.110	6.024	5.849	0.000	-1.397	1.806	1.600
σ		0.966%	0.034	0.267	0.402	0.000	0.032	0.143	0.137
%RSD		0.815	30.920	4.427	6.877	0.000	2.297	7.937	8.549
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	0.683	3.741	0.000	2.000	1.250	2.369	96.408%	0.078
2	21:14:55	0.644	3.399	0.000	0.729	4.620	2.237	97.207%	0.121
3	21:15:38	0.641	2.922	0.000	1.085	4.591	2.236	97.520%	0.054
x		0.656	3.354	0.000	1.271	3.487	2.281	97.045%	0.085
σ		0.024	0.411	0.000	0.656	1.937	0.077	0.574%	0.034
%RSD		3.583	12.250	0.000	51.580	55.560	3.363	0.591	40.260
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	0.001	0.040	0.334	0.105	15.970	5.457	0.003	0.016
2	21:14:55	0.045	0.025	0.238	0.092	14.660	4.585	0.003	0.007
3	21:15:38	0.008	0.035	0.297	0.093	12.430	4.143	0.004	0.006
x		0.018	0.033	0.290	0.096	14.360	4.728	0.003	0.009
σ		0.023	0.008	0.048	0.007	1.789	0.668	0.001	0.006
%RSD		131.800	23.090	16.630	7.286	12.460	14.140	30.340	58.250
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	-0.022	0.017	0.714	0.704	0.058	0.001	0.299	0.216
2	21:14:55	-0.011	0.019	0.740	0.657	0.007	0.004	0.134	0.189
3	21:15:38	-0.035	0.014	0.734	0.777	0.077	-0.003	0.503	0.410
x		-0.023	0.017	0.729	0.712	0.047	0.001	0.312	0.272
σ		0.012	0.003	0.014	0.061	0.036	0.003	0.185	0.121
%RSD		53.290	15.420	1.918	8.528	75.610	377.700	59.280	44.330
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	0.000	0.018	87.429%	0.223	0.210	89.483%	-0.046	0.298
2	21:14:55	0.000	0.019	89.910%	0.190	0.175	90.941%	-0.046	0.302
3	21:15:38	0.000	0.016	89.961%	0.144	0.164	91.441%	-0.050	0.418
x		0.000	0.017	89.100%	0.186	0.183	90.622%	-0.047	0.339
σ		0.000	0.001	1.447%	0.040	0.024	1.017%	0.002	0.068
%RSD		0.000	7.503	1.624	21.400	13.110	1.123	4.933	20.050
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:14:12	-0.049	-0.009	-0.011	85.570%	-0.009	0.041	0.042	0.018
2	21:14:55	-0.045	-0.017	-0.003	86.618%	-0.027	0.043	0.040	0.017
3	21:15:38	-0.045	-0.024	-0.012	87.862%	-0.033	0.030	0.041	0.016
x		-0.046	-0.017	-0.009	86.683%	-0.023	0.038	0.041	0.017
σ		0.002	0.007	0.005	1.147%	0.013	0.007	0.001	0.001
%RSD		5.062	43.330	58.970	1.324	55.530	19.420	2.669	4.226
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	21:14:12	0.015	77.622%	77.078%	0.013	0.012	0.140	76.414%	
2	21:14:55	0.016	80.636%	79.057%	0.010	0.009	0.135	77.877%	
3	21:15:38	0.027	81.439%	80.044%	0.013	0.009	0.136	78.206%	
x		0.019	79.899%	78.726%	0.012	0.010	0.137	77.499%	
σ		0.006	2.012%	1.510%	0.001	0.002	0.003	0.954%	
%RSD		33.380	2.519	1.918	10.600	16.510	1.837	1.231	

180-26370-B-42-F 11/13/2013 9:18:19 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	65.946%	1.454	543.100	539.600	0.000	3632.000	137000.000	136000.000
2	21:19:45	61.999%	1.245	533.200	538.400	0.000	3571.000	137300.000	137100.000
3	21:20:28	60.057%	1.453	563.300	550.900	0.000	3592.000	138300.000	137300.000
x		62.667%	1.384	546.500	543.000	0.000	3598.000	137500.000	136800.000
σ		3.001%	0.120	15.380	6.916	0.000	30.740	652.600	693.000
%RSD		4.789	8.689	2.814	1.274	0.000	0.854	0.474	0.506

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	42170.000	1795.000	0.000	5083.000	554000.000	524800.000	55.455%	1339.000
2	21:19:45	42440.000	775.400	0.000	5143.000	560400.000	531700.000	53.288%	1349.000
3	21:20:28	43120.000	684.500	0.000	5102.000	569900.000	534500.000	52.931%	1341.000
x		42570.000	1085.000	0.000	5109.000	561400.000	530300.000	53.891%	1343.000
σ		488.300	616.800	0.000	30.910	7983.000	5035.000	1.366%	5.505
%RSD		1.147	56.840	0.000	0.605	1.422	0.949	2.535	0.410

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	328.000	76.320	28.980	1856.000	72020.000	72360.000	16.480	57.790
2	21:19:45	327.300	75.880	26.310	1839.000	71700.000	72340.000	16.450	55.960
3	21:20:28	326.800	77.000	25.680	1834.000	70890.000	72010.000	16.330	54.660
x		327.300	76.400	26.990	1843.000	71530.000	72240.000	16.420	56.130
σ		0.606	0.566	1.751	11.130	580.100	199.400	0.077	1.571
%RSD		0.185	0.740	6.487	0.604	0.811	0.276	0.469	2.799

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	143.700	145.300	1679.000	1691.000	38.900	2.289	12.430	13.290
2	21:19:45	142.100	144.800	1675.000	1690.000	37.750	2.347	12.120	13.510
3	21:20:28	139.900	143.100	1662.000	1678.000	38.580	2.311	12.340	13.510
x		141.900	144.400	1672.000	1687.000	38.410	2.316	12.300	13.440
σ		1.897	1.147	9.086	7.600	0.593	0.029	0.159	0.126
%RSD		1.337	0.794	0.543	0.451	1.544	1.260	1.289	0.937

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	0.000	1353.000	0.000	13.810	14.100	55.805%	0.327	-5.191
2	21:19:45	0.000	1381.000	0.000	14.030	14.120	55.079%	0.339	-5.664
3	21:20:28	0.000	1383.000	0.000	14.140	14.100	54.654%	0.319	-4.426
x		0.000	1372.000	0.000	13.990	14.110	55.179%	0.328	-5.094
σ		0.000	16.680	0.000	0.168	0.012	0.582%	0.010	0.625
%RSD		0.000	1.215	0.000	1.203	0.088	1.056	3.058	12.260

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	0.288	10.500	9.924	59.281%	24.600	0.719	0.723	302.100
2	21:19:45	0.289	10.190	10.240	59.486%	24.610	0.694	0.750	297.900
3	21:20:28	0.248	10.340	10.060	59.378%	24.430	0.684	0.767	297.300
x		0.275	10.340	10.080	59.381%	24.550	0.699	0.747	299.100
σ		0.024	0.155	0.159	0.102%	0.100	0.018	0.023	2.640
%RSD		8.548	1.495	1.576	0.172	0.409	2.582	3.020	0.883

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:19:02	298.700	64.350%	64.701%	1.585	1.644	257.700	56.797%
2	21:19:45	298.700	65.747%	66.281%	1.623	1.654	261.300	57.847%
3	21:20:28	296.600	65.988%	66.637%	1.655	1.634	260.800	58.417%
x		298.000	65.362%	65.873%	1.621	1.644	259.900	57.687%
σ		1.235	0.884%	1.031%	0.035	0.010	1.902	0.822%
%RSD		0.414	1.353	1.564	2.163	0.604	0.732	1.425

180-26370-A-43-E 11/13/2013 9:23:06 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	51.266%	1.031	376.700	390.100	0.000	2398.000	1208000.000	1203000.000
2	21:24:32	47.697%	1.105	403.700	403.400	0.000	2474.000	1253000.000	1233000.000
3	21:25:15	47.075%	1.248	403.200	406.300	0.000	2480.000	1259000.000	1243000.000
x		48.679%	1.128	394.500	399.900	0.000	2451.000	1240000.000	1226000.000
σ		2.261%	0.110	15.440	8.615	0.000	45.620	28140.000	20550.000
%RSD		4.646	9.742	3.912	2.154	0.000	1.861	2.269	1.676
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	16760.000	2565.000	0.000	3298.000	2290000.000	2172000.000	45.852%	257.600
2	21:24:32	16990.000	2579.000	0.000	3280.000	2273000.000	2169000.000	45.604%	255.400
3	21:25:15	17350.000	2637.000	0.000	3293.000	2293000.000	2150000.000	45.391%	252.300
x		17030.000	2593.000	0.000	3290.000	2285000.000	2164000.000	45.616%	255.100
σ		294.100	37.990	0.000	9.532	10630.000	12260.000	0.231%	2.657
%RSD		1.727	1.465	0.000	0.290	0.465	0.566	0.506	1.042
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	64.240	95.720	35.340	2461.000	189500.000	196600.000	15.430	18.480
2	21:24:32	63.400	94.850	35.120	2471.000	188000.000	196700.000	15.540	19.940
3	21:25:15	64.220	94.840	35.180	2472.000	188200.000	196100.000	15.420	17.560
x		63.950	95.140	35.210	2468.000	188600.000	196500.000	15.460	18.660
σ		0.477	0.504	0.115	5.897	821.600	301.600	0.065	1.203
%RSD		0.746	0.529	0.326	0.239	0.436	0.154	0.421	6.447
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	42.060	46.080	877.400	882.300	28.300	11.450	2.141	4.498
2	21:24:32	41.830	45.530	874.900	887.300	31.060	11.110	2.255	4.560
3	21:25:15	42.110	45.280	877.300	892.000	28.120	11.510	2.380	4.338
x		42.000	45.630	876.500	887.200	29.160	11.350	2.259	4.465
σ		0.152	0.408	1.395	4.843	1.648	0.217	0.119	0.114
%RSD		0.362	0.894	0.159	0.546	5.650	1.908	5.276	2.556
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	0.000	976.400	0.000	12.150	12.180	42.028%	0.066	-6.810
2	21:24:32	0.000	987.200	0.000	12.150	12.590	41.920%	0.058	-8.415
3	21:25:15	0.000	989.800	0.000	12.480	12.440	41.804%	0.071	-4.489
x		0.000	984.500	0.000	12.260	12.400	41.917%	0.065	-6.571
σ		0.000	7.079	0.000	0.195	0.208	0.112%	0.006	1.974
%RSD		0.000	0.719	0.000	1.588	1.679	0.268	9.911	30.040
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:23:49	0.013	57.230	56.000	46.430%	23.390	0.910	0.922	110.600
2	21:24:32	0.049	57.040	56.270	47.286%	23.290	0.875	0.927	112.100
3	21:25:15	0.052	57.290	55.880	47.378%	23.410	0.866	0.879	111.100
x		0.038	57.190	56.050	47.031%	23.360	0.884	0.909	111.300
σ		0.022	0.134	0.201	0.523%	0.064	0.023	0.027	0.727
%RSD		57.870	0.235	0.359	1.112	0.276	2.642	2.927	0.653
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	21:23:49	110.300	52.010%	52.522%	0.996	1.023	211.500	40.455%	
2	21:24:32	112.000	53.041%	53.934%	1.033	1.027	213.000	41.502%	
3	21:25:15	110.200	53.493%	54.351%	0.987	1.027	211.500	41.978%	
x		110.800	52.848%	53.602%	1.006	1.025	212.000	41.312%	
σ		1.022	0.760%	0.959%	0.024	0.002	0.856	0.779%	
%RSD		0.922	1.439	1.789	2.422	0.215	0.404	1.886	

180-26370-A-33-H 11/13/2013 9:27:54 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	89.035%	2.697	294.900	290.300	0.000	2900.000	359900.000	359700.000
2	21:29:19	87.072%	2.698	303.600	293.800	0.000	2935.000	377700.000	379500.000
3	21:30:02	85.883%	2.706	295.400	293.600	0.000	2890.000	362300.000	363900.000
x		87.330%	2.700	298.000	292.600	0.000	2908.000	366600.000	367700.000
σ		1.591%	0.005	4.886	1.971	0.000	23.440	9676.000	10450.000
%RSD		1.822	0.193	1.640	0.674	0.000	0.806	2.639	2.842
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	47800.000	2459.000	0.000	4627.000	730000.000	679300.000	74.314%	765.800
2	21:29:19	49690.000	2569.000	0.000	4902.000	787100.000	739000.000	69.039%	821.500
3	21:30:02	48100.000	2455.000	0.000	4631.000	735600.000	686500.000	73.717%	772.200
x		48530.000	2494.000	0.000	4720.000	750900.000	701600.000	72.356%	786.500
σ		1014.000	64.770	0.000	158.000	31460.000	32610.000	2.889%	30.500
%RSD		2.090	2.597	0.000	3.348	4.190	4.648	3.992	3.878
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	193.100	124.700	5.465	2958.000	179700.000	183900.000	54.470	196.700
2	21:29:19	208.000	132.900	5.277	3137.000	188300.000	194500.000	56.620	202.700
3	21:30:02	196.200	126.300	4.425	2965.000	180100.000	186400.000	54.200	193.300
x		199.100	128.000	5.055	3020.000	182700.000	188300.000	55.100	197.600
σ		7.863	4.343	0.554	101.200	4837.000	5545.000	1.328	4.782
%RSD		3.948	3.394	10.960	3.352	2.648	2.945	2.410	2.421
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	233.600	236.500	7720.000	7752.000	61.550	0.198	2.646	5.216
2	21:29:19	246.000	246.000	8046.000	8070.000	62.760	0.139	2.861	5.625
3	21:30:02	233.600	235.900	7742.000	7789.000	61.770	0.129	2.848	5.101
x		237.700	239.500	7836.000	7870.000	62.030	0.155	2.785	5.314
σ		7.134	5.673	182.300	173.700	0.643	0.037	0.121	0.275
%RSD		3.001	2.369	2.326	2.207	1.037	23.860	4.328	5.176
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	0.000	431.400	0.000	12.480	12.810	60.722%	0.426	-10.310
2	21:29:19	0.000	440.700	0.000	12.920	12.770	60.647%	0.468	-10.610
3	21:30:02	0.000	434.900	0.000	12.620	12.860	60.870%	0.427	-10.630
x		0.000	435.700	0.000	12.670	12.810	60.746%	0.440	-10.510
σ		0.000	4.707	0.000	0.224	0.044	0.113%	0.024	0.178
%RSD		0.000	1.080	0.000	1.767	0.344	0.186	5.433	1.695
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:28:36	0.374	11.550	11.340	62.033%	13.830	0.707	0.710	568.600
2	21:29:19	0.368	11.400	11.280	62.962%	13.970	0.688	0.696	571.900
3	21:30:02	0.361	11.430	11.210	63.391%	13.970	0.661	0.680	569.800
x		0.368	11.460	11.270	62.795%	13.920	0.685	0.695	570.100
σ		0.007	0.077	0.065	0.694%	0.079	0.023	0.015	1.664
%RSD		1.811	0.669	0.578	1.105	0.569	3.392	2.167	0.292
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	21:28:36	575.000	60.240%	59.764%	1.256	1.279	2899.000	48.833%	
2	21:29:19	573.700	61.741%	61.000%	1.261	1.291	2906.000	50.035%	
3	21:30:02	574.200	62.136%	61.776%	1.259	1.316	2893.000	50.751%	
x		574.300	61.372%	60.847%	1.259	1.295	2899.000	49.873%	
σ		0.681	1.000%	1.015%	0.003	0.019	6.403	0.970%	
%RSD		0.119	1.630	1.668	0.233	1.448	0.221	1.944	

180-26370-A-33-H SD@5 11/13/2013 9:32:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	115.003%	0.471	70.110	68.090	0.000	569.200	71660.000	71340.000
2	21:34:07	111.924%	0.450	70.070	68.280	0.000	575.900	72530.000	71930.000
3	21:34:50	112.909%	0.485	69.280	69.510	0.000	572.100	72640.000	72610.000
x		113.279%	0.469	69.820	68.630	0.000	572.400	72280.000	71960.000
σ		1.572%	0.018	0.467	0.774	0.000	3.336	534.500	636.200
%RSD		1.388	3.795	0.669	1.128	0.000	0.583	0.740	0.884

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	9587.000	499.000	0.000	934.900	139400.000	134900.000	91.644%	153.400
2	21:34:07	9632.000	496.700	0.000	925.000	138800.000	133700.000	93.242%	151.800
3	21:34:50	9637.000	498.200	0.000	948.400	141600.000	136800.000	91.868%	153.900
x		9619.000	498.000	0.000	936.100	139900.000	135100.000	92.251%	153.000
σ		27.600	1.143	0.000	11.740	1480.000	1549.000	0.865%	1.088
%RSD		0.287	0.230	0.000	1.254	1.057	1.146	0.937	0.711

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	38.480	24.460	0.858	575.000	36170.000	35730.000	10.700	40.700
2	21:34:07	37.840	24.470	0.950	565.300	35440.000	35300.000	10.590	39.860
3	21:34:50	38.700	24.860	0.646	568.600	35850.000	35640.000	10.570	40.110
x		38.340	24.600	0.818	569.600	35820.000	35560.000	10.620	40.220
σ		0.445	0.227	0.156	4.932	369.800	223.200	0.069	0.431
%RSD		1.162	0.921	19.100	0.866	1.032	0.628	0.647	1.072

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	49.130	48.500	1690.000	1702.000	12.790	0.022	0.592	0.902
2	21:34:07	48.640	47.690	1669.000	1674.000	12.760	0.015	0.689	1.148
3	21:34:50	48.230	48.450	1673.000	1689.000	12.860	0.021	0.472	1.009
x		48.670	48.210	1677.000	1689.000	12.800	0.019	0.584	1.020
σ		0.454	0.452	10.850	13.720	0.048	0.004	0.109	0.123
%RSD		0.932	0.938	0.647	0.813	0.375	19.620	18.560	12.090

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	0.000	71.510	92.446%	2.148	2.266	80.281%	0.055	-1.961
2	21:34:07	0.000	71.930	93.688%	2.323	2.345	81.565%	0.035	-2.062
3	21:34:50	0.000	71.860	93.723%	2.236	2.323	82.028%	0.046	-1.540
x		0.000	71.770	93.286%	2.236	2.311	81.291%	0.045	-1.854
σ		0.000	0.227	0.727%	0.087	0.041	0.905%	0.010	0.277
%RSD		0.000	0.317	0.780	3.905	1.762	1.113	21.810	14.930

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	0.040	2.496	2.417	79.211%	2.724	0.152	0.135	113.200
2	21:34:07	0.038	2.544	2.414	80.981%	2.639	0.149	0.144	112.600
3	21:34:50	0.039	2.382	2.475	79.960%	2.707	0.171	0.154	112.800
x		0.039	2.474	2.435	80.051%	2.690	0.157	0.144	112.900
σ		0.001	0.084	0.034	0.889%	0.044	0.012	0.010	0.302
%RSD		3.065	3.376	1.415	1.110	1.654	7.643	6.619	0.268

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:33:24	113.400	73.535%	72.198%	0.231	0.239	515.800	65.453%
2	21:34:07	113.000	75.058%	73.950%	0.237	0.246	521.600	66.252%
3	21:34:50	112.800	74.446%	73.507%	0.238	0.239	525.300	65.669%
x		113.100	74.346%	73.218%	0.235	0.241	520.900	65.791%
σ		0.313	0.766%	0.911%	0.004	0.004	4.834	0.413%
%RSD		0.277	1.031	1.244	1.527	1.515	0.928	0.628

180-26370-A-33-I MS 11/13/2013 9:37:30 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	79.578%	48.530	1184.000	1171.000	0.000	51770.000	405600.000	405600.000
2	21:38:56	75.976%	49.360	1209.000	1164.000	0.000	51950.000	412100.000	414600.000
3	21:39:39	75.141%	47.520	1206.000	1176.000	0.000	52090.000	415200.000	416700.000
x		76.898%	48.470	1200.000	1171.000	0.000	51930.000	411000.000	412300.000
σ		2.358%	0.918	13.730	5.961	0.000	158.800	4864.000	5905.000
%RSD		3.066	1.895	1.145	0.509	0.000	0.306	1.183	1.432

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	96310.000	21180.000	0.000	60390.000	804500.000	744800.000	63.982%	2878.000
2	21:38:56	98740.000	21070.000	0.000	60280.000	803200.000	742100.000	63.385%	2885.000
3	21:39:39	97780.000	21070.000	0.000	59810.000	803400.000	748700.000	62.567%	2863.000
x		97610.000	21110.000	0.000	60160.000	803700.000	745200.000	63.312%	2875.000
σ		1222.000	61.640	0.000	307.000	667.200	3315.000	0.710%	11.210
%RSD		1.252	0.292	0.000	0.510	0.083	0.445	1.122	0.390

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	868.900	391.900	11.790	4823.000	213800.000	217800.000	589.500	757.700
2	21:38:56	864.200	391.200	10.980	4813.000	212800.000	219300.000	583.900	753.700
3	21:39:39	854.900	387.500	11.250	4836.000	213700.000	218000.000	580.500	751.400
x		862.700	390.200	11.340	4824.000	213400.000	218400.000	584.600	754.300
σ		7.114	2.364	0.411	11.080	549.200	807.500	4.576	3.165
%RSD		0.825	0.606	3.626	0.230	0.257	0.370	0.783	0.419

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	521.700	519.900	10300.000	10290.000	106.000	0.057	10.670	13.440
2	21:38:56	515.600	512.700	10260.000	10280.000	104.800	0.020	9.988	13.730
3	21:39:39	515.700	516.300	10310.000	10330.000	105.400	0.030	10.810	13.270
x		517.700	516.300	10290.000	10300.000	105.400	0.036	10.490	13.480
σ		3.510	3.591	30.900	25.500	0.569	0.019	0.440	0.236
%RSD		0.678	0.696	0.300	0.248	0.540	53.170	4.197	1.750

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	0.000	1477.000	0.000	1020.000	1026.000	53.566%	45.460	-2.065
2	21:38:56	0.000	1483.000	0.000	1023.000	1029.000	54.135%	45.280	1.220
3	21:39:39	0.000	1497.000	0.000	1029.000	1035.000	53.891%	45.140	-2.999
x		0.000	1485.000	0.000	1024.000	1030.000	53.864%	45.290	-1.281
σ		0.000	10.140	0.000	4.737	4.813	0.285%	0.158	2.216
%RSD		0.000	0.683	0.000	0.463	0.467	0.530	0.349	172.900

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	44.980	57.860	54.150	56.143%	1236.000	255.000	251.500	2291.000
2	21:38:56	45.220	57.090	53.510	56.969%	1239.000	255.000	252.900	2187.000
3	21:39:39	44.830	57.600	53.500	57.536%	1232.000	253.900	253.100	2384.000
x		45.010	57.520	53.720	56.883%	1236.000	254.600	252.500	2287.000
σ		0.196	0.396	0.373	0.701%	3.617	0.624	0.872	98.230
%RSD		0.436	0.689	0.695	1.232	0.293	0.245	0.345	4.295

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:38:13	2611.000	55.526%	55.000%	52.530	53.410	3688.000	45.319%
2	21:38:56	2602.000	57.344%	57.008%	53.170	53.870	3726.000	46.496%
3	21:39:39	2570.000	57.974%	57.876%	52.760	53.850	3693.000	47.678%
x		2594.000	56.948%	56.628%	52.820	53.710	3702.000	46.498%
σ		21.130	1.271%	1.475%	0.322	0.259	20.200	1.179%
%RSD		0.815	2.233	2.605	0.610	0.482	0.546	2.536

180-26370-A-33-J MSD 11/13/2013 9:42:18 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	77.637%	47.310	1202.000	1188.000	0.000	51240.000	231200.000	230600.000
2	21:43:44	75.525%	46.740	1193.000	1162.000	0.000	51800.000	232700.000	234800.000
3	21:44:27	73.803%	46.840	1210.000	1167.000	0.000	51160.000	232800.000	234800.000
x		75.655%	46.960	1202.000	1172.000	0.000	51400.000	232200.000	233400.000
σ		1.920%	0.304	8.427	13.770	0.000	348.000	913.600	2412.000
%RSD		2.538	0.647	0.701	1.174	0.000	0.677	0.393	1.034

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	84410.000	9276.000	0.000	58900.000	489800.000	453200.000	60.963%	2808.000
2	21:43:44	85370.000	9010.000	0.000	57470.000	486300.000	451600.000	60.156%	2829.000
3	21:44:27	85500.000	9090.000	0.000	57680.000	487300.000	457400.000	60.154%	2786.000
x		85090.000	9125.000	0.000	58020.000	487800.000	454000.000	60.424%	2808.000
σ		595.800	136.200	0.000	776.100	1802.000	2979.000	0.467%	21.830
%RSD		0.700	1.493	0.000	1.338	0.369	0.656	0.772	0.777

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	899.000	394.400	13.180	7622.000	501700.000	531400.000	642.300	939.200
2	21:43:44	903.200	391.300	16.780	7731.000	505600.000	540100.000	645.800	939.400
3	21:44:27	896.200	394.100	12.230	7698.000	503400.000	532400.000	634.500	924.700
x		899.400	393.300	14.060	7684.000	503600.000	534600.000	640.900	934.400
σ		3.519	1.686	2.400	55.730	1990.000	4791.000	5.752	8.461
%RSD		0.391	0.429	17.070	0.725	0.395	0.896	0.897	0.905

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	722.600	716.600	24720.000	24640.000	113.000	-0.023	11.040	14.160
2	21:43:44	722.800	718.100	24860.000	24830.000	111.700	-0.039	11.080	14.500
3	21:44:27	711.400	708.900	24830.000	24800.000	112.300	-0.039	10.750	14.110
x		719.000	714.500	24800.000	24760.000	112.300	-0.034	10.960	14.250
σ		6.502	4.944	72.270	99.740	0.667	0.009	0.180	0.216
%RSD		0.904	0.692	0.291	0.403	0.594	26.470	1.645	1.515

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	0.000	1360.000	0.000	996.900	1005.000	53.918%	45.210	0.027
2	21:43:44	0.000	1376.000	0.000	1008.000	1016.000	54.262%	45.210	-3.633
3	21:44:27	0.000	1377.000	0.000	1008.000	1014.000	54.443%	45.630	-2.346
x		0.000	1371.000	0.000	1004.000	1012.000	54.208%	45.350	-1.984
σ		0.000	9.578	0.000	6.282	5.682	0.266%	0.241	1.857
%RSD		0.000	0.699	0.000	0.626	0.562	0.492	0.532	93.590

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	45.300	65.570	62.300	56.440%	1469.000	249.100	247.100	1917.000
2	21:43:44	45.600	65.720	61.520	57.781%	1461.000	249.500	245.300	1952.000
3	21:44:27	45.250	66.590	61.380	57.619%	1475.000	250.100	249.200	1756.000
x		45.390	65.960	61.730	57.280%	1468.000	249.600	247.200	1875.000
σ		0.193	0.550	0.498	0.732%	6.640	0.490	1.929	104.900
%RSD		0.424	0.834	0.807	1.278	0.452	0.197	0.780	5.592

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:43:01	2512.000	55.614%	55.292%	51.900	52.810	3704.000	47.473%
2	21:43:44	2503.000	57.677%	57.079%	52.160	53.170	3734.000	48.557%
3	21:44:27	2521.000	58.248%	58.211%	52.380	53.480	3750.000	49.196%
x		2512.000	57.180%	56.860%	52.150	53.150	3729.000	48.409%
σ		9.123	1.386%	1.472%	0.242	0.332	23.310	0.871%
%RSD		0.363	2.423	2.588	0.464	0.625	0.625	1.800

180-26370-B-34-H 11/13/2013 9:47:06 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	92.466%	4.966	50.920	50.580	0.000	637.700	149100.000	148800.000
2	21:48:32	88.808%	5.103	50.430	48.590	0.000	637.200	153500.000	153700.000
3	21:49:15	87.078%	4.945	49.410	48.030	0.000	653.700	156000.000	155400.000
x		89.450%	5.005	50.250	49.060	0.000	642.900	152900.000	152600.000
σ		2.751%	0.086	0.768	1.339	0.000	9.391	3508.000	3402.000
%RSD		3.075	1.714	1.529	2.728	0.000	1.461	2.295	2.229

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	69330.000	2205.000	0.000	10510.000	381300.000	355900.000	78.354%	1223.000
2	21:48:32	71270.000	2218.000	0.000	10680.000	396500.000	362800.000	76.807%	1256.000
3	21:49:15	71930.000	2233.000	0.000	10620.000	388100.000	361600.000	76.531%	1235.000
x		70840.000	2219.000	0.000	10600.000	388700.000	360100.000	77.230%	1238.000
σ		1350.000	14.070	0.000	89.240	7586.000	3710.000	0.983%	17.010
%RSD		1.906	0.634	0.000	0.842	1.952	1.030	1.273	1.374

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	179.000	121.700	4.081	4478.000	187900.000	191400.000	163.700	186.800
2	21:48:32	184.500	122.500	3.521	4528.000	189700.000	192100.000	161.600	184.700
3	21:49:15	182.300	122.500	4.062	4517.000	189200.000	192100.000	161.800	186.500
x		182.000	122.200	3.888	4508.000	188900.000	191900.000	162.400	186.000
σ		2.780	0.473	0.318	26.610	931.700	404.500	1.175	1.159
%RSD		1.528	0.387	8.172	0.590	0.493	0.211	0.723	0.623

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	316.400	317.000	1490.000	1508.000	110.800	0.051	2.642	5.080
2	21:48:32	317.300	318.800	1496.000	1514.000	109.500	0.082	2.910	4.629
3	21:49:15	316.700	318.100	1493.000	1507.000	110.100	0.078	2.370	5.023
x		316.800	318.000	1493.000	1510.000	110.100	0.070	2.641	4.911
σ		0.465	0.894	2.819	3.513	0.631	0.017	0.270	0.246
%RSD		0.147	0.281	0.189	0.233	0.573	23.840	10.220	5.003

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	0.000	418.700	0.000	27.850	28.190	64.530%	0.509	-15.950
2	21:48:32	0.000	423.400	0.000	27.120	27.370	64.129%	0.508	-15.310
3	21:49:15	0.000	420.700	0.000	26.800	26.800	64.050%	0.526	-15.640
x		0.000	421.000	0.000	27.250	27.450	64.236%	0.514	-15.630
σ		0.000	2.349	0.000	0.538	0.700	0.257%	0.010	0.319
%RSD		0.000	0.558	0.000	1.973	2.549	0.400	1.933	2.043

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	0.394	5.405	5.038	66.731%	16.620	0.714	0.713	730.300
2	21:48:32	0.397	5.372	5.072	66.715%	15.560	0.629	0.647	728.300
3	21:49:15	0.392	5.562	5.066	66.612%	14.960	0.615	0.631	733.600
x		0.395	5.446	5.059	66.686%	15.720	0.653	0.663	730.700
σ		0.003	0.101	0.018	0.065%	0.839	0.054	0.043	2.709
%RSD		0.668	1.860	0.353	0.097	5.341	8.272	6.495	0.371

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:47:49	731.100	66.331%	65.315%	2.743	2.780	522.500	55.012%
2	21:48:32	735.500	67.136%	66.044%	2.762	2.793	527.500	55.546%
3	21:49:15	733.900	66.856%	66.106%	2.726	2.817	528.700	55.230%
x		733.500	66.774%	65.822%	2.744	2.796	526.200	55.262%
σ		2.208	0.409%	0.440%	0.018	0.019	3.289	0.268%
%RSD		0.301	0.612	0.668	0.646	0.665	0.625	0.486

180-26370-B-35-B 11/13/2013 9:51:54 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	94.173%	8.610	60.700	58.850	0.000	668.200	31900.000	32410.000
2	21:53:20	93.259%	8.465	62.050	59.560	0.000	658.500	32110.000	32400.000
3	21:54:03	90.001%	8.756	60.370	59.940	0.000	678.400	33230.000	33350.000
x		92.478%	8.610	61.040	59.450	0.000	668.400	32410.000	32720.000
σ		2.193%	0.145	0.889	0.556	0.000	9.909	712.400	544.300
%RSD		2.372	1.690	1.456	0.936	0.000	1.482	2.198	1.664

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	99230.000	2797.000	0.000	9162.000	56240.000	55170.000	82.933%	884.000
2	21:53:20	98650.000	2731.000	0.000	9211.000	56310.000	55330.000	82.645%	895.100
3	21:54:03	100900.000	2770.000	0.000	9309.000	56720.000	55410.000	81.190%	899.100
x		99610.000	2766.000	0.000	9227.000	56420.000	55300.000	82.256%	892.800
σ		1194.000	33.320	0.000	75.050	260.500	120.200	0.934%	7.812
%RSD		1.199	1.205	0.000	0.813	0.462	0.217	1.136	0.875

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	274.500	135.900	3.576	11540.000	216400.000	221000.000	130.400	187.700
2	21:53:20	274.500	137.100	3.444	11670.000	218500.000	223400.000	133.300	187.400
3	21:54:03	278.600	138.400	4.580	11840.000	219400.000	224400.000	132.800	188.700
x		275.900	137.100	3.867	11680.000	218100.000	222900.000	132.200	187.900
σ		2.349	1.231	0.621	151.200	1508.000	1724.000	1.557	0.685
%RSD		0.852	0.898	16.070	1.295	0.691	0.773	1.178	0.364

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	172.100	174.300	691.000	696.700	97.240	0.110	7.787	10.760
2	21:53:20	173.800	172.800	694.800	700.100	97.360	0.102	7.496	10.710
3	21:54:03	173.300	173.900	703.600	704.600	98.440	0.123	7.933	10.700
x		173.100	173.700	696.400	700.500	97.680	0.112	7.739	10.730
σ		0.872	0.802	6.446	4.001	0.659	0.011	0.223	0.031
%RSD		0.504	0.462	0.925	0.571	0.674	9.626	2.878	0.291

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	0.000	381.900	0.000	33.150	33.690	68.732%	0.675	-18.920
2	21:53:20	0.000	390.000	0.000	33.470	34.110	69.751%	0.639	-17.630
3	21:54:03	0.000	389.800	0.000	33.370	33.950	70.359%	0.672	-17.600
x		0.000	387.200	0.000	33.330	33.920	69.614%	0.662	-18.050
σ		0.000	4.630	0.000	0.164	0.216	0.822%	0.020	0.756
%RSD		0.000	1.196	0.000	0.493	0.637	1.181	3.023	4.187

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	0.554	9.632	9.148	69.622%	10.390	0.251	0.248	1229.000
2	21:53:20	0.534	9.468	9.096	71.102%	10.170	0.256	0.243	1052.000
3	21:54:03	0.498	9.333	9.028	71.673%	9.972	0.226	0.218	1233.000
x		0.529	9.478	9.091	70.799%	10.180	0.244	0.236	1171.000
σ		0.029	0.150	0.060	1.059%	0.208	0.016	0.016	103.500
%RSD		5.408	1.579	0.663	1.495	2.045	6.573	6.825	8.837

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:52:37	2292.000	72.045%	70.822%	1.259	1.260	184.800	58.625%
2	21:53:20	2295.000	74.225%	73.263%	1.267	1.304	186.100	60.147%
3	21:54:03	2297.000	74.720%	74.079%	1.242	1.297	186.700	61.100%
x		2295.000	73.663%	72.721%	1.256	1.287	185.900	59.957%
σ		2.731	1.423%	1.695%	0.013	0.024	0.991	1.248%
%RSD		0.119	1.932	2.331	1.021	1.834	0.533	2.082

180-26370-B-36-G 11/13/2013 9:56:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	83.140%	1.362	250.600	243.200	0.000	1650.000	886600.000	892000.000
2	21:58:08	81.404%	1.468	252.600	245.200	0.000	1695.000	909300.000	910700.000
3	21:58:51	80.738%	1.419	246.500	246.300	0.000	1682.000	906900.000	908600.000
x		81.761%	1.416	249.900	244.900	0.000	1676.000	900900.000	903800.000
σ		1.240%	0.053	3.076	1.548	0.000	23.170	12470.000	10220.000
%RSD		1.517	3.758	1.231	0.632	0.000	1.383	1.384	1.131
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	13710.000	9573.000	0.000	6349.000	1795000.000	1650000.000	75.307%	252.000
2	21:58:08	13930.000	9646.000	0.000	6445.000	1815000.000	1667000.000	75.863%	242.600
3	21:58:51	13850.000	9668.000	0.000	6406.000	1806000.000	1664000.000	76.049%	249.100
x		13830.000	9629.000	0.000	6400.000	1805000.000	1660000.000	75.740%	247.900
σ		111.000	49.870	0.000	48.410	10010.000	9026.000	0.386%	4.829
%RSD		0.803	0.518	0.000	0.756	0.554	0.544	0.509	1.948
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	49.050	42.990	1.241	1206.000	40270.000	48020.000	15.080	27.760
2	21:58:08	48.720	43.190	1.170	1215.000	40360.000	47760.000	14.860	27.080
3	21:58:51	48.720	43.490	1.371	1207.000	40390.000	47880.000	15.060	27.520
x		48.830	43.220	1.261	1209.000	40340.000	47890.000	15.000	27.450
σ		0.194	0.255	0.102	5.321	63.980	132.100	0.121	0.343
%RSD		0.396	0.589	8.112	0.440	0.159	0.276	0.807	1.251
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	26.340	29.250	97.300	96.720	22.090	0.002	1.806	4.075
2	21:58:08	26.160	29.380	96.950	97.690	21.770	-0.002	1.759	4.567
3	21:58:51	26.170	29.570	98.030	97.150	22.140	0.002	1.763	4.078
x		26.230	29.400	97.420	97.190	22.000	0.000	1.776	4.240
σ		0.101	0.158	0.550	0.488	0.200	0.002	0.026	0.283
%RSD		0.383	0.537	0.565	0.502	0.910	478.900	1.490	6.684
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	0.000	755.700	0.000	8.447	8.672	53.642%	0.088	-9.098
2	21:58:08	0.000	759.200	0.000	8.395	8.588	54.917%	0.083	-9.290
3	21:58:51	0.000	759.900	0.000	8.485	8.430	54.625%	0.077	-9.355
x		0.000	758.300	0.000	8.443	8.563	54.395%	0.083	-9.248
σ		0.000	2.251	0.000	0.045	0.123	0.668%	0.005	0.134
%RSD		0.000	0.297	0.000	0.534	1.433	1.227	6.442	1.445
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:57:25	0.039	1.461	1.226	56.379%	9.558	0.411	0.383	122.000
2	21:58:08	0.026	1.454	1.208	57.827%	9.694	0.429	0.392	122.200
3	21:58:51	0.018	1.391	1.189	57.750%	9.530	0.435	0.425	122.000
x		0.028	1.435	1.208	57.318%	9.594	0.425	0.400	122.000
σ		0.011	0.039	0.018	0.815%	0.088	0.013	0.022	0.104
%RSD		38.170	2.697	1.498	1.421	0.913	2.939	5.557	0.085
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	21:57:25	122.800	53.550%	52.996%	0.555	0.552	63.480	40.508%	
2	21:58:08	123.500	55.460%	54.672%	0.547	0.564	64.440	40.806%	
3	21:58:51	123.100	55.174%	54.292%	0.552	0.576	64.800	40.514%	
x		123.100	54.728%	53.987%	0.551	0.564	64.240	40.609%	
σ		0.384	1.031%	0.879%	0.004	0.012	0.681	0.171%	
%RSD		0.312	1.883	1.627	0.648	2.117	1.060	0.420	

180-26370-B-37-E 11/13/2013 10:01:30 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	82.891%	1.763	587.200	553.100	0.000	1841.000	281600.000	280700.000
2	22:02:56	80.941%	1.823	587.200	566.600	0.000	1856.000	294000.000	296300.000
3	22:03:39	79.051%	1.913	604.800	575.500	0.000	1878.000	298000.000	300400.000
x		80.961%	1.833	593.100	565.100	0.000	1859.000	291200.000	292500.000
σ		1.920%	0.076	10.170	11.270	0.000	18.600	8525.000	10420.000
%RSD		2.372	4.130	1.715	1.994	0.000	1.001	2.927	3.564

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	25050.000	2230.000	0.000	5516.000	989800.000	907500.000	68.163%	998.000
2	22:02:56	26030.000	2350.000	0.000	5754.000	1034000.000	964100.000	62.411%	1054.000
3	22:03:39	26510.000	2331.000	0.000	5743.000	1041000.000	963300.000	61.190%	1061.000
x		25870.000	2304.000	0.000	5671.000	1022000.000	944900.000	63.922%	1038.000
σ		746.600	64.120	0.000	134.500	28010.000	32460.000	3.724%	34.670
%RSD		2.887	2.784	0.000	2.371	2.741	3.435	5.826	3.340

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	92.790	339.200	11.110	4129.000	371400.000	391100.000	48.950	242.900
2	22:02:56	97.710	358.300	11.210	4390.000	390800.000	410900.000	50.700	250.100
3	22:03:39	99.670	365.500	11.040	4426.000	392900.000	412600.000	50.710	249.200
x		96.720	354.400	11.120	4315.000	385000.000	404900.000	50.120	247.400
σ		3.547	13.570	0.085	162.100	11830.000	11980.000	1.013	3.904
%RSD		3.667	3.831	0.763	3.758	3.073	2.958	2.020	1.578

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	1570.000	1719.000	3981.000	4002.000	77.090	-0.025	13.340	15.470
2	22:02:56	1613.000	1775.000	4137.000	4165.000	78.620	-0.033	14.240	15.270
3	22:03:39	1613.000	1771.000	4161.000	4172.000	79.340	-0.063	13.860	15.900
x		1598.000	1755.000	4093.000	4113.000	78.350	-0.040	13.810	15.550
σ		24.960	30.980	97.680	96.170	1.145	0.020	0.452	0.323
%RSD		1.562	1.765	2.387	2.338	1.462	48.800	3.272	2.078

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	0.000	888.800	0.000	4854.000	4881.000	54.732%	3.665	62.210
2	22:02:56	0.000	902.400	0.000	4921.000	4959.000	54.778%	3.650	58.120
3	22:03:39	0.000	911.300	0.000	4946.000	4963.000	54.625%	3.564	54.270
x		0.000	900.800	0.000	4907.000	4934.000	54.711%	3.627	58.200
σ		0.000	11.360	0.000	47.590	46.160	0.079%	0.054	3.967
%RSD		0.000	1.261	0.000	0.970	0.935	0.144	1.498	6.817

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	3.541	21.720	20.920	57.173%	70.160	5.382	5.101	751.100
2	22:02:56	3.551	21.860	21.210	57.605%	70.990	5.077	5.055	749.900
3	22:03:39	3.534	22.060	21.330	58.094%	70.610	5.286	5.354	748.500
x		3.542	21.880	21.150	57.624%	70.590	5.248	5.170	749.800
σ		0.008	0.169	0.209	0.461%	0.417	0.156	0.161	1.279
%RSD		0.239	0.772	0.987	0.799	0.590	2.972	3.116	0.171

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:02:13	759.100	53.091%	52.436%	1.242	1.307	18000.000	44.144%
2	22:02:56	757.700	55.159%	54.597%	1.260	1.256	18030.000	45.890%
3	22:03:39	758.600	55.685%	55.101%	1.272	1.285	18120.000	46.408%
x		758.500	54.645%	54.045%	1.258	1.283	18050.000	45.481%
σ		0.670	1.372%	1.416%	0.015	0.026	64.300	1.187%
%RSD		0.088	2.510	2.620	1.176	2.008	0.356	2.609

CCV 993939 11/13/2013 10:06:17 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	106.388%	107.900	105.500	104.900	0.000	48200.000	45050.000	45160.000
2	22:07:43	105.610%	106.300	106.700	102.000	0.000	48350.000	45640.000	45190.000
3	22:08:26	106.921%	104.800	102.600	98.730	0.000	47520.000	45060.000	45220.000
x		106.306%	106.355%	104.952%	101.905%	0.000	96.043%	90.499%	90.376%
σ		0.659%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.620	1.467	2.002	3.049	0.000	0.922	0.747	0.061

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	474.200	5073.000	0.000	51790.000	50520.000	49050.000	83.039%	101.100
2	22:07:43	473.000	5039.000	0.000	51040.000	51010.000	49470.000	83.844%	101.100
3	22:08:26	477.400	5033.000	0.000	51460.000	50670.000	49060.000	84.888%	101.300
x		94.973%	100.968%	0.000	102.867%	101.461%	98.393%	83.923%	101.200%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.927%	n/a
%RSD		0.478	0.429	0.000	0.728	0.491	0.487	1.105	0.119

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	102.100	102.500	2.721	476.500	24550.000	24540.000	105.600	109.100
2	22:07:43	103.400	102.500	2.514	474.900	24380.000	24310.000	105.400	108.300
3	22:08:26	103.800	101.700	1.982	476.200	24640.000	24260.000	105.700	108.700
x		103.103%	102.225%	2.406	95.177%	98.091%	97.485%	105.560%	108.675%
σ		n/a	n/a	0.381	n/a	n/a	n/a	n/a	n/a
%RSD		0.880	0.420	15.850	0.183	0.538	0.608	0.131	0.364

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	112.500	111.200	103.500	103.100	103.100	-0.316	102.100	101.600
2	22:07:43	112.900	111.600	103.300	102.700	103.200	-0.316	102.400	99.760
3	22:08:26	111.800	109.300	102.100	100.800	102.400	-0.346	101.200	99.960
x		112.384%	110.714%	102.987%	102.218%	102.903%	-0.326	101.858%	100.446%
σ		n/a	n/a	n/a	n/a	n/a	0.018	n/a	n/a
%RSD		0.492	1.094	0.744	1.205	0.421	5.422	0.615	1.011

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	0.000	93.990	78.751%	107.000	111.000	69.128%	108.700	6.131
2	22:07:43	0.000	93.310	80.304%	105.400	109.000	70.529%	108.300	3.270
3	22:08:26	0.000	93.560	81.503%	103.500	108.300	70.591%	109.200	5.915
x		0.000	93.620%	80.186%	105.310%	109.453%	70.083%	108.752%	5.105
σ		0.000	n/a	1.380%	n/a	n/a	0.827%	n/a	1.593
%RSD		0.000	0.368	1.721	1.667	1.295	1.180	0.416	31.210

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	109.500	104.600	105.600	68.897%	101.500	100.600	99.380	106.800
2	22:07:43	110.000	104.100	105.700	70.591%	101.500	100.600	98.940	106.500
3	22:08:26	109.600	105.300	105.600	71.251%	101.000	100.500	99.500	106.600
x		109.697%	104.690%	105.617%	70.246%	101.328%	100.554%	99.272%	106.644%
σ		n/a	n/a	n/a	1.214%	n/a	n/a	n/a	n/a
%RSD		0.254	0.573	0.048	1.729	0.301	0.041	0.298	0.173

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:07:00	107.700	65.111%	64.700%	103.600	104.700	107.000	59.350%
2	22:07:43	107.200	66.984%	66.065%	104.900	106.800	108.000	60.044%
3	22:08:26	108.000	67.309%	66.831%	105.400	106.300	108.200	60.523%
x		107.627%	66.468%	65.865%	104.636%	105.929%	107.748%	59.972%
σ		n/a	1.186%	1.079%	n/a	n/a	n/a	0.590%
%RSD		0.375	1.785	1.639	0.926	1.006	0.579	0.983

CCB11 11/13/2013 10:14:28 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	116.190%	-0.079	6.943	7.355	0.000	-0.194	3.765	3.752
2	22:15:54	112.185%	-0.109	7.134	6.835	0.000	-0.307	2.836	2.776
3	22:16:37	111.173%	-0.116	6.390	6.481	0.000	-0.551	2.298	2.613
x		113.183%	-0.101	6.823	6.890	0.000	-0.351	2.966	3.047
σ		2.653%	0.020	0.386	0.440	0.000	0.182	0.742	0.616
%RSD		2.344	19.350	5.662	6.383	0.000	51.990	25.000	20.230

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	1.019	6.450	0.000	4.104	6.944	5.626	95.441%	0.071
2	22:15:54	0.929	5.544	0.000	3.685	3.414	4.610	96.415%	0.042
3	22:16:37	0.963	5.340	0.000	3.621	5.748	3.009	94.540%	0.054
x		0.970	5.778	0.000	3.804	5.369	4.415	95.465%	0.056
σ		0.045	0.591	0.000	0.262	1.795	1.319	0.938%	0.014
%RSD		4.663	10.230	0.000	6.900	33.440	29.880	0.982	25.770

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	0.017	0.057	0.020	0.097	20.540	8.546	0.006	0.011
2	22:15:54	0.013	0.022	0.030	0.072	17.140	7.111	0.003	0.013
3	22:16:37	0.017	0.023	0.033	0.075	16.300	6.016	0.003	0.014
x		0.016	0.034	0.028	0.081	17.990	7.225	0.004	0.013
σ		0.002	0.020	0.007	0.014	2.249	1.269	0.002	0.001
%RSD		15.640	58.650	24.810	17.100	12.500	17.560	54.050	11.690

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	-0.001	0.026	0.715	0.847	0.104	-0.009	0.370	0.501
2	22:15:54	-0.010	0.019	0.715	0.744	0.116	-0.010	0.424	0.582
3	22:16:37	-0.010	0.035	0.678	0.633	0.111	-0.010	0.355	0.516
x		-0.007	0.027	0.703	0.742	0.111	-0.009	0.383	0.533
σ		0.006	0.008	0.022	0.107	0.006	0.001	0.036	0.043
%RSD		77.150	28.900	3.068	14.410	5.273	6.805	9.459	8.053

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	0.000	0.019	84.689%	0.862	0.860	85.817%	-0.048	-0.179
2	22:15:54	0.000	0.018	85.885%	0.756	0.732	87.027%	-0.046	0.585
3	22:16:37	0.000	0.021	86.080%	0.589	0.616	86.735%	-0.047	0.455
x		0.000	0.019	85.551%	0.736	0.736	86.526%	-0.047	0.287
σ		0.000	0.001	0.753%	0.137	0.122	0.631%	0.001	0.409
%RSD		0.000	5.403	0.880	18.680	16.600	0.729	2.192	142.500

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	-0.047	0.023	0.025	82.400%	0.254	0.033	0.043	0.039
2	22:15:54	-0.045	-0.037	-0.013	83.530%	0.230	0.033	0.041	0.028
3	22:16:37	-0.045	-0.027	-0.016	84.245%	0.196	0.032	0.033	0.040
x		-0.046	-0.014	-0.001	83.391%	0.227	0.033	0.039	0.036
σ		0.001	0.032	0.023	0.930%	0.029	0.000	0.005	0.007
%RSD		2.509	228.200	1541.000	1.115	12.960	0.354	13.680	18.790

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:15:11	0.021	72.992%	72.041%	0.006	0.008	0.051	71.700%
2	22:15:54	0.025	75.647%	74.049%	0.007	0.005	0.035	72.337%
3	22:16:37	0.023	75.962%	74.707%	0.006	0.007	0.033	72.524%
x		0.023	74.867%	73.599%	0.006	0.006	0.040	72.187%
σ		0.002	1.631%	1.389%	0.001	0.001	0.010	0.432%
%RSD		9.518	2.179	1.887	13.050	21.860	24.410	0.598

180-26370-B-38-E 11/13/2013 10:19:17 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	84.418%	1.933	544.200	524.400	0.000	2136.000	178400.000	178400.000
2	22:20:43	82.153%	1.948	543.600	520.100	0.000	2081.000	179300.000	181400.000
3	22:21:26	81.890%	2.056	538.200	515.700	0.000	2140.000	180900.000	180900.000
x		82.821%	1.979	542.000	520.000	0.000	2119.000	179500.000	180200.000
σ		1.390%	0.068	3.268	4.324	0.000	33.260	1246.000	1633.000
%RSD		1.678	3.413	0.603	0.832	0.000	1.570	0.694	0.906

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	26570.000	2765.000	0.000	5008.000	885300.000	816800.000	64.731%	1229.000
2	22:20:43	26780.000	2736.000	0.000	4999.000	879400.000	818700.000	63.124%	1217.000
3	22:21:26	26810.000	2763.000	0.000	4991.000	885200.000	821700.000	62.232%	1232.000
x		26720.000	2755.000	0.000	4999.000	883300.000	819100.000	63.363%	1226.000
σ		132.100	16.220	0.000	8.725	3388.000	2447.000	1.267%	8.117
%RSD		0.494	0.589	0.000	0.174	0.384	0.299	1.999	0.662

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	98.000	1007.000	24.930	5149.000	583300.000	636200.000	59.180	495.400
2	22:20:43	95.330	1019.000	27.620	5207.000	589400.000	638300.000	59.220	498.700
3	22:21:26	97.510	1023.000	25.920	5235.000	592100.000	646100.000	59.610	494.200
x		96.950	1016.000	26.160	5197.000	588300.000	640200.000	59.340	496.100
σ		1.419	8.364	1.360	43.760	4498.000	5199.000	0.237	2.337
%RSD		1.464	0.823	5.199	0.842	0.765	0.812	0.399	0.471

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	3186.000	3558.000	7957.000	7975.000	98.920	-0.010	4.881	7.314
2	22:20:43	3169.000	3532.000	7996.000	7987.000	98.640	0.007	4.799	6.317
3	22:21:26	3164.000	3536.000	8028.000	8052.000	99.430	-0.023	4.719	6.610
x		3173.000	3542.000	7994.000	8005.000	99.000	-0.009	4.800	6.747
σ		11.890	14.120	35.480	41.360	0.400	0.015	0.081	0.512
%RSD		0.375	0.399	0.444	0.517	0.404	171.900	1.686	7.597

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	0.000	985.300	0.000	840.300	844.500	55.680%	3.833	-0.070
2	22:20:43	0.000	995.700	0.000	852.300	852.300	55.406%	3.871	-1.921
3	22:21:26	0.000	1002.000	0.000	859.800	862.600	55.067%	3.829	0.945
x		0.000	994.400	0.000	850.800	853.100	55.385%	3.844	-0.348
σ		0.000	8.455	0.000	9.843	9.054	0.307%	0.023	1.453
%RSD		0.000	0.850	0.000	1.157	1.061	0.555	0.598	416.900

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	3.761	18.690	17.980	57.944%	141.200	5.522	5.514	859.500
2	22:20:43	3.802	18.970	18.240	58.424%	141.400	5.517	5.555	863.200
3	22:21:26	3.808	18.730	18.030	58.508%	142.100	5.463	5.456	862.300
x		3.790	18.800	18.090	58.292%	141.500	5.501	5.508	861.700
σ		0.026	0.151	0.138	0.304%	0.465	0.033	0.050	1.942
%RSD		0.674	0.804	0.764	0.522	0.328	0.592	0.902	0.225

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:20:00	873.600	53.913%	53.022%	1.051	1.153	26250.000	45.737%
2	22:20:43	867.600	55.577%	54.680%	1.089	1.159	26660.000	46.553%
3	22:21:26	871.100	55.412%	54.716%	1.116	1.152	26760.000	46.598%
x		870.800	54.967%	54.139%	1.085	1.155	26560.000	46.296%
σ		3.025	0.917%	0.968%	0.032	0.004	266.700	0.485%
%RSD		0.347	1.668	1.788	2.966	0.305	1.004	1.047

180-26370-A-39-H 11/13/2013 10:24:05 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	89.215%	5.280	272.800	257.400	0.000	1918.000	297500.000	299400.000
2	22:25:31	86.231%	5.371	266.800	262.400	0.000	1910.000	299300.000	305200.000
3	22:26:14	84.383%	5.393	263.300	261.600	0.000	1928.000	306400.000	306000.000
x		86.610%	5.348	267.600	260.500	0.000	1919.000	301100.000	303500.000
σ		2.438%	0.060	4.819	2.675	0.000	9.155	4707.000	3586.000
%RSD		2.815	1.117	1.801	1.027	0.000	0.477	1.564	1.181

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	76080.000	3181.000	0.000	8119.000	633800.000	588700.000	73.390%	755.100
2	22:25:31	76910.000	3176.000	0.000	8068.000	635100.000	588200.000	71.377%	759.000
3	22:26:14	76740.000	3148.000	0.000	8066.000	637200.000	587700.000	70.411%	770.000
x		76580.000	3168.000	0.000	8084.000	635300.000	588200.000	71.726%	761.400
σ		438.400	17.670	0.000	30.240	1729.000	468.600	1.520%	7.745
%RSD		0.573	0.558	0.000	0.374	0.272	0.080	2.119	1.017

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	197.300	147.100	4.709	7611.000	141800.000	143200.000	57.020	132.800
2	22:25:31	198.300	148.100	6.482	7720.000	142700.000	145400.000	57.970	135.600
3	22:26:14	200.400	149.300	5.307	7733.000	141300.000	144000.000	56.880	134.100
x		198.700	148.200	5.499	7688.000	141900.000	144200.000	57.290	134.200
σ		1.596	1.089	0.902	66.660	715.900	1110.000	0.594	1.395
%RSD		0.803	0.735	16.410	0.867	0.504	0.770	1.036	1.040

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	117.500	117.900	713.600	723.300	54.560	0.054	5.040	7.940
2	22:25:31	118.200	118.200	723.400	727.800	54.460	0.058	4.938	8.346
3	22:26:14	117.200	118.400	723.900	729.100	54.830	0.043	5.263	8.467
x		117.600	118.200	720.300	726.800	54.620	0.052	5.080	8.251
σ		0.533	0.265	5.795	3.020	0.190	0.008	0.167	0.276
%RSD		0.453	0.225	0.804	0.416	0.348	15.160	3.277	3.347

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	0.000	481.500	0.000	12.280	12.490	58.985%	0.561	-16.380
2	22:25:31	0.000	486.700	0.000	11.510	11.780	58.959%	0.526	-16.280
3	22:26:14	0.000	486.500	0.000	11.220	11.380	58.347%	0.531	-14.820
x		0.000	484.900	0.000	11.670	11.880	58.764%	0.539	-15.830
σ		0.000	2.928	0.000	0.552	0.562	0.361%	0.019	0.871
%RSD		0.000	0.604	0.000	4.731	4.732	0.614	3.522	5.504

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	0.466	5.437	4.926	62.037%	27.530	0.158	0.169	1072.000
2	22:25:31	0.466	5.387	4.935	62.286%	27.540	0.154	0.161	1071.000
3	22:26:14	0.449	5.154	4.806	62.273%	27.410	0.151	0.162	1064.000
x		0.460	5.326	4.889	62.199%	27.490	0.154	0.164	1069.000
σ		0.010	0.151	0.072	0.140%	0.073	0.003	0.004	4.200
%RSD		2.151	2.842	1.471	0.225	0.265	2.033	2.521	0.393

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:24:48	1071.000	61.531%	60.857%	1.105	1.150	735.200	49.007%
2	22:25:31	1078.000	62.723%	62.515%	1.117	1.146	762.000	50.472%
3	22:26:14	1068.000	63.261%	63.027%	1.122	1.155	764.400	50.822%
x		1072.000	62.505%	62.133%	1.115	1.151	753.900	50.100%
σ		5.272	0.886%	1.134%	0.009	0.005	16.170	0.963%
%RSD		0.492	1.417	1.826	0.796	0.405	2.145	1.921

180-26370-A-40-F 11/13/2013 10:28:53 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	86.286%	5.864	279.300	274.600	0.000	2102.000	328900.000	330500.000
2	22:30:18	83.969%	5.566	281.500	272.800	0.000	2060.000	322800.000	325600.000
3	22:31:01	82.828%	5.919	281.400	276.500	0.000	2080.000	326600.000	325900.000
x		84.361%	5.783	280.700	274.600	0.000	2081.000	326100.000	327300.000
σ		1.762%	0.190	1.228	1.876	0.000	20.910	3094.000	2742.000
%RSD		2.088	3.287	0.437	0.683	0.000	1.005	0.949	0.838
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	85090.000	2785.000	0.000	9019.000	714200.000	664900.000	66.277%	830.300
2	22:30:18	83160.000	2654.000	0.000	8594.000	684300.000	629700.000	69.301%	783.700
3	22:31:01	83530.000	2666.000	0.000	8466.000	672400.000	628900.000	68.916%	776.600
x		83930.000	2702.000	0.000	8693.000	690300.000	641200.000	68.165%	796.900
σ		1027.000	72.280	0.000	289.400	21520.000	20580.000	1.646%	29.150
%RSD		1.223	2.676	0.000	3.330	3.117	3.209	2.414	3.658
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	235.500	167.800	5.002	9651.000	167000.000	170600.000	65.970	158.200
2	22:30:18	222.500	161.000	5.148	9285.000	160900.000	164100.000	63.010	147.000
3	22:31:01	219.500	160.100	6.284	9270.000	159300.000	161900.000	62.750	149.000
x		225.800	163.000	5.478	9402.000	162400.000	165500.000	63.910	151.400
σ		8.472	4.192	0.702	215.600	4049.000	4523.000	1.790	5.975
%RSD		3.751	2.572	12.820	2.293	2.493	2.733	2.801	3.946
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	130.200	130.600	885.700	891.900	58.950	0.064	5.305	8.722
2	22:30:18	124.600	126.300	864.000	865.900	57.630	0.053	5.031	8.340
3	22:31:01	123.800	124.800	856.000	862.700	57.490	0.074	4.798	8.174
x		126.200	127.200	868.600	873.500	58.030	0.064	5.045	8.412
σ		3.507	3.003	15.350	16.010	0.807	0.011	0.254	0.281
%RSD		2.780	2.361	1.767	1.833	1.390	16.990	5.025	3.342
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	0.000	531.600	0.000	10.580	10.590	57.109%	0.542	-17.270
2	22:30:18	0.000	530.100	0.000	10.460	10.470	56.784%	0.559	-17.070
3	22:31:01	0.000	528.500	0.000	10.450	10.400	56.727%	0.553	-17.190
x		0.000	530.100	0.000	10.500	10.490	56.873%	0.551	-17.180
σ		0.000	1.537	0.000	0.075	0.094	0.206%	0.008	0.104
%RSD		0.000	0.290	0.000	0.711	0.895	0.363	1.540	0.607
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:29:35	0.483	7.274	6.853	60.035%	9.881	0.127	0.151	1145.000
2	22:30:18	0.497	7.531	6.811	60.338%	9.974	0.142	0.136	1141.000
3	22:31:01	0.501	7.507	6.860	60.626%	9.824	0.141	0.149	1143.000
x		0.494	7.437	6.841	60.333%	9.893	0.137	0.145	1143.000
σ		0.009	0.142	0.026	0.295%	0.076	0.008	0.008	2.220
%RSD		1.905	1.904	0.383	0.489	0.765	6.011	5.655	0.194
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	22:29:35	1151.000	60.206%	59.954%	1.204	1.234	208.000	48.057%	
2	22:30:18	1153.000	61.722%	61.124%	1.207	1.212	210.000	48.930%	
3	22:31:01	1145.000	62.101%	61.634%	1.218	1.254	209.800	49.003%	
x		1150.000	61.343%	60.904%	1.209	1.233	209.300	48.663%	
σ		4.373	1.003%	0.862%	0.007	0.021	1.114	0.526%	
%RSD		0.380	1.634	1.415	0.615	1.695	0.532	1.082	

180-26370-A-41-H 11/13/2013 10:33:40 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	84.784%	1.278	428.900	410.100	0.000	17370.000	177900.000	179300.000
2	22:35:06	80.855%	1.312	434.200	419.800	0.000	17660.000	182200.000	183000.000
3	22:35:49	81.181%	1.387	428.700	409.400	0.000	17520.000	181600.000	183600.000
x		82.274%	1.326	430.600	413.100	0.000	17520.000	180600.000	182000.000
σ		2.180%	0.056	3.123	5.847	0.000	145.000	2306.000	2342.000
%RSD		2.650	4.196	0.725	1.416	0.000	0.828	1.277	1.287
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	32600.000	2998.000	0.000	6089.000	1187000.000	1101000.000	63.141%	1002.000
2	22:35:06	33210.000	3051.000	0.000	6201.000	1217000.000	1125000.000	62.040%	1013.000
3	22:35:49	33390.000	3026.000	0.000	6162.000	1193000.000	1104000.000	61.387%	1008.000
x		33070.000	3025.000	0.000	6151.000	1199000.000	1110000.000	62.189%	1008.000
σ		414.600	26.860	0.000	57.220	15530.000	12620.000	0.886%	5.735
%RSD		1.254	0.888	0.000	0.930	1.296	1.137	1.425	0.569
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	94.400	114.800	3.198	2382.000	157500.000	164000.000	198.300	89.850
2	22:35:06	94.050	115.200	3.424	2413.000	159500.000	163000.000	195.300	89.260
3	22:35:49	94.690	115.400	2.855	2431.000	159300.000	163800.000	198.300	89.850
x		94.380	115.100	3.159	2409.000	158800.000	163600.000	197.300	89.660
σ		0.322	0.338	0.287	24.720	1121.000	525.000	1.752	0.339
%RSD		0.341	0.294	9.077	1.026	0.706	0.321	0.888	0.378
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	636.400	630.000	1086.000	1096.000	61.330	0.018	2.901	4.241
2	22:35:06	632.100	627.100	1086.000	1092.000	61.660	0.004	2.656	4.688
3	22:35:49	632.600	629.200	1094.000	1101.000	61.820	-0.006	2.818	4.578
x		633.700	628.800	1088.000	1096.000	61.600	0.005	2.791	4.503
σ		2.331	1.519	4.684	4.428	0.251	0.012	0.125	0.233
%RSD		0.368	0.242	0.430	0.404	0.407	233.700	4.468	5.168
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	0.000	1038.000	0.000	50.930	51.490	55.171%	0.416	-7.477
2	22:35:06	0.000	1046.000	0.000	50.820	51.680	55.402%	0.419	-7.386
3	22:35:49	0.000	1056.000	0.000	51.710	51.460	55.240%	0.405	-7.139
x		0.000	1046.000	0.000	51.150	51.540	55.271%	0.413	-7.334
σ		0.000	9.207	0.000	0.482	0.122	0.119%	0.007	0.175
%RSD		0.000	0.880	0.000	0.942	0.237	0.215	1.754	2.385
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:34:23	0.362	6.231	5.890	58.305%	29.510	1.444	1.423	229.500
2	22:35:06	0.339	6.224	5.821	59.220%	29.760	1.473	1.407	232.000
3	22:35:49	0.347	6.072	5.942	59.182%	29.670	1.552	1.457	232.000
x		0.349	6.176	5.884	58.902%	29.650	1.490	1.429	231.200
σ		0.012	0.090	0.061	0.518%	0.126	0.056	0.026	1.427
%RSD		3.452	1.458	1.031	0.879	0.425	3.747	1.797	0.617
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	22:34:23	233.300	54.643%	53.923%	1.008	1.052	708.400	46.029%	
2	22:35:06	234.500	55.920%	55.454%	1.008	1.053	714.000	47.068%	
3	22:35:49	234.400	56.530%	55.972%	1.056	1.055	727.600	47.524%	
x		234.100	55.697%	55.116%	1.024	1.053	716.700	46.874%	
σ		0.633	0.963%	1.065%	0.028	0.001	9.874	0.766%	
%RSD		0.270	1.729	1.933	2.691	0.127	1.378	1.634	

180-26370-B-42-G 11/13/2013 10:38:27 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	84.338%	1.207	378.600	373.700	0.000	3804.000	104200.000	104200.000
2	22:39:53	82.288%	1.361	392.100	372.300	0.000	3858.000	105800.000	104900.000
3	22:40:36	81.548%	1.117	379.000	371.300	0.000	3800.000	104000.000	104300.000
x		82.725%	1.228	383.200	372.400	0.000	3821.000	104700.000	104500.000
σ		1.445%	0.123	7.664	1.227	0.000	32.400	984.300	409.100
%RSD		1.747	10.020	2.000	0.329	0.000	0.848	0.940	0.392
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	34140.000	4513.000	0.000	5632.000	368100.000	342800.000	67.690%	588.900
2	22:39:53	34400.000	4431.000	0.000	5608.000	369000.000	344600.000	66.984%	598.600
3	22:40:36	33830.000	4442.000	0.000	5507.000	368900.000	345100.000	66.835%	593.200
x		34120.000	4462.000	0.000	5582.000	368600.000	344200.000	67.170%	593.600
σ		280.800	44.900	0.000	66.220	493.600	1210.000	0.457%	4.818
%RSD		0.823	1.006	0.000	1.186	0.134	0.351	0.680	0.812
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	222.800	58.890	1.735	955.000	40160.000	41030.000	11.470	43.470
2	22:39:53	220.900	58.070	1.647	972.800	40990.000	41170.000	11.540	44.860
3	22:40:36	221.800	57.900	2.202	968.000	40300.000	40810.000	11.270	42.780
x		221.800	58.290	1.861	965.300	40480.000	41000.000	11.430	43.710
σ		0.978	0.530	0.298	9.242	445.700	183.300	0.139	1.060
%RSD		0.441	0.910	16.030	0.958	1.101	0.447	1.215	2.425
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	138.600	139.900	1434.000	1450.000	39.820	0.011	6.304	8.094
2	22:39:53	140.000	139.900	1446.000	1461.000	39.730	0.037	6.484	7.786
3	22:40:36	137.300	137.900	1432.000	1443.000	39.530	-0.003	6.063	8.158
x		138.600	139.200	1437.000	1452.000	39.690	0.015	6.284	8.013
σ		1.344	1.172	7.601	9.248	0.152	0.021	0.211	0.199
%RSD		0.970	0.842	0.529	0.637	0.382	136.500	3.356	2.483
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	0.000	702.700	0.000	11.140	11.210	59.245%	0.135	-3.539
2	22:39:53	0.000	706.900	0.000	10.860	11.090	59.317%	0.141	-2.823
3	22:40:36	0.000	705.400	0.000	11.010	10.990	59.861%	0.130	-5.553
x		0.000	705.000	0.000	11.000	11.100	59.475%	0.135	-3.972
σ		0.000	2.124	0.000	0.141	0.112	0.337%	0.005	1.416
%RSD		0.000	0.301	0.000	1.278	1.009	0.566	4.049	35.640
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:39:10	0.129	6.980	6.816	63.041%	17.990	0.162	0.186	367.800
2	22:39:53	0.116	7.272	6.917	63.478%	18.430	0.159	0.166	368.400
3	22:40:36	0.113	7.227	6.818	64.069%	18.160	0.143	0.160	367.900
x		0.119	7.160	6.850	63.529%	18.190	0.155	0.171	368.000
σ		0.009	0.157	0.058	0.516%	0.220	0.010	0.014	0.307
%RSD		7.192	2.195	0.846	0.812	1.209	6.612	8.010	0.083
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	22:39:10	370.700	65.067%	65.185%	0.763	0.802	273.300	55.233%	
2	22:39:53	368.200	66.944%	66.994%	0.759	0.773	275.900	56.424%	
3	22:40:36	366.700	67.381%	67.169%	0.750	0.770	276.200	56.979%	
x		368.500	66.464%	66.449%	0.757	0.782	275.100	56.212%	
σ		2.006	1.230%	1.098%	0.007	0.018	1.565	0.892%	
%RSD		0.544	1.850	1.653	0.939	2.254	0.569	1.587	

180-26370-A-43-F 11/13/2013 10:43:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	75.185%	1.403	314.400	311.400	0.000	1857.000	842900.000	850600.000
2	22:44:41	72.994%	1.788	322.200	316.700	0.000	1839.000	843600.000	848700.000
3	22:45:24	74.490%	1.443	317.400	308.700	0.000	1861.000	860400.000	865400.000
x		74.223%	1.545	318.000	312.300	0.000	1853.000	849000.000	854900.000
σ		1.120%	0.212	3.940	4.048	0.000	12.050	9907.000	9151.000
%RSD		1.509	13.710	1.239	1.296	0.000	0.650	1.167	1.070
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	22220.000	4482.000	0.000	2806.000	1749000.000	1612000.000	61.118%	365.300
2	22:44:41	21970.000	4423.000	0.000	2707.000	1679000.000	1546000.000	65.140%	350.300
3	22:45:24	22640.000	4593.000	0.000	2844.000	1767000.000	1613000.000	62.178%	369.000
x		22280.000	4499.000	0.000	2785.000	1732000.000	1590000.000	62.812%	361.500
σ		340.600	86.160	0.000	70.720	46720.000	38110.000	2.085%	9.874
%RSD		1.529	1.915	0.000	2.539	2.697	2.396	3.319	2.731
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	76.630	96.920	2.377	2899.000	213600.000	222800.000	21.930	49.750
2	22:44:41	73.520	92.930	3.432	2813.000	206400.000	216000.000	21.030	48.180
3	22:45:24	77.200	98.610	3.530	2951.000	214800.000	224600.000	22.150	50.580
x		75.780	96.150	3.113	2888.000	211600.000	221100.000	21.710	49.500
σ		1.978	2.919	0.640	70.080	4502.000	4565.000	0.592	1.218
%RSD		2.610	3.036	20.550	2.427	2.128	2.064	2.728	2.460
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	52.300	54.460	1040.000	1051.000	20.340	-0.012	1.436	4.203
2	22:44:41	51.100	53.750	1015.000	1025.000	20.340	-0.004	1.550	4.313
3	22:45:24	53.310	55.920	1049.000	1063.000	20.550	-0.014	1.475	4.334
x		52.240	54.710	1034.000	1046.000	20.410	-0.010	1.487	4.283
σ		1.106	1.108	17.350	19.160	0.119	0.005	0.058	0.070
%RSD		2.117	2.025	1.677	1.831	0.583	52.800	3.890	1.642
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	0.000	748.000	0.000	12.700	12.500	49.098%	0.100	-9.707
2	22:44:41	0.000	743.400	0.000	12.540	12.940	49.752%	0.092	-8.824
3	22:45:24	0.000	751.800	0.000	12.570	12.840	50.151%	0.099	-6.772
x		0.000	747.700	0.000	12.610	12.760	49.667%	0.097	-8.434
σ		0.000	4.170	0.000	0.088	0.232	0.532%	0.005	1.506
%RSD		0.000	0.558	0.000	0.695	1.819	1.071	4.927	17.860
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:43:58	0.073	42.940	42.160	52.076%	15.560	0.343	0.329	201.600
2	22:44:41	0.049	43.270	41.930	53.410%	15.300	0.377	0.375	200.700
3	22:45:24	0.063	42.330	42.180	53.391%	15.340	0.321	0.353	202.000
x		0.062	42.850	42.090	52.959%	15.400	0.347	0.352	201.400
σ		0.012	0.481	0.139	0.765%	0.142	0.028	0.023	0.652
%RSD		19.490	1.124	0.329	1.444	0.920	8.181	6.477	0.324
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	22:43:58	201.600	50.609%	50.461%	0.967	1.023	259.300	39.304%	
2	22:44:41	203.100	51.624%	50.966%	0.994	1.012	265.400	39.065%	
3	22:45:24	203.300	51.381%	51.213%	0.995	0.983	264.000	39.229%	
x		202.700	51.205%	50.880%	0.985	1.006	262.900	39.199%	
σ		0.922	0.530%	0.383%	0.016	0.020	3.172	0.122%	
%RSD		0.455	1.036	0.754	1.642	2.029	1.207	0.312	

180-26700-A-1-I 11/13/2013 10:48:03 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	90.220%	10.950	93.120	88.620	0.000	1355.000	65090.000	65150.000
2	22:49:29	87.040%	10.290	88.940	88.330	0.000	1357.000	65750.000	65690.000
3	22:50:12	86.819%	10.660	88.410	87.150	0.000	1340.000	65230.000	65480.000
x		88.026%	10.630	90.160	88.030	0.000	1351.000	65360.000	65440.000
σ		1.903%	0.335	2.577	0.775	0.000	9.628	350.700	272.400
%RSD		2.162	3.150	2.858	0.880	0.000	0.713	0.537	0.416

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	73080.000	8187.000	0.000	6709.000	234200.000	225500.000	74.188%	1060.000
2	22:49:29	73780.000	8238.000	0.000	6671.000	234200.000	226700.000	72.895%	1056.000
3	22:50:12	73490.000	8203.000	0.000	6657.000	234500.000	226200.000	72.176%	1057.000
x		73450.000	8209.000	0.000	6679.000	234300.000	226100.000	73.086%	1058.000
σ		350.900	25.840	0.000	27.090	160.600	600.500	1.020%	2.176
%RSD		0.478	0.315	0.000	0.406	0.069	0.266	1.396	0.206

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	191.200	400.100	11.890	16560.000	175600.000	176800.000	85.780	134.600
2	22:49:29	186.500	386.600	20.410	16500.000	175100.000	177000.000	84.240	130.900
3	22:50:12	190.400	403.000	11.310	16490.000	173200.000	176300.000	83.410	130.600
x		189.400	396.600	14.530	16520.000	174700.000	176700.000	84.480	132.100
σ		2.541	8.726	5.093	40.800	1243.000	359.800	1.205	2.231
%RSD		1.342	2.200	35.040	0.247	0.712	0.204	1.427	1.689

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	157.400	155.300	1180.000	1191.000	50.620	0.037	3.569	6.988
2	22:49:29	154.700	153.700	1182.000	1191.000	50.610	0.046	3.821	7.261
3	22:50:12	153.000	152.700	1188.000	1196.000	50.780	0.048	3.832	6.132
x		155.000	153.900	1183.000	1193.000	50.670	0.044	3.740	6.794
σ		2.208	1.347	4.126	2.956	0.098	0.006	0.149	0.589
%RSD		1.424	0.875	0.349	0.248	0.193	13.040	3.975	8.672

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	0.000	458.100	0.000	6.603	6.520	61.449%	0.328	-16.210
2	22:49:29	0.000	463.700	0.000	6.581	6.667	61.509%	0.328	-14.430
3	22:50:12	0.000	460.200	0.000	6.626	6.538	61.625%	0.340	-14.240
x		0.000	460.700	0.000	6.603	6.575	61.528%	0.332	-14.960
σ		0.000	2.828	0.000	0.022	0.080	0.089%	0.007	1.087
%RSD		0.000	0.614	0.000	0.339	1.219	0.145	2.007	7.262

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	0.260	4.611	4.129	63.208%	28.090	0.212	0.201	872.300
2	22:49:29	0.238	4.481	3.938	64.371%	28.110	0.191	0.209	868.700
3	22:50:12	0.247	4.546	3.863	64.567%	28.180	0.249	0.227	868.700
x		0.248	4.546	3.977	64.049%	28.130	0.218	0.213	869.900
σ		0.011	0.065	0.137	0.735%	0.048	0.030	0.013	2.085
%RSD		4.454	1.427	3.455	1.147	0.169	13.590	6.144	0.240

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:48:46	878.800	62.665%	61.779%	0.832	0.874	426.800	52.550%
2	22:49:29	873.300	64.631%	63.674%	0.862	0.872	430.900	54.106%
3	22:50:12	872.200	65.340%	64.763%	0.844	0.863	430.800	54.811%
x		874.800	64.212%	63.406%	0.846	0.870	429.500	53.822%
σ		3.510	1.386%	1.510%	0.015	0.006	2.362	1.157%
%RSD		0.401	2.158	2.382	1.754	0.652	0.550	2.150

180-26700-A-2-G 11/13/2013 10:52:52 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	100.832%	2.671	13.630	12.960	0.000	405.400	9948.000	9905.000
2	22:54:18	94.919%	2.839	13.250	13.030	0.000	405.100	10050.000	10060.000
3	22:55:01	91.869%	2.812	14.010	11.970	0.000	324.500	10190.000	10160.000
x		95.873%	2.774	13.630	12.650	0.000	378.300	10060.000	10040.000
σ		4.557%	0.090	0.377	0.590	0.000	46.620	121.300	128.600
%RSD		4.754	3.246	2.767	4.659	0.000	12.320	1.206	1.280
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	36310.000	1498.000	0.000	4127.000	11670.000	10770.000	81.659%	311.700
2	22:54:18	37340.000	1514.000	0.000	4175.000	11830.000	10850.000	75.196%	311.500
3	22:55:01	36950.000	1469.000	0.000	4124.000	12010.000	11030.000	72.403%	311.100
x		36870.000	1494.000	0.000	4142.000	11840.000	10880.000	76.419%	311.400
σ		516.800	22.550	0.000	28.490	169.500	129.100	4.748%	0.304
%RSD		1.402	1.510	0.000	0.688	1.432	1.186	6.213	0.098
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	70.560	67.550	1.573	44900.000	137000.000	136700.000	56.520	178.000
2	22:54:18	71.910	68.790	1.154	45780.000	139500.000	138800.000	56.950	179.100
3	22:55:01	71.230	68.750	2.464	46140.000	139600.000	139500.000	56.720	176.800
x		71.230	68.360	1.730	45610.000	138700.000	138300.000	56.730	178.000
σ		0.676	0.705	0.669	636.600	1488.000	1484.000	0.216	1.145
%RSD		0.949	1.031	38.680	1.396	1.073	1.073	0.382	0.643
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	145.500	143.900	324.100	324.600	30.640	0.068	1.264	3.555
2	22:54:18	144.300	144.100	329.100	328.100	30.350	0.068	1.138	3.629
3	22:55:01	144.300	142.000	327.900	327.600	30.600	0.066	0.943	3.404
x		144.700	143.300	327.000	326.800	30.530	0.068	1.115	3.529
σ		0.664	1.169	2.630	1.885	0.157	0.001	0.162	0.115
%RSD		0.459	0.816	0.804	0.577	0.513	1.527	14.500	3.256
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	0.000	62.630	0.000	3.924	3.991	70.335%	0.020	-6.796
2	22:54:18	0.000	62.960	0.000	4.138	3.942	67.323%	0.030	-7.122
3	22:55:01	0.000	63.170	0.000	4.011	3.940	65.087%	0.031	-8.580
x		0.000	62.920	0.000	4.024	3.957	67.582%	0.027	-7.499
σ		0.000	0.274	0.000	0.108	0.029	2.634%	0.006	0.950
%RSD		0.000	0.435	0.000	2.684	0.724	3.897	21.990	12.670
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:53:35	-0.003	2.204	1.984	70.611%	15.300	0.311	0.292	348.600
2	22:54:18	-0.006	2.324	2.037	67.523%	15.390	0.343	0.338	347.500
3	22:55:01	-0.012	2.387	2.129	66.081%	15.590	0.342	0.299	348.000
x		-0.007	2.305	2.050	68.072%	15.430	0.332	0.310	348.000
σ		0.005	0.093	0.073	2.314%	0.152	0.018	0.024	0.592
%RSD		68.910	4.041	3.577	3.400	0.984	5.546	7.867	0.170
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	22:53:35	351.200	69.580%	68.746%	0.665	0.668	65.980	59.022%	
2	22:54:18	350.900	69.043%	68.114%	0.700	0.683	66.730	58.566%	
3	22:55:01	347.800	68.057%	67.312%	0.671	0.681	66.660	58.192%	
x		350.000	68.893%	68.057%	0.679	0.677	66.460	58.593%	
σ		1.910	0.773%	0.718%	0.019	0.008	0.413	0.416%	
%RSD		0.546	1.122	1.056	2.750	1.204	0.621	0.709	

180-26700-B-3-J 11/13/2013 10:57:40 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	90.387%	3.590	11.670	12.730	0.000	293.600	7954.000	7895.000
2	22:59:05	85.442%	3.857	11.880	12.260	0.000	272.100	8091.000	8058.000
3	22:59:48	85.424%	3.523	11.640	11.900	0.000	352.600	8309.000	8311.000
x		87.085%	3.657	11.730	12.300	0.000	306.100	8118.000	8088.000
σ		2.860%	0.177	0.130	0.417	0.000	41.690	178.800	209.200
%RSD		3.285	4.839	1.110	3.395	0.000	13.620	2.203	2.587

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	33720.000	1717.000	0.000	3843.000	7445.000	6865.000	67.384%	292.000
2	22:59:05	34200.000	1750.000	0.000	3825.000	7357.000	6882.000	66.495%	291.800
3	22:59:48	35320.000	1796.000	0.000	3948.000	7704.000	7311.000	61.816%	309.000
x		34410.000	1754.000	0.000	3872.000	7502.000	7019.000	65.232%	297.600
σ		819.700	39.380	0.000	66.500	180.700	252.600	2.991%	9.881
%RSD		2.382	2.245	0.000	1.717	2.409	3.599	4.585	3.320

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	86.280	81.390	1.678	5573.000	164200.000	166100.000	55.320	120.800
2	22:59:05	85.750	81.940	1.750	5632.000	168400.000	168700.000	55.340	121.500
3	22:59:48	90.480	87.010	2.699	5901.000	174200.000	175300.000	57.420	123.900
x		87.500	83.450	2.043	5702.000	169000.000	170100.000	56.030	122.100
σ		2.593	3.095	0.570	175.200	5028.000	4755.000	1.211	1.648
%RSD		2.963	3.709	27.900	3.073	2.976	2.796	2.161	1.350

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	127.900	127.700	291.100	292.800	38.810	0.081	0.804	2.472
2	22:59:05	128.400	127.400	292.100	295.500	39.070	0.071	0.690	3.193
3	22:59:48	132.400	131.400	303.000	303.600	39.910	0.055	0.795	2.961
x		129.600	128.800	295.400	297.300	39.260	0.069	0.763	2.875
σ		2.470	2.237	6.607	5.614	0.576	0.013	0.063	0.368
%RSD		1.906	1.737	2.237	1.888	1.466	19.230	8.321	12.800

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	0.000	45.120	0.000	5.745	5.906	59.906%	0.057	-7.798
2	22:59:05	0.000	45.940	0.000	5.982	6.041	59.583%	0.070	-8.732
3	22:59:48	0.000	46.370	0.000	5.998	5.951	59.547%	0.053	-9.210
x		0.000	45.810	0.000	5.908	5.966	59.679%	0.060	-8.580
σ		0.000	0.634	0.000	0.142	0.069	0.198%	0.009	0.718
%RSD		0.000	1.385	0.000	2.402	1.155	0.331	14.580	8.366

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	0.013	1.617	1.339	60.897%	13.210	0.236	0.246	389.700
2	22:59:05	-0.001	1.656	1.357	61.385%	13.100	0.243	0.242	391.200
3	22:59:48	0.004	1.605	1.428	61.323%	13.190	0.242	0.262	390.900
x		0.005	1.626	1.374	61.202%	13.170	0.240	0.250	390.600
σ		0.007	0.027	0.047	0.265%	0.061	0.004	0.011	0.783
%RSD		130.400	1.651	3.418	0.434	0.462	1.714	4.209	0.201

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:58:22	392.200	62.237%	61.727%	0.947	0.966	71.950	54.832%
2	22:59:05	392.700	64.109%	63.816%	0.945	1.016	72.370	56.253%
3	22:59:48	393.100	64.778%	64.017%	1.013	1.004	72.850	56.600%
x		392.700	63.708%	63.187%	0.968	0.995	72.390	55.895%
σ		0.439	1.317%	1.268%	0.039	0.026	0.451	0.937%
%RSD		0.112	2.068	2.007	4.013	2.642	0.623	1.676

180-26700-A-4-G 11/13/2013 11:02:27 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	67.660%	74.560	549.400	508.700	0.000	9348.000	406100.000	407200.000
2	23:03:53	65.965%	73.820	538.800	511.600	0.000	9573.000	417000.000	415900.000
3	23:04:36	66.267%	73.570	532.600	512.100	0.000	9434.000	414400.000	414500.000
x		66.631%	73.980	540.300	510.800	0.000	9452.000	412500.000	412600.000
σ		0.904%	0.514	8.480	1.867	0.000	113.100	5679.000	4681.000
%RSD		1.357	0.695	1.570	0.365	0.000	1.197	1.377	1.135

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	250900.000	3101.000	0.000	16440.000	1808000.000	1661000.000	56.614%	3721.000
2	23:03:53	255500.000	3159.000	0.000	16310.000	1798000.000	1657000.000	56.796%	3740.000
3	23:04:36	255700.000	3140.000	0.000	16200.000	1786000.000	1640000.000	57.038%	3724.000
x		254000.000	3133.000	0.000	16320.000	1797000.000	1653000.000	56.816%	3728.000
σ		2719.000	29.400	0.000	124.700	11320.000	11190.000	0.213%	10.120
%RSD		1.070	0.938	0.000	0.764	0.630	0.677	0.375	0.272

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	27.600	142.400	5.897	16880.000	338000.000	355200.000	17.740	18.390
2	23:03:53	28.750	143.800	4.669	17130.000	340400.000	356700.000	17.340	18.490
3	23:04:36	28.040	142.000	5.050	17040.000	337700.000	352900.000	17.340	19.240
x		28.130	142.700	5.206	17020.000	338700.000	355000.000	17.470	18.710
σ		0.577	0.964	0.628	128.100	1500.000	1895.000	0.231	0.465
%RSD		2.050	0.676	12.070	0.752	0.443	0.534	1.321	2.484

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	24.390	28.750	22.940	18.120	5.162	0.074	13.820	19.570
2	23:03:53	24.220	28.330	23.710	19.350	5.180	0.061	13.400	19.750
3	23:04:36	24.000	27.850	23.290	18.250	6.054	0.013	13.960	19.840
x		24.210	28.310	23.310	18.570	5.465	0.049	13.730	19.720
σ		0.195	0.449	0.384	0.674	0.510	0.032	0.293	0.138
%RSD		0.804	1.585	1.646	3.630	9.329	64.930	2.139	0.697

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	0.000	2837.000	0.000	11.180	11.440	42.637%	0.685	-74.100
2	23:03:53	0.000	2871.000	0.000	11.350	11.330	43.260%	0.652	-68.800
3	23:04:36	0.000	2875.000	0.000	11.440	11.540	43.657%	0.647	-61.810
x		0.000	2861.000	0.000	11.320	11.440	43.185%	0.661	-68.240
σ		0.000	20.580	0.000	0.135	0.105	0.514%	0.021	6.167
%RSD		0.000	0.719	0.000	1.194	0.916	1.191	3.128	9.038

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	0.025	5.830	3.779	46.220%	9.790	0.008	0.018	2389.000
2	23:03:53	0.036	5.455	3.511	47.616%	9.927	0.013	0.011	2185.000
3	23:04:36	0.032	4.872	3.128	48.169%	10.140	0.020	0.003	2218.000
x		0.031	5.386	3.473	47.335%	9.951	0.014	0.011	2264.000
σ		0.005	0.483	0.327	1.004%	0.174	0.006	0.008	109.600
%RSD		17.350	8.960	9.429	2.122	1.752	44.120	70.570	4.841

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:03:10	3044.000	47.916%	48.782%	0.017	0.016	3.760	35.754%
2	23:03:53	3015.000	49.921%	50.617%	0.014	0.015	3.767	37.274%
3	23:04:36	3021.000	50.563%	51.449%	0.014	0.014	3.749	37.336%
x		3027.000	49.467%	50.283%	0.015	0.015	3.759	36.788%
σ		15.010	1.381%	1.365%	0.001	0.001	0.009	0.896%
%RSD		0.496	2.791	2.714	9.866	4.607	0.234	2.435

CCV 993939 11/13/2013 11:07:15 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	100.778%	111.900	104.300	100.600	0.000	49290.000	44940.000	45160.000
2	23:08:41	101.647%	106.200	100.100	99.100	0.000	47700.000	44600.000	44660.000
3	23:09:24	99.675%	110.000	105.400	98.810	0.000	49520.000	46480.000	46120.000
x		100.700%	109.380%	103.267%	99.490%	0.000	97.673%	90.680%	90.626%
σ		0.989%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.982	2.657	2.697	0.945	0.000	2.024	2.205	1.646

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	493.100	5024.000	0.000	54070.000	53040.000	50660.000	74.550%	106.500
2	23:08:41	488.200	5005.000	0.000	52250.000	52430.000	50320.000	75.720%	103.700
3	23:09:24	485.500	5088.000	0.000	53380.000	53340.000	50960.000	74.888%	104.500
x		97.786%	100.779%	0.000	106.470%	105.872%	101.294%	75.053%	104.918%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.602%	n/a
%RSD		0.790	0.862	0.000	1.726	0.871	0.625	0.802	1.371

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	104.400	103.400	3.262	478.600	24380.000	24000.000	106.000	108.900
2	23:08:41	104.700	102.800	2.212	476.500	24470.000	24130.000	104.800	108.100
3	23:09:24	106.300	104.000	1.891	481.400	24850.000	24470.000	105.500	108.700
x		105.150%	103.398%	2.455	95.768%	98.266%	96.810%	105.457%	108.551%
σ		n/a	n/a	0.717	n/a	n/a	n/a	n/a	n/a
%RSD		0.983	0.573	29.200	0.505	1.000	1.000	0.561	0.403

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	111.600	110.500	103.400	102.300	101.200	-0.247	99.170	97.420
2	23:08:41	110.000	109.700	100.900	101.700	100.100	-0.346	97.190	96.920
3	23:09:24	110.400	109.600	102.400	101.500	100.000	-0.312	97.980	95.050
x		110.639%	109.937%	102.250%	101.858%	100.459%	-0.302	98.116%	96.464%
σ		n/a	n/a	n/a	n/a	n/a	0.050	n/a	n/a
%RSD		0.769	0.483	1.222	0.408	0.672	16.690	1.016	1.293

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	0.000	90.260	76.707%	96.760	100.600	63.844%	108.700	3.222
2	23:08:41	0.000	90.110	77.318%	98.720	103.200	64.126%	110.300	4.049
3	23:09:24	0.000	89.960	79.199%	98.670	102.400	65.173%	108.700	3.544
x		0.000	90.111%	77.741%	98.050%	102.074%	64.381%	109.231%	3.605
σ		0.000	n/a	1.299%	n/a	n/a	0.700%	n/a	0.417
%RSD		0.000	0.163	1.671	1.135	1.330	1.088	0.817	11.560

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	110.200	105.100	105.300	65.188%	101.000	100.200	99.520	106.600
2	23:08:41	110.000	105.300	105.000	66.371%	101.700	100.600	99.600	105.900
3	23:09:24	110.100	105.500	105.800	66.993%	101.000	101.100	99.890	107.500
x		110.084%	105.275%	105.368%	66.184%	101.228%	100.632%	99.669%	106.659%
σ		n/a	n/a	n/a	0.917%	n/a	n/a	n/a	n/a
%RSD		0.095	0.180	0.384	1.385	0.375	0.471	0.198	0.736

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:07:58	106.600	61.777%	61.143%	104.200	106.200	107.400	56.600%
2	23:08:41	106.800	63.660%	62.793%	105.500	106.500	108.600	57.628%
3	23:09:24	106.300	64.544%	63.679%	106.200	107.700	108.900	57.984%
x		106.539%	63.327%	62.538%	105.305%	106.799%	108.284%	57.404%
σ		n/a	1.413%	1.287%	n/a	n/a	n/a	0.719%
%RSD		0.223	2.232	2.058	0.972	0.711	0.741	1.252

CCB12 11/13/2013 11:15:26 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	116.707%	-0.073	4.951	4.503	0.000	1.034	25.460	25.360
2	23:16:52	117.960%	-0.095	4.336	4.300	0.000	0.748	21.000	21.350
3	23:17:35	119.453%	-0.122	3.789	4.199	0.000	0.387	20.090	20.990
x		118.040%	-0.096	4.359	4.334	0.000	0.723	22.180	22.570
σ		1.375%	0.025	0.581	0.155	0.000	0.324	2.872	2.427
%RSD		1.165	25.440	13.330	3.573	0.000	44.820	12.950	10.750

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	9.621	4.018	0.000	6.472	72.450	66.970	85.251%	0.170
2	23:16:52	7.747	3.914	0.000	5.193	69.750	50.780	85.551%	0.189
3	23:17:35	7.779	5.598	0.000	5.245	66.660	51.300	85.764%	0.178
x		8.383	4.510	0.000	5.637	69.620	56.350	85.522%	0.179
σ		1.072	0.944	0.000	0.724	2.896	9.202	0.258%	0.010
%RSD		12.790	20.920	0.000	12.850	4.159	16.330	0.302	5.392

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	0.042	0.065	0.016	1.749	37.910	30.170	0.012	0.050
2	23:16:52	0.017	0.020	0.023	1.405	32.550	26.200	0.009	0.007
3	23:17:35	0.022	0.035	0.019	1.377	31.460	25.310	0.010	0.011
x		0.027	0.040	0.019	1.510	33.970	27.220	0.011	0.023
σ		0.013	0.023	0.003	0.207	3.452	2.586	0.001	0.024
%RSD		48.630	57.180	16.650	13.720	10.160	9.499	12.230	104.000

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	0.010	0.025	0.904	0.909	0.160	-0.016	0.186	0.737
2	23:16:52	0.003	0.021	0.937	0.805	0.052	-0.004	0.334	0.239
3	23:17:35	-0.004	0.023	0.884	0.826	0.096	-0.009	0.334	0.453
x		0.003	0.023	0.908	0.847	0.103	-0.009	0.285	0.476
σ		0.007	0.002	0.026	0.055	0.054	0.006	0.086	0.250
%RSD		259.000	10.040	2.903	6.488	52.540	61.700	30.070	52.500

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	0.000	0.098	76.955%	0.212	0.204	77.262%	-0.048	-0.144
2	23:16:52	0.000	0.088	77.817%	0.171	0.181	78.327%	-0.043	0.591
3	23:17:35	0.000	0.088	78.334%	0.154	0.146	78.381%	-0.049	0.439
x		0.000	0.091	77.702%	0.179	0.177	77.990%	-0.047	0.295
σ		0.000	0.006	0.697%	0.030	0.029	0.631%	0.003	0.388
%RSD		0.000	6.664	0.897	16.480	16.620	0.809	7.214	131.300

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	-0.044	0.020	0.024	75.566%	0.036	0.009	0.009	0.117
2	23:16:52	-0.045	-0.036	-0.024	76.964%	0.047	0.001	0.014	0.099
3	23:17:35	-0.044	-0.030	-0.010	77.913%	0.038	0.014	0.012	0.078
x		-0.044	-0.015	-0.003	76.814%	0.040	0.008	0.012	0.098
σ		0.001	0.031	0.025	1.181%	0.006	0.007	0.002	0.019
%RSD		1.867	204.600	769.700	1.537	14.530	82.800	18.720	19.860

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:16:09	0.138	69.242%	67.953%	0.006	0.005	0.113	68.281%
2	23:16:52	0.094	70.604%	69.762%	0.004	0.005	0.097	68.942%
3	23:17:35	0.114	70.953%	69.921%	0.006	0.006	0.096	68.648%
x		0.115	70.266%	69.212%	0.005	0.005	0.102	68.624%
σ		0.022	0.904%	1.093%	0.001	0.000	0.009	0.332%
%RSD		18.930	1.287	1.580	16.430	4.176	8.855	0.483

180-26887-H-3-A@10 11/13/2013 11:20:16 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	91.905%	-0.118	39.280	37.110	0.000	821500.000	32550.000	32440.000
2	23:21:42	90.069%	-0.120	37.530	37.720	0.000	823600.000	33240.000	32810.000
3	23:22:25	89.679%	-0.102	37.090	38.030	0.000	829600.000	33310.000	33370.000
x		90.551%	-0.114	37.970	37.620	0.000	824900.000	33030.000	32870.000
σ		1.188%	0.010	1.154	0.469	0.000	4234.000	423.500	469.100
%RSD		1.312	8.386	3.040	1.247	0.000	0.513	1.282	1.427

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	6.849	355.100	0.000	5866.000	138500.000	134600.000	77.081%	0.534
2	23:21:42	6.162	357.200	0.000	5879.000	141200.000	136100.000	76.053%	0.405
3	23:22:25	5.956	354.200	0.000	5806.000	140100.000	136000.000	76.041%	0.456
x		6.322	355.500	0.000	5851.000	139900.000	135600.000	76.392%	0.465
σ		0.468	1.517	0.000	38.890	1368.000	867.400	0.597%	0.065
%RSD		7.397	0.427	0.000	0.665	0.978	0.640	0.782	14.040

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	-0.097	0.141	2.924	18.710	226.900	803.300	0.185	-0.638
2	23:21:42	-0.014	0.144	2.748	18.760	223.100	763.100	0.170	-0.622
3	23:22:25	-0.006	0.125	2.810	18.750	225.800	761.400	0.168	-0.639
x		-0.039	0.137	2.827	18.740	225.300	775.900	0.174	-0.633
σ		0.051	0.010	0.089	0.029	1.946	23.710	0.009	0.009
%RSD		130.100	7.525	3.147	0.152	0.864	3.056	5.332	1.437

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	5.950	1.921	3.393	-7.257	5.975	-0.523	0.654	23.440
2	23:21:42	6.891	1.768	3.404	-9.587	6.101	-0.539	0.720	24.000
3	23:22:25	7.474	1.943	3.468	-5.863	5.572	-0.479	0.685	22.280
x		6.772	1.877	3.422	-7.569	5.883	-0.514	0.687	23.240
σ		0.769	0.095	0.041	1.882	0.276	0.031	0.033	0.879
%RSD		11.360	5.079	1.185	24.860	4.691	6.032	4.814	3.781

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	0.000	7466.000	68.230%	0.237	0.145	61.978%	-0.034	-0.339
2	23:21:42	0.000	7443.000	70.232%	0.194	0.105	63.406%	-0.037	0.538
3	23:22:25	0.000	7475.000	70.529%	0.192	0.105	63.292%	-0.044	1.146
x		0.000	7461.000	69.664%	0.208	0.118	62.892%	-0.038	0.449
σ		0.000	16.760	1.250%	0.025	0.023	0.793%	0.005	0.746
%RSD		0.000	0.225	1.795	12.170	19.650	1.262	13.130	166.400

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	-0.032	0.030	0.016	64.080%	0.178	0.004	0.017	8931.000
2	23:21:42	-0.041	-0.039	-0.024	65.984%	0.122	0.001	0.013	8938.000
3	23:22:25	-0.050	-0.085	-0.062	67.195%	0.107	0.011	0.018	8845.000
x		-0.041	-0.031	-0.023	65.753%	0.136	0.005	0.016	8905.000
σ		0.009	0.058	0.039	1.570%	0.038	0.005	0.003	51.460
%RSD		21.960	183.400	166.000	2.388	27.780	92.870	16.960	0.578

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:20:59	8954.000	61.097%	60.525%	0.002	0.004	0.303	51.170%
2	23:21:42	8916.000	64.016%	63.307%	0.004	0.002	0.258	52.236%
3	23:22:25	8852.000	64.968%	64.343%	0.002	0.002	0.228	53.033%
x		8907.000	63.360%	62.725%	0.002	0.003	0.263	52.146%
σ		51.570	2.017%	1.974%	0.001	0.001	0.038	0.935%
%RSD		0.579	3.183	3.148	54.300	45.590	14.550	1.792

LCS 180-89541/2-A 11/13/2013 11:25:04 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	83.591%	44.910	804.700	799.500	0.000	43800.000	43550.000	43280.000
2	23:26:30	76.630%	43.990	811.300	830.200	0.000	46000.000	46050.000	46030.000
3	23:27:13	75.001%	43.370	826.800	799.500	0.000	45080.000	45560.000	44860.000
x		78.407%	44.090	814.300	809.800	0.000	44960.000	45050.000	44720.000
σ		4.563%	0.778	11.360	17.700	0.000	1108.000	1325.000	1379.000
%RSD		5.819	1.765	1.395	2.186	0.000	2.465	2.940	3.082
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	1755.000	5144.000	0.000	47440.000	49950.000	47800.000	62.842%	969.100
2	23:26:30	1889.000	5418.000	0.000	49540.000	52300.000	51060.000	55.815%	1038.000
3	23:27:13	1865.000	5377.000	0.000	48780.000	51850.000	50800.000	55.014%	1017.000
x		1836.000	5313.000	0.000	48590.000	51370.000	49890.000	57.890%	1008.000
σ		71.640	148.000	0.000	1062.000	1250.000	1813.000	4.307%	35.410
%RSD		3.902	2.785	0.000	2.185	2.434	3.633	7.440	3.513
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	497.500	198.600	37.610	471.700	1045.000	1171.000	486.900	509.000
2	23:26:30	525.800	211.100	41.450	486.900	1068.000	1216.000	504.700	521.200
3	23:27:13	512.500	206.000	46.470	479.100	1044.000	1186.000	469.400	509.000
x		512.000	205.200	41.840	479.300	1052.000	1191.000	487.000	513.100
σ		14.150	6.297	4.446	7.596	13.420	22.660	17.680	7.026
%RSD		2.765	3.068	10.620	1.585	1.276	1.903	3.630	1.369
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	255.900	256.600	436.200	432.300	34.300	0.706	8.208	8.922
2	23:26:30	262.000	259.900	442.700	441.900	34.600	0.737	7.942	8.994
3	23:27:13	260.900	260.900	440.200	439.400	34.160	0.790	7.870	8.220
x		259.600	259.100	439.700	437.900	34.350	0.744	8.007	8.712
σ		3.258	2.261	3.276	4.945	0.222	0.042	0.178	0.428
%RSD		1.255	0.873	0.745	1.129	0.645	5.706	2.223	4.909
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	0.000	911.000	63.050%	957.100	956.700	60.031%	49.890	12.230
2	23:26:30	0.000	903.400	61.213%	954.900	956.600	58.344%	49.760	14.430
3	23:27:13	0.000	910.600	59.804%	958.400	956.500	57.037%	49.550	13.210
x		0.000	908.300	61.356%	956.800	956.600	58.471%	49.730	13.290
σ		0.000	4.295	1.627%	1.764	0.070	1.501%	0.169	1.106
%RSD		0.000	0.473	2.652	0.184	0.007	2.567	0.339	8.319
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:25:47	49.320	46.010	42.190	63.715%	1843.000	419.800	418.600	1895.000
2	23:26:30	49.430	45.630	42.250	62.290%	1838.000	423.300	421.100	1878.000
3	23:27:13	49.580	46.260	41.180	60.978%	1845.000	427.500	426.200	1885.000
x		49.450	45.970	41.880	62.328%	1842.000	423.500	422.000	1886.000
σ		0.131	0.315	0.601	1.369%	3.712	3.845	3.889	8.696
%RSD		0.265	0.686	1.436	2.197	0.202	0.908	0.922	0.461
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	23:25:47	1879.000	67.355%	67.583%	48.460	49.720	20.670	60.213%	
2	23:26:30	1880.000	66.800%	67.176%	49.250	50.290	20.730	60.155%	
3	23:27:13	1879.000	66.716%	66.722%	48.800	49.780	20.600	60.488%	
x		1879.000	66.957%	67.160%	48.840	49.930	20.670	60.285%	
σ		0.430	0.347%	0.431%	0.394	0.312	0.065	0.178%	
%RSD		0.023	0.519	0.641	0.806	0.624	0.313	0.295	

180-26700-A-5-G 11/13/2013 11:29:52 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	70.678%	41.440	444.800	418.000	0.000	5177.000	288100.000	292600.000
2	23:31:18	66.736%	41.780	450.000	429.700	0.000	5263.000	297000.000	299200.000
3	23:32:01	65.610%	41.670	433.200	418.700	0.000	5274.000	299600.000	299700.000
x		67.675%	41.630	442.700	422.100	0.000	5238.000	294900.000	297200.000
σ		2.661%	0.174	8.616	6.603	0.000	52.980	6027.000	3956.000
%RSD		3.932	0.418	1.946	1.564	0.000	1.011	2.044	1.331
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	154300.000	2020.000	0.000	9049.000	1173000.000	1092000.000	55.101%	3866.000
2	23:31:18	157500.000	2028.000	0.000	8951.000	1153000.000	1082000.000	54.374%	3816.000
3	23:32:01	156800.000	2018.000	0.000	8868.000	1140000.000	1072000.000	53.837%	3831.000
x		156200.000	2022.000	0.000	8956.000	1155000.000	1082000.000	54.437%	3838.000
σ		1695.000	5.256	0.000	90.460	16880.000	9947.000	0.634%	25.720
%RSD		1.085	0.260	0.000	1.010	1.461	0.919	1.165	0.670
Run	**Time**	**51V**	**52Cr**	**53Cl O**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	407.100	703.200	18.560	40420.000	452300.000	474700.000	18.140	41.030
2	23:31:18	403.200	698.300	21.010	40750.000	448700.000	472900.000	18.030	39.950
3	23:32:01	398.300	690.300	23.040	40630.000	448400.000	470200.000	17.660	39.720
x		402.900	697.300	20.870	40600.000	449800.000	472600.000	17.940	40.230
σ		4.411	6.499	2.247	167.200	2145.000	2235.000	0.252	0.699
%RSD		1.095	0.932	10.770	0.412	0.477	0.473	1.402	1.738
Run	**Time**	**63Cu**	**65Cu**	**66Zn**	**68Zn**	**75As**	**77Ar Cl**	**78Se**	**82Se**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	43.960	46.900	145.300	142.800	8.256	0.104	7.212	11.230
2	23:31:18	43.910	46.820	145.900	145.400	8.149	0.080	7.189	10.650
3	23:32:01	43.260	46.890	147.300	145.000	8.145	0.047	6.968	11.080
x		43.710	46.870	146.200	144.400	8.184	0.077	7.123	10.990
σ		0.389	0.046	0.984	1.419	0.063	0.029	0.135	0.301
%RSD		0.890	0.097	0.673	0.983	0.772	37.120	1.888	2.737
Run	**Time**	**83Kr**	**88Sr**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**108Mo O**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	0.000	1540.000	0.000	8.000	8.087	46.504%	0.435	-44.610
2	23:31:18	0.000	1558.000	0.000	7.174	7.092	46.541%	0.429	-39.450
3	23:32:01	0.000	1551.000	0.000	7.039	6.755	46.711%	0.405	-39.980
x		0.000	1550.000	0.000	7.404	7.311	46.585%	0.423	-41.350
σ		0.000	9.306	0.000	0.520	0.692	0.110%	0.016	2.839
%RSD		0.000	0.601	0.000	7.027	9.468	0.237	3.838	6.865
Run	**Time**	**109Ag**	**111Cd**	**114Cd**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:30:35	0.036	3.729	2.550	50.031%	9.719	1.670	1.622	1689.000
2	23:31:18	0.048	3.352	2.299	50.609%	9.374	1.178	1.196	1690.000
3	23:32:01	0.022	3.395	2.277	51.084%	9.003	0.834	0.885	1691.000
x		0.036	3.492	2.375	50.575%	9.365	1.227	1.234	1690.000
σ		0.013	0.206	0.152	0.528%	0.358	0.420	0.370	0.811
%RSD		36.870	5.901	6.387	1.043	3.826	34.250	29.950	0.048
Run	**Time**	**137Ba**	**159Tb**	**165Ho**	**203Tl**	**205Tl**	**208Pb**	**209Bi**	
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	
1	23:30:35	1696.000	50.926%	51.334%	0.208	0.198	18.680	41.091%	
2	23:31:18	1701.000	52.225%	53.015%	0.160	0.155	18.970	41.850%	
3	23:32:01	1696.000	52.995%	53.934%	0.125	0.118	18.850	42.704%	
x		1698.000	52.048%	52.761%	0.164	0.157	18.830	41.882%	
σ		3.256	1.046%	1.319%	0.042	0.040	0.145	0.807%	
%RSD		0.192	2.009	2.500	25.590	25.370	0.769	1.927	

180-26700-A-6-G 11/13/2013 11:34:40 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	81.593%	18.150	247.000	238.500	0.000	3525.000	113000.000	112700.000
2	23:36:06	78.516%	17.920	241.900	234.800	0.000	3474.000	114400.000	114800.000
3	23:36:49	77.199%	17.490	246.500	238.100	0.000	3487.000	114500.000	114500.000
x		79.103%	17.850	245.100	237.100	0.000	3495.000	114000.000	114000.000
σ		2.255%	0.335	2.815	2.028	0.000	26.600	843.500	1120.000
%RSD		2.851	1.874	1.148	0.855	0.000	0.761	0.740	0.982

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	97690.000	10370.000	0.000	9037.000	480700.000	444000.000	59.596%	1898.000
2	23:36:06	100400.000	10420.000	0.000	9014.000	483500.000	445000.000	58.409%	1898.000
3	23:36:49	99370.000	10290.000	0.000	8886.000	481100.000	449300.000	58.189%	1875.000
x		99140.000	10360.000	0.000	8979.000	481800.000	446100.000	58.731%	1890.000
σ		1347.000	67.630	0.000	81.300	1528.000	2790.000	0.757%	13.560
%RSD		1.359	0.653	0.000	0.905	0.317	0.625	1.289	0.717

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	199.700	365.700	16.730	11050.000	245700.000	249500.000	54.130	131.800
2	23:36:06	204.100	375.400	11.980	11120.000	245500.000	250700.000	53.310	126.700
3	23:36:49	200.000	369.800	14.090	11020.000	244600.000	248600.000	53.050	127.500
x		201.300	370.300	14.270	11060.000	245300.000	249600.000	53.500	128.700
σ		2.476	4.862	2.381	52.720	632.500	1030.000	0.561	2.739
%RSD		1.230	1.313	16.690	0.476	0.258	0.413	1.049	2.129

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	175.400	174.300	3751.000	3837.000	113.200	0.008	7.992	11.360
2	23:36:06	172.000	174.300	3763.000	3850.000	114.400	0.033	8.300	10.340
3	23:36:49	173.100	172.500	3753.000	3833.000	113.100	0.032	8.060	10.340
x		173.500	173.700	3756.000	3840.000	113.600	0.024	8.117	10.680
σ		1.732	1.064	6.599	8.798	0.728	0.014	0.162	0.591
%RSD		0.998	0.613	0.176	0.229	0.641	57.440	1.993	5.539

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	0.000	762.500	0.000	12.190	12.570	53.449%	0.567	-21.730
2	23:36:06	0.000	770.100	0.000	12.370	12.390	53.320%	0.523	-20.680
3	23:36:49	0.000	771.400	0.000	12.250	12.410	53.207%	0.514	-24.030
x		0.000	768.000	0.000	12.270	12.460	53.325%	0.535	-22.150
σ		0.000	4.839	0.000	0.093	0.099	0.121%	0.028	1.715
%RSD		0.000	0.630	0.000	0.757	0.797	0.227	5.322	7.742

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	0.385	4.425	3.685	56.925%	127.300	1.628	1.597	1066.000
2	23:36:06	0.370	4.478	3.567	57.726%	128.000	1.529	1.561	1057.000
3	23:36:49	0.368	4.787	3.698	57.739%	128.600	1.543	1.499	1062.000
x		0.374	4.563	3.650	57.463%	128.000	1.567	1.552	1062.000
σ		0.009	0.195	0.072	0.466%	0.665	0.053	0.050	4.312
%RSD		2.519	4.282	1.983	0.811	0.520	3.395	3.220	0.406

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:35:23	1066.000	55.978%	55.435%	7.110	7.226	1298.000	47.961%
2	23:36:06	1066.000	57.209%	57.127%	7.103	7.292	1303.000	49.048%
3	23:36:49	1063.000	58.179%	57.855%	7.280	7.333	1305.000	49.574%
x		1065.000	57.122%	56.806%	7.164	7.284	1302.000	48.861%
σ		1.841	1.103%	1.241%	0.100	0.054	3.692	0.823%
%RSD		0.173	1.931	2.185	1.397	0.738	0.284	1.684

180-26700-A-7-G 11/13/2013 11:39:28 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	67.401%	21.810	319.800	312.400	0.000	12880.000	232700.000	233000.000
2	23:40:54	66.328%	21.950	315.700	308.200	0.000	12700.000	237000.000	236900.000
3	23:41:37	64.843%	21.530	322.100	314.400	0.000	12920.000	237400.000	238900.000
x		66.191%	21.760	319.200	311.600	0.000	12830.000	235700.000	236300.000
σ		1.285%	0.216	3.252	3.170	0.000	119.000	2600.000	2987.000
%RSD		1.941	0.995	1.019	1.017	0.000	0.927	1.103	1.264

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	111000.000	4183.000	0.000	7091.000	1038000.000	978000.000	52.742%	3869.000
2	23:40:54	113600.000	4245.000	0.000	7040.000	1039000.000	970300.000	51.646%	3887.000
3	23:41:37	114100.000	4264.000	0.000	7125.000	1044000.000	982200.000	51.491%	3894.000
x		112900.000	4231.000	0.000	7085.000	1040000.000	976800.000	51.960%	3884.000
σ		1655.000	42.280	0.000	42.930	3640.000	6025.000	0.682%	12.760
%RSD		1.466	0.999	0.000	0.606	0.350	0.617	1.313	0.329

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	929.800	2553.000	91.730	61210.000	366600.000	377900.000	23.930	121.700
2	23:40:54	936.000	2618.000	81.650	62330.000	372800.000	383800.000	23.670	121.600
3	23:41:37	940.800	2590.000	81.670	61850.000	372200.000	384400.000	24.130	122.300
x		935.500	2587.000	85.020	61800.000	370500.000	382000.000	23.910	121.900
σ		5.533	33.010	5.812	561.300	3407.000	3616.000	0.234	0.372
%RSD		0.592	1.276	6.836	0.908	0.920	0.947	0.979	0.305

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	438.600	441.400	806.300	806.100	32.980	-0.021	8.382	11.060
2	23:40:54	435.000	433.600	810.400	815.500	32.870	-0.001	8.267	11.220
3	23:41:37	439.100	440.600	816.500	822.300	32.580	0.014	8.518	10.630
x		437.600	438.500	811.100	814.600	32.810	-0.002	8.389	10.970
σ		2.245	4.267	5.179	8.152	0.205	0.017	0.126	0.303
%RSD		0.513	0.973	0.638	1.001	0.625	698.600	1.500	2.760

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	0.000	1156.000	0.000	23.120	22.810	46.800%	0.875	-29.440
2	23:40:54	0.000	1163.000	0.000	23.110	23.360	46.700%	0.871	-26.630
3	23:41:37	0.000	1178.000	0.000	23.040	23.450	46.637%	0.897	-26.880
x		0.000	1166.000	0.000	23.090	23.210	46.712%	0.881	-27.650
σ		0.000	11.100	0.000	0.043	0.346	0.083%	0.014	1.552
%RSD		0.000	0.952	0.000	0.186	1.490	0.177	1.569	5.614

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	0.594	5.019	4.033	51.187%	52.610	0.764	0.783	1369.000
2	23:40:54	0.587	4.729	3.788	51.876%	52.980	0.885	0.782	1360.000
3	23:41:37	0.587	4.725	3.919	51.646%	53.340	0.821	0.776	1373.000
x		0.589	4.824	3.914	51.570%	52.970	0.824	0.780	1367.000
σ		0.004	0.169	0.123	0.351%	0.363	0.061	0.004	6.421
%RSD		0.677	3.499	3.138	0.681	0.686	7.372	0.467	0.470

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:40:11	1374.000	50.887%	51.053%	0.294	0.286	276.000	43.135%
2	23:40:54	1372.000	51.952%	52.295%	0.293	0.283	277.300	44.424%
3	23:41:37	1378.000	52.015%	52.453%	0.289	0.280	281.000	43.998%
x		1375.000	51.618%	51.934%	0.292	0.283	278.100	43.852%
σ		2.851	0.634%	0.767%	0.003	0.003	2.549	0.657%
%RSD		0.207	1.228	1.476	0.971	1.087	0.916	1.497

180-26700-A-8-G 11/13/2013 11:44:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	55.507%	2.862	407.000	388.200	0.000	2554.000	174000.000	175600.000
2	23:45:41	55.324%	3.043	394.300	387.000	0.000	2554.000	175200.000	176400.000
3	23:46:24	54.643%	2.872	399.800	380.500	0.000	2530.000	176700.000	178400.000
x		55.158%	2.926	400.400	385.300	0.000	2546.000	175300.000	176800.000
σ		0.456%	0.102	6.374	4.135	0.000	14.040	1357.000	1414.000
%RSD		0.826	3.475	1.592	1.073	0.000	0.551	0.774	0.800

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	63360.000	3421.000	0.000	2145.000	2433000.000	2246000.000	41.709%	16090.000
2	23:45:41	63510.000	3398.000	0.000	2150.000	2419000.000	2238000.000	41.362%	16180.000
3	23:46:24	64320.000	3392.000	0.000	2143.000	2428000.000	2261000.000	41.058%	16150.000
x		63730.000	3404.000	0.000	2146.000	2427000.000	2248000.000	41.377%	16140.000
σ		517.500	15.180	0.000	3.249	7231.000	11450.000	0.326%	42.800
%RSD		0.812	0.446	0.000	0.151	0.298	0.509	0.787	0.265

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	3691.000	10300.000	388.600	279700.000	1182000.000	1362000.000	11.270	14.810
2	23:45:41	3651.000	10220.000	457.300	281700.000	1183000.000	1364000.000	11.160	13.720
3	23:46:24	3661.000	10230.000	417.400	281800.000	1185000.000	1372000.000	11.250	13.570
x		3668.000	10250.000	421.100	281000.000	1183000.000	1366000.000	11.230	14.030
σ		21.000	40.660	34.520	1176.000	1663.000	5479.000	0.059	0.672
%RSD		0.573	0.397	8.199	0.418	0.141	0.401	0.528	4.790

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	174.700	180.800	460.600	454.700	10.630	-0.006	2.555	4.668
2	23:45:41	173.800	180.600	465.100	457.400	10.900	0.010	2.471	4.138
3	23:46:24	173.900	181.200	466.200	458.800	11.070	0.003	2.749	4.408
x		174.100	180.900	464.000	456.900	10.860	0.002	2.592	4.404
σ		0.470	0.319	2.960	2.073	0.225	0.008	0.142	0.265
%RSD		0.270	0.176	0.638	0.454	2.066	333.300	5.491	6.025

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	0.000	1726.000	0.000	71.820	71.440	36.125%	0.801	-42.330
2	23:45:41	0.000	1748.000	0.000	72.590	72.300	36.526%	0.717	-39.790
3	23:46:24	0.000	1758.000	0.000	73.340	72.530	36.611%	0.735	-39.860
x		0.000	1744.000	0.000	72.580	72.090	36.421%	0.751	-40.660
σ		0.000	16.510	0.000	0.763	0.575	0.260%	0.044	1.450
%RSD		0.000	0.947	0.000	1.051	0.798	0.713	5.876	3.567

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	0.604	4.536	3.164	39.731%	35.870	0.654	0.652	1018.000
2	23:45:41	0.599	4.251	3.020	40.823%	36.120	0.643	0.651	1014.000
3	23:46:24	0.662	4.329	2.998	40.958%	36.180	0.638	0.626	1013.000
x		0.622	4.372	3.061	40.504%	36.060	0.645	0.643	1015.000
σ		0.035	0.147	0.090	0.673%	0.161	0.008	0.015	2.469
%RSD		5.684	3.365	2.954	1.662	0.445	1.230	2.318	0.243

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:44:58	1023.000	37.190%	36.767%	0.100	0.078	95.060	32.275%
2	23:45:41	1019.000	38.526%	38.134%	0.087	0.080	96.960	32.856%
3	23:46:24	1021.000	39.242%	38.997%	0.097	0.073	96.480	33.591%
x		1021.000	38.319%	37.966%	0.095	0.077	96.170	32.907%
σ		1.892	1.041%	1.124%	0.007	0.003	0.987	0.659%
%RSD		0.185	2.717	2.962	7.255	4.380	1.026	2.004

CCV 993939 11/13/2013 11:49:03 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	95.838%	106.700	101.700	101.000	0.000	47640.000	44680.000	44820.000
2	23:50:28	96.024%	106.000	98.870	99.720	0.000	48470.000	45300.000	45150.000
3	23:51:12	96.717%	106.000	104.500	100.800	0.000	47500.000	44990.000	45040.000
x		96.193%	106.254%	101.673%	100.494%	0.000	95.738%	89.982%	90.008%
σ		0.463%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.481	0.393	2.750	0.678	0.000	1.097	0.686	0.383

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	476.200	4963.000	0.000	52340.000	51840.000	49630.000	69.766%	108.300
2	23:50:28	484.800	5001.000	0.000	53460.000	52900.000	50010.000	70.501%	106.600
3	23:51:12	474.200	5036.000	0.000	52150.000	52460.000	49710.000	72.242%	107.200
x		95.680%	100.001%	0.000	105.296%	104.801%	99.565%	70.836%	107.353%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.272%	n/a
%RSD		1.186	0.735	0.000	1.344	1.012	0.408	1.795	0.785

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	104.100	103.800	3.268	488.000	24600.000	24510.000	106.700	109.200
2	23:50:28	105.700	105.300	2.577	490.100	24830.000	24490.000	106.500	110.700
3	23:51:12	106.000	103.500	2.761	483.100	24510.000	24360.000	105.300	107.900
x		105.257%	104.197%	2.869	97.414%	98.576%	97.811%	106.171%	109.246%
σ		n/a	n/a	0.358	n/a	n/a	n/a	n/a	n/a
%RSD		0.960	0.925	12.470	0.731	0.667	0.340	0.741	1.279

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	109.300	109.500	102.900	104.200	103.300	-0.390	100.600	100.500
2	23:50:28	113.000	109.600	103.300	102.200	101.600	-0.289	100.400	98.550
3	23:51:12	110.700	109.700	101.900	101.300	100.700	-0.199	99.090	98.470
x		110.982%	109.610%	102.705%	102.549%	101.862%	-0.292	100.037%	99.189%
σ		n/a	n/a	n/a	n/a	n/a	0.095	n/a	n/a
%RSD		1.705	0.117	0.721	1.448	1.271	32.580	0.830	1.183

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	0.000	93.400	68.859%	99.350	103.400	60.728%	109.100	5.606
2	23:50:28	0.000	94.440	70.649%	100.600	104.600	61.795%	109.300	5.429
3	23:51:12	0.000	93.720	72.439%	101.600	105.800	62.499%	109.700	2.655
x		0.000	93.854%	70.649%	100.511%	104.590%	61.674%	109.373%	4.564
σ		0.000	n/a	1.790%	n/a	n/a	0.892%	n/a	1.655
%RSD		0.000	0.568	2.533	1.124	1.162	1.446	0.302	36.260

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	110.600	105.500	105.500	62.156%	101.100	101.000	99.630	106.000
2	23:50:28	110.100	106.800	105.900	63.943%	101.900	101.000	99.930	106.200
3	23:51:12	110.000	105.900	105.900	65.243%	102.000	101.000	100.000	106.500
x		110.223%	106.067%	105.755%	63.781%	101.678%	100.989%	99.868%	106.246%
σ		n/a	n/a	n/a	1.550%	n/a	n/a	n/a	n/a
%RSD		0.278	0.611	0.237	2.430	0.528	0.018	0.217	0.206

Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:49:46	105.500	60.624%	60.348%	105.700	107.100	108.700	55.492%
2	23:50:28	106.600	62.463%	62.251%	105.800	107.800	109.100	56.969%
3	23:51:12	106.700	63.199%	63.267%	106.700	108.500	110.100	57.208%
x		106.287%	62.095%	61.955%	106.051%	107.828%	109.300%	56.556%
σ		n/a	1.326%	1.482%	n/a	n/a	n/a	0.930%
%RSD		0.666	2.136	2.391	0.521	0.637	0.663	1.644

CCB13 11/13/2013 11:57:13 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	111.943%	-0.109	5.962	5.674	0.000	0.335	4.607	4.806
2	23:58:39	109.515%	-0.126	5.275	4.927	0.000	0.309	4.717	4.526
3	23:59:22	110.985%	-0.092	5.548	5.122	0.000	0.374	4.760	4.442
x		110.815%	-0.109	5.595	5.241	0.000	0.339	4.695	4.591
σ		1.223%	0.017	0.346	0.388	0.000	0.033	0.079	0.190
%RSD		1.103	15.840	6.182	7.399	0.000	9.672	1.680	4.147

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	1.478	4.030	0.000	3.201	7.925	10.540	80.072%	0.164
2	23:58:39	1.448	4.555	0.000	2.725	12.070	10.330	79.962%	0.240
3	23:59:22	1.557	5.648	0.000	2.072	14.380	10.430	78.789%	0.207
x		1.494	4.744	0.000	2.666	11.460	10.430	79.608%	0.204
σ		0.056	0.825	0.000	0.567	3.272	0.105	0.711%	0.038
%RSD		3.765	17.400	0.000	21.260	28.550	1.008	0.893	18.650

Run	Time	51V	52Cr	53Cl O	55Mn	56Fe	57Fe	59Co	60Ni
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	0.025	0.047	0.045	0.269	21.840	12.400	0.006	0.012
2	23:58:39	0.022	0.018	0.035	0.215	19.070	10.510	0.003	0.008
3	23:59:22	0.016	0.020	0.032	0.232	17.530	10.190	0.005	0.006
x		0.021	0.028	0.037	0.239	19.480	11.030	0.005	0.009
σ		0.005	0.016	0.007	0.028	2.187	1.189	0.002	0.003
%RSD		23.730	58.100	18.780	11.580	11.220	10.780	35.430	36.410

Run	Time	63Cu	65Cu	66Zn	68Zn	75As	77Ar Cl	78Se	82Se
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	-0.038	0.004	0.673	0.741	0.058	-0.004	0.317	0.335
2	23:58:39	-0.018	0.016	0.724	0.887	-0.011	0.002	0.122	0.084
3	23:59:22	-0.016	0.001	0.762	0.762	0.087	-0.009	0.292	0.411
x		-0.024	0.007	0.720	0.796	0.045	-0.004	0.244	0.277
σ		0.012	0.008	0.045	0.079	0.050	0.005	0.106	0.171
%RSD		51.500	110.500	6.205	9.910	111.600	138.500	43.440	61.850

Run	Time	83Kr	88Sr	89Y	95Mo	98Mo	103Rh	107Ag	108Mo O
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	0.000	0.028	72.763%	0.248	0.253	73.583%	-0.050	0.703
2	23:58:39	0.000	0.025	74.341%	0.246	0.243	74.166%	-0.047	0.779
3	23:59:22	0.000	0.027	73.232%	0.210	0.200	74.445%	-0.046	0.734
x		0.000	0.026	73.445%	0.234	0.232	74.064%	-0.048	0.739
σ		0.000	0.001	0.810%	0.021	0.028	0.440%	0.002	0.038
%RSD		0.000	5.066	1.103	9.103	12.150	0.594	4.460	5.182

Run	Time	109Ag	111Cd	114Cd	115In	118Sn	121Sb	123Sb	135Ba
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	-0.040	-0.049	-0.028	73.437%	0.094	0.050	0.038	0.028
2	23:58:39	-0.041	-0.055	-0.042	74.231%	0.094	0.038	0.036	0.029
3	23:59:22	-0.042	-0.054	-0.033	74.186%	0.072	0.039	0.035	0.023
x		-0.041	-0.052	-0.034	73.951%	0.087	0.042	0.036	0.027
σ		0.001	0.003	0.007	0.446%	0.012	0.006	0.002	0.003
%RSD		2.380	6.215	19.980	0.603	14.200	15.190	4.814	11.670

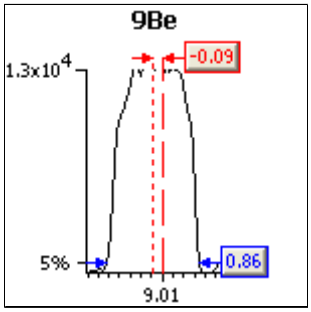
Run	Time	137Ba	159Tb	165Ho	203Tl	205Tl	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	23:57:56	0.032	68.610%	67.226%	0.008	0.011	0.041	67.697%
2	23:58:39	0.027	69.846%	68.582%	0.010	0.010	0.043	67.905%
3	23:59:22	0.041	69.484%	68.549%	0.008	0.010	0.048	67.503%
x		0.033	69.313%	68.119%	0.009	0.010	0.044	67.702%
σ		0.007	0.635%	0.774%	0.001	0.000	0.004	0.201%
%RSD		21.250	0.917	1.136	16.580	3.623	8.142	0.297

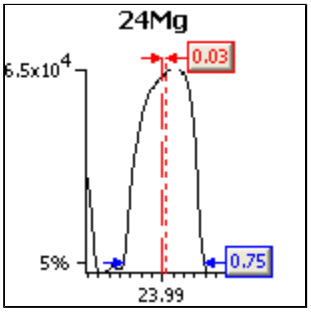
Performance Report

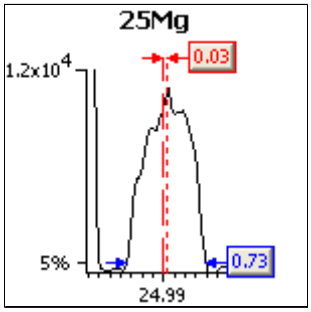
Sample details
Sample name : ITUNE
Acquired at : 11/13/2013 9:09:22 AM
Report name : EPA ILMO5.2/6020A 2.1 [3/15/2013 11:49:53 AM]

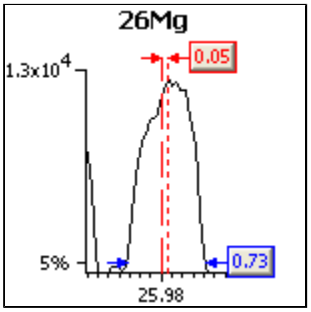
Mass Calibration verification

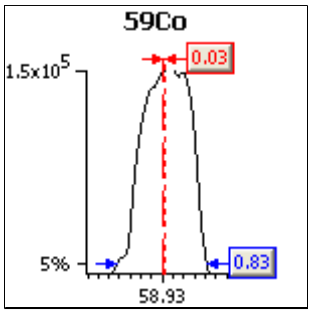
Acquisition parameters
Sweeps : 25
Dwell : 2.0 mSecs
Point spacing : 0.02 amu
Peak width measured at 5% of the peak maximum

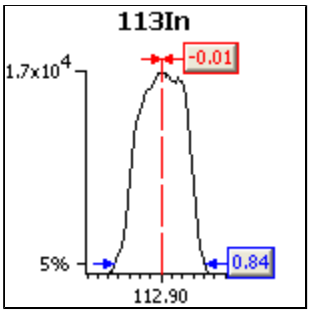


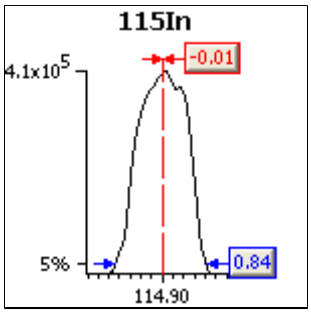


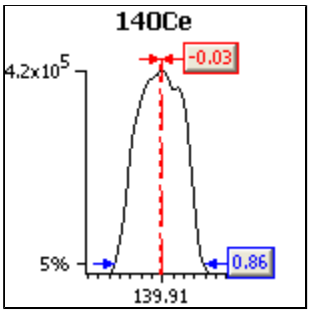


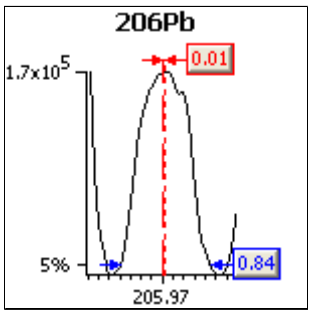


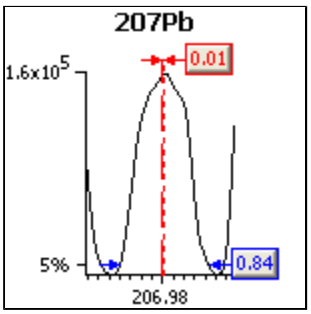


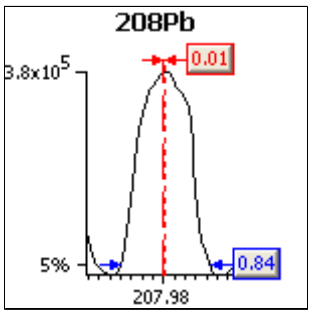












Analyte	Limits			Results	
	Max. width	Min. width	Max. error	Peak width	Peak error
9Be	0.90	0.45	0.10	0.86	-0.09
24Mg	0.90	0.45	0.10	0.75	0.03
25Mg	0.90	0.45	0.10	0.73	0.03
26Mg	0.90	0.45	0.10	0.73	0.05
59Co	0.90	0.45	0.10	0.83	0.03
113In	0.90	0.45	0.10	0.84	-0.01
115In	0.90	0.45	0.10	0.84	-0.01
140Ce	0.90	0.45	0.10	0.86	-0.03
206Pb	0.90	0.45	0.10	0.84	0.01
207Pb	0.90	0.45	0.10	0.84	0.01
208Pb	0.90	0.45	0.10	0.84	0.01

Sample details
Sample name : ITUNE
Acquired at : 11/13/2013 9:09:22 AM
Report name : EPA ILMO5.2/6020A 2.1 [3/15/2013 11:49:53 AM]

Tune conditions

Major	
Extraction	-102
Lens 1	2.0
Focus	25.1
D1	-49.4
Pole Bias	-1.0
Hexapole Bias	-4.0
Nebuliser	0.77
Sampling Depth	150

Minor	
Lens 2	-29.0
Lens 3	-187.5
Forward power	1302
Horizontal	75
Vertical	515
D2	-198
DA	-80.0
Cool	13.0
Auxiliary	0.90

Global	
Standard resolution	n/a
High resolution	n/a
Analogue Detector	n/a
PC Detector	n/a

Add. Gases	
He/H2	0.00
He/NH3	0.00

Sensitivity and stability results

Acquisition parameters
Sweeps : 150

Run	Time	5Bkg	9Be	24Mg	25Mg	26Mg	56Ar O	59Co	137Ba++
Dwell (mSecs)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limits	%RSD	-	5.0%	5.0%	5.0%	5.0%	-	5.0%	-
	Countrate	-	>500	>500	>500	>500	-	>5000	-
1	9:10:10 AM	1	12998	62049	8782	10846	305913	146809	0
2	9:11:35 AM	0	12914	62377	8892	10896	304657	149339	1
3	9:13:00 AM	1	13302	63138	8962	10894	303208	149258	1
4	9:14:25 AM	0	13112	62595	8885	10974	307862	148971	1
5	9:15:51 AM	1	13426	63457	9051	10923	305828	149709	1
x		0	13151	62723	8915	10907	305493	148817	1
σ		0.09	211.71	570.42	99.78	46.87	1719.19	1153.19	0.47
%RSD		18.130	1.610	0.909	1.119	0.430	0.563	0.775	70.711

Run	Time	138Ba++	101Bkg	113In	115In	138Ba	140Ce	156Ce O	206Pb
Dwell (mSecs)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limits	%RSD	-	-	5.0%	5.0%	-	5.0%	-	5.0%
	Countrate	-	-	>200	>5000	-	>10000	-	>500
1	9:10:10 AM	12	0	17067	399092	1347	417102	6475	175974
2	9:11:35 AM	15	0	17469	406209	1415	425928	6523	179937
3	9:13:00 AM	14	0	17420	408125	1336	426826	6579	179755
4	9:14:25 AM	12	0	17083	402467	1358	420183	6410	178054
5	9:15:51 AM	10	0	17305	404359	1364	424099	6390	176781
x		12	0	17269	404050	1364	422828	6475	178100
σ		1.97	0.06	186.83	3480.26	30.36	4092.51	78.38	1759.02
%RSD		15.848	46.481	1.082	0.861	2.226	0.968	1.210	0.988

Run	Time	207Pb	208Pb	220Bkg
Dwell (mSecs)		0.0	0.0	0.0
Limits	%RSD	5.0%	5.0%	-
	Countrate	>500	>500	<2500
1	9:10:10 AM	159656	381364	0
2	9:11:35 AM	163365	390491	0
3	9:13:00 AM	162440	389702	0
4	9:14:25 AM	160406	383073	0
5	9:15:51 AM	160547	383776	0
x		161283	385681	0
σ		1551.74	4134.36	0.14
%RSD		0.962	1.072	67.748

Ratio results

Run	Time	156Ce O/140Ce
Ratio limits		<0.0500
1	9:10:10 AM	0
2	9:11:35 AM	0

3	9:13:00 AM	0
4	9:14:25 AM	0
5	9:15:51 AM	0
x		0.0153
σ		0.00
%RSD		1.1219

Result : The performance report passed.

Dilution Corrected Concentrations

STD1 1009603 INT STD 11/14/2013 12:09:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	100.864%	0.140	0.318	0.156	0.000	-0.033	-0.085	0.102
2	12:11:18	100.332%	-0.062	-0.129	-0.110	0.000	0.088	0.070	-0.089
3	12:12:01	98.803%	-0.078	-0.189	-0.047	0.000	-0.055	0.016	-0.013
x		100.000%	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000
σ		1.070%	0.122	0.277	0.139	0.000	0.077	0.079	0.097
%RSD		1.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	0.004	-0.167	0.000	0.181	-1.125	0.424	99.845%	-0.007
2	12:11:18	0.002	0.335	0.000	-0.442	2.247	-0.412	100.724%	0.031
3	12:12:01	-0.006	-0.167	0.000	0.261	-1.121	-0.013	99.431%	-0.024
x		0.000	-0.000	0.000	0.000	-0.000	0.000	100.000%	0.000
σ		0.005	0.290	0.000	0.385	1.946	0.418	0.660%	0.028
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.660	0.000

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	0.003	0.008	-0.004	-0.038	0.256	-0.001	0.005	-0.001
2	12:11:18	-0.002	-0.013	0.003	0.111	0.332	-0.000	-0.005	-0.001
3	12:12:01	-0.000	0.005	0.001	-0.073	-0.588	0.001	-0.001	0.002
x		-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000	0.000
σ		0.003	0.012	0.004	0.098	0.511	0.001	0.005	0.002
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	-0.000	-0.017	0.016	0.022	-0.014	0.069	0.000	-0.001
2	12:11:18	-0.003	0.002	-0.035	0.000	0.029	0.006	0.000	0.002
3	12:12:01	0.003	0.015	0.020	-0.023	-0.016	-0.076	0.000	-0.001
x		0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	0.000
σ		0.003	0.016	0.031	0.022	0.025	0.073	0.000	0.001
%RSD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	99.537%	0.022	0.004	100.198%	-0.001	-0.003	0.008	0.008
2	12:11:18	100.198%	-0.016	0.005	100.263%	0.006	-0.001	0.017	0.010
3	12:12:01	100.266%	-0.005	-0.008	99.539%	-0.005	0.004	-0.025	-0.018
x		100.000%	0.000	-0.000	100.000%	0.000	0.000	0.000	-0.000
σ		0.403%	0.020	0.007	0.400%	0.006	0.004	0.022	0.016
%RSD		0.403	0.000	0.000	0.400	0.000	0.000	0.000	0.000

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	98.754%	-0.013	-0.002	-0.001	0.002	-0.004	99.346%	98.768%
2	12:11:18	100.719%	0.025	0.005	0.002	-0.009	0.006	100.132%	100.357%
3	12:12:01	100.528%	-0.012	-0.004	-0.001	0.007	-0.002	100.522%	100.875%
x		100.000%	0.000	0.000	0.000	0.000	-0.000	100.000%	100.000%
σ		1.084%	0.022	0.005	0.002	0.009	0.005	0.599%	1.098%
%RSD		1.084	0.000	0.000	0.000	0.000	0.000	0.599	1.098

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	12:10:34	-0.001	-0.000	-0.000	-0.000	-0.000	99.515%
2	12:11:18	0.000	0.001	-0.001	-0.000	-0.000	100.452%
3	12:12:01	0.000	-0.001	0.001	0.001	0.000	100.034%
x		0.000	0.000	0.000	-0.000	-0.000	100.000%
σ		0.001	0.001	0.001	0.001	0.000	0.469%
%RSD		0.000	0.000	0.000	0.000	0.000	0.469

STD2 993937 11/14/2013 12:31:05 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	80.059%	206.200	3.943	3.578	0.000	103600.000	102800.000	102500.000
2	12:32:31	85.027%	191.300	3.153	3.082	0.000	97210.000	97200.000	96880.000
3	12:33:14	82.779%	202.500	3.161	3.039	0.000	99170.000	99980.000	100700.000
x		82.621%	200.000	3.419	3.233	0.000	100000.000	100000.000	100000.000
σ		2.487%	7.743	0.454	0.300	0.000	3289.000	2812.000	2853.000
%RSD		3.011	3.871	13.270	9.275	0.000	3.289	2.812	2.853

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	1032.000	16.000	0.000	102700.000	102700.000	102800.000	80.608%	2.914
2	12:32:31	968.600	12.310	0.000	96750.000	97270.000	96910.000	85.988%	1.955
3	12:33:14	999.200	11.470	0.000	100600.000	100100.000	100300.000	85.171%	1.660
x		1000.000	13.260	0.000	100000.000	100000.000	100000.000	83.922%	2.176
σ		31.760	2.409	0.000	2995.000	2696.000	2958.000	2.899%	0.655
%RSD		3.176	18.170	0.000	2.995	2.696	2.958	3.455	30.110

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	205.700	205.300	1035.000	51150.000	51110.000	202.600	204.300	203.600
2	12:32:31	193.700	194.400	972.600	48560.000	48620.000	195.600	193.500	194.500
3	12:33:14	200.600	200.300	992.700	50290.000	50270.000	201.700	202.200	201.900
x		200.000	200.000	1000.000	50000.000	50000.000	200.000	200.000	200.000
σ		6.006	5.451	31.670	1318.000	1267.000	3.793	5.740	4.839
%RSD		3.003	2.726	3.167	2.637	2.534	1.896	2.870	2.420

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	201.900	203.900	202.300	202.600	203.800	203.600	0.000	203.300
2	12:32:31	195.700	195.000	195.200	193.900	193.900	193.200	0.000	195.300
3	12:33:14	202.400	201.100	202.500	203.400	202.400	203.200	0.000	201.400
x		200.000	200.000	200.000	200.000	200.000	200.000	0.000	200.000
σ		3.739	4.576	4.129	5.277	5.350	5.879	0.000	4.194
%RSD		1.869	2.288	2.064	2.639	2.675	2.939	0.000	2.097

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	80.686%	0.329	0.299	77.570%	204.500	203.900	202.600	203.700
2	12:32:31	84.344%	0.291	0.272	81.149%	194.400	194.900	194.100	193.800
3	12:33:14	83.148%	0.310	0.260	79.880%	201.100	201.200	203.300	202.400
x		82.726%	0.310	0.277	79.533%	200.000	200.000	200.000	200.000
σ		1.865%	0.019	0.020	1.814%	5.148	4.627	5.105	5.371
%RSD		2.254	6.171	7.229	2.281	2.574	2.313	2.553	2.686

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	79.552%	0.020	0.110	0.088	203.000	202.400	83.707%	84.581%
2	12:32:31	83.374%	-0.023	0.081	0.077	193.700	194.000	87.158%	87.540%
3	12:33:14	81.906%	0.016	0.104	0.085	203.300	203.500	85.126%	85.637%
x		81.611%	0.004	0.099	0.084	200.000	200.000	85.330%	85.919%
σ		1.928%	0.024	0.015	0.005	5.440	5.192	1.735%	1.500%
%RSD		2.363	586.500	15.450	6.404	2.720	2.596	2.033	1.746

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	12:31:47	199.800	200.000	199.400	199.000	199.200	80.987%
2	12:32:31	195.600	196.000	196.200	196.800	196.500	80.894%
3	12:33:14	204.700	203.900	204.400	204.200	204.300	78.725%
x		200.000	200.000	200.000	200.000	200.000	80.202%
σ		4.558	3.957	4.174	3.806	3.969	1.280%
%RSD		2.279	1.978	2.087	1.903	1.984	1.596

STD3 993938 11/14/2013 12:35:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	88.649%	0.109	202.600	200.600	0.000	9.850	10.820	10.960
2	12:37:17	89.149%	0.045	197.500	194.800	0.000	7.539	9.446	8.953
3	12:38:00	83.226%	-0.025	199.900	204.600	0.000	6.868	8.099	8.379
x		87.008%	0.043	200.000	200.000	0.000	8.086	9.455	9.431
σ		3.285%	0.067	2.530	4.942	0.000	1.565	1.360	1.356
%RSD		3.776	155.700	1.265	2.471	0.000	19.350	14.380	14.380
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	2.960	10040.000	0.000	4.527	32.050	101.000	87.437%	201.800
2	12:37:17	2.855	9840.000	0.000	0.839	28.240	97.070	85.693%	200.300
3	12:38:00	3.069	10120.000	0.000	-0.020	24.210	94.270	84.529%	197.900
x		2.961	10000.000	0.000	1.782	28.170	97.450	85.886%	200.000
σ		0.107	143.800	0.000	2.415	3.921	3.398	1.464%	1.998
%RSD		3.598	1.438	0.000	135.500	13.920	3.487	1.704	0.999
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	0.015	-0.027	0.285	18.370	20.220	0.024	0.098	0.075
2	12:37:17	0.031	-0.051	0.195	10.790	13.920	0.017	0.085	0.081
3	12:38:00	0.008	-0.056	0.169	7.169	9.525	0.014	0.094	0.080
x		0.018	-0.044	0.216	12.110	14.560	0.019	0.092	0.079
σ		0.012	0.016	0.061	5.717	5.376	0.005	0.006	0.003
%RSD		66.060	35.420	28.060	47.200	36.930	26.930	7.036	4.228
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	0.130	0.376	0.251	-0.074	-0.106	-0.377	0.000	0.039
2	12:37:17	0.104	0.344	0.302	0.006	-0.118	-0.122	0.000	0.044
3	12:38:00	0.089	0.399	0.268	-0.089	-0.155	-0.357	0.000	0.033
x		0.108	0.373	0.274	-0.052	-0.126	-0.285	0.000	0.039
σ		0.021	0.028	0.026	0.051	0.025	0.141	0.000	0.005
%RSD		19.420	7.443	9.612	98.210	20.130	49.570	0.000	13.870
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	85.161%	197.600	197.400	87.471%	0.056	0.123	0.045	-0.352
2	12:37:17	85.480%	200.100	200.000	87.334%	0.071	0.090	-0.009	-0.473
3	12:38:00	84.893%	202.300	202.600	85.802%	0.066	0.087	0.012	-0.337
x		85.178%	200.000	200.000	86.869%	0.065	0.100	0.016	-0.387
σ		0.294%	2.387	2.613	0.926%	0.008	0.020	0.027	0.074
%RSD		0.345	1.193	1.306	1.066	12.450	20.000	168.400	19.170
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:36:34	86.641%	199.300	199.500	199.700	0.079	0.274	88.754%	88.847%
2	12:37:17	87.452%	200.100	200.300	200.100	0.056	0.325	90.560%	90.755%
3	12:38:00	87.546%	200.600	200.200	200.100	0.087	0.236	90.510%	91.413%
x		87.213%	200.000	200.000	200.000	0.074	0.278	89.941%	90.338%
σ		0.498%	0.663	0.440	0.244	0.017	0.045	1.028%	1.333%
%RSD		0.571	0.332	0.220	0.122	22.290	16.010	1.143	1.476
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	12:36:34	0.065	0.073	0.057	0.057	0.054	90.179%		
2	12:37:17	0.050	0.052	0.048	0.049	0.046	92.030%		
3	12:38:00	0.041	0.044	0.045	0.048	0.046	91.503%		
x		0.052	0.056	0.050	0.052	0.048	91.237%		
σ		0.012	0.015	0.006	0.005	0.005	0.954%		
%RSD		22.570	26.780	11.630	10.080	10.110	1.045		

ICV 1013779 11/14/2013 12:40:38 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	95.223%	82.690	81.290	80.750	0.000	39630.000	38470.000	38210.000
2	12:42:04	90.299%	82.430	82.020	81.680	0.000	40840.000	39280.000	38240.000
3	12:42:47	89.725%	80.580	79.820	81.010	0.000	39500.000	38650.000	38590.000
x		91.749%	102.375%	101.304%	101.432%	0.000	99.971%	96.998%	95.868%
σ		3.022%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		3.294	1.404	1.383	0.595	0.000	1.854	1.093	0.547
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	401.000	4597.000	0.000	40260.000	40520.000	39370.000	90.432%	78.660
2	12:42:04	404.200	4722.000	0.000	39620.000	39510.000	39050.000	90.979%	77.960
3	12:42:47	403.200	4773.000	0.000	39770.000	39010.000	39050.000	91.320%	76.090
x		100.707%	117.430%	0.000	99.711%	99.204%	97.891%	90.910%	96.965%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.448%	n/a
%RSD		0.409	1.920	0.000	0.844	1.936	0.477	0.493	1.711
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	83.100	82.160	400.500	20290.000	20160.000	82.010	84.140	84.660
2	12:42:04	80.440	80.930	403.900	20250.000	20130.000	82.600	84.450	82.300
3	12:42:47	79.210	80.930	402.600	20200.000	20110.000	81.910	83.250	84.700
x		101.144%	101.675%	100.586%	101.252%	100.653%	102.718%	104.934%	104.860%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		2.453	0.870	0.427	0.226	0.134	0.454	0.746	1.642
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	84.240	86.010	87.270	83.210	86.600	86.320	0.000	82.120
2	12:42:04	83.810	85.690	84.860	83.420	83.880	84.280	0.000	81.380
3	12:42:47	85.440	86.030	86.490	82.370	85.270	84.230	0.000	81.850
x		105.623%	107.385%	107.758%	103.752%	106.564%	106.178%	0.000	102.228%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		1.000	0.223	1.427	0.666	1.597	1.407	0.000	0.460
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	83.731%	80.990	82.130	82.418%	84.890	86.490	85.470	85.450
2	12:42:04	84.443%	80.890	83.140	82.921%	85.830	85.950	84.700	85.290
3	12:42:47	85.206%	81.540	82.550	82.971%	85.950	86.450	85.740	85.010
x		84.460%	101.424%	103.260%	82.770%	106.944%	107.874%	106.629%	106.560%
σ		0.738%	n/a	n/a	0.306%	n/a	n/a	n/a	n/a
%RSD		0.873	0.438	0.616	0.369	0.678	0.347	0.631	0.259
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:41:21	82.234%	81.860	81.610	81.070	83.970	84.130	85.121%	85.412%
2	12:42:04	83.988%	81.090	80.490	80.170	82.550	83.050	87.340%	87.622%
3	12:42:47	84.742%	81.590	80.560	80.120	83.010	82.680	88.128%	88.718%
x		83.655%	101.892%	101.109%	100.566%	103.971%	104.110%	86.863%	87.251%
σ		1.287%	n/a	n/a	n/a	n/a	n/a	1.559%	1.684%
%RSD		1.539	0.479	0.776	0.665	0.869	0.903	1.795	1.930
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	12:41:21	82.700	83.410	80.690	83.720	82.040	82.454%		
2	12:42:04	83.450	84.560	81.380	84.890	83.430	83.178%		
3	12:42:47	84.350	85.420	82.460	86.000	84.230	82.920%		
x		104.375%	105.575%	101.884%	106.090%	104.039%	82.851%		
σ		n/a	n/a	n/a	n/a	n/a	0.367%		
%RSD		0.988	1.194	1.095	1.342	1.331	0.443		

ICB 11/14/2013 12:45:28 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	99.202%	-0.034	2.390	2.320	0.000	1.411	2.120	1.905
2	12:46:54	97.443%	-0.032	2.051	1.911	0.000	0.394	1.399	1.074
3	12:47:37	94.678%	0.031	1.515	1.621	0.000	-0.042	0.769	0.604
x		97.108%	-0.012	1.985	1.950	0.000	0.588	1.429	1.194
σ		2.281%	0.037	0.442	0.351	0.000	0.746	0.676	0.659
%RSD		2.349	317.200	22.240	17.990	0.000	126.900	47.270	55.150

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	0.074	6.212	0.000	0.599	0.637	0.705	97.547%	0.048
2	12:46:54	-0.049	4.699	0.000	-0.886	0.166	0.627	99.340%	-0.011
3	12:47:37	-0.040	4.148	0.000	-2.049	0.612	0.067	98.778%	-0.019
x		-0.005	5.020	0.000	-0.779	0.472	0.466	98.555%	0.006
σ		0.069	1.068	0.000	1.327	0.265	0.348	0.917%	0.037
%RSD		1383.000	21.280	0.000	170.400	56.200	74.550	0.930	620.400

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	0.017	-0.008	0.072	7.724	4.737	0.006	0.003	-0.013
2	12:46:54	0.009	0.011	0.051	4.134	1.032	0.004	-0.004	-0.016
3	12:47:37	0.007	-0.009	0.054	3.990	0.925	0.001	-0.010	-0.012
x		0.011	-0.002	0.059	5.283	2.231	0.004	-0.004	-0.014
σ		0.005	0.011	0.011	2.116	2.171	0.003	0.007	0.002
%RSD		49.510	514.900	19.080	40.050	97.290	63.070	168.200	17.850

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	-0.005	-0.166	-0.236	-0.055	0.082	-0.218	0.000	0.004
2	12:46:54	-0.032	-0.197	-0.233	0.006	0.146	0.090	0.000	0.000
3	12:47:37	-0.014	-0.205	-0.189	0.059	0.202	0.199	0.000	0.001
x		-0.017	-0.190	-0.219	0.003	0.143	0.024	0.000	0.002
σ		0.013	0.021	0.026	0.057	0.060	0.216	0.000	0.002
%RSD		78.340	10.890	11.950	1829.000	41.930	904.800	0.000	132.500

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	97.168%	0.213	0.208	98.094%	-0.078	-0.080	-0.011	-0.008
2	12:46:54	98.664%	0.134	0.144	99.268%	-0.072	-0.068	-0.014	-0.004
3	12:47:37	98.852%	0.108	0.114	99.685%	-0.075	-0.068	-0.034	-0.025
x		98.228%	0.152	0.155	99.016%	-0.075	-0.072	-0.020	-0.012
σ		0.923%	0.055	0.048	0.825%	0.003	0.007	0.013	0.011
%RSD		0.939	36.180	30.940	0.833	4.069	9.411	64.250	89.250

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	97.830%	-0.085	0.002	-0.019	-0.007	-0.009	96.352%	96.482%
2	12:46:54	98.156%	-0.090	-0.012	-0.013	-0.004	-0.009	98.433%	99.192%
3	12:47:37	99.674%	-0.123	-0.012	-0.025	-0.013	-0.009	100.360%	100.240%
x		98.553%	-0.099	-0.007	-0.019	-0.008	-0.009	98.381%	98.638%
σ		0.984%	0.020	0.008	0.006	0.004	0.000	2.005%	1.939%
%RSD		0.999	20.370	105.800	32.230	53.680	4.679	2.038	1.966

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	12:46:11	0.003	0.006	0.015	0.014	0.015	96.928%
2	12:46:54	0.003	0.002	0.017	0.016	0.018	98.162%
3	12:47:37	0.001	0.000	0.017	0.022	0.016	99.331%
x		0.002	0.003	0.016	0.017	0.016	98.140%
σ		0.001	0.003	0.001	0.004	0.002	1.202%
%RSD		48.600	103.000	8.383	24.260	10.890	1.224

CRI 1011230 11/14/2013 12:50:18 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	98.924%	1.138	6.559	6.334	0.000	100.500	108.700	106.900
2	12:51:44	95.939%	1.194	6.145	5.763	0.000	96.980	108.500	107.100
3	12:52:28	94.853%	1.129	5.546	6.037	0.000	98.500	109.100	108.200
x		96.572%	115.400%	121.670%	120.897%	0.000	98.666%	108.729%	107.411%
σ		2.108%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.183	3.042	8.371	4.724	0.000	1.798	0.270	0.626

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	37.240	544.100	0.000	107.800	110.800	108.700	94.052%	5.266
2	12:51:44	36.870	535.500	0.000	105.400	106.800	109.900	93.363%	5.224
3	12:52:28	37.590	542.800	0.000	107.900	126.700	111.400	92.467%	5.559
x		124.108%	108.152%	0.000	107.022%	114.733%	109.981%	93.294%	106.994%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.795%	n/a
%RSD		0.969	0.858	0.000	1.285	9.167	1.210	0.852	3.403

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	0.979	2.173	5.435	57.350	57.330	0.564	1.218	2.466
2	12:51:44	1.058	2.155	5.434	54.920	56.360	0.584	1.090	2.402
3	12:52:28	1.085	2.190	5.360	56.030	56.440	0.528	1.097	2.369
x		104.033%	108.624%	1081.933%	112.194%	113.424%	111.752%	113.480%	120.605%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		5.313	0.793	0.791	2.168	0.945	5.037	6.352	2.061

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	2.495	6.197	6.040	1.251	5.532	5.795	0.000	5.259
2	12:51:44	2.397	6.031	6.248	1.223	5.616	5.467	0.000	5.257
3	12:52:28	2.352	6.102	5.912	1.213	5.750	5.533	0.000	5.156
x		120.744%	122.205%	121.339%	122.891%	112.652%	111.968%	0.000	104.478%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		3.027	1.358	2.797	1.620	1.950	3.102	0.000	1.131

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	91.227%	4.971	4.917	92.611%	1.068	1.098	1.088	1.070
2	12:51:44	91.516%	5.055	4.906	92.178%	1.079	1.075	1.029	0.999
3	12:52:28	91.452%	4.830	4.846	93.111%	1.110	1.110	1.031	1.063
x		91.398%	99.040%	97.800%	92.634%	108.549%	109.423%	104.922%	104.414%
σ		0.151%	n/a	n/a	0.467%	n/a	n/a	n/a	n/a
%RSD		0.166	2.296	0.781	0.504	2.043	1.613	3.243	3.724

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	91.625%	5.356	2.044	2.043	10.870	10.570	90.907%	91.672%
2	12:51:44	92.526%	5.080	2.064	1.995	10.490	10.650	93.017%	93.188%
3	12:52:28	91.821%	5.250	2.059	2.057	10.570	10.500	93.574%	93.978%
x		91.991%	104.570%	102.781%	101.584%	106.451%	105.764%	92.500%	92.946%
σ		0.474%	n/a	n/a	n/a	n/a	n/a	1.407%	1.172%
%RSD		0.516	2.661	0.503	1.593	1.878	0.717	1.521	1.261

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	12:51:01	1.003	1.007	0.987	1.108	1.036	92.710%
2	12:51:44	1.020	1.011	1.001	1.115	1.043	94.061%
3	12:52:28	0.991	1.024	1.026	1.090	1.057	94.474%
x		100.469%	101.435%	100.430%	110.460%	104.576%	93.748%
σ		n/a	n/a	n/a	n/a	n/a	0.923%
%RSD		1.473	0.874	1.975	1.169	1.026	0.984

ICSA 1002133 11/14/2013 12:55:08 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	69.184%	0.051	1.448	1.879	0.000	115500.000	116700.000	115200.000
2	12:56:34	64.509%	-0.110	2.022	1.978	0.000	117000.000	119000.000	118300.000
3	12:57:17	63.508%	-0.039	0.616	1.524	0.000	112300.000	115500.000	116700.000
x		65.734%	-0.032	1.362	1.793	0.000	114900.000	117100.000	116800.000
σ		3.029%	0.081	0.707	0.239	0.000	2422.000	1753.000	1563.000
%RSD		4.609	249.400	51.880	13.310	0.000	2.108	1.498	1.338

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	112100.000	28.090	0.000	117400.000	119400.000	119400.000	66.016%	2371.000
2	12:56:34	114500.000	28.980	0.000	113500.000	117600.000	118900.000	64.722%	2362.000
3	12:57:17	112100.000	29.580	0.000	112700.000	117400.000	116900.000	64.596%	2287.000
x		112900.000	28.880	0.000	114500.000	118100.000	118400.000	65.111%	2340.000
σ		1415.000	0.747	0.000	2511.000	1135.000	1332.000	0.786%	46.100
%RSD		1.253	2.585	0.000	2.192	0.961	1.125	1.208	1.970

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	-0.810	-0.491	1.393	118700.000	118400.000	0.136	-0.030	1.687
2	12:56:34	-0.741	-0.387	1.351	119600.000	118300.000	0.133	0.020	1.681
3	12:57:17	-0.768	-0.318	1.325	116900.000	116800.000	0.125	0.018	1.654
x		-0.773	-0.399	1.356	118400.000	117800.000	0.131	0.003	1.674
σ		0.035	0.087	0.034	1343.000	863.500	0.006	0.028	0.017
%RSD		4.531	21.840	2.543	1.134	0.733	4.409	1094.000	1.035

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	2.045	9.150	8.148	0.064	0.197	-0.185	0.000	1.864
2	12:56:34	2.006	8.975	8.484	0.025	0.090	-0.254	0.000	1.814
3	12:57:17	2.092	8.702	7.922	0.071	0.207	0.026	0.000	1.741
x		2.048	8.942	8.185	0.053	0.165	-0.137	0.000	1.806
σ		0.043	0.226	0.283	0.025	0.065	0.146	0.000	0.062
%RSD		2.102	2.527	3.457	46.500	39.220	106.100	0.000	3.428

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	68.342%	2342.000	2333.000	67.796%	0.011	0.022	0.394	0.315
2	12:56:34	68.471%	2366.000	2367.000	67.561%	0.035	0.028	0.330	0.290
3	12:57:17	69.315%	2302.000	2308.000	68.365%	0.033	0.043	0.326	0.248
x		68.709%	2337.000	2336.000	67.907%	0.026	0.031	0.350	0.284
σ		0.529%	32.550	29.290	0.413%	0.013	0.011	0.038	0.034
%RSD		0.769	1.393	1.254	0.609	51.390	34.040	10.940	11.820

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	72.087%	0.165	0.131	0.133	0.299	0.346	76.452%	76.846%
2	12:56:34	72.622%	0.183	0.122	0.149	0.350	0.320	78.490%	79.334%
3	12:57:17	73.334%	0.114	0.125	0.114	0.341	0.344	79.712%	80.538%
x		72.681%	0.154	0.126	0.132	0.330	0.337	78.218%	78.906%
σ		0.625%	0.036	0.004	0.018	0.027	0.015	1.647%	1.883%
%RSD		0.860	23.330	3.542	13.490	8.116	4.341	2.106	2.386

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	12:55:50	0.026	0.025	0.394	0.417	0.405	75.438%
2	12:56:34	0.013	0.015	0.399	0.405	0.400	76.375%
3	12:57:17	0.013	0.011	0.388	0.378	0.381	78.820%
x		0.017	0.017	0.394	0.400	0.395	76.877%
σ		0.008	0.007	0.006	0.020	0.012	1.746%
%RSD		45.130	43.010	1.432	4.882	3.150	2.271

ICSAB 1002160 11/14/2013 12:59:57 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	65.525%	21.890	53.380	51.930	0.000	111100.000	112600.000	112400.000
2	13:01:23	61.626%	21.890	52.690	53.550	0.000	112300.000	114800.000	114400.000
3	13:02:06	61.238%	21.840	52.960	53.770	0.000	113800.000	116800.000	115600.000
x		62.796%	109.377%	106.021%	106.166%	0.000	112.406%	114.712%	114.131%
σ		2.371%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		3.776	0.123	0.654	1.890	0.000	1.187	1.853	1.393

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	109900.000	598.000	0.000	110400.000	113300.000	115400.000	65.006%	2281.000
2	13:01:23	112100.000	600.000	0.000	110600.000	114700.000	115100.000	63.959%	2264.000
3	13:02:06	111300.000	604.400	0.000	109700.000	113700.000	116000.000	63.960%	2256.000
x		111.081%	120.160%	0.000	110.264%	113.897%	115.482%	64.308%	113.359%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.604%	n/a
%RSD		0.997	0.543	0.000	0.419	0.659	0.376	0.940	0.563

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	22.290	22.300	23.700	112800.000	112900.000	22.410	21.470	22.770
2	13:01:23	22.670	22.630	23.830	112200.000	111700.000	22.230	21.080	22.270
3	13:02:06	22.490	22.160	23.840	112100.000	113200.000	21.840	21.110	22.210
x		112.411%	111.824%	103.440%	112.369%	112.607%	110.795%	106.095%	112.072%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.853	1.071	0.347	0.335	0.720	1.303	1.012	1.370

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	23.050	28.170	26.950	22.040	56.290	54.960	0.000	23.870
2	13:01:23	22.630	27.510	26.980	23.240	55.070	54.790	0.000	24.370
3	13:02:06	22.960	27.540	26.460	22.540	54.750	54.220	0.000	24.340
x		114.393%	110.953%	107.179%	113.026%	110.737%	109.307%	0.000	120.967%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.970	1.360	1.094	2.663	1.465	0.711	0.000	1.173

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	70.342%	2256.000	2269.000	66.142%	22.090	21.880	22.480	22.160
2	13:01:23	70.749%	2262.000	2273.000	66.205%	22.200	21.890	22.370	22.190
3	13:02:06	70.518%	2245.000	2279.000	66.308%	21.970	21.990	22.530	22.240
x		70.536%	112.708%	113.685%	66.218%	110.430%	109.582%	112.310%	110.990%
σ		0.204%	n/a	n/a	0.083%	n/a	n/a	n/a	n/a
%RSD		0.290	0.380	0.218	0.126	0.512	0.274	0.358	0.186

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	71.064%	109.100	21.950	21.740	22.750	22.890	76.521%	77.249%
2	13:01:23	71.710%	110.200	22.020	22.290	22.490	22.450	77.908%	79.349%
3	13:02:06	72.110%	109.900	21.640	21.580	22.850	22.620	79.547%	80.400%
x		71.628%	109.743%	109.357%	109.340%	113.490%	113.264%	77.992%	78.999%
σ		0.528%	n/a	n/a	n/a	n/a	n/a	1.515%	1.604%
%RSD		0.737	0.498	0.938	1.692	0.816	0.989	1.942	2.031

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	13:00:40	22.390	22.740	23.500	23.390	23.500	75.061%
2	13:01:23	22.900	23.150	23.820	23.770	23.780	76.211%
3	13:02:06	23.050	23.180	23.750	23.800	23.810	77.264%
x		113.900%	115.125%	118.440%	118.268%	118.475%	76.179%
σ		n/a	n/a	n/a	n/a	n/a	1.102%
%RSD		1.510	1.081	0.718	0.957	0.723	1.447

CCV 993939 11/14/2013 1:04:46 PM QC Status: PASS (Initial: FAIL)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	78.731%	102.200	97.150	93.550	0.000	50470.000	51660.000	51700.000
2	13:06:12	75.172%	104.500	97.580	99.100	0.000	53250.000	53730.000	53460.000
3	13:06:55	77.543%	101.500	98.170	98.290	0.000	51480.000	52120.000	52060.000
x		77.149%	102.743%	97.633%	96.978%	0.000	103.464%	105.002%	104.810%
σ		1.812%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.348	1.563	0.528	3.087	0.000	2.726	2.069	1.777

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	530.800	5055.000	0.000	50500.000	52150.000	51860.000	78.400%	100.200
2	13:06:12	550.600	5111.000	0.000	50710.000	51600.000	52010.000	78.017%	100.200
3	13:06:55	517.700	5057.000	0.000	51320.000	52190.000	51550.000	78.349%	99.730
x		106.608%	101.485%	0.000	101.691%	103.962%	103.614%	78.255%	100.037%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.208%	n/a
%RSD		3.108	0.623	0.000	0.839	0.640	0.455	0.266	0.267

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	102.200	104.000	526.700	26330.000	26190.000	102.500	103.300	103.900
2	13:06:12	103.800	103.700	524.300	26000.000	25750.000	101.900	101.400	102.900
3	13:06:55	102.700	103.600	523.500	26190.000	26280.000	103.200	103.200	102.200
x		102.901%	103.782%	104.961%	104.686%	104.287%	102.514%	102.629%	103.019%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.823	0.221	0.322	0.635	1.090	0.627	1.079	0.826

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	104.500	108.300	106.900	104.300	106.900	107.400	0.000	102.700
2	13:06:12	102.500	108.100	106.000	102.900	106.100	106.100	0.000	102.300
3	13:06:55	103.200	108.100	108.900	103.500	105.500	107.100	0.000	102.000
x		103.427%	108.170%	107.273%	103.562%	106.194%	106.886%	0.000	102.337%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.959	0.099	1.386	0.664	0.660	0.612	0.000	0.314

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	80.673%	104.900	107.400	79.740%	103.600	104.200	104.900	105.600
2	13:06:12	81.802%	105.800	105.900	80.582%	103.700	104.100	104.900	105.100
3	13:06:55	82.182%	104.000	104.600	81.275%	103.300	104.100	104.300	104.800
x		81.552%	104.881%	105.955%	80.532%	103.510%	104.144%	104.699%	105.166%
σ		0.784%	n/a	n/a	0.769%	n/a	n/a	n/a	n/a
%RSD		0.962	0.860	1.327	0.955	0.171	0.067	0.349	0.355

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	82.501%	98.390	99.420	99.820	100.200	100.900	89.470%	90.470%
2	13:06:12	83.213%	99.130	99.990	100.000	100.700	101.700	91.094%	92.573%
3	13:06:55	84.018%	98.260	99.260	99.210	101.000	100.600	91.636%	92.344%
x		83.244%	98.593%	99.555%	99.679%	100.607%	101.053%	90.733%	91.796%
σ		0.759%	n/a	n/a	n/a	n/a	n/a	1.127%	1.154%
%RSD		0.911	0.479	0.384	0.421	0.371	0.556	1.242	1.257

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	13:05:29	100.400	102.300	103.700	103.900	103.700	86.337%
2	13:06:12	101.800	103.300	105.100	105.100	105.000	87.920%
3	13:06:55	102.400	103.800	105.500	104.700	105.000	87.428%
x		101.495%	103.148%	104.782%	104.604%	104.571%	87.228%
σ		n/a	n/a	n/a	n/a	n/a	0.810%
%RSD		1.020	0.734	0.883	0.582	0.755	0.929

CCB1 11/14/2013 1:12:57 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	88.212%	-0.050	-0.155	0.108	0.000	2.616	0.876	0.827
2	13:14:23	85.908%	-0.045	-0.277	0.003	0.000	2.304	0.529	0.648
3	13:15:06	88.477%	-0.078	-0.267	-0.322	0.000	1.597	0.584	0.598
x		87.532%	-0.058	-0.233	-0.070	0.000	2.172	0.663	0.691
σ		1.413%	0.018	0.068	0.224	0.000	0.522	0.186	0.120
%RSD		1.614	31.050	29.150	319.300	0.000	24.030	28.130	17.430

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	0.031	-0.330	0.000	-1.120	0.543	0.102	84.195%	0.022
2	13:14:23	0.015	0.122	0.000	-1.204	0.505	0.244	85.685%	0.096
3	13:15:06	0.040	-0.026	0.000	-2.566	-0.971	0.124	84.344%	0.027
x		0.029	-0.078	0.000	-1.630	0.026	0.157	84.741%	0.048
σ		0.013	0.230	0.000	0.812	0.863	0.076	0.821%	0.041
%RSD		44.130	295.200	0.000	49.790	3372.000	48.730	0.968	85.560

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	-0.004	-0.012	0.057	0.489	2.028	0.003	0.004	-0.013
2	13:14:23	0.004	-0.015	0.062	-1.073	0.974	0.003	0.004	-0.022
3	13:15:06	0.003	-0.006	0.071	-0.345	0.665	-0.001	0.001	-0.024
x		0.001	-0.011	0.064	-0.310	1.223	0.002	0.003	-0.020
σ		0.005	0.005	0.007	0.782	0.715	0.002	0.002	0.006
%RSD		503.900	43.810	11.160	252.400	58.460	113.500	65.150	29.480

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	-0.018	-0.131	-0.201	-0.076	-0.036	-0.280	0.000	0.002
2	13:14:23	-0.014	-0.093	-0.209	-0.078	-0.249	-0.269	0.000	-0.001
3	13:15:06	-0.014	-0.105	-0.153	-0.094	-0.239	-0.314	0.000	0.003
x		-0.016	-0.110	-0.188	-0.083	-0.175	-0.288	0.000	0.001
σ		0.002	0.020	0.031	0.010	0.120	0.024	0.000	0.002
%RSD		15.630	17.890	16.350	11.630	68.790	8.293	0.000	180.500

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	86.741%	0.494	0.480	88.447%	-0.078	-0.087	-0.008	-0.006
2	13:14:23	87.538%	0.454	0.453	88.872%	-0.082	-0.071	-0.046	-0.029
3	13:15:06	86.322%	0.455	0.431	88.302%	-0.080	-0.070	0.025	0.020
x		86.867%	0.468	0.455	88.540%	-0.080	-0.076	-0.010	-0.005
σ		0.618%	0.023	0.024	0.296%	0.002	0.009	0.035	0.025
%RSD		0.711	4.915	5.338	0.334	2.578	12.170	352.900	509.000

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	88.683%	-0.115	-0.014	-0.027	-0.001	-0.012	91.940%	92.168%
2	13:14:23	89.709%	-0.087	-0.012	-0.019	0.003	-0.013	94.054%	94.445%
3	13:15:06	88.640%	-0.117	-0.016	-0.020	-0.008	-0.010	92.881%	93.908%
x		89.011%	-0.106	-0.014	-0.022	-0.002	-0.011	92.959%	93.507%
σ		0.605%	0.017	0.002	0.004	0.005	0.002	1.059%	1.191%
%RSD		0.680	15.760	11.790	18.990	254.700	14.400	1.139	1.273

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	13:13:40	0.003	0.007	0.014	0.011	0.012	95.561%
2	13:14:23	0.004	0.006	0.016	0.017	0.014	95.465%
3	13:15:06	0.006	0.006	0.014	0.009	0.010	93.864%
x		0.004	0.007	0.015	0.012	0.012	94.963%
σ		0.002	0.001	0.001	0.004	0.002	0.953%
%RSD		48.070	10.510	4.573	36.270	15.400	1.004

MB 11/14/2013 1:17:45 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	87.595%	-0.028	-0.184	-0.320	0.000	1.094	-0.014	0.068
2	13:19:11	86.268%	-0.207	-0.403	-0.331	0.000	1.035	0.002	-0.024
3	13:19:55	83.924%	-0.100	-0.799	-0.556	0.000	0.864	-0.148	-0.063
x		85.929%	-0.112	-0.462	-0.402	0.000	0.998	-0.053	-0.006
σ		1.859%	0.090	0.312	0.133	0.000	0.119	0.082	0.068
%RSD		2.163	80.590	67.490	33.040	0.000	11.960	154.400	1091.000

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	0.754	1.260	0.000	-1.810	6.476	4.766	85.428%	0.041
2	13:19:11	0.662	0.932	0.000	-2.245	6.496	4.902	85.285%	0.051
3	13:19:55	0.720	1.222	0.000	-3.229	7.591	5.614	84.493%	0.057
x		0.712	1.138	0.000	-2.428	6.854	5.094	85.069%	0.050
σ		0.047	0.180	0.000	0.727	0.638	0.456	0.504%	0.008
%RSD		6.554	15.790	0.000	29.930	9.305	8.944	0.592	16.760

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	-0.016	-0.041	0.041	-2.068	0.384	-0.000	0.023	-0.008
2	13:19:11	-0.023	-0.047	0.040	-4.096	-0.055	0.001	0.003	-0.009
3	13:19:55	-0.025	-0.039	0.041	-4.845	-0.570	0.000	-0.005	-0.005
x		-0.022	-0.042	0.040	-3.670	-0.080	0.000	0.007	-0.007
σ		0.005	0.004	0.001	1.437	0.477	0.000	0.015	0.002
%RSD		21.780	9.601	1.389	39.160	593.200	188.100	212.000	28.290

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	-0.017	0.357	0.297	-0.053	-0.325	-0.009	0.000	0.005
2	13:19:11	0.004	0.383	0.376	-0.109	-0.337	-0.416	0.000	0.005
3	13:19:55	0.003	0.375	0.380	-0.066	-0.151	-0.224	0.000	0.006
x		-0.004	0.372	0.351	-0.076	-0.271	-0.216	0.000	0.005
σ		0.012	0.013	0.047	0.029	0.104	0.204	0.000	0.001
%RSD		337.400	3.520	13.290	38.170	38.490	94.320	0.000	16.370

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	86.192%	0.232	0.240	87.467%	-0.088	-0.086	0.063	0.043
2	13:19:11	88.082%	0.221	0.202	89.519%	-0.089	-0.086	-0.007	-0.012
3	13:19:55	87.668%	0.176	0.168	88.873%	-0.082	-0.086	-0.011	-0.012
x		87.314%	0.210	0.203	88.620%	-0.086	-0.086	0.015	0.006
σ		0.993%	0.030	0.036	1.049%	0.004	0.000	0.042	0.032
%RSD		1.137	14.070	17.790	1.184	4.548	0.405	279.600	492.100

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	89.016%	-0.159	-0.023	-0.032	-0.004	-0.007	91.501%	91.843%
2	13:19:11	90.833%	-0.167	-0.031	-0.029	-0.007	-0.010	95.521%	96.725%
3	13:19:55	90.820%	-0.181	-0.028	-0.035	-0.007	-0.007	96.128%	96.532%
x		90.223%	-0.169	-0.027	-0.032	-0.006	-0.008	94.383%	95.033%
σ		1.045%	0.011	0.004	0.003	0.001	0.002	2.515%	2.764%
%RSD		1.159	6.671	15.490	9.490	22.170	19.970	2.664	2.909

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	13:18:28	0.006	0.007	0.011	0.012	0.011	95.263%
2	13:19:11	0.005	0.004	0.012	0.014	0.011	98.725%
3	13:19:55	0.004	0.005	0.011	0.012	0.011	98.648%
x		0.005	0.005	0.011	0.013	0.011	97.545%
σ		0.001	0.002	0.001	0.001	0.000	1.977%
%RSD		25.530	34.740	6.026	10.490	0.274	2.027

180-27104-A-1 @10 11/14/2013 1:35:26 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	85.077%	-0.050	-0.313	0.019	0.000	65010.000	5.033	4.629
2	13:36:52	81.602%	-0.093	-0.360	-0.167	0.000	65170.000	4.592	5.054
3	13:37:35	79.139%	-0.101	-0.211	-0.154	0.000	63880.000	4.593	4.708
x		81.939%	-0.082	-0.295	-0.101	0.000	64690.000	4.739	4.797
σ		2.983%	0.027	0.076	0.104	0.000	700.500	0.255	0.226
%RSD		3.641	33.500	25.720	103.500	0.000	1.083	5.372	4.716
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	51.700	26.700	0.000	0.959	33.000	37.430	83.849%	0.970
2	13:36:52	52.360	27.590	0.000	0.324	37.560	34.340	79.507%	0.955
3	13:37:35	51.810	26.650	0.000	-0.044	45.410	38.090	77.091%	1.061
x		51.950	26.980	0.000	0.413	38.650	36.620	80.149%	0.996
σ		0.356	0.531	0.000	0.508	6.277	1.999	3.424%	0.057
%RSD		0.685	1.970	0.000	123.000	16.240	5.460	4.272	5.764
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	1.750	52.260	282.500	109600.000	108600.000	3.730	26.490	23.460
2	13:36:52	1.602	52.520	285.900	111300.000	111400.000	3.880	27.360	23.610
3	13:37:35	1.969	52.520	68.730	109200.000	109500.000	3.706	26.490	23.320
x		1.774	52.430	212.400	110000.000	109800.000	3.772	26.780	23.460
σ		0.185	0.146	124.400	1154.000	1407.000	0.094	0.504	0.147
%RSD		10.410	0.279	58.590	1.049	1.281	2.501	1.884	0.628
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	23.700	5.049	5.036	0.460	-0.138	0.396	0.000	0.600
2	13:36:52	23.450	5.201	5.144	0.318	0.009	0.169	0.000	0.595
3	13:37:35	23.520	5.037	5.179	0.477	-0.308	0.087	0.000	0.572
x		23.560	5.096	5.120	0.418	-0.146	0.217	0.000	0.589
σ		0.131	0.092	0.075	0.087	0.159	0.160	0.000	0.015
%RSD		0.556	1.797	1.456	20.850	108.700	73.630	0.000	2.504
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	84.045%	3.254	3.278	83.368%	-0.075	-0.069	0.043	0.021
2	13:36:52	81.882%	3.406	3.474	80.609%	-0.078	-0.074	0.034	0.027
3	13:37:35	78.363%	3.367	3.453	77.292%	-0.067	-0.061	-0.035	-0.029
x		81.430%	3.342	3.402	80.423%	-0.073	-0.068	0.014	0.006
σ		2.868%	0.079	0.108	3.042%	0.006	0.006	0.043	0.031
%RSD		3.522	2.369	3.174	3.783	7.903	9.094	298.500	486.400
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:36:09	85.169%	-0.130	0.095	0.062	1.109	1.083	89.454%	90.150%
2	13:36:52	83.382%	-0.127	0.074	0.060	0.991	1.035	89.501%	90.546%
3	13:37:35	79.856%	-0.124	0.072	0.061	1.068	1.032	87.569%	88.879%
x		82.802%	-0.127	0.080	0.061	1.056	1.050	88.841%	89.858%
σ		2.704%	0.003	0.013	0.001	0.060	0.028	1.102%	0.871%
%RSD		3.265	2.708	15.750	1.525	5.665	2.714	1.240	0.969
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	13:36:09	-0.000	0.003	0.336	0.337	0.334	90.198%		
2	13:36:52	-0.003	-0.000	0.326	0.356	0.347	88.261%		
3	13:37:35	-0.002	-0.001	0.339	0.322	0.330	87.478%		
x		-0.002	0.001	0.334	0.339	0.337	88.646%		
σ		0.001	0.002	0.007	0.017	0.009	1.400%		
%RSD		77.570	293.900	2.049	5.061	2.637	1.580		

180-27104-A-2 @10 11/14/2013 1:40:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	76.784%	-0.074	-0.243	-0.304	0.000	447000.000	4.229	3.364
2	13:41:41	75.442%	-0.091	0.189	-0.398	0.000	455500.000	3.417	3.501
3	13:42:24	73.829%	-0.048	-0.109	-0.172	0.000	448600.000	3.607	3.951
x		75.351%	-0.071	-0.054	-0.291	0.000	450400.000	3.751	3.605
σ		1.480%	0.022	0.221	0.114	0.000	4546.000	0.425	0.307
%RSD		1.964	30.520	406.100	38.980	0.000	1.009	11.320	8.523
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	1.860	4.642	0.000	12.650	12.000	9.638	76.061%	0.016
2	13:41:41	1.739	4.785	0.000	11.590	9.184	9.544	76.257%	0.061
3	13:42:24	1.830	5.272	0.000	11.610	7.048	9.149	75.491%	0.022
x		1.810	4.899	0.000	11.950	9.409	9.444	75.936%	0.033
σ		0.063	0.330	0.000	0.607	2.482	0.259	0.398%	0.024
%RSD		3.480	6.739	0.000	5.082	26.370	2.746	0.525	73.410
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	-0.159	-0.307	14.170	12.460	17.470	0.202	0.147	1.555
2	13:41:41	-0.137	-0.308	14.180	5.277	9.091	0.214	0.112	1.594
3	13:42:24	-0.133	-0.307	14.190	2.291	7.505	0.193	0.167	1.688
x		-0.143	-0.307	14.180	6.677	11.350	0.203	0.142	1.612
σ		0.014	0.000	0.012	5.228	5.352	0.011	0.028	0.068
%RSD		10.060	0.130	0.084	78.300	47.140	5.264	19.500	4.240
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	0.060	0.140	0.123	-0.015	-0.123	-0.086	0.000	0.121
2	13:41:41	0.045	0.232	0.089	-0.019	-0.209	0.124	0.000	0.127
3	13:42:24	0.061	0.083	0.069	-0.035	0.085	0.054	0.000	0.130
x		0.055	0.152	0.094	-0.023	-0.083	0.031	0.000	0.126
σ		0.009	0.075	0.027	0.010	0.151	0.107	0.000	0.005
%RSD		16.480	49.210	28.950	45.140	183.500	348.400	0.000	3.580
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	75.503%	0.095	0.058	70.864%	-0.078	-0.064	-0.027	-0.023
2	13:41:41	76.660%	0.076	0.065	72.283%	-0.066	-0.063	-0.032	-0.031
3	13:42:24	76.718%	0.080	0.070	72.323%	-0.067	-0.061	0.002	-0.001
x		76.294%	0.083	0.064	71.823%	-0.070	-0.063	-0.019	-0.018
σ		0.685%	0.010	0.006	0.831%	0.007	0.002	0.018	0.015
%RSD		0.898	12.030	9.173	1.157	9.501	2.498	96.220	84.570
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:40:58	74.401%	-0.154	-0.032	-0.049	0.014	0.035	79.861%	80.794%
2	13:41:41	75.738%	-0.149	-0.036	-0.053	0.052	0.030	83.343%	84.103%
3	13:42:24	75.997%	-0.167	-0.040	-0.055	0.044	0.048	83.749%	84.731%
x		75.379%	-0.157	-0.036	-0.052	0.037	0.038	82.318%	83.209%
σ		0.857%	0.009	0.004	0.003	0.020	0.009	2.137%	2.115%
%RSD		1.137	5.805	10.280	6.454	55.820	24.100	2.597	2.542
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	13:40:58	-0.004	-0.002	0.081	0.091	0.081	73.937%		
2	13:41:41	-0.003	-0.003	0.086	0.086	0.075	75.036%		
3	13:42:24	-0.001	-0.002	0.071	0.078	0.071	76.027%		
x		-0.003	-0.002	0.079	0.085	0.076	75.000%		
σ		0.002	0.001	0.007	0.007	0.005	1.045%		
%RSD		63.410	35.510	9.321	7.638	6.636	1.394		

180-27093-B-1 11/14/2013 1:45:04 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	76.634%	-0.156	2.020	2.108	0.000	12750.000	6078.000	6124.000
2	13:46:30	77.018%	-0.153	1.279	1.958	0.000	12540.000	6052.000	6089.000
3	13:47:13	78.040%	-0.192	1.182	1.899	0.000	12470.000	6088.000	6083.000
x		77.231%	-0.167	1.494	1.988	0.000	12590.000	6072.000	6099.000
σ		0.726%	0.022	0.459	0.108	0.000	143.100	18.530	22.080
%RSD		0.941	13.000	30.700	5.422	0.000	1.137	0.305	0.362
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	114.500	1435.000	0.000	432.200	19530.000	19430.000	74.561%	0.191
2	13:46:30	113.300	1398.000	0.000	373.600	19200.000	19390.000	76.555%	0.252
3	13:47:13	114.400	1409.000	0.000	429.600	19430.000	19280.000	76.863%	0.166
x		114.100	1414.000	0.000	411.800	19390.000	19370.000	75.993%	0.203
σ		0.647	19.050	0.000	33.090	166.700	78.030	1.250%	0.044
%RSD		0.567	1.347	0.000	8.035	0.860	0.403	1.644	21.690
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	-0.103	-1.424	4.709	-0.010	78.460	0.583	3.245	0.270
2	13:46:30	-0.138	-1.397	4.699	0.978	79.130	0.615	3.195	0.246
3	13:47:13	-0.128	-1.396	4.727	0.296	75.240	0.599	3.139	0.257
x		-0.123	-1.406	4.712	0.421	77.610	0.599	3.193	0.258
σ		0.018	0.016	0.015	0.506	2.081	0.016	0.053	0.012
%RSD		14.700	1.118	0.310	120.100	2.681	2.641	1.651	4.744
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	0.307	85.600	87.420	0.756	-0.238	0.164	0.000	282.100
2	13:46:30	0.260	84.370	85.600	0.597	-0.165	-0.106	0.000	287.900
3	13:47:13	0.295	85.950	86.160	0.474	-0.262	-0.451	0.000	285.900
x		0.287	85.300	86.390	0.609	-0.222	-0.131	0.000	285.300
σ		0.025	0.827	0.929	0.142	0.050	0.308	0.000	2.954
%RSD		8.564	0.970	1.075	23.270	22.710	235.100	0.000	1.035
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	78.247%	1.010	0.983	78.411%	-0.085	-0.080	0.231	0.208
2	13:46:30	78.784%	0.948	1.027	79.051%	-0.075	-0.075	0.236	0.245
3	13:47:13	80.176%	1.002	0.988	80.697%	-0.069	-0.068	0.234	0.213
x		79.069%	0.987	0.999	79.386%	-0.077	-0.074	0.234	0.222
σ		0.995%	0.033	0.024	1.179%	0.008	0.006	0.002	0.020
%RSD		1.259	3.392	2.409	1.486	10.690	8.345	1.023	9.098
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:45:47	80.736%	-0.251	1.741	1.767	131.600	131.700	86.448%	86.854%
2	13:46:30	81.465%	-0.249	1.715	1.736	132.100	132.200	88.181%	89.897%
3	13:47:13	82.711%	-0.243	1.758	1.761	132.700	132.400	89.146%	90.772%
x		81.638%	-0.248	1.738	1.755	132.100	132.100	87.925%	89.174%
σ		0.999%	0.004	0.021	0.016	0.557	0.351	1.367%	2.056%
%RSD		1.223	1.493	1.223	0.939	0.421	0.266	1.554	2.306
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	13:45:47	-0.001	-0.001	0.079	0.082	0.079	85.081%		
2	13:46:30	-0.001	0.001	0.080	0.088	0.082	88.027%		
3	13:47:13	-0.001	-0.000	0.080	0.089	0.085	89.937%		
x		-0.001	-0.000	0.080	0.086	0.082	87.682%		
σ		0.000	0.001	0.000	0.003	0.003	2.446%		
%RSD		28.050	1756.000	0.275	3.968	3.876	2.790		

180-27093-B-2 11/14/2013 1:49:53 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	81.911%	-0.164	1.117	1.729	0.000	13250.000	6020.000	5974.000
2	13:51:18	77.098%	-0.123	1.326	1.886	0.000	13170.000	6111.000	6073.000
3	13:52:01	78.440%	-0.144	1.298	1.863	0.000	12330.000	5831.000	5907.000
x		79.150%	-0.144	1.247	1.826	0.000	12920.000	5988.000	5984.000
σ		2.484%	0.020	0.114	0.085	0.000	508.900	142.800	83.360
%RSD		3.138	14.140	9.120	4.631	0.000	3.939	2.385	1.393
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	102.000	1374.000	0.000	542.400	18720.000	18240.000	78.035%	0.268
2	13:51:18	104.400	1392.000	0.000	526.400	18240.000	18270.000	78.190%	0.107
3	13:52:01	101.700	1360.000	0.000	515.600	17890.000	17600.000	80.135%	0.188
x		102.700	1375.000	0.000	528.200	18280.000	18040.000	78.787%	0.188
σ		1.470	15.660	0.000	13.500	414.400	383.300	1.170%	0.080
%RSD		1.432	1.139	0.000	2.556	2.267	2.125	1.486	42.830
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	-0.109	-1.445	3.422	7.457	80.220	0.635	5.454	0.139
2	13:51:18	-0.114	-1.450	3.437	7.071	76.570	0.586	5.517	0.131
3	13:52:01	-0.096	-1.374	3.317	5.185	72.730	0.590	5.152	0.145
x		-0.106	-1.423	3.392	6.571	76.510	0.604	5.374	0.138
σ		0.009	0.043	0.065	1.216	3.747	0.027	0.195	0.007
%RSD		8.569	3.003	1.920	18.500	4.898	4.499	3.628	5.229
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	0.120	74.200	75.110	0.714	-0.268	-0.198	0.000	242.500
2	13:51:18	0.155	72.640	73.450	0.636	-0.235	-0.457	0.000	241.300
3	13:52:01	0.130	71.450	71.440	0.808	-0.160	-0.032	0.000	235.200
x		0.135	72.760	73.330	0.719	-0.221	-0.229	0.000	239.600
σ		0.018	1.378	1.838	0.086	0.055	0.214	0.000	3.919
%RSD		13.510	1.894	2.507	11.950	25.070	93.520	0.000	1.635
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	80.557%	1.050	1.013	81.792%	-0.091	-0.096	0.160	0.216
2	13:51:18	81.823%	1.103	1.126	82.247%	-0.080	-0.090	0.148	0.157
3	13:52:01	83.854%	1.056	1.070	84.272%	-0.083	-0.088	0.122	0.144
x		82.078%	1.070	1.070	82.770%	-0.085	-0.091	0.143	0.172
σ		1.663%	0.029	0.057	1.321%	0.006	0.004	0.019	0.038
%RSD		2.027	2.725	5.291	1.595	6.698	4.811	13.540	22.180
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:50:35	83.031%	-0.247	1.851	1.826	100.100	100.700	87.665%	88.515%
2	13:51:18	84.608%	-0.256	1.820	1.809	99.670	98.170	89.637%	91.060%
3	13:52:01	86.744%	-0.234	1.758	1.747	97.120	96.930	93.182%	94.003%
x		84.794%	-0.246	1.809	1.794	98.960	98.610	90.162%	91.193%
σ		1.863%	0.011	0.047	0.042	1.612	1.935	2.796%	2.746%
%RSD		2.198	4.611	2.612	2.325	1.629	1.962	3.101	3.011
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	13:50:35	-0.000	-0.001	0.091	0.088	0.091	86.401%		
2	13:51:18	-0.002	-0.001	0.086	0.082	0.084	89.937%		
3	13:52:01	-0.001	-0.001	0.081	0.089	0.084	93.519%		
x		-0.001	-0.001	0.086	0.086	0.086	89.952%		
σ		0.001	0.000	0.005	0.004	0.004	3.559%		
%RSD		59.300	28.140	5.691	4.054	4.413	3.957		

180-27093-B-3 11/14/2013 1:54:40 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	84.811%	-0.064	2.021	1.960	0.000	12800.000	5950.000	5985.000
2	13:56:06	83.976%	-0.122	1.619	2.171	0.000	13000.000	6049.000	6029.000
3	13:56:49	83.917%	-0.187	1.337	1.852	0.000	12940.000	6072.000	6067.000
x		84.235%	-0.125	1.659	1.994	0.000	12910.000	6024.000	6027.000
σ		0.500%	0.061	0.344	0.162	0.000	100.700	65.110	40.900
%RSD		0.594	49.180	20.730	8.141	0.000	0.780	1.081	0.679

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	114.900	1426.000	0.000	591.200	19400.000	19150.000	81.745%	0.173
2	13:56:06	114.700	1421.000	0.000	594.100	19130.000	19000.000	82.886%	0.112
3	13:56:49	116.800	1441.000	0.000	598.900	19080.000	19160.000	82.669%	0.154
x		115.500	1430.000	0.000	594.800	19200.000	19100.000	82.433%	0.146
σ		1.150	10.530	0.000	3.874	174.700	90.050	0.606%	0.031
%RSD		0.996	0.737	0.000	0.651	0.910	0.471	0.735	21.270

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	-0.174	-1.480	3.258	5.196	78.010	0.670	2.744	0.283
2	13:56:06	-0.165	-1.499	3.121	3.590	75.410	0.668	2.642	0.314
3	13:56:49	-0.174	-1.505	3.176	4.568	75.810	0.678	2.645	0.297
x		-0.171	-1.495	3.185	4.451	76.410	0.672	2.677	0.298
σ		0.005	0.013	0.069	0.809	1.396	0.005	0.058	0.016
%RSD		2.998	0.893	2.173	18.180	1.827	0.790	2.171	5.199

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	0.309	95.430	95.450	0.555	-0.083	-0.235	0.000	321.300
2	13:56:06	0.337	94.050	95.590	0.551	-0.212	-0.368	0.000	320.900
3	13:56:49	0.339	94.860	95.870	0.701	-0.156	0.286	0.000	318.400
x		0.328	94.780	95.630	0.603	-0.150	-0.106	0.000	320.200
σ		0.017	0.689	0.213	0.086	0.065	0.346	0.000	1.574
%RSD		5.180	0.727	0.223	14.220	43.030	325.900	0.000	0.491

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	83.091%	1.052	1.051	84.199%	-0.087	-0.088	0.196	0.207
2	13:56:06	84.594%	1.080	1.075	84.761%	-0.079	-0.077	0.156	0.178
3	13:56:49	84.937%	1.118	1.115	85.792%	-0.071	-0.070	0.238	0.240
x		84.207%	1.083	1.080	84.918%	-0.079	-0.078	0.196	0.208
σ		0.982%	0.033	0.032	0.808%	0.008	0.009	0.041	0.031
%RSD		1.166	3.037	3.000	0.951	9.919	11.590	20.740	14.770

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	85.069%	-0.256	1.834	1.808	133.700	134.300	89.552%	91.008%
2	13:56:06	86.969%	-0.246	1.803	1.776	132.900	133.100	91.932%	92.483%
3	13:56:49	87.008%	-0.237	1.741	1.799	132.700	133.300	92.160%	93.948%
x		86.348%	-0.247	1.793	1.794	133.100	133.600	91.215%	92.480%
σ		1.108%	0.010	0.047	0.016	0.516	0.599	1.444%	1.470%
%RSD		1.284	3.854	2.646	0.894	0.388	0.448	1.583	1.589

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	13:55:23	0.000	0.000	0.067	0.065	0.066	88.845%
2	13:56:06	0.000	0.002	0.072	0.074	0.068	91.272%
3	13:56:49	-0.000	-0.001	0.066	0.065	0.065	92.342%
x		0.000	0.000	0.068	0.068	0.066	90.820%
σ		0.000	0.001	0.003	0.005	0.002	1.792%
%RSD		1320.000	409.700	4.910	7.420	2.322	1.973

180-27093-B-4 11/14/2013 1:59:26 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	89.361%	-0.171	-0.312	-0.475	0.000	12050.000	5151.000	5117.000
2	14:00:53	85.370%	-0.217	-0.912	-0.449	0.000	12180.000	5198.000	5143.000
3	14:01:36	85.586%	-0.137	-0.720	-0.423	0.000	11960.000	5160.000	5192.000
x		86.772%	-0.175	-0.648	-0.449	0.000	12060.000	5170.000	5151.000
σ		2.245%	0.040	0.306	0.026	0.000	113.800	24.940	38.150
%RSD		2.587	22.830	47.260	5.736	0.000	0.944	0.482	0.741
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	1.633	11.450	0.000	8.166	12550.000	11530.000	84.742%	-0.030
2	14:00:53	1.617	11.770	0.000	6.914	12180.000	11770.000	86.836%	-0.036
3	14:01:36	1.646	11.520	0.000	7.373	12310.000	11800.000	85.825%	-0.020
x		1.632	11.580	0.000	7.484	12350.000	11700.000	85.801%	-0.029
σ		0.015	0.169	0.000	0.633	185.800	150.400	1.048%	0.008
%RSD		0.913	1.462	0.000	8.464	1.505	1.285	1.221	27.520
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	-0.322	-1.030	2.810	1.155	51.270	0.030	0.955	1.069
2	14:00:53	-0.330	-0.986	2.747	-0.353	46.350	0.024	0.916	1.077
3	14:01:36	-0.327	-1.041	2.803	-0.486	43.020	0.031	0.927	1.072
x		-0.326	-1.019	2.787	0.106	46.880	0.028	0.933	1.073
σ		0.004	0.029	0.035	0.911	4.151	0.004	0.020	0.004
%RSD		1.311	2.833	1.246	862.700	8.854	12.740	2.125	0.369
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	1.041	43.230	43.230	0.069	-0.039	0.209	0.000	3.014
2	14:00:53	1.029	41.700	42.440	-0.002	0.047	-0.100	0.000	2.915
3	14:01:36	1.038	42.470	42.780	-0.049	0.010	-0.167	0.000	3.008
x		1.036	42.470	42.810	0.006	0.006	-0.019	0.000	2.979
σ		0.006	0.766	0.396	0.060	0.043	0.201	0.000	0.056
%RSD		0.610	1.804	0.924	994.200	717.900	1047.000	0.000	1.866
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	86.118%	-0.039	-0.033	87.814%	-0.070	-0.069	2.087	2.034
2	14:00:53	87.914%	-0.026	-0.038	88.606%	-0.070	-0.077	2.084	2.147
3	14:01:36	88.042%	-0.046	-0.037	88.927%	-0.067	-0.060	2.081	2.121
x		87.358%	-0.037	-0.036	88.449%	-0.069	-0.068	2.084	2.101
σ		1.076%	0.010	0.003	0.573%	0.002	0.008	0.003	0.059
%RSD		1.232	27.800	7.302	0.648	2.641	12.230	0.143	2.817
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:00:10	88.615%	2.748	-0.032	-0.035	1.818	1.826	91.837%	92.626%
2	14:00:53	90.183%	2.858	-0.029	-0.037	1.803	1.859	93.997%	95.075%
3	14:01:36	91.150%	2.857	-0.026	-0.040	1.879	1.903	95.928%	96.596%
x		89.982%	2.821	-0.029	-0.037	1.833	1.863	93.921%	94.766%
σ		1.279%	0.063	0.003	0.003	0.040	0.039	2.046%	2.003%
%RSD		1.422	2.226	10.580	7.231	2.201	2.089	2.179	2.113
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	14:00:10	-0.001	-0.003	2.497	2.624	2.558	90.632%		
2	14:00:53	-0.003	-0.003	2.421	2.612	2.500	93.999%		
3	14:01:36	-0.004	-0.003	2.440	2.628	2.512	95.604%		
x		-0.003	-0.003	2.453	2.621	2.523	93.412%		
σ		0.001	0.000	0.040	0.009	0.031	2.537%		
%RSD		46.810	6.554	1.616	0.326	1.218	2.716		

180-27093-B-5 11/14/2013 2:04:13 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	85.882%	-0.186	-0.714	-0.403	0.000	12120.000	5168.000	5167.000
2	14:05:39	85.851%	-0.169	-0.424	-0.523	0.000	12190.000	5166.000	5153.000
3	14:06:22	84.489%	-0.207	-0.738	-0.524	0.000	11930.000	5160.000	5224.000
x		85.407%	-0.187	-0.625	-0.483	0.000	12080.000	5165.000	5181.000
σ		0.796%	0.019	0.175	0.070	0.000	135.700	3.845	37.110
%RSD		0.931	10.310	27.970	14.420	0.000	1.123	0.074	0.716
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	1.790	13.980	0.000	6.969	12780.000	11860.000	85.106%	0.001
2	14:05:39	1.816	13.510	0.000	6.953	12750.000	11560.000	85.126%	-0.030
3	14:06:22	1.854	13.610	0.000	5.623	12480.000	11890.000	85.578%	0.025
x		1.820	13.700	0.000	6.515	12670.000	11770.000	85.270%	-0.001
σ		0.032	0.245	0.000	0.772	166.900	182.800	0.267%	0.028
%RSD		1.770	1.789	0.000	11.860	1.317	1.553	0.313	2227.000
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	-0.310	-0.979	2.678	0.342	52.530	0.041	0.856	1.306
2	14:05:39	-0.302	-0.964	2.648	-0.515	49.130	0.047	0.825	1.295
3	14:06:22	-0.292	-0.957	2.617	-0.408	48.500	0.041	0.920	1.314
x		-0.301	-0.967	2.648	-0.194	50.050	0.043	0.867	1.305
σ		0.009	0.011	0.031	0.467	2.167	0.003	0.049	0.010
%RSD		2.865	1.147	1.164	241.400	4.330	8.038	5.598	0.746
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	1.265	59.800	60.010	0.088	0.041	0.042	0.000	2.803
2	14:05:39	1.206	59.210	58.310	0.015	-0.064	-0.011	0.000	2.776
3	14:06:22	1.264	59.100	60.650	0.103	-0.050	0.382	0.000	2.745
x		1.245	59.370	59.660	0.069	-0.024	0.137	0.000	2.774
σ		0.033	0.378	1.207	0.047	0.057	0.213	0.000	0.029
%RSD		2.681	0.637	2.023	68.440	233.700	155.100	0.000	1.040
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	85.321%	-0.033	-0.051	86.602%	-0.087	-0.091	2.037	2.062
2	14:05:39	86.902%	-0.035	-0.037	87.380%	-0.082	-0.081	2.016	1.956
3	14:06:22	87.005%	-0.037	-0.038	87.914%	-0.079	-0.082	2.030	2.060
x		86.409%	-0.035	-0.042	87.298%	-0.083	-0.084	2.027	2.026
σ		0.944%	0.002	0.008	0.660%	0.004	0.005	0.010	0.061
%RSD		1.092	5.975	18.890	0.756	5.216	6.264	0.512	2.988
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:04:56	87.274%	1.190	-0.044	-0.042	1.489	1.499	90.586%	91.556%
2	14:05:39	88.302%	1.261	-0.027	-0.037	1.450	1.540	93.237%	93.747%
3	14:06:22	89.410%	1.260	-0.039	-0.044	1.488	1.488	94.024%	95.087%
x		88.328%	1.237	-0.037	-0.041	1.476	1.509	92.616%	93.463%
σ		1.068%	0.041	0.009	0.004	0.023	0.028	1.801%	1.783%
%RSD		1.209	3.282	23.190	8.887	1.540	1.830	1.945	1.907
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	14:04:56	-0.002	-0.001	1.607	1.744	1.680	89.663%		
2	14:05:39	-0.003	-0.000	1.594	1.722	1.657	93.206%		
3	14:06:22	-0.004	-0.003	1.663	1.740	1.683	93.502%		
x		-0.003	-0.002	1.621	1.735	1.673	92.124%		
σ		0.001	0.001	0.037	0.012	0.014	2.136%		
%RSD		24.570	82.320	2.276	0.682	0.856	2.319		

LCS 11/14/2013 2:08:59 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	79.217%	52.010	996.100	983.100	0.000	51150.000	51060.000	50830.000
2	14:10:25	76.911%	53.790	992.800	982.500	0.000	51030.000	51250.000	50810.000
3	14:11:08	78.836%	52.190	999.000	980.300	0.000	51190.000	51830.000	51300.000
x		78.321%	52.660	996.000	982.000	0.000	51120.000	51380.000	50980.000
σ		1.236%	0.980	3.095	1.474	0.000	82.970	400.900	276.800
%RSD		1.578	1.861	0.311	0.150	0.000	0.162	0.780	0.543

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	2021.000	10080.000	0.000	51640.000	52280.000	52480.000	79.780%	984.500
2	14:10:25	2005.000	10130.000	0.000	51410.000	52150.000	51780.000	79.622%	976.800
3	14:11:08	2043.000	10100.000	0.000	50730.000	51860.000	51790.000	79.055%	989.600
x		2023.000	10100.000	0.000	51260.000	52090.000	52020.000	79.486%	983.600
σ		18.920	29.820	0.000	476.600	216.200	399.100	0.381%	6.463
%RSD		0.935	0.295	0.000	0.930	0.415	0.767	0.480	0.657

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	528.800	204.400	519.200	1072.000	1255.000	519.200	508.200	261.100
2	14:10:25	529.200	205.500	524.400	1069.000	1237.000	517.000	512.900	262.400
3	14:11:08	536.100	208.200	526.100	1083.000	1256.000	525.100	515.700	261.500
x		531.400	206.000	523.300	1075.000	1249.000	520.500	512.300	261.700
σ		4.120	1.934	3.603	7.034	10.370	4.192	3.800	0.673
%RSD		0.775	0.939	0.689	0.654	0.830	0.805	0.742	0.257

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	264.300	540.100	536.700	41.080	10.900	10.710	0.000	1022.000
2	14:10:25	260.100	534.100	535.900	40.920	10.730	10.490	0.000	1038.000
3	14:11:08	260.800	540.800	540.400	41.130	10.650	10.530	0.000	1031.000
x		261.700	538.300	537.700	41.040	10.760	10.580	0.000	1030.000
σ		2.276	3.689	2.402	0.112	0.128	0.116	0.000	8.067
%RSD		0.869	0.685	0.447	0.273	1.186	1.100	0.000	0.783

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	80.222%	1008.000	1028.000	77.522%	53.080	53.680	54.020	48.390
2	14:10:25	80.709%	1015.000	1046.000	78.108%	53.460	53.240	54.030	49.490
3	14:11:08	80.735%	1019.000	1049.000	77.885%	53.320	53.400	53.660	48.800
x		80.555%	1014.000	1041.000	77.838%	53.290	53.440	53.900	48.890
σ		0.289%	5.357	11.780	0.296%	0.194	0.221	0.211	0.559
%RSD		0.359	0.528	1.131	0.380	0.364	0.413	0.391	1.143

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	79.633%	2059.000	507.000	507.500	1042.000	2108.000	85.798%	86.742%
2	14:10:25	81.082%	2056.000	508.800	508.500	1197.000	2115.000	88.136%	89.132%
3	14:11:08	81.573%	2057.000	505.900	505.100	832.400	2108.000	87.866%	89.213%
x		80.763%	2057.000	507.200	507.000	1024.000	2111.000	87.267%	88.362%
σ		1.008%	1.197	1.452	1.725	183.100	3.859	1.279%	1.403%
%RSD		1.249	0.058	0.286	0.340	17.880	0.183	1.466	1.588

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:09:42	49.070	49.370	19.340	20.870	20.060	87.295%
2	14:10:25	50.410	50.960	20.010	21.500	20.670	86.724%
3	14:11:08	50.790	51.690	20.010	21.780	20.880	86.641%
x		50.090	50.670	19.780	21.380	20.530	86.886%
σ		0.900	1.184	0.385	0.463	0.428	0.356%
%RSD		1.797	2.336	1.946	2.165	2.084	0.410

LCSD 11/14/2013 2:13:45 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	81.289%	55.600	1058.000	1037.000	0.000	52470.000	51850.000	51400.000
2	14:15:11	76.860%	57.420	1106.000	1090.000	0.000	54280.000	54290.000	53700.000
3	14:15:54	77.440%	56.020	1078.000	1050.000	0.000	52650.000	52390.000	51820.000
x		78.530%	56.350	1081.000	1059.000	0.000	53130.000	52850.000	52300.000
σ		2.407%	0.954	24.250	27.360	0.000	998.900	1282.000	1225.000
%RSD		3.065	1.693	2.243	2.584	0.000	1.880	2.426	2.342
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	2137.000	10380.000	0.000	52470.000	53540.000	52260.000	78.303%	994.000
2	14:15:11	2215.000	10540.000	0.000	53680.000	53880.000	53820.000	76.543%	1010.000
3	14:15:54	2143.000	10260.000	0.000	52070.000	52980.000	53340.000	77.191%	1001.000
x		2165.000	10390.000	0.000	52740.000	53460.000	53140.000	77.346%	1002.000
σ		43.510	141.400	0.000	840.400	455.800	797.700	0.890%	7.996
%RSD		2.010	1.360	0.000	1.594	0.853	1.501	1.150	0.798
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	565.300	218.100	548.800	1121.000	1314.000	549.600	538.600	273.300
2	14:15:11	566.100	220.600	563.500	1157.000	1353.000	563.900	553.100	281.500
3	14:15:54	564.300	219.900	555.100	1134.000	1316.000	552.500	539.400	273.800
x		565.200	219.500	555.800	1137.000	1328.000	555.300	543.700	276.200
σ		0.897	1.314	7.397	18.330	21.890	7.565	8.110	4.595
%RSD		0.159	0.599	1.331	1.612	1.649	1.362	1.492	1.664
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	273.900	563.900	565.600	42.930	11.500	11.130	0.000	1066.000
2	14:15:11	280.500	577.000	578.000	43.430	11.750	11.500	0.000	1099.000
3	14:15:54	277.200	566.500	563.700	42.780	11.220	11.350	0.000	1078.000
x		277.200	569.100	569.100	43.050	11.490	11.330	0.000	1081.000
σ		3.257	6.923	7.761	0.339	0.266	0.187	0.000	16.360
%RSD		1.175	1.216	1.364	0.787	2.315	1.646	0.000	1.513
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	79.006%	1015.000	1042.000	76.164%	55.710	55.600	55.800	51.100
2	14:15:11	77.882%	1047.000	1078.000	75.901%	56.590	56.590	58.000	52.220
3	14:15:54	78.860%	1026.000	1064.000	76.177%	55.910	55.970	56.080	50.880
x		78.583%	1029.000	1061.000	76.081%	56.070	56.050	56.630	51.400
σ		0.611%	16.640	18.120	0.155%	0.461	0.499	1.200	0.719
%RSD		0.778	1.616	1.707	0.204	0.822	0.889	2.119	1.398
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:14:28	79.208%	2050.000	505.400	505.000	824.700	2193.000	84.520%	85.013%
2	14:15:11	78.630%	2119.000	524.600	525.500	804.600	2243.000	84.737%	85.992%
3	14:15:54	79.153%	2079.000	517.000	515.000	615.000	2199.000	85.747%	86.607%
x		78.997%	2083.000	515.700	515.200	748.100	2212.000	85.002%	85.871%
σ		0.319%	34.780	9.672	10.270	115.700	27.320	0.655%	0.804%
%RSD		0.404	1.670	1.876	1.993	15.470	1.235	0.770	0.936
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	14:14:28	52.290	53.050	20.760	22.470	21.540	83.198%		
2	14:15:11	54.440	55.030	21.580	23.140	22.390	82.888%		
3	14:15:54	53.990	54.800	21.700	23.220	22.350	82.377%		
x		53.570	54.300	21.350	22.950	22.090	82.821%		
σ		1.135	1.082	0.507	0.410	0.477	0.414%		
%RSD		2.119	1.993	2.374	1.788	2.161	0.500		

CCV 993939 11/14/2013 2:21:51 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	81.550%	106.700	111.400	110.700	0.000	50810.000	50180.000	49430.000
2	14:23:17	81.262%	104.200	107.700	105.600	0.000	50490.000	49490.000	49070.000
3	14:24:00	81.067%	102.700	105.200	106.100	0.000	50600.000	49850.000	49110.000
x		81.293%	104.540%	108.093%	107.442%	0.000	101.264%	99.684%	98.406%
σ		0.243%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.299	1.922	2.864	2.621	0.000	0.328	0.692	0.396

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	490.900	4900.000	0.000	50000.000	49770.000	50190.000	80.495%	95.710
2	14:23:17	489.500	4852.000	0.000	50100.000	51020.000	50690.000	79.351%	95.790
3	14:24:00	500.700	4825.000	0.000	49890.000	49700.000	50140.000	79.780%	95.610
x		98.736%	97.182%	0.000	99.999%	100.326%	100.681%	79.876%	95.703%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.578%	n/a
%RSD		1.232	0.786	0.000	0.206	1.477	0.607	0.723	0.091

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	100.700	100.600	501.800	25420.000	25180.000	101.400	102.000	102.600
2	14:23:17	100.400	100.800	507.700	25550.000	25550.000	101.600	102.200	103.500
3	14:24:00	99.810	101.400	508.000	25800.000	25550.000	102.300	100.700	101.500
x		100.290%	100.939%	101.165%	102.356%	101.704%	101.765%	101.612%	102.522%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.442	0.421	0.695	0.740	0.853	0.502	0.777	0.946

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	103.800	106.200	106.900	104.800	108.800	109.900	0.000	103.000
2	14:23:17	103.600	106.300	106.500	104.000	106.400	107.200	0.000	103.700
3	14:24:00	101.900	104.200	106.200	104.000	107.200	107.600	0.000	103.700
x		103.091%	105.567%	106.519%	104.258%	107.453%	108.206%	0.000	103.469%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		1.019	1.106	0.338	0.438	1.155	1.333	0.000	0.407

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	77.029%	101.400	103.500	75.313%	105.400	105.800	105.500	105.600
2	14:23:17	78.020%	104.000	104.200	76.407%	104.500	105.400	106.200	106.200
3	14:24:00	78.747%	104.000	104.700	77.004%	103.900	104.800	105.500	105.000
x		77.932%	103.125%	104.155%	76.241%	104.602%	105.336%	105.744%	105.586%
σ		0.862%	n/a	n/a	0.857%	n/a	n/a	n/a	n/a
%RSD		1.106	1.419	0.589	1.125	0.710	0.478	0.384	0.545

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	78.388%	99.690	100.400	100.300	99.820	101.500	83.655%	84.324%
2	14:23:17	78.688%	101.100	102.200	101.500	101.900	102.500	85.325%	86.200%
3	14:24:00	80.362%	100.500	100.400	100.200	101.900	100.600	86.349%	87.446%
x		79.146%	100.434%	100.994%	100.632%	101.197%	101.536%	85.110%	85.990%
σ		1.063%	n/a	n/a	n/a	n/a	n/a	1.360%	1.572%
%RSD		1.344	0.697	1.059	0.707	1.178	0.915	1.598	1.828

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:22:34	98.710	98.940	101.400	100.800	101.000	82.315%
2	14:23:17	100.200	101.600	102.900	102.300	102.700	82.912%
3	14:24:00	101.400	102.600	104.100	103.600	104.200	83.093%
x		100.096%	101.026%	102.827%	102.223%	102.646%	82.773%
σ		n/a	n/a	n/a	n/a	n/a	0.407%
%RSD		1.351	1.854	1.321	1.334	1.568	0.492

CCB2 11/14/2013 2:30:01 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	93.145%	-0.211	5.351	4.725	0.000	1.073	0.794	0.679
2	14:31:27	90.298%	-0.165	4.909	4.602	0.000	0.960	0.654	0.645
3	14:32:10	90.988%	-0.210	4.480	4.409	0.000	0.844	0.827	0.615
x		91.477%	-0.195	4.913	4.578	0.000	0.959	0.758	0.646
σ		1.485%	0.026	0.435	0.159	0.000	0.115	0.092	0.032
%RSD		1.623	13.400	8.860	3.478	0.000	11.950	12.090	4.953
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	-0.038	-0.469	0.000	0.382	0.974	-0.399	86.150%	-0.000
2	14:31:27	-0.018	-0.565	0.000	-0.738	-0.987	0.177	85.741%	0.020
3	14:32:10	-0.025	-0.998	0.000	-1.381	1.486	-0.292	85.707%	0.091
x		-0.027	-0.677	0.000	-0.579	0.491	-0.171	85.866%	0.037
σ		0.010	0.282	0.000	0.892	1.306	0.307	0.246%	0.048
%RSD		38.460	41.620	0.000	154.100	265.900	179.000	0.287	129.400
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	-0.006	-0.030	0.042	-2.286	1.246	0.004	-0.003	-0.003
2	14:31:27	-0.016	-0.039	0.040	-2.917	1.074	0.002	0.000	-0.014
3	14:32:10	-0.013	-0.038	0.043	-4.725	0.801	0.002	-0.010	-0.020
x		-0.012	-0.035	0.041	-3.309	1.040	0.003	-0.004	-0.013
σ		0.005	0.005	0.002	1.266	0.225	0.001	0.005	0.009
%RSD		42.420	13.890	4.252	38.260	21.600	58.500	129.300	69.560
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	-0.013	-0.105	-0.090	-0.067	-0.151	-0.201	0.000	0.001
2	14:31:27	-0.001	-0.085	-0.135	-0.137	-0.241	-0.482	0.000	0.001
3	14:32:10	-0.005	-0.089	-0.169	-0.009	-0.286	0.068	0.000	0.002
x		-0.006	-0.093	-0.131	-0.071	-0.226	-0.205	0.000	0.001
σ		0.006	0.010	0.040	0.064	0.068	0.275	0.000	0.001
%RSD		99.810	11.220	30.340	89.770	30.270	134.000	0.000	51.460
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	85.092%	0.355	0.311	86.513%	-0.095	-0.087	-0.001	-0.010
2	14:31:27	86.498%	0.261	0.270	86.945%	-0.089	-0.085	0.012	0.011
3	14:32:10	86.463%	0.257	0.226	87.450%	-0.084	-0.089	-0.009	-0.007
x		86.018%	0.291	0.269	86.969%	-0.089	-0.087	0.001	-0.002
σ		0.802%	0.056	0.043	0.469%	0.006	0.002	0.011	0.012
%RSD		0.932	19.130	15.910	0.540	6.186	2.093	1833.000	520.700
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:30:44	86.991%	0.431	0.116	0.125	-0.004	-0.010	89.724%	89.455%
2	14:31:27	87.487%	0.442	0.101	0.122	-0.006	-0.012	91.191%	91.591%
3	14:32:10	87.973%	0.320	0.120	0.110	0.007	-0.011	92.057%	93.285%
x		87.484%	0.398	0.112	0.119	-0.001	-0.011	90.991%	91.443%
σ		0.491%	0.067	0.010	0.008	0.007	0.001	1.179%	1.919%
%RSD		0.561	16.880	8.755	6.725	584.400	5.802	1.296	2.099
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	14:30:44	0.037	0.033	-0.001	0.000	0.001	93.059%		
2	14:31:27	0.036	0.036	0.005	0.004	0.002	93.637%		
3	14:32:10	0.031	0.032	0.003	0.004	0.002	93.878%		
x		0.035	0.034	0.002	0.003	0.002	93.525%		
σ		0.003	0.002	0.003	0.002	0.000	0.421%		
%RSD		10.060	6.940	129.200	78.820	16.940	0.450		

180-27105-B-1 11/14/2013 2:34:50 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	83.833%	-0.180	8.359	8.453	0.000	6912.000	3041.000	2995.000
2	14:36:16	80.341%	-0.212	7.598	8.359	0.000	6818.000	2980.000	2969.000
3	14:36:59	80.174%	-0.230	8.519	8.869	0.000	6879.000	3091.000	3073.000
x		81.449%	-0.207	8.159	8.561	0.000	6870.000	3037.000	3013.000
σ		2.066%	0.025	0.492	0.271	0.000	47.380	55.780	53.970
%RSD		2.537	12.210	6.036	3.168	0.000	0.690	1.837	1.792

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	113.500	1207.000	0.000	382.400	16650.000	16400.000	80.210%	0.145
2	14:36:16	114.400	1217.000	0.000	380.500	16910.000	16370.000	78.944%	0.143
3	14:36:59	115.600	1275.000	0.000	384.400	17210.000	16670.000	79.372%	0.175
x		114.500	1233.000	0.000	382.400	16920.000	16480.000	79.509%	0.155
σ		1.005	36.840	0.000	1.924	282.800	165.400	0.644%	0.018
%RSD		0.878	2.988	0.000	0.503	1.671	1.004	0.810	11.380

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	-0.155	-1.144	1.662	6.167	77.860	0.297	2.061	0.301
2	14:36:16	-0.160	-1.099	1.678	7.167	73.830	0.289	1.941	0.290
3	14:36:59	-0.161	-1.152	1.673	8.284	72.510	0.287	2.017	0.298
x		-0.159	-1.132	1.671	7.206	74.730	0.291	2.006	0.297
σ		0.003	0.029	0.008	1.059	2.789	0.005	0.061	0.006
%RSD		2.082	2.542	0.488	14.690	3.731	1.747	3.039	1.890

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	0.326	21.840	22.000	0.208	-0.197	-0.570	0.000	362.700
2	14:36:16	0.329	21.720	21.790	0.320	-0.422	-0.027	0.000	358.500
3	14:36:59	0.336	22.280	22.140	0.322	-0.340	-0.081	0.000	365.700
x		0.330	21.950	21.970	0.283	-0.320	-0.226	0.000	362.300
σ		0.005	0.294	0.179	0.065	0.114	0.299	0.000	3.596
%RSD		1.584	1.342	0.813	22.960	35.620	132.200	0.000	0.992

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	81.824%	0.341	0.346	81.781%	-0.105	-0.094	-0.027	-0.022
2	14:36:16	82.552%	0.388	0.379	82.746%	-0.098	-0.105	-0.056	-0.042
3	14:36:59	82.516%	0.350	0.365	83.255%	-0.097	-0.093	-0.054	-0.036
x		82.297%	0.359	0.363	82.594%	-0.100	-0.097	-0.046	-0.033
σ		0.410%	0.025	0.016	0.748%	0.005	0.006	0.016	0.010
%RSD		0.498	6.921	4.487	0.906	4.577	6.542	35.220	30.800

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	83.895%	0.044	1.492	1.497	237.700	239.300	88.725%	89.700%
2	14:36:16	85.044%	0.067	1.507	1.498	236.400	236.600	90.255%	91.584%
3	14:36:59	86.026%	0.059	1.492	1.454	238.400	238.600	90.982%	92.539%
x		84.988%	0.057	1.497	1.483	237.500	238.200	89.988%	91.274%
σ		1.066%	0.012	0.009	0.025	1.042	1.382	1.152%	1.444%
%RSD		1.255	20.580	0.606	1.696	0.439	0.580	1.280	1.582

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:35:33	0.066	0.071	0.035	0.040	0.035	87.597%
2	14:36:16	0.065	0.065	0.046	0.037	0.042	90.548%
3	14:36:59	0.048	0.044	0.039	0.044	0.041	91.519%
x		0.060	0.060	0.040	0.040	0.039	89.888%
σ		0.010	0.014	0.005	0.003	0.003	2.042%
%RSD		17.170	23.620	13.190	8.157	8.722	2.272

180-27105-B-2 11/14/2013 2:39:36 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	84.804%	-0.212	7.278	8.195	0.000	7235.000	3026.000	2974.000
2	14:41:02	85.150%	-0.111	7.777	7.632	0.000	7187.000	2992.000	2911.000
3	14:41:45	83.519%	-0.176	7.036	7.469	0.000	7129.000	2996.000	2963.000
x		84.491%	-0.166	7.364	7.765	0.000	7184.000	3004.000	2949.000
σ		0.859%	0.051	0.378	0.381	0.000	52.950	18.350	33.710
%RSD		1.017	30.950	5.130	4.905	0.000	0.737	0.611	1.143

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	131.900	1296.000	0.000	404.500	17180.000	16800.000	80.607%	0.069
2	14:41:02	130.300	1272.000	0.000	392.500	17100.000	16610.000	81.165%	0.089
3	14:41:45	130.500	1292.000	0.000	394.300	17010.000	16510.000	80.993%	0.106
x		130.900	1287.000	0.000	397.100	17090.000	16640.000	80.922%	0.088
σ		0.892	12.500	0.000	6.458	83.710	146.800	0.285%	0.018
%RSD		0.681	0.972	0.000	1.626	0.490	0.882	0.353	20.660

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	-0.126	-1.130	1.393	5.402	76.030	0.245	1.856	0.153
2	14:41:02	-0.153	-1.135	1.393	4.831	71.630	0.250	1.871	0.150
3	14:41:45	-0.122	-1.157	1.382	6.107	70.660	0.240	1.841	0.163
x		-0.134	-1.141	1.390	5.447	72.770	0.245	1.856	0.156
σ		0.017	0.014	0.007	0.639	2.865	0.005	0.015	0.007
%RSD		12.790	1.267	0.473	11.730	3.937	1.915	0.804	4.480

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	0.185	10.770	10.580	0.277	-0.289	-0.018	0.000	377.800
2	14:41:02	0.192	10.830	10.380	0.285	-0.063	-0.298	0.000	373.400
3	14:41:45	0.175	10.430	10.450	0.388	-0.176	0.098	0.000	377.100
x		0.184	10.680	10.470	0.317	-0.176	-0.073	0.000	376.100
σ		0.009	0.211	0.099	0.062	0.113	0.203	0.000	2.325
%RSD		4.739	1.981	0.946	19.530	64.280	279.700	0.000	0.618

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	81.927%	0.333	0.344	82.962%	-0.100	-0.096	-0.049	-0.035
2	14:41:02	83.880%	0.373	0.338	83.974%	-0.103	-0.093	-0.050	-0.037
3	14:41:45	84.219%	0.341	0.359	85.344%	-0.089	-0.094	-0.056	-0.045
x		83.342%	0.349	0.347	84.093%	-0.097	-0.094	-0.051	-0.039
σ		1.237%	0.021	0.011	1.195%	0.008	0.001	0.004	0.005
%RSD		1.484	6.139	3.037	1.421	7.751	1.430	7.392	13.290

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	84.981%	0.186	1.699	1.704	262.100	261.800	88.735%	89.331%
2	14:41:02	86.753%	0.229	1.692	1.631	259.300	260.000	91.164%	92.297%
3	14:41:45	87.441%	0.203	1.661	1.669	258.500	260.600	91.928%	93.011%
x		86.392%	0.206	1.684	1.668	260.000	260.800	90.609%	91.546%
σ		1.269%	0.021	0.021	0.037	1.891	0.948	1.667%	1.952%
%RSD		1.469	10.390	1.219	2.199	0.727	0.363	1.840	2.132

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:40:19	0.013	0.018	0.036	0.043	0.036	87.827%
2	14:41:02	0.019	0.017	0.041	0.043	0.041	91.024%
3	14:41:45	0.012	0.016	0.048	0.034	0.041	92.485%
x		0.015	0.017	0.041	0.040	0.040	90.445%
σ		0.004	0.001	0.006	0.005	0.003	2.382%
%RSD		24.850	6.417	14.210	13.160	7.203	2.634

180-27105-B-3 11/14/2013 2:44:23 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	84.954%	-0.213	6.784	6.716	0.000	6976.000	3016.000	3013.000
2	14:45:49	85.177%	-0.248	6.233	6.547	0.000	6773.000	2981.000	2945.000
3	14:46:32	82.725%	-0.139	6.671	6.666	0.000	6835.000	3028.000	2961.000
x		84.285%	-0.200	6.563	6.643	0.000	6861.000	3008.000	2973.000
σ		1.356%	0.056	0.291	0.087	0.000	104.300	24.120	35.330
%RSD		1.609	27.910	4.435	1.309	0.000	1.520	0.802	1.188

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	125.800	1322.000	0.000	372.000	15670.000	15530.000	81.367%	0.079
2	14:45:49	122.100	1284.000	0.000	368.900	15280.000	15040.000	82.890%	0.112
3	14:46:32	123.700	1298.000	0.000	353.500	15590.000	15120.000	84.151%	0.109
x		123.900	1301.000	0.000	364.800	15510.000	15230.000	82.803%	0.100
σ		1.863	19.120	0.000	9.925	205.800	259.000	1.394%	0.019
%RSD		1.504	1.469	0.000	2.720	1.327	1.701	1.684	18.540

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	-0.151	-1.065	1.724	5.852	67.010	0.259	1.781	0.129
2	14:45:49	-0.143	-1.067	1.652	4.843	61.970	0.264	1.945	0.130
3	14:46:32	-0.151	-1.070	1.656	5.822	63.280	0.248	1.822	0.150
x		-0.148	-1.067	1.677	5.506	64.090	0.257	1.849	0.136
σ		0.005	0.003	0.040	0.574	2.615	0.008	0.086	0.012
%RSD		3.249	0.239	2.406	10.430	4.081	3.252	4.626	8.555

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	0.207	12.160	11.610	0.392	-0.294	0.193	0.000	382.400
2	14:45:49	0.186	11.930	11.350	0.235	-0.279	-0.508	0.000	367.900
3	14:46:32	0.197	11.370	10.770	0.234	-0.358	-0.220	0.000	369.900
x		0.197	11.820	11.250	0.287	-0.311	-0.178	0.000	373.400
σ		0.011	0.406	0.429	0.091	0.042	0.352	0.000	7.852
%RSD		5.537	3.438	3.819	31.570	13.500	197.400	0.000	2.103

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	83.176%	0.258	0.289	84.496%	-0.100	-0.095	-0.026	-0.020
2	14:45:49	85.693%	0.276	0.260	86.177%	-0.097	-0.098	-0.043	-0.024
3	14:46:32	86.560%	0.253	0.316	86.982%	-0.104	-0.088	-0.085	-0.068
x		85.143%	0.263	0.288	85.885%	-0.100	-0.094	-0.052	-0.037
σ		1.758%	0.012	0.028	1.268%	0.003	0.005	0.030	0.026
%RSD		2.065	4.605	9.856	1.476	3.202	5.403	58.930	70.740

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	85.286%	0.007	1.674	1.684	289.600	289.200	89.773%	90.997%
2	14:45:49	88.126%	0.058	1.550	1.575	276.800	280.100	93.100%	93.367%
3	14:46:32	88.686%	0.077	1.628	1.628	280.700	283.300	94.375%	95.295%
x		87.366%	0.047	1.617	1.629	282.400	284.200	92.416%	93.220%
σ		1.823%	0.036	0.063	0.054	6.532	4.632	2.376%	2.153%
%RSD		2.086	76.210	3.886	3.336	2.313	1.630	2.571	2.310

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:45:06	0.007	0.005	0.018	0.022	0.021	88.694%
2	14:45:49	0.006	0.008	0.024	0.025	0.021	93.473%
3	14:46:32	0.009	0.011	0.025	0.020	0.020	94.615%
x		0.007	0.008	0.022	0.022	0.021	92.261%
σ		0.001	0.003	0.004	0.002	0.001	3.141%
%RSD		19.780	38.370	16.230	11.320	2.394	3.405

180-27105-B-4 11/14/2013 2:49:10 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	85.547%	-0.211	18.220	17.740	0.000	11940.000	3329.000	3246.000
2	14:50:35	83.396%	-0.247	17.340	17.220	0.000	11930.000	3316.000	3129.000
3	14:51:18	82.025%	-0.252	18.140	17.570	0.000	11990.000	3364.000	3283.000
x		83.656%	-0.236	17.900	17.510	0.000	11950.000	3337.000	3219.000
σ		1.775%	0.023	0.487	0.264	0.000	32.730	24.940	80.440
%RSD		2.122	9.567	2.720	1.508	0.000	0.274	0.748	2.499

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	24.420	463.000	0.000	617.500	9945.000	9298.000	82.034%	0.209
2	14:50:35	25.980	453.700	0.000	609.700	9494.000	9237.000	81.739%	0.078
3	14:51:18	24.290	457.200	0.000	617.500	9842.000	9167.000	80.640%	0.214
x		24.900	458.000	0.000	614.900	9760.000	9234.000	81.471%	0.167
σ		0.943	4.676	0.000	4.476	236.300	65.460	0.735%	0.077
%RSD		3.787	1.021	0.000	0.728	2.421	0.709	0.902	46.220

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	6.644	-0.799	0.511	-1.599	38.900	0.034	0.490	1.324
2	14:50:35	6.876	-0.819	0.525	-2.266	38.050	0.041	0.470	1.368
3	14:51:18	6.905	-0.833	0.518	-2.213	36.920	0.040	0.485	1.265
x		6.808	-0.817	0.518	-2.026	37.960	0.038	0.482	1.319
σ		0.143	0.017	0.007	0.371	0.992	0.004	0.011	0.052
%RSD		2.101	2.071	1.362	18.290	2.614	10.400	2.213	3.938

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	1.262	7.103	6.952	0.057	-0.161	-0.122	0.000	49.310
2	14:50:35	1.360	7.080	7.050	0.116	-0.166	0.069	0.000	49.070
3	14:51:18	1.330	7.215	7.232	-0.004	-0.178	-0.344	0.000	48.710
x		1.317	7.133	7.078	0.056	-0.168	-0.133	0.000	49.030
σ		0.050	0.072	0.142	0.060	0.008	0.207	0.000	0.302
%RSD		3.821	1.015	2.005	106.700	5.000	155.700	0.000	0.617

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	83.233%	0.346	0.385	84.289%	-0.096	-0.095	-0.087	-0.054
2	14:50:35	84.208%	0.349	0.384	84.659%	-0.096	-0.097	-0.047	-0.034
3	14:51:18	83.683%	0.395	0.412	84.339%	-0.091	-0.090	-0.046	-0.032
x		83.708%	0.363	0.394	84.429%	-0.094	-0.094	-0.060	-0.040
σ		0.488%	0.027	0.016	0.201%	0.003	0.004	0.024	0.013
%RSD		0.583	7.510	4.007	0.238	2.955	3.942	39.690	31.230

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	85.876%	0.123	0.013	0.015	10.260	10.310	89.996%	90.454%
2	14:50:35	86.750%	0.179	0.001	-0.004	9.974	10.230	91.582%	92.705%
3	14:51:18	86.995%	0.176	0.018	-0.002	10.200	10.020	90.859%	91.727%
x		86.541%	0.159	0.011	0.003	10.140	10.190	90.812%	91.629%
σ		0.588%	0.032	0.009	0.010	0.150	0.148	0.794%	1.129%
%RSD		0.680	19.890	82.970	369.600	1.478	1.453	0.874	1.232

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:49:52	0.001	0.002	0.026	0.026	0.029	89.294%
2	14:50:35	-0.001	0.001	0.038	0.041	0.035	92.503%
3	14:51:18	0.001	-0.001	0.042	0.030	0.035	91.800%
x		0.000	0.001	0.035	0.032	0.033	91.199%
σ		0.001	0.001	0.008	0.008	0.003	1.687%
%RSD		1497.000	200.300	23.160	23.760	9.222	1.850

180-27105-B-5 11/14/2013 2:53:57 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	84.430%	-0.180	1.886	1.661	0.000	5872.000	1011.000	1011.000
2	14:55:23	86.151%	-0.252	1.759	1.322	0.000	5723.000	976.500	959.900
3	14:56:05	84.132%	-0.278	1.399	1.478	0.000	5757.000	1003.000	999.900
x		84.904%	-0.237	1.681	1.487	0.000	5784.000	996.600	990.200
σ		1.090%	0.050	0.253	0.170	0.000	78.070	17.880	26.790
%RSD		1.284	21.280	15.020	11.420	0.000	1.350	1.794	2.706

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	0.866	9.935	0.000	1.397	2776.000	2656.000	82.016%	-0.023
2	14:55:23	0.840	9.570	0.000	0.719	2702.000	2659.000	81.923%	-0.033
3	14:56:05	0.816	10.220	0.000	0.664	2787.000	2629.000	81.564%	-0.022
x		0.840	9.907	0.000	0.926	2755.000	2648.000	81.835%	-0.026
σ		0.025	0.325	0.000	0.408	45.980	16.360	0.239%	0.006
%RSD		2.995	3.281	0.000	44.080	1.669	0.618	0.292	23.620

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	-0.140	-0.445	0.489	-3.966	11.330	0.010	0.026	0.262
2	14:55:23	-0.131	-0.432	0.477	-4.850	11.310	0.007	0.028	0.297
3	14:56:05	-0.139	-0.466	0.463	-4.198	10.820	0.009	0.049	0.331
x		-0.136	-0.448	0.476	-4.338	11.150	0.009	0.034	0.297
σ		0.005	0.017	0.013	0.458	0.288	0.001	0.013	0.034
%RSD		3.604	3.864	2.788	10.570	2.580	13.200	38.140	11.540

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	0.232	10.110	10.230	-0.119	-0.247	-0.382	0.000	0.832
2	14:55:23	0.284	9.799	10.130	-0.101	-0.244	-0.437	0.000	0.783
3	14:56:05	0.251	9.964	10.110	-0.067	-0.300	-0.231	0.000	0.778
x		0.256	9.956	10.160	-0.096	-0.264	-0.350	0.000	0.797
σ		0.027	0.153	0.065	0.027	0.032	0.107	0.000	0.030
%RSD		10.400	1.538	0.642	27.930	12.040	30.450	0.000	3.708

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	81.909%	-0.009	-0.026	83.538%	-0.103	-0.091	-0.030	-0.025
2	14:55:23	83.127%	-0.017	-0.016	84.857%	-0.097	-0.095	-0.001	-0.002
3	14:56:05	84.086%	-0.029	-0.015	85.046%	-0.097	-0.097	-0.015	-0.018
x		83.041%	-0.018	-0.019	84.480%	-0.099	-0.094	-0.016	-0.015
σ		1.091%	0.010	0.006	0.821%	0.004	0.003	0.014	0.012
%RSD		1.314	55.020	31.400	0.972	3.632	3.067	91.660	77.860

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	85.078%	-0.197	-0.031	-0.034	0.485	0.452	88.480%	88.923%
2	14:55:23	85.589%	-0.184	-0.026	-0.034	0.479	0.443	90.850%	91.335%
3	14:56:05	87.035%	-0.170	-0.032	-0.028	0.491	0.423	92.354%	93.110%
x		85.900%	-0.184	-0.030	-0.032	0.485	0.439	90.561%	91.123%
σ		1.015%	0.013	0.003	0.003	0.006	0.015	1.953%	2.101%
%RSD		1.182	7.274	10.330	10.510	1.257	3.374	2.157	2.306

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:54:40	0.001	0.001	0.031	0.034	0.030	89.103%
2	14:55:23	0.002	0.001	0.035	0.026	0.028	91.947%
3	14:56:05	0.002	0.003	0.035	0.033	0.032	94.017%
x		0.002	0.002	0.033	0.031	0.030	91.689%
σ		0.001	0.001	0.002	0.004	0.002	2.467%
%RSD		40.860	75.510	7.254	13.370	6.760	2.691

180-27105-B-5 SD@5 11/14/2013 2:58:44 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	87.110%	-0.225	-0.202	0.181	0.000	1145.000	195.100	193.100
2	15:00:10	85.568%	-0.266	0.047	0.537	0.000	1156.000	199.300	198.200
3	15:00:53	84.845%	-0.236	0.276	0.203	0.000	1132.000	194.600	195.700
x		85.841%	-0.242	0.040	0.307	0.000	1144.000	196.300	195.700
σ		1.157%	0.021	0.239	0.199	0.000	12.070	2.577	2.507
%RSD		1.347	8.768	592.200	64.930	0.000	1.055	1.313	1.281

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	0.543	1.693	0.000	-1.000	553.700	511.900	82.210%	0.030
2	15:00:10	0.546	2.072	0.000	-1.416	585.100	525.500	81.910%	0.014
3	15:00:53	0.484	1.871	0.000	-1.748	507.100	531.800	82.003%	-0.028
x		0.524	1.879	0.000	-1.388	548.600	523.100	82.041%	0.005
σ		0.035	0.190	0.000	0.375	39.280	10.160	0.153%	0.030
%RSD		6.657	10.110	0.000	27.030	7.160	1.942	0.187	553.300

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	-0.041	-0.124	0.090	-3.707	3.433	0.002	0.010	0.077
2	15:00:10	-0.035	-0.126	0.082	-5.219	2.575	0.002	0.015	0.057
3	15:00:53	-0.035	-0.127	0.112	-5.310	2.871	0.001	0.001	0.054
x		-0.037	-0.126	0.095	-4.746	2.960	0.002	0.009	0.063
σ		0.003	0.002	0.016	0.900	0.436	0.001	0.007	0.013
%RSD		8.598	1.495	16.440	18.970	14.730	38.020	83.460	20.260

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	0.070	2.127	1.762	-0.065	-0.288	-0.111	0.000	0.164
2	15:00:10	0.059	1.946	1.949	-0.051	-0.240	-0.183	0.000	0.161
3	15:00:53	0.079	1.923	2.121	-0.061	-0.329	-0.222	0.000	0.165
x		0.069	1.999	1.944	-0.059	-0.286	-0.172	0.000	0.163
σ		0.010	0.112	0.180	0.007	0.044	0.056	0.000	0.003
%RSD		14.250	5.595	9.250	12.710	15.450	32.650	0.000	1.546

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	83.648%	0.005	-0.016	84.865%	-0.099	-0.097	0.013	0.003
2	15:00:10	83.731%	-0.010	0.002	85.294%	-0.102	-0.098	-0.014	-0.012
3	15:00:53	83.616%	-0.036	-0.024	84.493%	-0.098	-0.095	-0.046	-0.036
x		83.665%	-0.014	-0.013	84.884%	-0.100	-0.097	-0.015	-0.015
σ		0.060%	0.021	0.014	0.401%	0.002	0.002	0.030	0.019
%RSD		0.071	153.900	108.700	0.472	2.119	1.847	191.500	130.900

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	85.556%	-0.005	0.007	-0.011	0.089	0.089	90.735%	91.232%
2	15:00:10	86.488%	-0.044	0.001	-0.014	0.091	0.086	91.332%	91.663%
3	15:00:53	86.428%	-0.041	-0.007	-0.004	0.102	0.066	91.738%	91.905%
x		86.157%	-0.030	0.000	-0.010	0.094	0.080	91.268%	91.600%
σ		0.521%	0.021	0.007	0.005	0.007	0.012	0.505%	0.341%
%RSD		0.605	71.390	1469.000	54.320	7.767	15.170	0.553	0.372

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	14:59:27	0.022	0.026	0.006	0.013	0.007	97.357%
2	15:00:10	0.018	0.015	0.008	0.009	0.006	95.405%
3	15:00:53	0.011	0.011	0.010	0.008	0.009	95.188%
x		0.017	0.017	0.008	0.010	0.007	95.983%
σ		0.006	0.008	0.002	0.002	0.001	1.195%
%RSD		32.750	45.540	26.250	21.920	15.180	1.245

180-26887-I-3-A @50 11/14/2013 3:03:31 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	86.467%	-0.216	7.239	7.644	0.000	196200.000	7103.000	6972.000
2	15:04:57	84.849%	-0.214	7.245	7.351	0.000	191800.000	7018.000	7007.000
3	15:05:40	86.783%	-0.211	7.072	7.184	0.000	192800.000	6982.000	6945.000
x		86.033%	-0.214	7.185	7.393	0.000	193600.000	7034.000	6975.000
σ		1.038%	0.002	0.098	0.233	0.000	2263.000	61.960	31.150
%RSD		1.206	1.022	1.365	3.152	0.000	1.169	0.881	0.447
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	1.918	62.580	0.000	1123.000	27620.000	27650.000	85.081%	0.082
2	15:04:57	1.999	63.800	0.000	1115.000	27570.000	27540.000	84.506%	0.093
3	15:05:40	1.941	62.410	0.000	1110.000	27810.000	27580.000	84.714%	0.149
x		1.953	62.930	0.000	1116.000	27670.000	27590.000	84.767%	0.108
σ		0.042	0.755	0.000	6.431	128.300	59.250	0.291%	0.036
%RSD		2.153	1.200	0.000	0.576	0.464	0.215	0.343	32.990
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	-0.026	-0.051	3.036	1.986	118.000	0.042	-0.097	0.691
2	15:04:57	-0.033	-0.051	3.087	2.048	114.800	0.040	-0.083	0.686
3	15:05:40	-0.008	-0.045	3.041	2.196	115.600	0.033	-0.095	0.729
x		-0.022	-0.049	3.055	2.076	116.100	0.038	-0.092	0.702
σ		0.013	0.004	0.028	0.108	1.630	0.004	0.008	0.024
%RSD		56.730	7.726	0.925	5.198	1.404	11.260	8.644	3.366
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	0.357	1.167	-0.759	1.135	-0.203	4.800	0.000	1542.000
2	15:04:57	0.347	1.245	-1.446	1.010	-0.261	4.266	0.000	1531.000
3	15:05:40	0.389	0.972	-1.095	0.991	-0.263	4.036	0.000	1525.000
x		0.364	1.128	-1.100	1.045	-0.242	4.367	0.000	1532.000
σ		0.022	0.141	0.344	0.078	0.034	0.392	0.000	8.393
%RSD		6.127	12.470	31.250	7.470	14.120	8.976	0.000	0.548
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	81.857%	0.003	-0.017	78.848%	-0.106	-0.098	0.009	0.007
2	15:04:57	83.471%	0.008	-0.013	81.226%	-0.089	-0.093	0.015	0.009
3	15:05:40	85.407%	0.007	-0.010	82.431%	-0.097	-0.093	0.030	0.016
x		83.579%	0.006	-0.013	80.835%	-0.097	-0.095	0.018	0.011
σ		1.778%	0.002	0.003	1.823%	0.008	0.003	0.011	0.005
%RSD		2.127	41.600	24.940	2.255	8.536	3.056	58.470	46.390
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:04:14	81.297%	0.052	-0.009	-0.020	1586.000	1770.000	85.366%	86.931%
2	15:04:57	83.554%	0.020	0.007	-0.006	1138.000	1754.000	89.260%	89.692%
3	15:05:40	84.879%	-0.008	0.004	-0.013	1297.000	1755.000	90.012%	90.948%
x		83.243%	0.021	0.000	-0.013	1340.000	1760.000	88.213%	89.190%
σ		1.811%	0.030	0.008	0.007	227.200	9.196	2.494%	2.055%
%RSD		2.176	142.300	1887.000	53.440	16.950	0.523	2.827	2.304
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:04:14	0.024	0.027	0.066	0.064	0.063	82.997%		
2	15:04:57	0.011	0.014	0.067	0.074	0.065	83.135%		
3	15:05:40	0.001	0.003	0.061	0.061	0.062	84.113%		
x		0.012	0.015	0.065	0.067	0.063	83.415%		
σ		0.011	0.012	0.003	0.007	0.001	0.608%		
%RSD		96.270	80.480	4.833	10.140	2.347	0.729		

180-26887-H-3-A @50 11/14/2013 3:08:20 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	85.461%	-0.203	6.907	7.492	0.000	198500.000	7172.000	7029.000
2	15:09:46	82.355%	-0.204	6.796	7.534	0.000	200500.000	7250.000	7201.000
3	15:10:29	84.068%	-0.242	7.659	7.571	0.000	199900.000	7278.000	7332.000
x		83.961%	-0.216	7.121	7.532	0.000	199600.000	7233.000	7187.000
σ		1.556%	0.022	0.469	0.040	0.000	1006.000	54.940	151.900
%RSD		1.853	10.380	6.594	0.525	0.000	0.504	0.759	2.114
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	1.431	67.520	0.000	1144.000	28370.000	27800.000	84.765%	0.047
2	15:09:46	1.385	70.140	0.000	1145.000	28460.000	28190.000	86.414%	0.064
3	15:10:29	1.351	71.640	0.000	1161.000	29100.000	28610.000	86.140%	1.954
x		1.389	69.770	0.000	1150.000	28650.000	28200.000	85.773%	0.689
σ		0.040	2.085	0.000	9.806	400.800	407.500	0.884%	1.096
%RSD		2.907	2.989	0.000	0.853	1.399	1.445	1.030	159.200
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	-0.032	-0.019	3.911	42.060	153.000	0.038	-0.109	0.758
2	15:09:46	-0.017	-0.048	3.869	39.810	153.100	0.035	-0.107	0.681
3	15:10:29	-0.025	-0.027	3.944	42.530	149.900	0.032	-0.111	0.800
x		-0.025	-0.032	3.908	41.460	152.000	0.035	-0.109	0.746
σ		0.008	0.015	0.038	1.454	1.836	0.003	0.002	0.061
%RSD		30.720	48.180	0.961	3.507	1.208	8.705	1.878	8.112
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	0.362	0.996	0.581	1.029	-0.151	4.280	0.000	1541.000
2	15:09:46	0.326	1.031	-1.485	1.179	0.054	4.818	0.000	1552.000
3	15:10:29	0.367	1.037	-0.773	1.199	-0.058	4.804	0.000	1578.000
x		0.351	1.021	-0.559	1.135	-0.051	4.634	0.000	1557.000
σ		0.022	0.022	1.050	0.093	0.103	0.307	0.000	19.010
%RSD		6.376	2.178	187.800	8.202	199.700	6.625	0.000	1.221
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	84.584%	-0.029	-0.038	81.243%	-0.099	-0.104	0.023	0.018
2	15:09:46	86.241%	-0.010	-0.036	82.970%	-0.097	-0.098	-0.028	-0.019
3	15:10:29	86.197%	-0.022	-0.043	83.004%	-0.097	-0.103	0.020	0.014
x		85.674%	-0.020	-0.039	82.406%	-0.098	-0.102	0.005	0.004
σ		0.944%	0.009	0.004	1.007%	0.001	0.003	0.029	0.021
%RSD		1.102	45.110	9.221	1.222	1.492	3.219	586.500	465.400
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:09:03	84.065%	-0.062	-0.023	-0.027	1545.000	1775.000	89.611%	89.814%
2	15:09:46	86.130%	-0.060	-0.020	-0.018	1373.000	1783.000	91.960%	92.523%
3	15:10:29	85.937%	-0.049	-0.015	-0.014	1370.000	1825.000	92.460%	93.124%
x		85.377%	-0.057	-0.019	-0.020	1429.000	1794.000	91.344%	91.820%
σ		1.140%	0.007	0.004	0.006	100.200	26.870	1.521%	1.763%
%RSD		1.336	12.870	20.290	32.770	7.015	1.497	1.665	1.921
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:09:03	-0.002	0.000	0.070	0.063	0.065	85.187%		
2	15:09:46	-0.000	-0.001	0.064	0.055	0.062	86.474%		
3	15:10:29	-0.002	-0.002	0.064	0.064	0.064	85.834%		
x		-0.001	-0.001	0.066	0.061	0.064	85.831%		
σ		0.001	0.001	0.003	0.005	0.002	0.644%		
%RSD		74.320	118.800	4.976	8.022	2.811	0.750		

180-26700-A-1-H @10 11/14/2013 3:13:09 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	89.450%	1.406	19.070	18.720	0.000	225.800	14000.000	13910.000
2	15:14:34	86.633%	1.479	18.780	18.450	0.000	223.400	14070.000	13970.000
3	15:15:18	87.458%	1.459	17.670	18.070	0.000	210.200	13540.000	13530.000
x		87.847%	1.448	18.510	18.410	0.000	219.800	13870.000	13800.000
σ		1.448%	0.037	0.738	0.327	0.000	8.425	289.500	240.600
%RSD		1.649	2.587	3.987	1.775	0.000	3.833	2.087	1.743

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	12210.000	608.500	0.000	731.000	60480.000	59480.000	85.972%	288.900
2	15:14:34	12260.000	598.600	0.000	712.800	60030.000	59330.000	85.328%	287.600
3	15:15:18	11740.000	575.700	0.000	679.200	57130.000	57320.000	85.968%	281.100
x		12070.000	594.300	0.000	707.700	59210.000	58710.000	85.756%	285.900
σ		285.100	16.820	0.000	26.270	1817.000	1203.000	0.371%	4.169
%RSD		2.362	2.830	0.000	3.712	3.069	2.049	0.433	1.458

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	47.740	88.600	4949.000	30570.000	30160.000	3.816	9.473	21.000
2	15:14:34	47.210	88.910	4985.000	30840.000	30590.000	3.911	9.597	20.930
3	15:15:18	46.040	86.330	4762.000	29650.000	29140.000	3.682	8.973	20.190
x		46.990	87.950	4899.000	30350.000	29960.000	3.803	9.348	20.700
σ		0.868	1.406	120.100	621.100	745.600	0.115	0.330	0.452
%RSD		1.847	1.599	2.452	2.046	2.489	3.022	3.532	2.183

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	21.210	230.200	230.000	4.958	0.183	0.039	0.000	75.890
2	15:14:34	20.890	229.800	230.900	5.070	0.220	0.140	0.000	75.940
3	15:15:18	20.320	220.100	222.500	4.892	0.221	0.423	0.000	72.890
x		20.810	226.700	227.800	4.973	0.208	0.201	0.000	74.910
σ		0.448	5.708	4.616	0.090	0.022	0.199	0.000	1.743
%RSD		2.154	2.518	2.027	1.808	10.540	99.150	0.000	2.327

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	94.062%	0.907	0.968	84.608%	-0.015	-0.031	1.054	1.004
2	15:14:34	95.503%	0.953	0.982	86.219%	-0.014	-0.039	1.008	0.893
3	15:15:18	97.608%	0.844	0.915	88.074%	-0.012	-0.028	0.956	0.894
x		95.724%	0.901	0.955	86.300%	-0.014	-0.033	1.006	0.930
σ		1.783%	0.055	0.035	1.735%	0.002	0.006	0.049	0.064
%RSD		1.863	6.105	3.711	2.010	12.130	18.160	4.894	6.893

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	86.056%	15.670	0.249	0.247	120.800	121.400	91.279%	91.306%
2	15:14:34	88.915%	15.690	0.248	0.274	121.200	121.100	93.722%	94.607%
3	15:15:18	91.078%	14.950	0.245	0.243	115.600	115.100	96.450%	97.430%
x		88.683%	15.440	0.248	0.254	119.200	119.200	93.817%	94.447%
σ		2.519%	0.418	0.002	0.017	3.121	3.527	2.587%	3.065%
%RSD		2.840	2.706	0.778	6.631	2.618	2.959	2.757	3.245

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	15:13:51	0.071	0.075	73.990	73.710	73.370	89.976%
2	15:14:34	0.070	0.066	74.920	74.230	74.420	91.549%
3	15:15:18	0.062	0.063	70.950	71.010	70.730	95.481%
x		0.068	0.068	73.290	72.980	72.840	92.336%
σ		0.005	0.006	2.077	1.729	1.903	2.836%
%RSD		7.242	9.348	2.834	2.370	2.612	3.071

180-26700-A-2-F @10 11/14/2013 3:17:56 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	94.469%	0.025	0.282	0.535	0.000	33.850	633.600	635.900
2	15:19:22	92.619%	0.029	0.152	0.221	0.000	35.840	652.800	651.300
3	15:20:05	91.539%	-0.008	0.330	0.281	0.000	35.010	649.200	644.400
x		92.876%	0.015	0.255	0.345	0.000	34.900	645.200	643.900
σ		1.482%	0.021	0.092	0.167	0.000	0.998	10.170	7.711
%RSD		1.595	133.200	36.190	48.240	0.000	2.860	1.577	1.198
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	2661.000	236.600	0.000	391.900	832.300	758.100	92.823%	28.850
2	15:19:22	2660.000	243.100	0.000	366.000	838.000	781.100	92.204%	29.920
3	15:20:05	2659.000	244.200	0.000	346.500	806.000	764.000	93.452%	28.830
x		2660.000	241.300	0.000	368.100	825.400	767.700	92.826%	29.200
σ		1.077	4.094	0.000	22.760	17.080	11.930	0.624%	0.625
%RSD		0.040	1.697	0.000	6.183	2.069	1.554	0.672	2.139
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	5.939	4.979	4609.000	13910.000	13520.000	3.372	13.270	8.988
2	15:19:22	5.781	5.024	4646.000	13900.000	13580.000	3.370	12.970	9.180
3	15:20:05	5.922	5.014	4567.000	13780.000	13470.000	3.298	12.920	8.915
x		5.880	5.006	4607.000	13860.000	13520.000	3.347	13.060	9.027
σ		0.087	0.024	39.570	68.900	52.830	0.042	0.190	0.137
%RSD		1.475	0.474	0.859	0.497	0.391	1.255	1.455	1.517
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	9.080	26.610	25.960	4.240	0.049	-0.015	0.000	4.628
2	15:19:22	9.077	26.950	27.360	4.301	-0.001	0.122	0.000	4.603
3	15:20:05	9.026	26.110	26.290	4.099	0.076	-0.218	0.000	4.637
x		9.061	26.560	26.540	4.213	0.041	-0.037	0.000	4.623
σ		0.030	0.421	0.737	0.103	0.039	0.171	0.000	0.018
%RSD		0.336	1.587	2.778	2.457	93.850	464.400	0.000	0.381
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	99.646%	0.347	0.339	94.810%	-0.093	-0.099	0.213	0.167
2	15:19:22	100.459%	0.364	0.344	96.022%	-0.088	-0.091	0.195	0.161
3	15:20:05	102.556%	0.404	0.361	97.115%	-0.092	-0.092	0.184	0.168
x		100.887%	0.371	0.348	95.982%	-0.091	-0.094	0.197	0.166
σ		1.501%	0.029	0.012	1.153%	0.003	0.004	0.015	0.004
%RSD		1.488	7.809	3.439	1.201	3.005	4.525	7.484	2.214
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:18:39	95.936%	2.411	0.088	0.092	30.660	30.880	100.875%	100.392%
2	15:19:22	96.993%	2.439	0.094	0.101	30.850	31.290	102.288%	102.563%
3	15:20:05	98.575%	2.412	0.088	0.090	30.750	31.010	103.681%	104.234%
x		97.168%	2.421	0.090	0.094	30.760	31.060	102.281%	102.396%
σ		1.328%	0.016	0.003	0.006	0.095	0.209	1.403%	1.926%
%RSD		1.367	0.660	3.835	5.842	0.310	0.675	1.371	1.881
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:18:39	0.042	0.046	6.345	6.222	6.256	99.409%		
2	15:19:22	0.047	0.049	6.501	6.339	6.438	100.631%		
3	15:20:05	0.041	0.049	6.387	6.282	6.327	101.835%		
x		0.043	0.048	6.411	6.281	6.340	100.625%		
σ		0.003	0.002	0.081	0.059	0.092	1.213%		
%RSD		7.285	3.414	1.258	0.938	1.452	1.205		

CCV 993939 11/14/2013 3:22:42 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	88.220%	107.400	96.030	96.430	0.000	51360.000	49860.000	49010.000
2	15:24:08	82.935%	103.500	99.240	97.080	0.000	51630.000	50270.000	49750.000
3	15:24:52	81.356%	107.600	99.580	101.000	0.000	51980.000	51350.000	51330.000
x		84.170%	106.194%	98.282%	98.163%	0.000	103.316%	100.984%	100.054%
σ		3.595%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		4.271	2.177	1.995	2.506	0.000	0.593	1.526	2.369
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	495.100	4950.000	0.000	52420.000	52380.000	51440.000	83.297%	98.280
2	15:24:08	508.100	4963.000	0.000	51190.000	52120.000	51210.000	80.242%	99.420
3	15:24:52	507.200	5138.000	0.000	52430.000	52780.000	52250.000	79.065%	100.500
x		100.693%	100.338%	0.000	104.027%	104.856%	103.265%	80.868%	99.404%
σ		n/a	n/a	0.000	n/a	n/a	n/a	2.185%	n/a
%RSD		1.444	2.101	0.000	1.375	0.635	1.059	2.702	1.125
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	102.200	103.000	511.800	25990.000	25610.000	103.300	104.800	105.200
2	15:24:08	101.300	101.200	517.200	26050.000	26060.000	104.500	104.700	105.100
3	15:24:52	104.600	104.100	524.000	26200.000	25950.000	104.700	103.600	106.600
x		102.690%	102.797%	103.537%	104.321%	103.496%	104.161%	104.388%	105.634%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		1.685	1.414	1.177	0.414	0.919	0.763	0.615	0.831
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	105.600	106.900	107.000	105.600	109.600	109.500	0.000	102.400
2	15:24:08	105.300	107.200	105.900	105.800	109.400	108.000	0.000	103.400
3	15:24:52	106.800	109.200	109.500	107.000	109.900	111.200	0.000	103.400
x		105.897%	107.753%	107.469%	106.111%	109.624%	109.561%	0.000	103.057%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.776	1.154	1.696	0.737	0.204	1.490	0.000	0.561
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	81.865%	100.800	102.000	79.498%	105.400	106.000	105.000	104.700
2	15:24:08	80.096%	102.900	102.800	77.919%	105.300	104.700	105.900	105.200
3	15:24:52	79.303%	104.200	105.600	77.107%	106.800	106.500	107.100	106.300
x		80.421%	102.663%	103.488%	78.174%	105.842%	105.748%	105.981%	105.412%
σ		1.312%	n/a	n/a	1.216%	n/a	n/a	n/a	n/a
%RSD		1.631	1.665	1.803	1.555	0.758	0.858	0.979	0.763
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:23:25	82.489%	98.140	99.420	99.400	100.900	103.100	86.323%	87.403%
2	15:24:08	81.564%	98.790	99.770	99.200	101.700	102.100	86.454%	87.140%
3	15:24:52	80.851%	99.560	101.600	100.900	102.700	102.900	86.699%	87.489%
x		81.635%	98.829%	100.261%	99.844%	101.779%	102.683%	86.492%	87.344%
σ		0.821%	n/a	n/a	n/a	n/a	n/a	0.191%	0.182%
%RSD		1.006	0.716	1.169	0.947	0.907	0.501	0.221	0.208
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:23:25	100.700	101.700	103.400	103.000	103.500	82.318%		
2	15:24:08	101.500	103.100	104.800	104.700	104.800	82.357%		
3	15:24:52	103.800	104.900	107.300	107.700	107.600	81.372%		
x		101.975%	103.263%	105.136%	105.120%	105.325%	82.016%		
σ		n/a	n/a	n/a	n/a	n/a	0.558%		
%RSD		1.571	1.561	1.882	2.255	1.981	0.680		

CCB3 11/14/2013 3:30:53 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	94.850%	-0.317	-0.058	-0.055	0.000	0.885	0.592	0.624
2	15:32:19	93.253%	-0.286	-0.161	-0.202	0.000	0.927	0.672	0.602
3	15:33:02	91.068%	-0.175	-0.112	-0.337	0.000	0.719	0.681	0.440
x		93.057%	-0.259	-0.110	-0.198	0.000	0.844	0.649	0.555
σ		1.899%	0.075	0.051	0.141	0.000	0.110	0.049	0.101
%RSD		2.040	28.810	46.520	71.140	0.000	13.040	7.544	18.130

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	-0.001	-0.950	0.000	0.365	-1.029	-0.186	89.444%	0.016
2	15:32:19	-0.004	-0.942	0.000	-0.043	0.900	-0.344	88.453%	0.027
3	15:33:02	-0.035	-1.280	0.000	-0.762	-1.495	0.245	88.068%	0.003
x		-0.013	-1.057	0.000	-0.147	-0.541	-0.095	88.655%	0.015
σ		0.019	0.193	0.000	0.571	1.270	0.305	0.710%	0.012
%RSD		142.400	18.260	0.000	389.200	234.700	321.600	0.801	78.770

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	0.005	-0.018	0.039	0.493	2.333	0.002	-0.016	-0.011
2	15:32:19	-0.004	-0.025	0.042	-0.117	1.433	0.004	0.007	-0.002
3	15:33:02	-0.006	-0.021	0.035	-1.476	0.739	0.004	-0.011	-0.007
x		-0.001	-0.021	0.039	-0.367	1.501	0.003	-0.007	-0.007
σ		0.006	0.004	0.003	1.008	0.799	0.001	0.012	0.005
%RSD		457.800	18.100	8.834	274.800	53.210	40.660	189.100	71.370

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	-0.029	-0.098	-0.179	-0.037	-0.088	-0.028	0.000	0.002
2	15:32:19	-0.005	-0.096	-0.110	-0.085	-0.141	-0.256	0.000	0.002
3	15:33:02	-0.020	-0.116	-0.144	0.031	-0.189	0.159	0.000	0.003
x		-0.018	-0.103	-0.144	-0.030	-0.140	-0.042	0.000	0.003
σ		0.012	0.011	0.034	0.058	0.051	0.207	0.000	0.001
%RSD		66.690	10.490	23.870	191.000	36.340	496.700	0.000	22.800

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	88.487%	0.040	0.063	89.110%	-0.099	-0.102	0.049	0.035
2	15:32:19	88.769%	0.026	0.034	89.551%	-0.095	-0.100	0.030	0.017
3	15:33:02	88.403%	0.022	0.014	89.128%	-0.088	-0.092	-0.014	-0.012
x		88.553%	0.029	0.037	89.263%	-0.094	-0.098	0.022	0.013
σ		0.192%	0.009	0.025	0.249%	0.006	0.005	0.032	0.024
%RSD		0.216	31.850	67.310	0.279	6.224	5.259	149.000	179.100

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	89.455%	-0.094	-0.026	-0.039	-0.014	-0.011	91.817%	92.264%
2	15:32:19	91.232%	-0.085	-0.022	-0.037	-0.017	-0.005	93.569%	93.746%
3	15:33:02	89.616%	-0.098	-0.030	-0.041	0.003	-0.010	92.992%	93.932%
x		90.101%	-0.093	-0.026	-0.039	-0.009	-0.008	92.792%	93.314%
σ		0.983%	0.007	0.004	0.002	0.011	0.003	0.893%	0.914%
%RSD		1.091	7.029	15.180	5.677	112.500	39.000	0.962	0.980

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	15:31:36	0.019	0.021	0.015	0.009	0.012	94.394%
2	15:32:19	0.023	0.021	0.012	0.012	0.011	95.088%
3	15:33:02	0.022	0.020	0.011	0.015	0.011	93.918%
x		0.021	0.021	0.013	0.012	0.012	94.467%
σ		0.002	0.001	0.002	0.003	0.001	0.589%
%RSD		10.300	4.930	16.990	26.420	6.891	0.623

180-26700-A-4-F @10 11/14/2013 3:35:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	81.919%	8.333	62.890	63.400	0.000	1107.000	55810.000	56120.000
2	15:37:07	80.787%	8.332	63.730	63.940	0.000	1101.000	56430.000	55880.000
3	15:37:49	78.938%	8.241	65.360	65.790	0.000	1115.000	57110.000	56440.000
x		80.548%	8.302	64.000	64.380	0.000	1108.000	56450.000	56150.000
σ		1.505%	0.053	1.256	1.255	0.000	7.084	650.500	282.800
%RSD		1.868	0.635	1.962	1.950	0.000	0.639	1.152	0.504

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	32410.000	253.900	0.000	1826.000	201100.000	200000.000	80.081%	480.200
2	15:37:07	31950.000	248.600	0.000	1821.000	201600.000	203000.000	77.983%	482.200
3	15:37:49	32470.000	254.400	0.000	1825.000	200100.000	202400.000	78.080%	485.700
x		32280.000	252.300	0.000	1824.000	200900.000	201800.000	78.715%	482.700
σ		281.900	3.202	0.000	2.283	721.400	1569.000	1.184%	2.777
%RSD		0.873	1.269	0.000	0.125	0.359	0.778	1.504	0.575

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	3.158	17.110	1995.000	34300.000	34440.000	1.603	1.856	2.369
2	15:37:07	3.193	17.540	2033.000	35170.000	35000.000	1.601	1.817	2.414
3	15:37:49	3.045	17.210	2027.000	34780.000	34970.000	1.615	1.908	2.488
x		3.132	17.290	2018.000	34750.000	34800.000	1.606	1.861	2.424
σ		0.077	0.225	20.380	431.600	312.100	0.008	0.046	0.060
%RSD		2.474	1.298	1.010	1.242	0.897	0.468	2.447	2.485

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	2.720	2.875	2.616	0.065	1.418	0.861	0.000	232.200
2	15:37:07	2.773	2.867	2.540	0.202	1.201	0.791	0.000	235.900
3	15:37:49	2.795	2.940	2.064	0.232	1.272	1.245	0.000	234.300
x		2.763	2.894	2.407	0.166	1.297	0.966	0.000	234.100
σ		0.039	0.040	0.299	0.089	0.111	0.244	0.000	1.833
%RSD		1.395	1.394	12.440	53.510	8.559	25.290	0.000	0.783

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	106.498%	1.156	1.190	78.852%	-0.062	-0.097	0.440	0.293
2	15:37:07	106.068%	1.117	1.215	78.072%	-0.031	-0.100	0.465	0.290
3	15:37:49	105.837%	1.073	1.219	77.675%	-0.024	-0.091	0.338	0.223
x		106.135%	1.115	1.208	78.200%	-0.039	-0.096	0.414	0.269
σ		0.335%	0.042	0.016	0.599%	0.020	0.004	0.067	0.039
%RSD		0.316	3.731	1.283	0.766	52.000	4.623	16.270	14.590

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	82.914%	2.164	-0.023	-0.020	352.200	352.300	88.885%	89.862%
2	15:37:07	82.605%	2.152	-0.023	-0.026	358.500	359.500	89.392%	91.327%
3	15:37:49	82.241%	2.167	-0.013	-0.028	358.700	357.900	89.898%	91.385%
x		82.587%	2.161	-0.020	-0.025	356.500	356.600	89.392%	90.858%
σ		0.337%	0.008	0.006	0.004	3.720	3.777	0.506%	0.863%
%RSD		0.407	0.363	28.900	16.550	1.044	1.059	0.567	0.950

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	15:36:24	0.026	0.029	0.401	0.414	0.403	86.128%
2	15:37:07	0.006	0.007	0.434	0.418	0.422	85.853%
3	15:37:49	0.004	0.003	0.438	0.398	0.416	84.469%
x		0.012	0.013	0.424	0.410	0.414	85.483%
σ		0.013	0.014	0.021	0.011	0.010	0.889%
%RSD		105.800	111.300	4.841	2.641	2.388	1.040

180-26700-A-5-F @10 11/14/2013 3:40:27 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	82.528%	6.248	63.760	64.800	0.000	732.900	48380.000	47760.000
2	15:41:52	78.032%	6.396	62.910	63.400	0.000	736.200	49230.000	48600.000
3	15:42:35	77.724%	6.333	64.650	64.010	0.000	739.200	48700.000	48740.000
x		79.428%	6.326	63.780	64.070	0.000	736.100	48770.000	48370.000
σ		2.689%	0.075	0.871	0.705	0.000	3.168	433.600	529.300
%RSD		3.386	1.178	1.365	1.100	0.000	0.430	0.889	1.094

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	24560.000	348.500	0.000	1140.000	146800.000	146500.000	80.540%	467.200
2	15:41:52	25260.000	361.200	0.000	1138.000	147000.000	146700.000	78.731%	469.200
3	15:42:35	25420.000	353.800	0.000	1125.000	147800.000	149800.000	77.482%	468.100
x		25080.000	354.500	0.000	1134.000	147200.000	147700.000	78.918%	468.200
σ		458.100	6.358	0.000	8.218	533.400	1843.000	1.538%	0.992
%RSD		1.827	1.794	0.000	0.725	0.362	1.248	1.949	0.212

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	24.130	42.060	3473.000	46760.000	46440.000	1.701	3.530	3.707
2	15:41:52	23.790	42.330	3469.000	46440.000	46190.000	1.699	3.396	3.653
3	15:42:35	24.900	43.900	3586.000	47900.000	47730.000	1.683	3.408	3.801
x		24.270	42.760	3509.000	47040.000	46790.000	1.694	3.444	3.720
σ		0.568	0.993	66.210	768.800	825.700	0.010	0.074	0.075
%RSD		2.338	2.322	1.887	1.634	1.765	0.588	2.152	2.021

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	4.188	9.151	8.576	0.415	0.546	0.377	0.000	169.200
2	15:41:52	3.883	9.017	8.454	0.561	0.350	0.426	0.000	168.400
3	15:42:35	4.020	9.126	8.657	0.346	0.629	0.292	0.000	172.100
x		4.030	9.098	8.563	0.441	0.508	0.365	0.000	169.900
σ		0.153	0.071	0.102	0.110	0.143	0.068	0.000	1.951
%RSD		3.784	0.781	1.192	24.950	28.210	18.500	0.000	1.148

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	100.093%	0.312	0.315	79.417%	-0.037	-0.088	0.501	0.318
2	15:41:52	100.761%	0.290	0.341	79.175%	-0.036	-0.090	0.446	0.290
3	15:42:35	99.470%	0.346	0.336	78.335%	-0.036	-0.084	0.389	0.245
x		100.108%	0.316	0.331	78.976%	-0.036	-0.087	0.445	0.284
σ		0.646%	0.028	0.014	0.568%	0.000	0.003	0.056	0.037
%RSD		0.645	8.844	4.222	0.719	1.043	3.227	12.660	13.020

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	82.484%	2.288	-0.019	-0.031	243.100	244.000	89.052%	90.217%
2	15:41:52	82.708%	2.337	-0.016	-0.018	245.300	244.100	90.751%	91.644%
3	15:42:35	82.069%	2.414	-0.018	-0.027	248.000	249.600	90.568%	92.363%
x		82.420%	2.346	-0.018	-0.025	245.500	245.900	90.123%	91.408%
σ		0.324%	0.063	0.002	0.007	2.419	3.198	0.932%	1.092%
%RSD		0.393	2.699	8.655	25.810	0.986	1.301	1.035	1.195

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	15:41:09	-0.001	0.000	1.253	1.201	1.239	85.279%
2	15:41:52	-0.001	0.001	1.284	1.235	1.263	86.401%
3	15:42:35	0.003	0.002	1.325	1.274	1.290	86.513%
x		0.000	0.001	1.287	1.237	1.264	86.065%
σ		0.002	0.001	0.036	0.036	0.026	0.682%
%RSD		2219.000	76.810	2.805	2.922	2.038	0.793

180-26700-A-6-F @10 11/14/2013 3:45:12 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	84.120%	2.621	46.910	46.900	0.000	1565.000	29740.000	29890.000
2	15:46:38	79.940%	2.461	47.390	46.970	0.000	1595.000	30520.000	30420.000
3	15:47:21	79.474%	2.504	45.820	45.400	0.000	1496.000	29840.000	29760.000
x		81.178%	2.529	46.710	46.430	0.000	1552.000	30040.000	30020.000
σ		2.558%	0.083	0.807	0.888	0.000	51.020	424.900	354.100
%RSD		3.152	3.276	1.728	1.912	0.000	3.287	1.415	1.179

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	14600.000	462.700	0.000	987.700	116200.000	116300.000	80.081%	573.900
2	15:46:38	14580.000	450.900	0.000	992.300	117300.000	117800.000	77.505%	578.700
3	15:47:21	14360.000	473.600	0.000	1000.000	116500.000	116900.000	76.668%	573.400
x		14510.000	462.400	0.000	993.500	116700.000	117000.000	78.085%	575.300
σ		134.500	11.320	0.000	6.347	588.100	769.400	1.779%	2.914
%RSD		0.927	2.449	0.000	0.639	0.504	0.657	2.278	0.507

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	129.200	321.200	7321.000	54050.000	53770.000	3.247	18.110	64.030
2	15:46:38	130.400	329.600	7462.000	54480.000	54580.000	3.243	18.470	63.660
3	15:47:21	129.100	326.300	7545.000	54980.000	54140.000	3.235	17.940	62.700
x		129.600	325.700	7443.000	54500.000	54160.000	3.242	18.180	63.460
σ		0.702	4.225	112.900	463.000	405.600	0.007	0.271	0.685
%RSD		0.541	1.297	1.517	0.850	0.749	0.202	1.490	1.079

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	63.430	129.300	129.300	3.874	0.899	0.556	0.000	118.500
2	15:46:38	62.970	132.000	129.500	3.746	0.856	0.737	0.000	119.400
3	15:47:21	62.460	129.300	128.300	3.487	0.943	0.867	0.000	118.600
x		62.950	130.200	129.000	3.702	0.899	0.720	0.000	118.900
σ		0.486	1.524	0.628	0.197	0.043	0.157	0.000	0.508
%RSD		0.772	1.170	0.487	5.323	4.806	21.740	0.000	0.428

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	90.625%	3.372	3.539	80.787%	0.012	-0.030	0.970	0.839
2	15:46:38	89.873%	3.523	3.636	80.042%	0.032	-0.033	1.008	0.839
3	15:47:21	89.711%	3.542	3.575	79.615%	0.004	-0.021	0.998	0.850
x		90.070%	3.479	3.583	80.148%	0.016	-0.028	0.992	0.843
σ		0.488%	0.093	0.049	0.593%	0.014	0.006	0.020	0.007
%RSD		0.541	2.682	1.377	0.740	87.820	22.700	1.980	0.786

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	83.852%	9.924	0.415	0.397	177.700	176.700	88.899%	89.840%
2	15:46:38	83.024%	10.100	0.432	0.420	178.800	178.800	90.032%	90.675%
3	15:47:21	83.983%	9.963	0.413	0.380	175.000	175.700	91.111%	92.224%
x		83.620%	9.997	0.420	0.399	177.200	177.100	90.014%	90.913%
σ		0.520%	0.094	0.011	0.020	1.924	1.604	1.106%	1.210%
%RSD		0.622	0.941	2.569	5.037	1.086	0.906	1.228	1.331

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	15:45:55	0.033	0.027	24.990	24.860	24.730	86.388%
2	15:46:38	0.034	0.028	25.390	24.890	25.140	87.042%
3	15:47:21	0.024	0.030	24.920	24.720	24.710	88.718%
x		0.030	0.028	25.100	24.820	24.860	87.382%
σ		0.006	0.001	0.251	0.091	0.243	1.202%
%RSD		18.380	5.162	0.999	0.367	0.977	1.375

180-26700-A-8-F @10 11/14/2013 3:49:59 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	89.882%	1.071	19.320	18.310	0.000	234.100	7345.000	7393.000
2	15:51:25	86.123%	1.131	17.860	19.260	0.000	233.500	7538.000	7506.000
3	15:52:08	85.974%	1.155	17.940	18.180	0.000	240.800	7660.000	7666.000
x		87.326%	1.119	18.380	18.590	0.000	236.100	7514.000	7522.000
σ		2.215%	0.043	0.820	0.590	0.000	4.026	158.800	137.400
%RSD		2.536	3.841	4.461	3.173	0.000	1.705	2.114	1.826
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	9447.000	765.600	0.000	982.800	27900.000	27780.000	86.485%	232.300
2	15:51:25	9525.000	782.300	0.000	981.200	27930.000	28100.000	87.627%	230.700
3	15:52:08	9626.000	762.900	0.000	1008.000	28450.000	28510.000	85.146%	236.300
x		9533.000	770.300	0.000	990.600	28090.000	28130.000	86.419%	233.100
σ		89.600	10.480	0.000	14.830	309.400	363.700	1.242%	2.857
%RSD		0.940	1.361	0.000	1.497	1.101	1.293	1.437	1.226
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	35.960	79.940	1834.000	51470.000	50840.000	7.342	20.090	27.080
2	15:51:25	35.190	79.710	1842.000	51560.000	51590.000	7.396	19.710	26.650
3	15:52:08	36.020	80.710	1901.000	52880.000	52070.000	7.396	20.040	26.800
x		35.720	80.120	1859.000	51970.000	51500.000	7.378	19.950	26.840
σ		0.463	0.527	36.430	788.200	617.600	0.031	0.203	0.221
%RSD		1.296	0.658	1.960	1.517	1.199	0.426	1.019	0.824
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	27.510	480.900	482.200	22.270	0.658	0.936	0.000	45.690
2	15:51:25	27.100	485.600	483.600	22.150	0.916	0.752	0.000	46.590
3	15:52:08	26.880	488.700	489.600	22.260	1.070	0.843	0.000	46.580
x		27.170	485.100	485.100	22.230	0.881	0.844	0.000	46.290
σ		0.320	3.915	3.935	0.066	0.208	0.092	0.000	0.516
%RSD		1.177	0.807	0.811	0.299	23.610	10.870	0.000	1.114
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	93.492%	2.097	2.157	88.450%	0.012	-0.033	0.626	0.317
2	15:51:25	94.671%	2.107	2.207	89.744%	0.008	-0.032	0.506	0.267
3	15:52:08	95.296%	2.108	2.175	90.366%	-0.003	-0.013	0.521	0.246
x		94.486%	2.104	2.180	89.520%	0.005	-0.026	0.551	0.277
σ		0.916%	0.006	0.025	0.978%	0.008	0.011	0.066	0.036
%RSD		0.969	0.291	1.167	1.092	145.600	43.780	11.920	13.030
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:50:42	89.556%	68.250	0.491	0.482	94.060	94.290	94.178%	94.466%
2	15:51:25	91.725%	68.350	0.504	0.498	93.270	94.370	96.778%	98.034%
3	15:52:08	91.837%	69.500	0.502	0.534	94.790	94.420	98.523%	98.668%
x		91.039%	68.700	0.499	0.505	94.040	94.360	96.493%	97.056%
σ		1.286%	0.694	0.007	0.027	0.760	0.065	2.186%	2.265%
%RSD		1.412	1.010	1.381	5.281	0.808	0.069	2.266	2.334
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:50:42	0.700	0.715	144.100	145.100	143.800	92.783%		
2	15:51:25	0.730	0.741	145.400	146.000	144.800	95.640%		
3	15:52:08	0.761	0.741	146.300	147.600	145.900	96.570%		
x		0.730	0.732	145.300	146.300	144.800	94.998%		
σ		0.031	0.015	1.131	1.270	1.085	1.974%		
%RSD		4.202	2.022	0.778	0.869	0.749	2.078		

180-26700-A-7-F @10 11/14/2013 3:54:46 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	76.916%	0.195	51.740	50.690	0.000	216.800	20990.000	21080.000
2	15:56:12	73.909%	0.140	48.940	50.400	0.000	213.900	21350.000	21200.000
3	15:56:55	75.745%	0.147	47.560	49.590	0.000	214.000	21210.000	21040.000
x		75.523%	0.161	49.410	50.230	0.000	214.900	21180.000	21100.000
σ		1.516%	0.030	2.131	0.566	0.000	1.649	180.400	82.550
%RSD		2.007	18.430	4.312	1.128	0.000	0.767	0.852	0.391
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	6228.000	535.900	0.000	144.400	237700.000	237800.000	74.345%	1606.000
2	15:56:12	6100.000	521.800	0.000	140.200	238400.000	240400.000	71.605%	1590.000
3	15:56:55	6109.000	518.900	0.000	138.400	235700.000	238000.000	69.973%	1609.000
x		6146.000	525.500	0.000	141.000	237200.000	238700.000	71.974%	1602.000
σ		71.170	9.100	0.000	3.059	1403.000	1474.000	2.209%	10.430
%RSD		1.158	1.732	0.000	2.170	0.592	0.618	3.069	0.651
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	389.300	1189.000	31240.000	189600.000	192200.000	3.421	20.530	62.580
2	15:56:12	386.800	1203.000	31440.000	191900.000	193500.000	3.424	20.290	63.130
3	15:56:55	383.700	1205.000	32060.000	195000.000	196800.000	3.386	20.510	62.970
x		386.600	1199.000	31580.000	192200.000	194200.000	3.410	20.440	62.890
σ		2.793	8.382	428.900	2687.000	2356.000	0.021	0.135	0.282
%RSD		0.722	0.699	1.358	1.398	1.213	0.622	0.660	0.449
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	63.650	63.170	62.590	2.978	-0.060	-0.138	0.000	164.200
2	15:56:12	63.060	63.700	62.910	3.193	0.004	0.209	0.000	163.700
3	15:56:55	65.080	63.350	64.530	2.698	-0.125	0.010	0.000	163.000
x		63.930	63.410	63.340	2.956	-0.060	0.027	0.000	163.600
σ		1.036	0.269	1.040	0.248	0.064	0.174	0.000	0.553
%RSD		1.621	0.425	1.641	8.387	106.600	649.800	0.000	0.338
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	77.510%	35.520	36.030	73.736%	-0.029	-0.022	0.326	0.251
2	15:56:12	77.501%	36.650	36.280	73.045%	-0.021	-0.013	0.408	0.241
3	15:56:55	76.655%	35.840	36.730	72.513%	-0.021	-0.016	0.362	0.249
x		77.222%	36.000	36.350	73.098%	-0.024	-0.017	0.365	0.247
σ		0.491%	0.582	0.353	0.613%	0.005	0.005	0.041	0.005
%RSD		0.636	1.617	0.972	0.839	19.560	28.800	11.140	2.111
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	15:55:29	77.190%	6.323	0.347	0.354	111.800	110.300	83.117%	83.293%
2	15:56:12	77.124%	6.346	0.378	0.371	111.300	111.300	82.992%	83.720%
3	15:56:55	76.440%	6.053	0.353	0.361	108.900	109.300	83.311%	83.670%
x		76.918%	6.241	0.359	0.362	110.600	110.300	83.140%	83.561%
σ		0.415%	0.163	0.017	0.008	1.547	0.972	0.161%	0.233%
%RSD		0.540	2.614	4.627	2.330	1.399	0.881	0.194	0.279
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	15:55:29	0.008	0.006	10.900	10.760	10.760	79.209%		
2	15:56:12	0.005	0.005	11.020	10.760	10.830	79.849%		
3	15:56:55	0.005	0.003	11.110	10.740	10.830	79.617%		
x		0.006	0.005	11.010	10.750	10.800	79.558%		
σ		0.002	0.002	0.106	0.008	0.039	0.324%		
%RSD		27.920	34.830	0.958	0.074	0.365	0.407		

180-26700-A-7-F @100 11/14/2013 3:59:33 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	87.029%	-0.209	5.098	5.421	0.000	24.960	2153.000	2102.000
2	16:00:59	84.267%	-0.279	5.440	5.007	0.000	24.640	2161.000	2152.000
3	16:01:43	86.099%	-0.233	4.968	5.320	0.000	25.830	2207.000	2182.000
x		85.798%	-0.240	5.169	5.249	0.000	25.140	2174.000	2146.000
σ		1.406%	0.035	0.244	0.216	0.000	0.619	29.140	40.600
%RSD		1.638	14.750	4.719	4.114	0.000	2.463	1.340	1.892

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	616.400	53.190	0.000	13.620	23450.000	23360.000	84.442%	160.700
2	16:00:59	623.700	51.780	0.000	13.130	23620.000	23560.000	84.511%	159.100
3	16:01:43	625.800	52.480	0.000	13.570	24540.000	24120.000	82.612%	166.400
x		622.000	52.480	0.000	13.440	23870.000	23680.000	83.855%	162.100
σ		4.908	0.701	0.000	0.269	585.200	395.200	1.077%	3.850
%RSD		0.789	1.336	0.000	2.003	2.451	1.669	1.285	2.376

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	38.260	117.100	3145.000	19540.000	19480.000	0.350	2.204	7.167
2	16:00:59	38.340	117.500	3165.000	19710.000	19480.000	0.318	2.143	7.015
3	16:01:43	38.500	119.900	3282.000	20310.000	20130.000	0.375	2.201	7.242
x		38.360	118.200	3197.000	19850.000	19700.000	0.348	2.182	7.141
σ		0.125	1.490	73.780	403.000	375.900	0.029	0.034	0.116
%RSD		0.325	1.261	2.308	2.030	1.908	8.191	1.573	1.618

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	7.132	8.973	8.653	0.266	0.164	-0.135	0.000	16.670
2	16:00:59	7.124	8.369	8.685	0.205	-0.092	-0.223	0.000	16.820
3	16:01:43	7.440	9.097	8.912	0.318	-0.076	-0.014	0.000	17.100
x		7.232	8.813	8.750	0.263	-0.001	-0.124	0.000	16.860
σ		0.180	0.389	0.141	0.056	0.143	0.105	0.000	0.214
%RSD		2.487	4.418	1.609	21.350	11180.000	84.360	0.000	1.270

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	84.440%	3.621	3.676	85.514%	-0.103	-0.096	0.026	0.026
2	16:00:59	86.226%	3.543	3.615	86.486%	-0.106	-0.098	0.044	0.025
3	16:01:43	85.541%	3.734	3.755	85.394%	-0.098	-0.086	-0.034	-0.017
x		85.402%	3.633	3.682	85.798%	-0.102	-0.094	0.012	0.011
σ		0.901%	0.096	0.070	0.599%	0.004	0.006	0.041	0.024
%RSD		1.055	2.634	1.900	0.698	3.504	6.809	341.300	215.200

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	86.755%	0.504	0.039	0.016	11.700	11.580	91.388%	91.691%
2	16:00:59	88.232%	0.530	0.023	0.017	11.390	11.400	93.481%	94.180%
3	16:01:43	87.730%	0.530	0.033	0.023	11.740	11.780	93.439%	94.179%
x		87.573%	0.521	0.032	0.019	11.610	11.580	92.769%	93.350%
σ		0.751%	0.015	0.008	0.004	0.188	0.190	1.196%	1.437%
%RSD		0.858	2.874	24.530	20.000	1.615	1.635	1.289	1.539

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:00:16	-0.002	-0.003	1.171	1.176	1.173	91.824%
2	16:00:59	-0.001	-0.003	1.204	1.173	1.184	93.571%
3	16:01:43	-0.003	-0.003	1.225	1.242	1.219	92.559%
x		-0.002	-0.003	1.200	1.197	1.192	92.651%
σ		0.001	0.000	0.027	0.039	0.024	0.877%
%RSD		45.330	2.817	2.258	3.256	2.029	0.946

180-26370-B-42-F 11/14/2013 4:04:22 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	65.710%	1.220	525.900	526.100	0.000	3590.000	136600.000	137700.000
2	16:05:48	60.722%	1.169	518.100	528.900	0.000	3619.000	139800.000	141800.000
3	16:06:31	59.683%	1.110	524.600	536.400	0.000	3586.000	139200.000	140100.000
x		62.038%	1.166	522.900	530.500	0.000	3598.000	138500.000	139900.000
σ		3.222%	0.055	4.165	5.321	0.000	17.910	1710.000	2043.000
%RSD		5.194	4.738	0.796	1.003	0.000	0.498	1.235	1.460
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	42050.000	1519.000	0.000	5045.000	555000.000	538600.000	60.815%	1278.000
2	16:05:48	43000.000	655.200	0.000	5151.000	565300.000	537000.000	57.860%	1282.000
3	16:06:31	42360.000	681.800	0.000	5019.000	552800.000	534400.000	58.120%	1286.000
x		42470.000	951.900	0.000	5072.000	557700.000	536700.000	58.932%	1282.000
σ		483.700	491.100	0.000	69.980	6668.000	2128.000	1.636%	3.858
%RSD		1.139	51.590	0.000	1.380	1.196	0.397	2.776	0.301
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	313.100	74.350	1838.000	69320.000	70540.000	15.330	50.280	124.200
2	16:05:48	314.600	74.480	1865.000	70050.000	71310.000	15.150	49.470	121.200
3	16:06:31	312.800	73.250	1837.000	69510.000	70270.000	15.240	49.740	119.800
x		313.500	74.030	1846.000	69630.000	70700.000	15.240	49.830	121.800
σ		0.967	0.679	15.850	376.400	539.000	0.086	0.408	2.232
%RSD		0.309	0.917	0.858	0.541	0.762	0.564	0.819	1.833
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	124.100	1473.000	1463.000	30.250	9.129	9.360	0.000	1021.000
2	16:05:48	122.500	1486.000	1480.000	31.420	8.977	9.230	0.000	1015.000
3	16:06:31	121.000	1472.000	1461.000	31.490	9.298	9.065	0.000	1019.000
x		122.500	1477.000	1468.000	31.050	9.135	9.219	0.000	1018.000
σ		1.559	7.886	10.510	0.694	0.161	0.148	0.000	2.893
%RSD		1.272	0.534	0.716	2.236	1.759	1.604	0.000	0.284
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	88.399%	11.510	12.440	64.523%	0.345	0.264	10.910	10.290
2	16:05:48	88.162%	11.740	12.440	64.115%	0.327	0.261	10.560	10.280
3	16:06:31	87.195%	11.290	12.510	63.638%	0.334	0.253	10.590	10.350
x		87.919%	11.510	12.460	64.092%	0.336	0.259	10.690	10.310
σ		0.638%	0.225	0.039	0.443%	0.009	0.005	0.192	0.038
%RSD		0.725	1.957	0.315	0.691	2.712	2.111	1.795	0.372
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:05:05	69.437%	26.540	0.731	0.719	299.700	302.200	80.504%	81.408%
2	16:05:48	69.341%	26.460	0.764	0.761	304.600	301.400	81.747%	83.369%
3	16:06:31	69.491%	25.630	0.724	0.781	301.200	300.100	81.984%	82.986%
x		69.423%	26.210	0.739	0.754	301.800	301.200	81.412%	82.587%
σ		0.076%	0.504	0.021	0.032	2.528	1.038	0.795%	1.040%
%RSD		0.110	1.923	2.874	4.214	0.838	0.345	0.976	1.259
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	16:05:05	1.583	1.610	273.400	257.300	263.100	71.303%		
2	16:05:48	1.612	1.616	275.000	259.500	265.000	72.859%		
3	16:06:31	1.560	1.667	274.000	258.200	263.400	74.064%		
x		1.585	1.631	274.100	258.300	263.900	72.742%		
σ		0.026	0.031	0.774	1.089	1.034	1.384%		
%RSD		1.635	1.927	0.282	0.422	0.392	1.903		

180-26370-A-43-E 11/14/2013 4:09:09 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	46.391%	0.931	388.100	392.200	0.000	2448.000	1262000.000	1264000.000
2	16:10:35	45.432%	0.912	387.000	394.900	0.000	2449.000	1276000.000	1266000.000
3	16:11:18	46.165%	0.904	378.200	395.300	0.000	2437.000	1272000.000	1272000.000
x		45.996%	0.916	384.400	394.100	0.000	2445.000	1270000.000	1268000.000
σ		0.501%	0.014	5.420	1.693	0.000	6.697	6790.000	4292.000
%RSD		1.090	1.523	1.410	0.430	0.000	0.274	0.535	0.339

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	17170.000	2534.000	0.000	3256.000	2261000.000	2190000.000	48.822%	246.500
2	16:10:35	17230.000	2541.000	0.000	3235.000	2273000.000	2193000.000	47.932%	242.900
3	16:11:18	17200.000	2510.000	0.000	3214.000	2280000.000	2219000.000	48.013%	246.300
x		17200.000	2528.000	0.000	3235.000	2271000.000	2201000.000	48.256%	245.200
σ		34.220	16.010	0.000	20.800	9852.000	15890.000	0.492%	2.029
%RSD		0.199	0.633	0.000	0.643	0.434	0.722	1.020	0.827

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	60.330	88.700	2327.000	171000.000	177300.000	12.960	16.830	31.940
2	16:10:35	60.540	89.280	2311.000	172800.000	178100.000	12.990	16.170	31.010
3	16:11:18	60.690	89.350	2307.000	172900.000	178200.000	12.880	17.270	31.650
x		60.520	89.110	2315.000	172200.000	177900.000	12.940	16.760	31.540
σ		0.178	0.356	10.680	1048.000	512.100	0.056	0.558	0.478
%RSD		0.294	0.400	0.461	0.609	0.288	0.432	3.329	1.516

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	34.240	668.000	651.400	18.670	-0.201	-0.268	0.000	499.100
2	16:10:35	33.090	667.300	655.200	19.600	-0.042	-0.704	0.000	495.800
3	16:11:18	33.610	671.500	655.400	17.090	-0.075	-0.700	0.000	498.700
x		33.640	668.900	654.000	18.450	-0.106	-0.557	0.000	497.900
σ		0.576	2.244	2.248	1.269	0.084	0.250	0.000	1.789
%RSD		1.710	0.335	0.344	6.877	78.860	44.940	0.000	0.359

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	100.411%	8.460	9.904	47.737%	0.014	0.002	58.610	57.490
2	16:10:35	101.332%	8.392	9.837	47.777%	0.037	-0.016	58.600	57.430
3	16:11:18	101.866%	8.696	10.090	47.714%	0.027	-0.001	58.980	57.120
x		101.203%	8.516	9.944	47.743%	0.026	-0.005	58.730	57.350
σ		0.736%	0.159	0.131	0.032%	0.011	0.010	0.218	0.202
%RSD		0.727	1.871	1.320	0.067	43.800	186.800	0.372	0.352

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	53.628%	24.110	0.960	0.912	111.900	111.400	63.911%	65.513%
2	16:10:35	53.857%	24.420	0.984	0.964	111.100	111.000	65.067%	66.295%
3	16:11:18	54.021%	24.370	0.969	0.978	112.600	112.100	64.287%	66.316%
x		53.835%	24.300	0.971	0.951	111.900	111.500	64.421%	66.041%
σ		0.198%	0.163	0.012	0.035	0.741	0.542	0.590%	0.458%
%RSD		0.367	0.673	1.287	3.657	0.662	0.487	0.915	0.693

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:09:52	1.038	1.027	225.700	210.000	216.100	50.394%
2	16:10:35	1.037	1.054	227.200	208.500	216.500	51.163%
3	16:11:18	0.988	1.073	227.400	210.400	217.200	51.123%
x		1.021	1.051	226.800	209.600	216.600	50.894%
σ		0.028	0.023	0.917	0.966	0.541	0.433%
%RSD		2.781	2.195	0.404	0.461	0.250	0.850

180-26740-D-1-A 11/14/2013 4:13:56 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	63.964%	0.596	33.670	34.040	0.000	20290.000	15460.000	15570.000
2	16:15:22	58.164%	0.550	33.680	35.230	0.000	21100.000	16060.000	15860.000
3	16:16:05	55.478%	0.578	31.420	33.110	0.000	19880.000	15370.000	15180.000
x		59.202%	0.575	32.920	34.120	0.000	20420.000	15630.000	15540.000
σ		4.337%	0.023	1.305	1.066	0.000	624.400	378.000	341.100
%RSD		7.326	3.981	3.965	3.123	0.000	3.057	2.418	2.195

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	7308.000	16600.000	0.000	8449.000	37340.000	38430.000	56.752%	121.000
2	16:15:22	7431.000	16900.000	0.000	8487.000	37650.000	38370.000	54.112%	122.300
3	16:16:05	7161.000	16150.000	0.000	8058.000	36750.000	37410.000	55.160%	115.900
x		7300.000	16550.000	0.000	8331.000	37240.000	38070.000	55.341%	119.700
σ		135.300	380.000	0.000	237.400	458.800	574.700	1.329%	3.394
%RSD		1.853	2.296	0.000	2.850	1.232	1.510	2.402	2.835

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	12.410	15.070	2449.000	15930.000	16200.000	12.280	13.980	28.130
2	16:15:22	11.430	14.730	2514.000	16230.000	16180.000	12.260	14.340	28.250
3	16:16:05	11.040	14.110	2369.000	15170.000	15280.000	11.560	13.240	26.730
x		11.630	14.640	2444.000	15780.000	15890.000	12.030	13.860	27.700
σ		0.706	0.484	72.830	544.500	529.200	0.408	0.560	0.845
%RSD		6.070	3.310	2.980	3.451	3.331	3.388	4.041	3.049

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	28.910	222.300	222.400	6.413	0.262	0.940	0.000	164.900
2	16:15:22	29.150	223.400	223.300	6.358	0.170	0.652	0.000	165.800
3	16:16:05	27.640	216.800	214.400	6.340	0.054	0.880	0.000	160.400
x		28.570	220.800	220.000	6.370	0.162	0.824	0.000	163.700
σ		0.810	3.564	4.902	0.038	0.104	0.152	0.000	2.925
%RSD		2.834	1.614	2.228	0.592	64.310	18.470	0.000	1.787

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	68.831%	1.459	1.434	65.880%	0.319	0.319	1.169	1.310
2	16:15:22	68.552%	1.453	1.477	65.249%	0.312	0.342	1.217	1.284
3	16:16:05	68.467%	1.404	1.437	65.164%	0.326	0.302	1.113	1.180
x		68.617%	1.439	1.449	65.431%	0.319	0.321	1.166	1.258
σ		0.191%	0.030	0.024	0.391%	0.007	0.020	0.052	0.069
%RSD		0.278	2.102	1.624	0.598	2.221	6.264	4.456	5.492

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	68.800%	2.379	0.486	0.445	209.700	210.000	79.919%	81.741%
2	16:15:22	69.049%	2.311	0.458	0.441	208.900	209.900	81.768%	83.461%
3	16:16:05	68.992%	2.189	0.460	0.477	204.200	205.400	83.285%	86.082%
x		68.947%	2.293	0.468	0.454	207.600	208.400	81.657%	83.761%
σ		0.131%	0.097	0.016	0.020	2.990	2.641	1.686%	2.186%
%RSD		0.190	4.215	3.398	4.423	1.441	1.267	2.064	2.610

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:14:39	0.057	0.052	37.350	37.030	37.010	79.922%
2	16:15:22	0.061	0.054	37.000	36.640	36.640	82.860%
3	16:16:05	0.053	0.052	35.690	35.380	35.330	86.236%
x		0.057	0.053	36.680	36.350	36.330	83.006%
σ		0.004	0.001	0.878	0.862	0.881	3.159%
%RSD		7.531	2.263	2.395	2.371	2.426	3.806

180-26740-A-1-C 11/14/2013 4:18:43 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	61.161%	-0.246	30.170	31.050	0.000	23560.000	16250.000	16310.000
2	16:20:09	58.616%	-0.247	29.540	31.810	0.000	23400.000	16370.000	16150.000
3	16:20:52	56.447%	-0.188	30.270	32.520	0.000	23190.000	16330.000	16320.000
x		58.741%	-0.227	30.000	31.800	0.000	23380.000	16320.000	16260.000
σ		2.360%	0.034	0.394	0.735	0.000	187.200	60.390	95.240
%RSD		4.017	14.780	1.314	2.312	0.000	0.800	0.370	0.586
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	33.450	4691.000	0.000	8834.000	41100.000	41730.000	55.146%	1.287
2	16:20:09	31.890	4645.000	0.000	8510.000	40230.000	41390.000	54.245%	1.096
3	16:20:52	33.790	4699.000	0.000	8499.000	39610.000	40640.000	54.346%	1.063
x		33.040	4679.000	0.000	8614.000	40310.000	41250.000	54.579%	1.149
σ		1.013	29.000	0.000	190.100	747.100	557.800	0.494%	0.121
%RSD		3.067	0.620	0.000	2.207	1.853	1.352	0.905	10.540
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	0.513	0.945	325.000	63.150	188.500	0.888	3.220	4.148
2	16:20:09	-0.735	0.965	334.300	60.380	184.000	0.886	3.078	4.237
3	16:20:52	0.358	0.946	325.700	55.710	186.200	0.882	3.185	4.054
x		0.045	0.952	328.300	59.750	186.200	0.885	3.161	4.146
σ		0.680	0.011	5.170	3.759	2.247	0.003	0.074	0.091
%RSD		1504.000	1.197	1.575	6.291	1.207	0.324	2.343	2.206
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	4.335	15.500	15.050	0.496	0.218	0.904	0.000	179.700
2	16:20:09	4.136	15.080	15.330	0.859	-0.052	0.875	0.000	178.200
3	16:20:52	4.221	15.090	14.830	0.288	0.014	0.326	0.000	179.100
x		4.231	15.220	15.070	0.547	0.060	0.701	0.000	179.000
σ		0.100	0.241	0.252	0.289	0.141	0.326	0.000	0.732
%RSD		2.356	1.584	1.673	52.710	234.600	46.440	0.000	0.409
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	65.986%	1.088	1.207	65.316%	-0.107	-0.093	-0.056	-0.007
2	16:20:09	65.907%	1.152	1.213	65.260%	-0.100	-0.096	-0.037	0.004
3	16:20:52	64.779%	1.235	1.231	64.363%	-0.094	-0.091	-0.042	-0.005
x		65.557%	1.159	1.217	64.980%	-0.100	-0.093	-0.045	-0.003
σ		0.675%	0.074	0.012	0.535%	0.006	0.003	0.010	0.006
%RSD		1.030	6.370	1.023	0.823	6.201	2.805	22.520	242.600
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:19:26	68.586%	0.054	0.448	0.475	96.320	96.010	81.248%	83.005%
2	16:20:09	68.238%	0.092	0.433	0.493	96.340	96.520	82.044%	84.021%
3	16:20:52	67.785%	0.091	0.503	0.461	96.680	96.930	81.623%	83.661%
x		68.203%	0.079	0.461	0.476	96.440	96.490	81.639%	83.562%
σ		0.402%	0.021	0.037	0.016	0.204	0.461	0.398%	0.515%
%RSD		0.589	26.960	8.032	3.387	0.211	0.478	0.488	0.616
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	16:19:26	0.005	0.004	0.170	0.187	0.178	82.014%		
2	16:20:09	0.006	0.007	0.174	0.176	0.170	83.295%		
3	16:20:52	0.005	0.007	0.196	0.167	0.175	83.061%		
x		0.005	0.006	0.180	0.177	0.174	82.790%		
σ		0.001	0.002	0.014	0.010	0.005	0.682%		
%RSD		10.310	28.450	7.805	5.730	2.613	0.824		

CCV 993939 11/14/2013 4:23:30 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	86.382%	105.800	101.000	97.380	0.000	50620.000	50300.000	49810.000
2	16:24:56	85.177%	105.500	101.200	98.490	0.000	50530.000	50530.000	49880.000
3	16:25:40	83.704%	106.700	100.600	97.800	0.000	50770.000	50910.000	51180.000
x		85.088%	106.016%	100.933%	97.893%	0.000	101.281%	101.159%	100.582%
σ		1.341%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.576	0.579	0.276	0.572	0.000	0.239	0.613	1.540

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	495.700	5008.000	0.000	50520.000	51460.000	51420.000	81.166%	99.390
2	16:24:56	493.600	5076.000	0.000	50500.000	50630.000	51090.000	82.021%	98.390
3	16:25:40	510.100	5139.000	0.000	50650.000	51320.000	51540.000	82.924%	99.120
x		99.963%	101.486%	0.000	101.113%	102.268%	102.698%	82.037%	98.969%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.879%	n/a
%RSD		1.792	1.282	0.000	0.161	0.869	0.451	1.072	0.524

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	103.200	102.300	509.300	25650.000	25680.000	102.600	102.700	103.800
2	16:24:56	102.500	101.900	513.300	25780.000	25610.000	103.700	102.400	103.500
3	16:25:40	103.700	103.200	512.600	25930.000	26010.000	103.900	102.900	105.600
x		103.150%	102.468%	102.350%	103.137%	103.073%	103.397%	102.663%	104.283%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.563	0.652	0.415	0.538	0.839	0.698	0.239	1.123

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	103.500	105.800	105.000	106.100	109.500	107.500	0.000	102.300
2	16:24:56	105.400	106.600	106.300	106.300	108.600	108.600	0.000	102.800
3	16:25:40	104.900	106.100	106.600	106.800	108.700	110.300	0.000	102.700
x		104.602%	106.179%	105.955%	106.384%	108.952%	108.812%	0.000	102.585%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.929	0.371	0.788	0.313	0.430	1.273	0.000	0.263

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	79.606%	99.770	101.000	77.569%	106.000	105.800	105.100	105.100
2	16:24:56	80.785%	102.400	103.100	79.113%	105.400	105.600	104.400	105.300
3	16:25:40	82.170%	102.800	103.200	80.303%	105.500	106.300	104.800	105.600
x		80.853%	101.647%	102.432%	78.995%	105.650%	105.890%	104.773%	105.328%
σ		1.283%	n/a	n/a	1.371%	n/a	n/a	n/a	n/a
%RSD		1.587	1.611	1.241	1.735	0.310	0.333	0.337	0.257

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	78.877%	97.630	99.710	99.390	101.800	102.600	82.106%	82.717%
2	16:24:56	80.923%	99.000	100.400	100.500	101.500	102.500	84.843%	86.057%
3	16:25:40	82.316%	98.860	100.900	100.300	102.200	102.900	86.065%	86.795%
x		80.705%	98.497%	100.344%	100.088%	101.835%	102.659%	84.338%	85.190%
σ		1.730%	n/a	n/a	n/a	n/a	n/a	2.028%	2.173%
%RSD		2.144	0.768	0.615	0.615	0.364	0.215	2.404	2.551

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:24:13	99.960	101.900	104.100	103.300	103.600	78.293%
2	16:24:56	101.400	102.700	104.800	104.700	104.700	80.249%
3	16:25:40	102.000	103.400	104.700	104.600	104.900	81.220%
x		101.129%	102.682%	104.564%	104.198%	104.406%	79.921%
σ		n/a	n/a	n/a	n/a	n/a	1.491%
%RSD		1.043	0.749	0.355	0.785	0.699	1.866

CCB4 11/14/2013 4:31:42 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	103.771%	-0.277	1.122	0.976	0.000	-1.258	0.795	0.975
2	16:33:08	101.240%	-0.255	1.006	0.835	0.000	-1.274	0.645	0.789
3	16:33:50	100.344%	-0.366	0.745	0.687	0.000	-1.337	0.760	0.726
x		101.785%	-0.299	0.958	0.833	0.000	-1.290	0.734	0.830
σ		1.777%	0.059	0.193	0.144	0.000	0.042	0.079	0.130
%RSD		1.746	19.590	20.180	17.360	0.000	3.236	10.720	15.600
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	-0.016	-1.512	0.000	-0.035	0.205	-0.111	97.139%	-0.000
2	16:33:08	-0.020	-0.765	0.000	-0.737	0.672	-0.593	96.085%	-0.008
3	16:33:50	-0.019	-0.719	0.000	-0.422	1.139	-0.382	95.309%	-0.008
x		-0.019	-0.999	0.000	-0.398	0.672	-0.362	96.178%	-0.006
σ		0.002	0.445	0.000	0.351	0.467	0.242	0.918%	0.005
%RSD		10.670	44.570	0.000	88.240	69.470	66.730	0.955	81.970
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	-0.010	-0.029	0.090	4.556	1.594	-0.000	-0.002	0.003
2	16:33:08	-0.014	-0.014	0.075	2.440	1.148	0.001	-0.017	-0.014
3	16:33:50	-0.031	-0.009	0.084	2.463	0.613	0.002	-0.017	-0.015
x		-0.018	-0.018	0.083	3.153	1.118	0.001	-0.012	-0.009
σ		0.011	0.010	0.008	1.215	0.491	0.001	0.009	0.010
%RSD		60.270	58.880	9.225	38.540	43.900	116.200	75.360	117.500
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	-0.013	-0.118	-0.170	0.056	0.017	0.360	0.000	0.003
2	16:33:08	-0.022	-0.036	-0.125	-0.002	0.042	-0.056	0.000	0.000
3	16:33:50	-0.010	-0.069	-0.135	0.002	0.084	0.084	0.000	0.001
x		-0.015	-0.074	-0.143	0.019	0.048	0.129	0.000	0.001
σ		0.006	0.041	0.024	0.033	0.034	0.212	0.000	0.001
%RSD		42.920	55.420	16.560	174.100	71.370	163.500	0.000	93.070
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	92.932%	0.028	0.041	93.121%	-0.108	-0.106	-0.009	-0.002
2	16:33:08	92.514%	0.016	0.006	95.098%	-0.108	-0.104	-0.037	-0.026
3	16:33:50	93.621%	-0.003	0.017	94.768%	-0.103	-0.103	-0.011	-0.011
x		93.023%	0.013	0.021	94.329%	-0.107	-0.104	-0.019	-0.013
σ		0.559%	0.016	0.018	1.059%	0.003	0.002	0.015	0.012
%RSD		0.601	115.900	83.530	1.123	2.899	1.566	81.860	91.450
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:32:25	92.105%	-0.183	-0.035	-0.047	-0.012	-0.014	91.382%	91.436%
2	16:33:08	94.070%	-0.210	-0.046	-0.047	-0.003	-0.010	93.060%	93.186%
3	16:33:50	93.136%	-0.197	-0.045	-0.049	-0.007	-0.014	94.098%	93.896%
x		93.103%	-0.197	-0.042	-0.047	-0.007	-0.013	92.847%	92.839%
σ		0.983%	0.013	0.006	0.001	0.004	0.002	1.370%	1.266%
%RSD		1.055	6.785	15.130	2.253	59.210	18.510	1.476	1.364
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	16:32:25	0.015	0.016	0.046	0.039	0.045	91.910%		
2	16:33:08	0.015	0.013	0.051	0.048	0.042	93.020%		
3	16:33:50	0.013	0.013	0.044	0.040	0.042	93.512%		
x		0.014	0.014	0.047	0.042	0.043	92.814%		
σ		0.001	0.002	0.004	0.005	0.002	0.821%		
%RSD		5.958	12.420	7.505	11.830	3.909	0.884		

MB 180-88935/1-A 11/14/2013 4:36:31 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	90.475%	-0.290	0.202	-0.021	0.000	1.869	0.680	0.642
2	16:37:57	86.192%	-0.292	0.085	-0.061	0.000	1.648	0.651	0.675
3	16:38:39	82.669%	-0.395	-0.030	-0.030	0.000	1.636	0.617	0.477
x		86.445%	-0.326	0.086	-0.037	0.000	1.718	0.649	0.598
σ		3.909%	0.060	0.116	0.021	0.000	0.131	0.031	0.106
%RSD		4.522	18.310	134.800	55.840	0.000	7.647	4.834	17.710

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	1.118	1.305	0.000	1.312	5.943	6.385	80.083%	0.000
2	16:37:57	1.184	1.494	0.000	-0.764	8.279	6.382	78.429%	0.029
3	16:38:39	1.207	1.741	0.000	-1.001	5.790	5.311	76.363%	0.010
x		1.170	1.514	0.000	-0.151	6.671	6.026	78.292%	0.013
σ		0.046	0.219	0.000	1.272	1.395	0.619	1.864%	0.015
%RSD		3.953	14.450	0.000	841.200	20.910	10.280	2.381	112.600

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	-0.074	0.171	0.022	-0.461	-0.574	-0.000	0.078	0.065
2	16:37:57	-0.050	0.198	0.026	0.045	-0.934	0.001	0.035	0.071
3	16:38:39	-0.090	0.186	0.010	-2.903	-1.805	-0.000	0.038	0.073
x		-0.071	0.185	0.019	-1.107	-1.104	0.000	0.051	0.070
σ		0.020	0.014	0.008	1.576	0.633	0.001	0.024	0.004
%RSD		28.600	7.484	42.790	142.400	57.330	591.900	47.300	5.319

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	0.080	0.878	0.905	-0.291	-0.230	-0.205	0.000	0.019
2	16:37:57	0.071	0.834	0.840	-0.177	-0.332	-0.295	0.000	0.011
3	16:38:39	0.064	0.835	0.834	0.070	-0.443	-0.030	0.000	0.013
x		0.072	0.849	0.860	-0.133	-0.335	-0.177	0.000	0.014
σ		0.008	0.025	0.040	0.184	0.107	0.135	0.000	0.004
%RSD		10.950	2.952	4.609	138.600	31.910	76.290	0.000	26.370

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	81.603%	0.003	-0.018	84.177%	-0.102	-0.107	-0.027	-0.011
2	16:37:57	80.377%	-0.034	-0.020	82.347%	-0.103	-0.104	-0.012	-0.014
3	16:38:39	79.575%	-0.006	-0.030	81.615%	-0.099	-0.105	-0.027	-0.024
x		80.518%	-0.012	-0.023	82.713%	-0.102	-0.105	-0.022	-0.016
σ		1.022%	0.019	0.006	1.320%	0.002	0.001	0.009	0.007
%RSD		1.269	157.700	28.440	1.595	2.076	1.405	40.580	39.630

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	83.733%	-0.083	-0.051	-0.049	0.014	0.014	88.702%	89.011%
2	16:37:57	83.071%	-0.124	-0.039	-0.048	0.006	0.003	89.195%	90.557%
3	16:38:39	82.896%	-0.147	-0.037	-0.050	0.010	-0.008	89.671%	90.777%
x		83.233%	-0.118	-0.042	-0.049	0.010	0.003	89.189%	90.115%
σ		0.441%	0.032	0.008	0.001	0.004	0.011	0.484%	0.963%
%RSD		0.530	27.480	17.860	2.193	38.740	357.800	0.543	1.068

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:37:14	0.021	0.019	0.043	0.039	0.043	90.145%
2	16:37:57	0.005	0.003	0.033	0.041	0.034	91.086%
3	16:38:39	-0.002	-0.000	0.032	0.030	0.031	91.850%
x		0.008	0.008	0.036	0.037	0.036	91.027%
σ		0.012	0.010	0.006	0.005	0.006	0.854%
%RSD		148.000	137.400	17.300	14.700	16.980	0.938

LCS 180-88935/2-A 11/14/2013 4:41:18 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	66.071%	48.520	955.300	956.600	0.000	45770.000	49190.000	48620.000
2	16:42:43	60.600%	51.080	958.200	996.800	0.000	47530.000	50350.000	50170.000
3	16:43:26	58.654%	50.320	943.800	990.600	0.000	48680.000	52640.000	52070.000
x		61.775%	49.970	952.500	981.300	0.000	47330.000	50730.000	50290.000
σ		3.845%	1.313	7.640	21.670	0.000	1465.000	1759.000	1725.000
%RSD		6.225	2.628	0.802	2.208	0.000	3.095	3.468	3.430

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	1891.000	9702.000	0.000	44750.000	46390.000	47030.000	72.268%	893.600
2	16:42:43	1975.000	9905.000	0.000	44410.000	45660.000	47020.000	70.803%	895.500
3	16:43:26	2010.000	10070.000	0.000	45040.000	46920.000	47810.000	68.233%	923.000
x		1959.000	9893.000	0.000	44730.000	46320.000	47290.000	70.435%	904.100
σ		61.280	184.400	0.000	317.100	630.000	454.300	2.043%	16.460
%RSD		3.129	1.864	0.000	0.709	1.360	0.961	2.900	1.821

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	478.500	187.400	475.700	1160.000	1308.000	462.600	460.600	233.200
2	16:42:43	481.400	190.400	484.200	1164.000	1283.000	467.900	458.700	230.300
3	16:43:26	498.200	192.900	485.800	1194.000	1324.000	478.300	463.900	234.600
x		486.000	190.200	481.900	1173.000	1305.000	469.600	461.100	232.700
σ		10.620	2.745	5.446	18.600	20.500	7.975	2.597	2.179
%RSD		2.184	1.443	1.130	1.586	1.571	1.698	0.563	0.937

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	233.700	493.500	494.900	38.100	10.040	10.380	0.000	986.800
2	16:42:43	235.100	496.400	499.000	38.020	9.918	10.060	0.000	984.500
3	16:43:26	240.600	507.300	503.400	38.140	9.730	10.290	0.000	1002.000
x		236.500	499.000	499.100	38.090	9.896	10.250	0.000	991.100
σ		3.617	7.282	4.253	0.063	0.156	0.166	0.000	9.524
%RSD		1.529	1.459	0.852	0.166	1.580	1.623	0.000	0.961

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	72.884%	1008.000	1052.000	67.328%	54.870	54.480	55.300	50.410
2	16:42:43	72.871%	1019.000	1065.000	67.373%	54.620	54.620	55.490	48.810
3	16:43:26	71.286%	1028.000	1071.000	66.603%	55.020	55.190	56.980	51.400
x		72.347%	1018.000	1062.000	67.101%	54.840	54.760	55.920	50.210
σ		0.918%	9.619	9.637	0.432%	0.201	0.373	0.918	1.306
%RSD		1.269	0.945	0.907	0.644	0.366	0.680	1.642	2.602

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	70.188%	2099.000	529.600	529.800	1715.000	2109.000	82.301%	83.800%
2	16:42:43	71.135%	2096.000	528.000	529.000	1333.000	2120.000	84.272%	85.950%
3	16:43:26	69.715%	2122.000	534.600	538.000	1660.000	2128.000	83.691%	85.790%
x		70.346%	2106.000	530.700	532.300	1569.000	2119.000	83.421%	85.180%
σ		0.723%	13.800	3.472	4.932	206.400	9.489	1.013%	1.198%
%RSD		1.028	0.655	0.654	0.927	13.160	0.448	1.214	1.406

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:42:01	51.070	51.990	21.180	22.760	21.940	79.707%
2	16:42:43	51.560	52.890	21.070	22.840	21.950	81.973%
3	16:43:26	52.460	53.560	21.380	22.920	22.010	82.431%
x		51.700	52.810	21.210	22.840	21.970	81.370%
σ		0.702	0.792	0.160	0.082	0.039	1.458%
%RSD		1.357	1.500	0.754	0.357	0.175	1.792

180-26669-G-2-A 11/14/2013 4:49:28 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	63.720%	-0.301	55.690	54.540	0.000	28220.000	12150.000	11890.000
2	16:50:54	59.995%	-0.315	51.630	57.090	0.000	28720.000	12390.000	12160.000
3	16:51:36	56.982%	-0.321	54.790	56.110	0.000	29280.000	12620.000	12610.000
x		60.233%	-0.312	54.040	55.910	0.000	28740.000	12380.000	12220.000
σ		3.375%	0.010	2.136	1.284	0.000	534.300	234.700	362.200
%RSD		5.604	3.228	3.952	2.297	0.000	1.859	1.895	2.964
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	37.390	4685.000	0.000	4576.000	36600.000	38070.000	57.156%	1.075
2	16:50:54	35.800	4853.000	0.000	4410.000	36590.000	37950.000	54.918%	1.035
3	16:51:36	37.750	4983.000	0.000	4574.000	36920.000	38650.000	53.604%	1.118
x		36.980	4840.000	0.000	4520.000	36700.000	38220.000	55.226%	1.076
σ		1.041	149.200	0.000	95.090	189.700	377.400	1.796%	0.042
%RSD		2.814	3.083	0.000	2.104	0.517	0.987	3.252	3.859
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	-0.235	0.998	212.300	1083.000	1203.000	2.510	3.608	1.366
2	16:50:54	0.576	0.934	210.600	1069.000	1179.000	2.509	3.822	1.351
3	16:51:36	-0.628	0.899	214.800	1088.000	1195.000	2.585	3.780	1.367
x		-0.096	0.944	212.600	1080.000	1192.000	2.535	3.737	1.361
σ		0.614	0.050	2.130	9.896	12.300	0.044	0.113	0.009
%RSD		641.700	5.346	1.002	0.916	1.032	1.729	3.036	0.654
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	1.472	6.723	6.908	0.029	-0.177	-0.257	0.000	155.600
2	16:50:54	1.474	6.936	6.780	0.210	-0.343	-0.213	0.000	155.900
3	16:51:36	1.368	7.024	7.159	0.249	-0.308	0.338	0.000	159.300
x		1.438	6.894	6.949	0.162	-0.276	-0.044	0.000	156.900
σ		0.061	0.155	0.193	0.117	0.087	0.331	0.000	2.038
%RSD		4.216	2.242	2.777	72.250	31.690	752.600	0.000	1.299
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	67.256%	1.079	1.122	66.811%	-0.109	-0.108	-0.026	-0.021
2	16:50:54	66.461%	0.936	0.992	65.869%	-0.100	-0.105	-0.039	-0.013
3	16:51:36	65.228%	0.899	0.878	65.085%	-0.105	-0.114	-0.079	-0.049
x		66.315%	0.972	0.997	65.922%	-0.104	-0.109	-0.048	-0.028
σ		1.022%	0.095	0.122	0.864%	0.005	0.005	0.027	0.019
%RSD		1.541	9.759	12.250	1.311	4.465	4.375	56.760	67.800
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:50:10	68.902%	1.203	0.066	0.092	40.730	40.370	81.101%	83.185%
2	16:50:54	69.101%	0.718	0.095	0.108	40.930	41.050	82.694%	84.579%
3	16:51:36	68.477%	0.494	0.096	0.083	41.080	41.620	82.149%	83.600%
x		68.827%	0.805	0.086	0.094	40.910	41.010	81.982%	83.788%
σ		0.319%	0.363	0.017	0.013	0.173	0.627	0.810%	0.716%
%RSD		0.463	45.060	19.590	13.300	0.423	1.529	0.988	0.854
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	16:50:10	0.120	0.127	0.141	0.151	0.144	81.658%		
2	16:50:54	0.100	0.098	0.160	0.146	0.155	83.851%		
3	16:51:36	0.091	0.086	0.158	0.180	0.158	83.501%		
x		0.104	0.104	0.153	0.159	0.152	83.004%		
σ		0.014	0.021	0.010	0.018	0.008	1.178%		
%RSD		13.950	20.660	6.623	11.580	4.986	1.420		

180-26669-E-3-A 11/14/2013 4:54:16 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	61.369%	-0.289	44.550	45.970	0.000	33350.000	10220.000	10030.000
2	16:55:41	58.441%	-0.290	44.570	46.240	0.000	33070.000	10510.000	10420.000
3	16:56:24	55.827%	-0.242	43.400	46.230	0.000	33830.000	10580.000	10600.000
x		58.546%	-0.274	44.170	46.150	0.000	33420.000	10440.000	10350.000
σ		2.773%	0.027	0.671	0.155	0.000	383.900	189.200	288.100
%RSD		4.736	9.976	1.520	0.337	0.000	1.149	1.813	2.784

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	63.670	4507.000	0.000	3944.000	42470.000	43650.000	54.254%	2.021
2	16:55:41	64.040	4530.000	0.000	4014.000	43270.000	44650.000	52.344%	1.245
3	16:56:24	64.890	4722.000	0.000	4047.000	44340.000	44950.000	52.048%	1.450
x		64.200	4586.000	0.000	4002.000	43360.000	44410.000	52.882%	1.572
σ		0.626	117.800	0.000	52.280	937.300	678.700	1.197%	0.402
%RSD		0.976	2.569	0.000	1.307	2.162	1.528	2.264	25.570

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	0.091	1.215	35.530	243.900	401.500	0.963	3.011	1.560
2	16:55:41	0.009	1.141	35.620	244.000	384.600	0.968	2.936	1.585
3	16:56:24	0.135	1.238	35.670	247.400	384.700	0.940	2.828	1.530
x		0.078	1.198	35.610	245.100	390.300	0.957	2.925	1.558
σ		0.064	0.051	0.072	1.976	9.739	0.015	0.092	0.027
%RSD		82.000	4.221	0.203	0.806	2.495	1.560	3.150	1.764

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	1.551	10.670	10.100	0.416	-0.315	0.435	0.000	155.600
2	16:55:41	1.591	10.820	10.870	-0.366	-0.526	-0.340	0.000	159.900
3	16:56:24	1.560	10.760	10.320	0.289	-0.432	0.032	0.000	162.000
x		1.567	10.750	10.430	0.113	-0.424	0.043	0.000	159.200
σ		0.021	0.076	0.396	0.420	0.106	0.388	0.000	3.282
%RSD		1.334	0.707	3.801	371.400	24.870	908.600	0.000	2.062

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	64.690%	1.339	1.430	64.435%	-0.112	-0.113	0.003	0.012
2	16:55:41	63.797%	1.416	1.458	63.161%	-0.106	-0.106	0.014	0.013
3	16:56:24	62.838%	1.407	1.407	62.071%	-0.109	-0.102	-0.007	0.017
x		63.775%	1.388	1.432	63.222%	-0.109	-0.107	0.003	0.014
σ		0.926%	0.042	0.026	1.183%	0.003	0.006	0.011	0.003
%RSD		1.453	3.030	1.796	1.872	2.714	5.292	329.400	20.080

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	66.673%	0.355	0.123	0.131	44.400	44.630	78.971%	80.920%
2	16:55:41	66.477%	0.309	0.155	0.147	44.980	45.220	80.152%	81.896%
3	16:56:24	66.098%	0.225	0.151	0.136	45.540	45.720	80.537%	81.838%
x		66.416%	0.296	0.143	0.138	44.970	45.190	79.886%	81.551%
σ		0.292%	0.066	0.017	0.008	0.568	0.550	0.816%	0.548%
%RSD		0.440	22.130	12.160	5.960	1.264	1.218	1.022	0.672

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:54:58	0.067	0.070	0.171	0.173	0.167	80.034%
2	16:55:41	0.059	0.060	0.170	0.177	0.171	81.255%
3	16:56:24	0.064	0.060	0.185	0.186	0.175	81.080%
x		0.063	0.063	0.175	0.179	0.171	80.789%
σ		0.004	0.006	0.009	0.007	0.004	0.660%
%RSD		6.518	9.098	4.884	3.896	2.397	0.817

180-26669-G-5-A 11/14/2013 4:59:04 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	66.753%	-0.265	21.970	22.440	0.000	706.600	4.704	5.349
2	17:00:29	58.480%	-0.308	22.420	22.910	0.000	718.200	5.301	5.258
3	17:01:12	60.976%	-0.229	20.820	22.660	0.000	716.200	4.270	4.893
x		62.070%	-0.268	21.740	22.670	0.000	713.700	4.758	5.167
σ		4.244%	0.040	0.825	0.237	0.000	6.194	0.517	0.241
%RSD		6.837	14.840	3.794	1.046	0.000	0.868	10.870	4.674

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	10.340	438.200	0.000	11.590	126.400	141.600	53.774%	0.349
2	17:00:29	10.550	446.200	0.000	9.158	147.600	131.200	55.873%	0.142
3	17:01:12	10.540	438.800	0.000	9.605	144.200	137.100	54.988%	0.169
x		10.480	441.100	0.000	10.120	139.400	136.600	54.878%	0.220
σ		0.121	4.448	0.000	1.295	11.390	5.184	1.054%	0.113
%RSD		1.159	1.008	0.000	12.800	8.165	3.794	1.920	51.190

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	-0.772	1.092	0.243	-0.056	3.479	0.011	0.031	2.112
2	17:00:29	-1.143	1.002	0.234	-4.325	0.779	0.013	0.039	2.037
3	17:01:12	0.551	0.960	0.235	-4.574	1.698	0.019	0.047	2.065
x		-0.454	1.018	0.237	-2.985	1.985	0.014	0.039	2.071
σ		0.890	0.068	0.005	2.540	1.373	0.004	0.008	0.038
%RSD		195.900	6.641	2.027	85.070	69.150	28.100	20.620	1.832

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	2.108	1.809	1.743	0.199	-0.499	-0.475	0.000	0.239
2	17:00:29	2.072	2.053	1.879	-0.522	-0.377	-0.251	0.000	0.241
3	17:01:12	2.114	1.938	1.914	-0.019	-0.331	0.110	0.000	0.233
x		2.098	1.933	1.845	-0.114	-0.402	-0.205	0.000	0.238
σ		0.023	0.122	0.090	0.370	0.087	0.295	0.000	0.004
%RSD		1.081	6.310	4.895	325.000	21.540	143.600	0.000	1.797

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	67.605%	0.042	0.050	68.858%	-0.115	-0.113	-0.046	-0.038
2	17:00:29	66.444%	0.057	0.031	68.634%	-0.111	-0.110	-0.076	-0.058
3	17:01:12	66.307%	0.059	0.041	67.421%	-0.110	-0.103	-0.061	-0.052
x		66.785%	0.053	0.041	68.304%	-0.112	-0.109	-0.061	-0.049
σ		0.713%	0.009	0.009	0.773%	0.003	0.005	0.015	0.010
%RSD		1.068	17.710	22.730	1.132	2.561	4.748	24.900	20.310

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	70.505%	0.020	-0.007	0.004	0.388	0.333	82.172%	83.554%
2	17:00:29	70.791%	0.024	0.001	-0.006	0.370	0.372	82.240%	84.181%
3	17:01:12	70.037%	0.013	0.001	-0.000	0.344	0.358	82.149%	84.112%
x		70.444%	0.019	-0.002	-0.001	0.367	0.354	82.187%	83.949%
σ		0.380%	0.005	0.005	0.005	0.022	0.020	0.048%	0.344%
%RSD		0.540	28.570	288.600	541.100	6.123	5.590	0.058	0.410

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	16:59:47	0.023	0.027	0.024	0.023	0.022	86.550%
2	17:00:29	0.025	0.027	0.027	0.023	0.021	87.702%
3	17:01:12	0.015	0.027	0.023	0.018	0.022	87.192%
x		0.021	0.027	0.025	0.021	0.022	87.148%
σ		0.005	0.000	0.002	0.003	0.000	0.577%
%RSD		24.580	1.530	8.390	13.170	1.248	0.662

180-26669-G-6-A 11/14/2013 5:03:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	63.366%	-0.169	50.720	51.860	0.000	65410.000	15550.000	15600.000
2	17:05:16	57.517%	-0.203	48.910	51.000	0.000	68550.000	16310.000	16210.000
3	17:05:59	55.403%	-0.184	51.220	52.030	0.000	66580.000	16390.000	16230.000
x		58.762%	-0.186	50.290	51.630	0.000	66850.000	16080.000	16010.000
σ		4.125%	0.017	1.215	0.552	0.000	1586.000	460.000	359.700
%RSD		7.020	9.060	2.416	1.070	0.000	2.372	2.860	2.246

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	130.900	6804.000	0.000	6090.000	41520.000	43120.000	53.868%	0.731
2	17:05:16	134.300	6927.000	0.000	6075.000	42250.000	43330.000	52.847%	0.811
3	17:05:59	135.900	6894.000	0.000	5966.000	41860.000	42870.000	52.380%	0.917
x		133.700	6875.000	0.000	6044.000	41880.000	43110.000	53.032%	0.820
σ		2.534	63.470	0.000	67.590	366.200	228.200	0.761%	0.093
%RSD		1.895	0.923	0.000	1.118	0.875	0.529	1.435	11.360

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	-1.372	0.854	614.500	2506.000	2648.000	12.850	16.780	1.407
2	17:05:16	-0.655	0.809	629.300	2529.000	2625.000	12.800	16.540	1.391
3	17:05:59	-0.638	0.765	606.600	2459.000	2585.000	12.310	16.550	1.364
x		-0.888	0.809	616.800	2498.000	2620.000	12.650	16.620	1.387
σ		0.419	0.045	11.520	35.610	32.000	0.296	0.136	0.021
%RSD		47.140	5.511	1.868	1.426	1.222	2.340	0.820	1.546

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	1.315	34.650	34.650	0.537	-0.463	-0.089	0.000	167.900
2	17:05:16	1.290	36.230	34.690	0.626	-0.416	0.069	0.000	170.800
3	17:05:59	1.259	33.890	34.950	0.884	-0.371	-0.109	0.000	170.100
x		1.288	34.920	34.760	0.682	-0.417	-0.043	0.000	169.600
σ		0.028	1.198	0.166	0.180	0.046	0.098	0.000	1.502
%RSD		2.166	3.429	0.478	26.390	11.070	227.900	0.000	0.885

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	64.195%	0.225	0.275	62.277%	-0.113	-0.112	0.931	0.843
2	17:05:16	63.472%	0.267	0.246	62.057%	-0.108	-0.109	0.770	0.807
3	17:05:59	64.031%	0.246	0.242	61.888%	-0.118	-0.106	0.778	0.829
x		63.899%	0.246	0.254	62.074%	-0.113	-0.109	0.826	0.827
σ		0.379%	0.021	0.018	0.195%	0.005	0.003	0.091	0.018
%RSD		0.593	8.646	6.960	0.315	4.401	2.834	11.000	2.211

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	66.104%	-0.029	0.010	-0.008	59.610	60.100	77.438%	79.387%
2	17:05:16	66.091%	-0.034	0.015	0.021	60.210	60.220	78.935%	80.796%
3	17:05:59	66.478%	-0.037	0.021	0.033	59.330	59.520	80.062%	81.907%
x		66.225%	-0.033	0.015	0.015	59.720	59.950	78.812%	80.697%
σ		0.220%	0.004	0.006	0.021	0.446	0.373	1.316%	1.263%
%RSD		0.332	12.670	36.680	135.800	0.747	0.623	1.670	1.565

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:04:33	0.088	0.089	0.154	0.165	0.157	77.663%
2	17:05:16	0.090	0.087	0.163	0.156	0.155	79.194%
3	17:05:59	0.079	0.102	0.154	0.160	0.156	80.909%
x		0.085	0.092	0.157	0.160	0.156	79.255%
σ		0.006	0.008	0.005	0.005	0.001	1.624%
%RSD		6.882	8.789	3.307	3.006	0.446	2.049

180-26669-A-7-A 11/14/2013 5:08:37 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	60.532%	-0.245	60.120	66.240	0.000	95160.000	15800.000	15650.000
2	17:10:02	56.873%	-0.286	60.710	63.330	0.000	93320.000	15950.000	15740.000
3	17:10:45	54.850%	-0.206	59.600	64.180	0.000	91350.000	15750.000	16030.000
x		57.418%	-0.246	60.140	64.580	0.000	93280.000	15830.000	15810.000
σ		2.880%	0.040	0.559	1.493	0.000	1907.000	105.100	196.100
%RSD		5.016	16.390	0.929	2.311	0.000	2.044	0.664	1.240

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	31.490	9823.000	0.000	4620.000	82170.000	84440.000	53.011%	1.448
2	17:10:02	33.140	9854.000	0.000	4595.000	82500.000	85450.000	51.975%	1.396
3	17:10:45	31.970	9892.000	0.000	4525.000	82700.000	84960.000	51.399%	1.453
x		32.200	9856.000	0.000	4580.000	82460.000	84950.000	52.128%	1.432
σ		0.849	34.350	0.000	49.270	268.600	505.700	0.817%	0.032
%RSD		2.636	0.348	0.000	1.076	0.326	0.595	1.567	2.205

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	0.673	0.781	2863.000	848.700	1147.000	20.330	9.443	1.325
2	17:10:02	0.281	0.730	2808.000	839.600	1091.000	19.600	9.499	1.322
3	17:10:45	0.025	0.734	2810.000	840.800	1115.000	19.890	9.479	1.259
x		0.326	0.748	2827.000	843.000	1118.000	19.940	9.473	1.302
σ		0.326	0.028	30.960	4.938	27.940	0.370	0.028	0.037
%RSD		100.000	3.766	1.095	0.586	2.500	1.854	0.300	2.859

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	1.224	10.960	11.100	0.896	-0.138	0.612	0.000	216.100
2	17:10:02	1.200	11.050	10.910	1.107	0.148	0.985	0.000	214.800
3	17:10:45	1.182	11.220	10.550	1.499	-0.117	0.538	0.000	216.100
x		1.202	11.080	10.850	1.168	-0.036	0.712	0.000	215.700
σ		0.021	0.127	0.275	0.306	0.159	0.240	0.000	0.775
%RSD		1.755	1.148	2.534	26.190	446.100	33.650	0.000	0.359

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	63.067%	1.380	1.416	61.498%	-0.096	-0.106	-0.018	0.016
2	17:10:02	61.759%	1.469	1.398	60.648%	-0.106	-0.097	-0.042	-0.019
3	17:10:45	62.297%	1.318	1.440	60.078%	-0.102	-0.099	-0.044	-0.017
x		62.374%	1.389	1.418	60.741%	-0.101	-0.101	-0.035	-0.006
σ		0.658%	0.076	0.021	0.715%	0.005	0.005	0.015	0.019
%RSD		1.055	5.473	1.471	1.176	4.677	4.511	41.870	301.300

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	64.392%	-0.051	0.139	0.148	67.300	66.300	77.718%	79.395%
2	17:10:02	64.832%	0.003	0.117	0.188	66.360	66.690	78.408%	80.619%
3	17:10:45	65.016%	-0.012	0.165	0.141	66.650	66.550	78.652%	80.907%
x		64.746%	-0.020	0.141	0.159	66.770	66.510	78.259%	80.307%
σ		0.321%	0.028	0.024	0.025	0.479	0.197	0.484%	0.802%
%RSD		0.496	137.000	17.190	15.980	0.717	0.296	0.619	0.999

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:09:19	0.023	0.021	0.592	0.564	0.569	76.446%
2	17:10:02	0.019	0.026	0.570	0.602	0.578	78.190%
3	17:10:45	0.024	0.023	0.587	0.585	0.582	78.373%
x		0.022	0.023	0.583	0.584	0.576	77.669%
σ		0.003	0.002	0.012	0.019	0.006	1.064%
%RSD		13.560	10.640	1.995	3.195	1.087	1.370

180-26669-A-8-A 11/14/2013 5:13:23 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	60.593%	-0.349	34.580	36.540	0.000	28170.000	8475.000	8560.000
2	17:14:48	56.350%	-0.347	35.710	36.580	0.000	27810.000	8614.000	8759.000
3	17:15:31	53.042%	-0.233	37.480	38.060	0.000	28630.000	8905.000	8920.000
x		56.662%	-0.310	35.920	37.060	0.000	28210.000	8665.000	8746.000
σ		3.785%	0.066	1.460	0.866	0.000	411.300	219.200	180.200
%RSD		6.680	21.340	4.065	2.337	0.000	1.458	2.530	2.060

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	16.340	5135.000	0.000	4447.000	23590.000	24090.000	53.949%	0.746
2	17:14:48	17.640	5206.000	0.000	4354.000	24010.000	24250.000	52.068%	0.800
3	17:15:31	17.110	5202.000	0.000	4428.000	23710.000	24420.000	51.184%	0.806
x		17.030	5181.000	0.000	4410.000	23770.000	24260.000	52.400%	0.784
σ		0.655	40.020	0.000	48.930	215.900	164.700	1.412%	0.033
%RSD		3.844	0.772	0.000	1.109	0.908	0.679	2.695	4.219

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	-0.265	0.995	764.900	2102.000	2197.000	10.410	5.782	0.878
2	17:14:48	0.023	0.909	761.200	2088.000	2175.000	10.470	5.899	0.822
3	17:15:31	-0.605	0.824	756.700	2112.000	2168.000	10.350	5.987	0.816
x		-0.282	0.909	760.900	2101.000	2180.000	10.410	5.890	0.839
σ		0.315	0.085	4.087	11.660	14.820	0.061	0.103	0.035
%RSD		111.500	9.384	0.537	0.555	0.680	0.584	1.746	4.130

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	0.853	12.300	11.760	0.446	-0.599	-0.224	0.000	110.100
2	17:14:48	0.800	12.290	11.820	0.106	-0.521	-0.375	0.000	110.900
3	17:15:31	0.822	11.930	12.240	0.173	-0.526	0.450	0.000	111.800
x		0.825	12.170	11.940	0.242	-0.548	-0.050	0.000	110.900
σ		0.026	0.207	0.259	0.180	0.044	0.439	0.000	0.881
%RSD		3.195	1.700	2.172	74.390	7.972	886.300	0.000	0.795

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	63.599%	0.130	0.139	63.550%	-0.112	-0.110	-0.015	-0.016
2	17:14:48	62.684%	0.163	0.134	61.902%	-0.100	-0.111	-0.031	-0.019
3	17:15:31	62.493%	0.100	0.100	61.988%	-0.100	-0.109	-0.052	-0.032
x		62.925%	0.131	0.124	62.480%	-0.104	-0.110	-0.033	-0.023
σ		0.591%	0.031	0.021	0.928%	0.007	0.001	0.019	0.008
%RSD		0.940	23.910	17.230	1.485	6.584	0.790	57.660	37.400

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	66.516%	-0.086	0.011	0.004	97.900	98.070	78.227%	80.795%
2	17:14:48	66.570%	-0.097	0.032	0.021	98.900	97.950	79.550%	82.063%
3	17:15:31	65.925%	-0.085	0.012	0.034	99.900	99.030	80.165%	81.598%
x		66.337%	-0.089	0.018	0.020	98.900	98.350	79.314%	81.485%
σ		0.358%	0.006	0.012	0.015	1.004	0.595	0.990%	0.642%
%RSD		0.540	7.242	63.700	74.310	1.015	0.605	1.249	0.787

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:14:05	0.017	0.017	0.446	0.476	0.465	80.273%
2	17:14:48	0.016	0.018	0.447	0.467	0.454	82.522%
3	17:15:31	0.018	0.018	0.496	0.459	0.479	83.532%
x		0.017	0.018	0.463	0.467	0.466	82.109%
σ		0.001	0.000	0.029	0.009	0.012	1.668%
%RSD		6.062	1.411	6.233	1.838	2.661	2.032

180-26669-A-9-A 11/14/2013 5:18:09 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	61.941%	-0.211	36.000	37.710	0.000	132400.000	17970.000	18040.000
2	17:19:34	57.556%	-0.291	37.270	38.730	0.000	137100.000	18440.000	18270.000
3	17:20:18	56.655%	-0.261	36.900	38.110	0.000	133900.000	17960.000	17980.000
x		58.717%	-0.254	36.720	38.180	0.000	134500.000	18130.000	18100.000
σ		2.828%	0.040	0.654	0.516	0.000	2445.000	275.200	153.500
%RSD		4.816	15.810	1.782	1.351	0.000	1.818	1.518	0.849

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	124.500	7211.000	0.000	4473.000	50640.000	53030.000	54.882%	2.905
2	17:19:34	125.600	7391.000	0.000	4374.000	51570.000	52690.000	53.877%	2.329
3	17:20:18	127.000	7243.000	0.000	4323.000	50010.000	51590.000	54.374%	2.251
x		125.700	7282.000	0.000	4390.000	50740.000	52440.000	54.378%	2.495
σ		1.267	96.130	0.000	76.300	786.400	755.100	0.502%	0.357
%RSD		1.008	1.320	0.000	1.738	1.550	1.440	0.924	14.320

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	0.790	0.934	727.300	5908.000	6122.000	5.926	6.368	1.322
2	17:19:34	-0.224	0.913	740.200	5929.000	6043.000	5.795	6.369	1.358
3	17:20:18	0.032	0.793	707.100	5653.000	5795.000	5.671	6.194	1.309
x		0.200	0.880	724.900	5830.000	5987.000	5.797	6.310	1.330
σ		0.527	0.076	16.690	153.600	170.900	0.128	0.100	0.025
%RSD		264.200	8.659	2.302	2.634	2.854	2.204	1.592	1.901

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	1.045	11.920	12.720	0.904	-0.367	0.178	0.000	221.800
2	17:19:34	1.050	12.250	11.870	0.671	-0.223	0.344	0.000	222.300
3	17:20:18	1.030	12.000	11.910	0.326	-0.281	0.202	0.000	216.100
x		1.042	12.060	12.170	0.634	-0.290	0.241	0.000	220.100
σ		0.010	0.173	0.482	0.291	0.072	0.090	0.000	3.465
%RSD		0.958	1.438	3.962	45.960	25.000	37.170	0.000	1.575

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	64.105%	0.304	0.326	61.933%	-0.112	-0.116	0.027	0.056
2	17:19:34	65.154%	0.296	0.335	63.313%	-0.103	-0.108	0.061	0.061
3	17:20:18	65.992%	0.304	0.302	63.226%	-0.096	-0.103	-0.034	0.004
x		65.084%	0.301	0.321	62.824%	-0.104	-0.109	0.018	0.040
σ		0.946%	0.004	0.017	0.773%	0.008	0.006	0.048	0.032
%RSD		1.453	1.469	5.251	1.230	7.843	5.885	271.500	78.140

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	66.136%	-0.074	0.056	0.047	94.300	92.640	77.113%	79.467%
2	17:19:34	66.526%	-0.035	0.057	0.075	93.070	93.560	80.745%	82.045%
3	17:20:18	67.616%	-0.061	0.057	0.071	90.740	91.100	82.249%	83.953%
x		66.759%	-0.057	0.057	0.065	92.700	92.430	80.035%	81.822%
σ		0.767%	0.020	0.001	0.015	1.809	1.241	2.640%	2.251%
%RSD		1.149	34.650	1.070	23.220	1.951	1.343	3.299	2.751

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:18:52	0.022	0.022	0.773	0.755	0.741	75.632%
2	17:19:34	0.024	0.023	0.747	0.754	0.760	78.143%
3	17:20:18	0.021	0.022	0.721	0.706	0.729	81.645%
x		0.022	0.022	0.747	0.738	0.743	78.473%
σ		0.001	0.001	0.026	0.028	0.016	3.020%
%RSD		5.524	3.457	3.492	3.782	2.123	3.848

180-26669-G-11-A 11/14/2013 5:22:55 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	59.558%	-0.212	72.060	73.760	0.000	54410.000	13700.000	13830.000
2	17:24:21	54.682%	-0.240	71.880	77.540	0.000	57860.000	14130.000	14250.000
3	17:25:04	54.814%	-0.436	70.340	73.820	0.000	54440.000	13570.000	13480.000
x		56.351%	-0.296	71.430	75.040	0.000	55570.000	13800.000	13850.000
σ		2.778%	0.122	0.945	2.163	0.000	1987.000	293.200	384.000
%RSD		4.929	41.200	1.323	2.882	0.000	3.576	2.125	2.772

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	13.910	4633.000	0.000	4551.000	54370.000	55030.000	53.764%	0.589
2	17:24:21	14.790	4833.000	0.000	4543.000	53730.000	55420.000	52.856%	0.511
3	17:25:04	14.670	4637.000	0.000	4308.000	51530.000	53550.000	52.600%	0.587
x		14.450	4701.000	0.000	4468.000	53210.000	54670.000	53.074%	0.563
σ		0.473	114.300	0.000	137.900	1490.000	988.200	0.612%	0.044
%RSD		3.273	2.432	0.000	3.087	2.799	1.808	1.152	7.909

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	0.094	0.768	14.810	17.150	200.500	0.429	4.933	1.834
2	17:24:21	0.630	0.710	14.630	14.610	186.300	0.436	4.852	1.804
3	17:25:04	0.011	0.718	14.060	12.640	180.900	0.420	4.488	1.750
x		0.245	0.732	14.500	14.800	189.300	0.428	4.757	1.796
σ		0.336	0.031	0.391	2.263	10.130	0.008	0.237	0.042
%RSD		137.100	4.268	2.693	15.290	5.353	1.875	4.985	2.362

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	1.735	10.400	10.460	-0.099	1.016	1.354	0.000	242.900
2	17:24:21	1.752	10.390	10.400	-0.018	0.755	1.042	0.000	240.400
3	17:25:04	1.641	9.983	9.820	0.225	0.842	0.820	0.000	231.900
x		1.709	10.260	10.230	0.036	0.871	1.072	0.000	238.400
σ		0.060	0.239	0.356	0.169	0.133	0.268	0.000	5.767
%RSD		3.487	2.333	3.477	467.200	15.210	25.020	0.000	2.419

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	63.428%	0.638	0.707	62.738%	-0.119	-0.114	-0.082	-0.051
2	17:24:21	63.670%	0.661	0.664	62.533%	-0.113	-0.114	-0.065	-0.038
3	17:25:04	64.156%	0.590	0.642	62.329%	-0.102	-0.110	-0.062	-0.052
x		63.751%	0.630	0.671	62.533%	-0.111	-0.113	-0.070	-0.047
σ		0.371%	0.036	0.033	0.204%	0.008	0.002	0.011	0.008
%RSD		0.582	5.733	4.906	0.327	7.375	1.954	15.150	16.370

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	66.832%	-0.104	0.205	0.229	51.240	51.610	79.535%	81.817%
2	17:24:21	66.382%	-0.100	0.232	0.223	51.240	51.230	80.341%	82.581%
3	17:25:04	67.217%	-0.103	0.200	0.198	48.910	48.820	81.991%	84.574%
x		66.810%	-0.102	0.212	0.217	50.460	50.550	80.623%	82.991%
σ		0.418%	0.002	0.017	0.016	1.344	1.511	1.252%	1.423%
%RSD		0.626	1.936	8.045	7.572	2.664	2.989	1.553	1.715

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:23:38	0.016	0.017	0.046	0.063	0.048	79.703%
2	17:24:21	0.017	0.019	0.059	0.051	0.054	81.628%
3	17:25:04	0.017	0.016	0.050	0.055	0.051	83.554%
x		0.017	0.017	0.052	0.056	0.051	81.628%
σ		0.001	0.001	0.007	0.006	0.003	1.926%
%RSD		4.924	7.979	13.310	10.460	5.764	2.359

CCV 993939 11/14/2013 5:27:41 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	87.931%	102.500	98.660	96.520	0.000	50190.000	50030.000	48910.000
2	17:29:07	85.952%	104.600	97.190	97.960	0.000	50630.000	49910.000	49650.000
3	17:29:50	86.072%	108.700	103.600	99.220	0.000	50760.000	50570.000	51130.000
x		86.652%	105.255%	99.824%	97.902%	0.000	101.046%	100.340%	99.790%
σ		1.110%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		1.281	3.025	3.380	1.378	0.000	0.593	0.706	2.267

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	501.300	4891.000	0.000	50420.000	51490.000	51290.000	76.280%	99.250
2	17:29:07	493.700	4996.000	0.000	50180.000	51390.000	51250.000	77.458%	99.030
3	17:29:50	519.000	5142.000	0.000	53250.000	53630.000	53450.000	78.081%	102.500
x		100.932%	100.196%	0.000	102.567%	104.338%	103.989%	77.273%	100.267%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.915%	n/a
%RSD		2.569	2.510	0.000	3.335	2.425	2.423	1.184	1.946

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	101.900	103.100	510.900	25670.000	25440.000	101.600	101.900	102.900
2	17:29:07	103.900	104.500	508.000	25490.000	25600.000	102.400	102.400	102.700
3	17:29:50	107.600	108.000	530.100	26670.000	26320.000	105.900	106.000	106.300
x		104.478%	105.176%	103.263%	103.773%	103.153%	103.278%	103.411%	103.948%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		2.751	2.436	2.323	2.442	1.826	2.226	2.199	1.932

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	102.400	103.000	102.800	102.000	105.100	103.700	0.000	97.530
2	17:29:07	103.200	104.100	103.100	102.300	105.200	103.900	0.000	98.150
3	17:29:50	106.100	107.500	107.000	103.900	108.100	109.000	0.000	101.100
x		103.861%	104.856%	104.315%	102.719%	106.103%	105.536%	0.000	98.930%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		1.875	2.225	2.249	0.987	1.595	2.869	0.000	1.936

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	79.606%	97.250	99.910	73.322%	106.200	106.900	105.200	106.100
2	17:29:07	81.490%	99.230	102.600	74.820%	106.300	105.700	105.900	106.500
3	17:29:50	81.585%	103.600	105.000	75.457%	108.900	109.400	108.300	108.600
x		80.893%	100.038%	102.473%	74.533%	107.167%	107.307%	106.466%	107.053%
σ		1.116%	n/a	n/a	1.096%	n/a	n/a	n/a	n/a
%RSD		1.380	3.269	2.461	1.470	1.418	1.753	1.554	1.278

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	74.993%	98.770	100.100	99.970	102.200	102.400	79.238%	80.109%
2	17:29:07	77.035%	98.560	99.660	100.600	101.900	102.100	81.606%	82.217%
3	17:29:50	77.530%	103.000	103.700	102.900	105.000	106.000	81.359%	82.038%
x		76.519%	100.112%	101.135%	101.160%	103.043%	103.495%	80.734%	81.455%
σ		1.345%	n/a	n/a	n/a	n/a	n/a	1.302%	1.169%
%RSD		1.758	2.514	2.189	1.507	1.651	2.128	1.613	1.435

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:28:24	101.100	102.500	103.700	104.300	104.400	75.689%
2	17:29:07	102.700	103.600	105.200	105.500	105.500	76.801%
3	17:29:50	105.400	106.500	108.300	108.300	108.500	77.095%
x		103.081%	104.188%	105.716%	106.033%	106.123%	76.529%
σ		n/a	n/a	n/a	n/a	n/a	0.742%
%RSD		2.122	2.019	2.229	1.949	1.968	0.969

CCB5 11/14/2013 5:35:52 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	99.485%	-0.346	0.434	0.739	0.000	-1.244	0.682	0.571
2	17:37:18	101.224%	-0.333	0.556	0.359	0.000	-1.389	0.595	0.603
3	17:38:01	96.948%	-0.396	0.690	0.448	0.000	-1.276	0.594	0.500
x		99.219%	-0.359	0.560	0.515	0.000	-1.303	0.624	0.558
σ		2.150%	0.033	0.128	0.199	0.000	0.077	0.051	0.053
%RSD		2.167	9.250	22.820	38.530	0.000	5.876	8.097	9.430
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	0.031	-0.858	0.000	1.046	-0.124	-0.598	91.457%	0.047
2	17:37:18	-0.005	-0.997	0.000	-0.209	-0.097	-0.799	89.979%	0.030
3	17:38:01	0.025	-0.978	0.000	-0.375	0.380	0.102	89.908%	0.016
x		0.017	-0.944	0.000	0.154	0.053	-0.432	90.448%	0.031
σ		0.019	0.076	0.000	0.777	0.283	0.473	0.875%	0.016
%RSD		113.200	8.029	0.000	505.700	537.400	109.600	0.967	51.190
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	-0.003	-0.036	0.081	-0.580	1.602	0.003	0.001	-0.021
2	17:37:18	0.035	-0.044	0.071	-0.108	1.141	0.002	-0.018	-0.012
3	17:38:01	-0.012	-0.028	0.064	-1.019	1.057	0.002	-0.015	-0.019
x		0.007	-0.036	0.072	-0.569	1.267	0.002	-0.011	-0.017
σ		0.025	0.008	0.008	0.456	0.293	0.001	0.010	0.005
%RSD		374.900	22.230	11.370	80.080	23.170	38.680	95.950	29.000
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	0.000	-0.128	-0.109	-0.035	-0.141	-0.060	0.000	0.002
2	17:37:18	-0.010	-0.064	-0.068	-0.116	-0.159	-0.406	0.000	0.001
3	17:38:01	0.010	-0.019	-0.109	-0.044	-0.071	-0.153	0.000	0.002
x		0.000	-0.070	-0.095	-0.065	-0.124	-0.206	0.000	0.002
σ		0.010	0.055	0.023	0.044	0.047	0.179	0.000	0.000
%RSD		19990.000	77.800	24.420	68.630	37.790	86.800	0.000	12.880
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	87.499%	0.076	0.052	88.147%	-0.108	-0.107	0.001	-0.001
2	17:37:18	88.645%	0.059	0.030	88.871%	-0.110	-0.108	0.048	0.030
3	17:38:01	88.902%	0.011	0.015	89.209%	-0.107	-0.104	-0.011	-0.008
x		88.349%	0.049	0.033	88.742%	-0.108	-0.106	0.013	0.007
σ		0.747%	0.033	0.019	0.543%	0.001	0.002	0.031	0.020
%RSD		0.846	68.910	56.870	0.611	1.307	1.924	239.700	299.500
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:36:35	87.628%	-0.168	-0.042	-0.044	0.004	-0.006	87.236%	87.089%
2	17:37:18	89.168%	-0.180	-0.037	-0.044	-0.017	-0.004	88.781%	89.455%
3	17:38:01	88.806%	-0.209	-0.046	-0.051	-0.012	-0.013	89.839%	89.751%
x		88.534%	-0.186	-0.042	-0.046	-0.008	-0.008	88.619%	88.765%
σ		0.805%	0.021	0.004	0.004	0.011	0.004	1.309%	1.459%
%RSD		0.909	11.440	10.460	9.641	128.100	59.740	1.477	1.644
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	17:36:35	0.011	0.010	0.027	0.030	0.024	87.717%		
2	17:37:18	0.013	0.010	0.023	0.024	0.023	89.398%		
3	17:38:01	0.011	0.009	0.029	0.023	0.026	88.880%		
x		0.012	0.010	0.026	0.026	0.024	88.665%		
σ		0.001	0.001	0.003	0.003	0.001	0.861%		
%RSD		12.170	9.139	12.440	13.450	6.057	0.971		

180-26669-E-14-A 11/14/2013 5:40:41 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	69.123%	-0.366	36.470	40.130	0.000	25550.000	7396.000	7450.000
2	17:42:07	64.811%	-0.365	39.220	40.140	0.000	26130.000	7504.000	7471.000
3	17:42:50	63.554%	-0.353	35.720	39.660	0.000	26250.000	7699.000	7690.000
x		65.829%	-0.361	37.130	39.970	0.000	25980.000	7533.000	7537.000
σ		2.921%	0.007	1.844	0.276	0.000	373.100	153.800	132.600
%RSD		4.437	1.950	4.965	0.691	0.000	1.436	2.042	1.759
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	9.949	3520.000	0.000	4892.000	28970.000	29270.000	59.073%	0.660
2	17:42:07	9.568	3529.000	0.000	4824.000	28800.000	29240.000	57.527%	0.672
3	17:42:50	10.070	3621.000	0.000	4718.000	28710.000	29510.000	57.048%	0.596
x		9.862	3557.000	0.000	4811.000	28830.000	29340.000	57.883%	0.643
σ		0.262	55.980	0.000	87.400	129.400	147.700	1.058%	0.041
%RSD		2.652	1.574	0.000	1.817	0.449	0.504	1.828	6.391
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	0.423	0.838	226.800	214.500	308.400	0.822	2.910	1.802
2	17:42:07	0.210	0.803	222.500	204.900	299.400	0.826	2.677	1.757
3	17:42:50	0.896	0.694	222.100	202.400	291.200	0.810	2.677	1.709
x		0.510	0.778	223.800	207.300	299.700	0.819	2.755	1.756
σ		0.351	0.075	2.617	6.396	8.573	0.008	0.134	0.047
%RSD		68.940	9.630	1.169	3.086	2.861	1.000	4.879	2.652
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	1.873	4.628	4.303	-0.158	-0.073	0.454	0.000	132.500
2	17:42:07	1.843	4.359	4.603	0.171	-0.156	-0.113	0.000	132.500
3	17:42:50	1.666	4.612	4.492	0.147	-0.228	0.118	0.000	133.400
x		1.794	4.533	4.466	0.053	-0.153	0.153	0.000	132.800
σ		0.112	0.151	0.151	0.184	0.077	0.285	0.000	0.512
%RSD		6.236	3.324	3.387	344.700	50.750	186.400	0.000	0.386
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	68.917%	1.346	1.399	68.535%	-0.113	-0.111	-0.065	-0.037
2	17:42:07	68.837%	1.349	1.360	68.095%	-0.111	-0.106	-0.069	-0.050
3	17:42:50	68.113%	1.328	1.403	67.502%	-0.110	-0.104	-0.072	-0.049
x		68.622%	1.341	1.387	68.044%	-0.111	-0.107	-0.069	-0.045
σ		0.443%	0.012	0.024	0.518%	0.001	0.004	0.004	0.007
%RSD		0.646	0.871	1.706	0.762	1.315	3.414	5.612	15.650
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:41:24	71.318%	0.229	0.381	0.368	53.100	53.050	81.712%	83.437%
2	17:42:07	70.955%	0.103	0.379	0.369	53.060	53.370	82.666%	85.383%
3	17:42:50	70.660%	0.033	0.361	0.376	52.970	52.910	82.724%	85.022%
x		70.977%	0.122	0.374	0.371	53.050	53.110	82.367%	84.614%
σ		0.330%	0.100	0.011	0.005	0.065	0.235	0.568%	1.035%
%RSD		0.464	81.980	2.918	1.252	0.122	0.443	0.690	1.224
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	17:41:24	0.009	0.013	0.420	0.403	0.400	82.693%		
2	17:42:07	0.007	0.007	0.396	0.421	0.408	84.585%		
3	17:42:50	0.006	0.003	0.413	0.433	0.412	84.670%		
x		0.007	0.008	0.410	0.419	0.407	83.983%		
σ		0.001	0.005	0.013	0.015	0.006	1.118%		
%RSD		20.200	63.040	3.061	3.694	1.537	1.331		

180-26669-E-15-A 11/14/2013 5:45:28 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	67.383%	-0.320	32.640	33.860	0.000	21620.000	6785.000	6946.000
2	17:46:54	60.178%	-0.276	33.480	35.010	0.000	23020.000	7068.000	7044.000
3	17:47:37	58.982%	-0.327	31.370	34.430	0.000	21470.000	5774.000	6926.000
x		62.181%	-0.308	32.490	34.430	0.000	22040.000	6542.000	6972.000
σ		4.545%	0.027	1.061	0.575	0.000	852.500	680.400	63.160
%RSD		7.309	8.882	3.266	1.670	0.000	3.869	10.400	0.906

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	12.760	3346.000	0.000	4523.000	27620.000	27900.000	57.122%	0.648
2	17:46:54	13.390	3419.000	0.000	4459.000	27350.000	27810.000	55.590%	0.768
3	17:47:37	12.530	3369.000	0.000	4358.000	26740.000	27630.000	55.337%	0.609
x		12.900	3378.000	0.000	4447.000	27240.000	27780.000	56.016%	0.675
σ		0.446	37.340	0.000	83.150	450.700	135.100	0.966%	0.083
%RSD		3.459	1.105	0.000	1.870	1.655	0.486	1.724	12.250

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	1.478	0.764	226.300	343.100	443.000	0.993	2.773	1.731
2	17:46:54	0.502	0.713	227.000	348.300	442.800	0.945	2.661	1.615
3	17:47:37	0.688	1.132	224.000	344.700	429.600	0.922	2.471	1.623
x		0.889	0.870	225.800	345.400	438.500	0.953	2.635	1.656
σ		0.518	0.229	1.568	2.655	7.721	0.036	0.153	0.065
%RSD		58.280	26.270	0.694	0.769	1.761	3.799	5.795	3.933

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	1.570	4.166	4.353	0.446	-0.274	-0.179	0.000	123.300
2	17:46:54	1.653	4.240	4.259	0.444	-0.273	-0.386	0.000	123.700
3	17:47:37	1.627	4.100	4.104	0.359	-0.136	-0.317	0.000	123.600
x		1.617	4.169	4.239	0.416	-0.228	-0.294	0.000	123.500
σ		0.042	0.070	0.126	0.050	0.079	0.105	0.000	0.222
%RSD		2.618	1.685	2.969	11.970	34.810	35.810	0.000	0.180

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	66.025%	1.190	1.256	65.567%	-0.113	-0.116	-0.086	-0.067
2	17:46:54	65.985%	1.176	1.238	65.901%	-0.110	-0.112	-0.086	-0.058
3	17:47:37	65.497%	1.127	1.257	64.641%	-0.111	-0.106	-0.106	-0.085
x		65.836%	1.164	1.251	65.370%	-0.111	-0.112	-0.093	-0.070
σ		0.294%	0.033	0.011	0.653%	0.001	0.005	0.011	0.014
%RSD		0.446	2.846	0.851	0.999	1.341	4.488	12.080	19.290

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	68.814%	-0.048	0.380	0.396	43.880	44.010	80.190%	81.561%
2	17:46:54	69.412%	-0.058	0.362	0.398	43.940	43.240	81.088%	83.239%
3	17:47:37	68.542%	-0.072	0.402	0.368	43.740	43.460	82.796%	85.022%
x		68.923%	-0.060	0.381	0.388	43.850	43.570	81.358%	83.274%
σ		0.445%	0.012	0.020	0.017	0.100	0.397	1.324%	1.731%
%RSD		0.646	20.560	5.324	4.326	0.228	0.910	1.627	2.079

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:46:11	0.004	0.006	0.631	0.670	0.652	80.554%
2	17:46:54	-0.001	0.006	0.639	0.663	0.651	83.023%
3	17:47:37	0.006	0.005	0.653	0.628	0.636	84.971%
x		0.003	0.006	0.641	0.654	0.646	82.849%
σ		0.004	0.000	0.011	0.022	0.009	2.213%
%RSD		112.200	6.399	1.666	3.428	1.360	2.672

180-26669-E-16-A 11/14/2013 5:50:16 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	62.277%	-0.310	37.250	36.690	0.000	23310.000	6952.000	7027.000
2	17:51:41	60.423%	-0.276	34.760	37.500	0.000	23500.000	7030.000	7156.000
3	17:52:24	59.268%	-0.331	35.410	36.850	0.000	23280.000	7035.000	7141.000
x		60.656%	-0.306	35.810	37.010	0.000	23360.000	7006.000	7108.000
σ		1.518%	0.028	1.291	0.429	0.000	118.000	46.660	70.720
%RSD		2.503	9.021	3.604	1.159	0.000	0.505	0.666	0.995
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	15.040	3457.000	0.000	4576.000	27540.000	27610.000	55.966%	0.993
2	17:51:41	14.960	3482.000	0.000	4610.000	27420.000	28220.000	53.364%	0.803
3	17:52:24	14.590	3402.000	0.000	4483.000	26560.000	27740.000	53.627%	0.847
x		14.860	3447.000	0.000	4556.000	27170.000	27850.000	54.319%	0.881
σ		0.241	40.860	0.000	65.670	533.500	321.700	1.432%	0.100
%RSD		1.621	1.185	0.000	1.441	1.964	1.155	2.637	11.330
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	0.017	0.871	233.900	319.200	400.000	0.883	2.624	1.737
2	17:51:41	0.083	0.846	236.900	319.500	407.600	0.885	2.837	1.645
3	17:52:24	1.366	0.773	233.400	319.000	401.600	0.899	2.684	1.654
x		0.489	0.830	234.800	319.300	403.000	0.889	2.715	1.679
σ		0.761	0.051	1.910	0.247	3.998	0.009	0.110	0.051
%RSD		155.500	6.109	0.814	0.077	0.992	0.972	4.037	3.031
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	1.686	3.845	3.397	0.857	-0.513	-0.051	0.000	122.200
2	17:51:41	1.649	3.987	4.024	0.231	-0.309	-0.005	0.000	122.500
3	17:52:24	1.596	3.758	3.707	0.764	-0.388	-0.121	0.000	123.200
x		1.643	3.863	3.709	0.617	-0.403	-0.059	0.000	122.700
σ		0.045	0.116	0.314	0.338	0.103	0.058	0.000	0.512
%RSD		2.763	2.998	8.457	54.760	25.530	98.840	0.000	0.417
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	64.403%	1.273	1.260	64.426%	-0.113	-0.108	-0.053	-0.035
2	17:51:41	64.379%	1.326	1.250	63.642%	-0.114	-0.102	-0.072	-0.061
3	17:52:24	64.158%	1.262	1.282	63.586%	-0.108	-0.111	-0.086	-0.058
x		64.313%	1.287	1.264	63.884%	-0.112	-0.107	-0.070	-0.051
σ		0.135%	0.035	0.016	0.469%	0.003	0.005	0.016	0.014
%RSD		0.210	2.682	1.269	0.735	2.843	4.366	23.130	27.080
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:50:59	67.514%	-0.071	0.376	0.346	44.820	45.190	79.062%	80.728%
2	17:51:41	67.336%	-0.059	0.376	0.392	46.510	46.230	79.952%	82.163%
3	17:52:24	66.982%	-0.043	0.379	0.387	45.060	45.740	80.752%	83.177%
x		67.277%	-0.058	0.377	0.375	45.460	45.720	79.922%	82.023%
σ		0.271%	0.014	0.002	0.025	0.913	0.522	0.845%	1.231%
%RSD		0.403	24.170	0.515	6.802	2.008	1.141	1.057	1.500
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	17:50:59	0.001	0.002	0.646	0.639	0.642	80.584%		
2	17:51:41	0.004	0.003	0.639	0.669	0.650	82.413%		
3	17:52:24	0.003	0.003	0.630	0.653	0.641	83.242%		
x		0.003	0.003	0.638	0.654	0.644	82.080%		
σ		0.002	0.001	0.008	0.015	0.005	1.360%		
%RSD		70.080	29.250	1.293	2.277	0.838	1.657		

180-26669-E-17-A 11/14/2013 5:55:03 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	63.336%	-0.325	36.600	39.940	0.000	26950.000	7473.000	7547.000
2	17:56:29	57.677%	-0.271	38.810	39.770	0.000	26540.000	7715.000	7664.000
3	17:57:12	56.626%	-0.344	38.560	38.840	0.000	26250.000	7733.000	7878.000
x		59.213%	-0.314	37.990	39.520	0.000	26580.000	7640.000	7696.000
σ		3.609%	0.038	1.213	0.595	0.000	355.400	145.100	168.200
%RSD		6.095	12.100	3.192	1.506	0.000	1.337	1.899	2.185

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	50.620	3481.000	0.000	4613.000	28320.000	29020.000	54.362%	1.551
2	17:56:29	49.270	3462.000	0.000	4526.000	27950.000	28660.000	54.926%	1.816
3	17:57:12	49.040	3559.000	0.000	4665.000	28740.000	29500.000	53.062%	1.582
x		49.640	3501.000	0.000	4601.000	28340.000	29060.000	54.117%	1.650
σ		0.853	50.960	0.000	70.000	393.300	421.700	0.956%	0.145
%RSD		1.719	1.456	0.000	1.521	1.388	1.451	1.766	8.785

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	0.396	0.903	250.100	430.600	513.400	1.033	2.883	2.642
2	17:56:29	0.452	0.859	245.100	435.000	513.700	1.030	2.725	2.537
3	17:57:12	1.448	0.800	244.800	417.100	516.200	1.012	2.742	2.532
x		0.765	0.854	246.700	427.600	514.400	1.025	2.783	2.570
σ		0.592	0.052	2.988	9.323	1.530	0.011	0.087	0.062
%RSD		77.410	6.058	1.211	2.180	0.297	1.076	3.130	2.405

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	2.569	5.153	5.112	0.299	-0.206	0.549	0.000	127.100
2	17:56:29	2.471	4.801	4.825	0.450	-0.494	-0.203	0.000	127.000
3	17:57:12	2.595	4.952	5.039	0.739	-0.159	0.155	0.000	126.800
x		2.545	4.969	4.992	0.496	-0.287	0.167	0.000	127.000
σ		0.065	0.176	0.149	0.223	0.181	0.376	0.000	0.174
%RSD		2.569	3.550	2.990	45.030	63.170	225.000	0.000	0.137

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	64.957%	1.286	1.257	63.981%	-0.121	-0.116	-0.054	-0.045
2	17:56:29	64.910%	1.291	1.240	64.075%	-0.117	-0.115	-0.046	-0.031
3	17:57:12	64.784%	1.312	1.265	63.790%	-0.113	-0.104	-0.075	-0.066
x		64.884%	1.296	1.254	63.949%	-0.117	-0.112	-0.058	-0.047
σ		0.089%	0.014	0.013	0.145%	0.004	0.006	0.015	0.017
%RSD		0.138	1.066	1.016	0.227	3.477	5.690	25.720	36.600

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	67.182%	-0.125	0.365	0.351	47.690	47.790	79.371%	81.253%
2	17:56:29	68.096%	-0.151	0.346	0.380	48.320	48.090	81.153%	83.171%
3	17:57:12	67.543%	-0.115	0.342	0.349	48.130	48.210	81.363%	83.599%
x		67.607%	-0.130	0.351	0.360	48.050	48.030	80.629%	82.675%
σ		0.461%	0.019	0.012	0.017	0.322	0.215	1.094%	1.249%
%RSD		0.681	14.330	3.498	4.813	0.671	0.447	1.357	1.511

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	17:55:46	0.003	0.004	0.817	0.793	0.811	80.968%
2	17:56:29	0.003	0.005	0.768	0.812	0.801	83.493%
3	17:57:12	0.004	0.004	0.808	0.780	0.805	83.896%
x		0.003	0.004	0.798	0.795	0.806	82.786%
σ		0.001	0.001	0.026	0.016	0.005	1.587%
%RSD		16.060	23.200	3.309	2.030	0.643	1.917

180-26669-G-25-B 11/14/2013 5:59:51 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	62.898%	-0.297	59.150	60.920	0.000	53650.000	19280.000	19130.000
2	18:01:17	58.273%	-0.262	58.700	62.010	0.000	54230.000	19940.000	19850.000
3	18:02:00	60.285%	-0.296	59.250	60.570	0.000	52460.000	19190.000	19330.000
x		60.485%	-0.285	59.030	61.160	0.000	53450.000	19470.000	19430.000
σ		2.319%	0.020	0.290	0.750	0.000	904.100	408.900	372.000
%RSD		3.834	7.019	0.492	1.226	0.000	1.691	2.101	1.914

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	12.840	5378.000	0.000	6448.000	60470.000	61580.000	55.896%	0.580
2	18:01:17	12.720	5469.000	0.000	6344.000	60530.000	62270.000	54.823%	0.436
3	18:02:00	12.570	5258.000	0.000	6261.000	60010.000	61090.000	54.572%	0.721
x		12.710	5368.000	0.000	6351.000	60340.000	61650.000	55.097%	0.579
σ		0.137	106.200	0.000	93.500	283.500	591.400	0.703%	0.142
%RSD		1.081	1.979	0.000	1.472	0.470	0.959	1.276	24.620

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	-0.170	0.840	12.390	25.310	233.000	0.140	1.254	1.659
2	18:01:17	0.298	0.904	12.700	24.500	222.400	0.137	1.206	1.543
3	18:02:00	-0.294	0.907	12.310	22.910	208.300	0.136	0.991	1.656
x		-0.055	0.884	12.470	24.240	221.200	0.138	1.150	1.619
σ		0.312	0.038	0.205	1.222	12.400	0.002	0.140	0.066
%RSD		564.700	4.258	1.644	5.041	5.603	1.511	12.140	4.092

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	1.546	10.260	9.785	-0.296	-0.048	0.020	0.000	369.400
2	18:01:17	1.521	10.700	10.250	-0.459	-0.004	0.263	0.000	368.600
3	18:02:00	1.536	10.110	9.503	-0.213	0.031	0.424	0.000	361.200
x		1.534	10.350	9.847	-0.323	-0.007	0.236	0.000	366.400
σ		0.012	0.305	0.378	0.125	0.039	0.203	0.000	4.485
%RSD		0.794	2.942	3.838	38.710	559.700	86.110	0.000	1.224

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	65.162%	0.417	0.418	63.068%	-0.119	-0.111	-0.071	-0.053
2	18:01:17	64.989%	0.427	0.399	63.700%	-0.112	-0.110	-0.085	-0.052
3	18:02:00	65.264%	0.438	0.414	63.925%	-0.115	-0.110	-0.038	-0.030
x		65.139%	0.427	0.410	63.564%	-0.115	-0.110	-0.065	-0.045
σ		0.139%	0.011	0.010	0.445%	0.004	0.000	0.024	0.013
%RSD		0.213	2.461	2.472	0.700	3.156	0.293	36.950	29.200

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	66.927%	-0.164	0.096	0.086	134.100	134.500	78.720%	80.478%
2	18:01:17	67.340%	-0.129	0.082	0.106	135.200	135.100	80.408%	82.533%
3	18:02:00	67.704%	-0.147	0.091	0.101	133.800	133.600	81.648%	84.059%
x		67.324%	-0.146	0.090	0.097	134.400	134.400	80.259%	82.357%
σ		0.389%	0.017	0.007	0.011	0.757	0.766	1.470%	1.797%
%RSD		0.577	11.900	7.747	10.830	0.563	0.570	1.831	2.182

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	18:00:34	0.013	0.017	0.194	0.199	0.198	78.034%
2	18:01:17	0.012	0.016	0.209	0.180	0.194	80.867%
3	18:02:00	0.014	0.018	0.191	0.180	0.183	83.021%
x		0.013	0.017	0.198	0.187	0.192	80.641%
σ		0.001	0.001	0.010	0.011	0.008	2.501%
%RSD		7.958	4.809	5.060	5.936	4.166	3.102

180-26669-G-25-B SD@5 11/14/2013 6:04:39 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	76.623%	-0.372	12.090	12.320	0.000	10700.000	3711.000	3612.000
2	18:06:05	75.409%	-0.330	11.440	12.040	0.000	10680.000	3740.000	3718.000
3	18:06:48	75.689%	-0.404	11.350	12.040	0.000	10920.000	3823.000	3731.000
x		75.907%	-0.368	11.630	12.130	0.000	10770.000	3758.000	3687.000
σ		0.636%	0.037	0.406	0.161	0.000	130.700	57.750	65.690
%RSD		0.838	9.974	3.489	1.325	0.000	1.214	1.537	1.782
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	3.170	1062.000	0.000	1231.000	11230.000	10980.000	70.676%	0.133
2	18:06:05	3.190	1049.000	0.000	1222.000	11480.000	11060.000	69.998%	0.067
3	18:06:48	3.429	1078.000	0.000	1255.000	11820.000	11380.000	69.573%	0.167
x		3.263	1063.000	0.000	1236.000	11510.000	11140.000	70.083%	0.122
σ		0.144	14.700	0.000	17.160	297.200	210.800	0.556%	0.051
%RSD		4.424	1.383	0.000	1.389	2.582	1.893	0.794	41.430
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	0.055	0.188	2.405	-1.359	46.070	0.030	0.190	0.301
2	18:06:05	-0.129	0.206	2.406	-2.231	43.370	0.028	0.252	0.292
3	18:06:48	-0.384	0.186	2.494	-0.789	47.000	0.029	0.207	0.328
x		-0.152	0.193	2.435	-1.460	45.480	0.029	0.216	0.307
σ		0.220	0.011	0.051	0.726	1.884	0.001	0.032	0.019
%RSD		144.600	5.571	2.088	49.770	4.143	4.154	14.740	6.072
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	0.317	2.153	2.113	0.005	-0.299	-0.093	0.000	72.680
2	18:06:05	0.275	2.426	2.377	-0.004	-0.388	-0.262	0.000	73.780
3	18:06:48	0.277	2.292	2.175	-0.223	-0.515	-0.556	0.000	73.800
x		0.290	2.291	2.222	-0.074	-0.401	-0.304	0.000	73.420
σ		0.024	0.136	0.138	0.129	0.109	0.234	0.000	0.639
%RSD		8.118	5.948	6.225	174.800	27.070	77.030	0.000	0.870
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	73.329%	0.017	-0.011	73.997%	-0.114	-0.112	-0.064	-0.044
2	18:06:05	73.826%	0.011	0.015	73.983%	-0.114	-0.114	-0.099	-0.069
3	18:06:48	74.969%	0.019	0.007	73.744%	-0.113	-0.109	-0.057	-0.046
x		74.041%	0.016	0.004	73.908%	-0.114	-0.112	-0.073	-0.053
σ		0.841%	0.004	0.014	0.142%	0.001	0.002	0.023	0.014
%RSD		1.136	26.940	363.800	0.192	0.806	2.090	30.950	26.500
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:05:22	76.320%	-0.190	-0.037	-0.026	26.680	26.870	83.898%	84.927%
2	18:06:05	76.721%	-0.213	-0.023	-0.044	26.920	27.070	84.892%	86.808%
3	18:06:48	76.595%	-0.215	-0.023	-0.032	27.120	27.080	84.911%	86.647%
x		76.545%	-0.206	-0.027	-0.034	26.910	27.010	84.567%	86.127%
σ		0.205%	0.014	0.008	0.009	0.222	0.120	0.580%	1.043%
%RSD		0.268	6.564	30.340	27.050	0.827	0.446	0.686	1.211
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	18:05:22	0.002	0.003	0.048	0.046	0.044	84.457%		
2	18:06:05	0.001	0.004	0.040	0.047	0.042	85.906%		
3	18:06:48	-0.000	0.003	0.035	0.046	0.040	86.068%		
x		0.001	0.003	0.041	0.046	0.042	85.477%		
σ		0.001	0.001	0.007	0.001	0.002	0.887%		
%RSD		168.100	28.240	16.250	1.939	3.900	1.038		

180-26669-A-25-A MS 11/14/2013 6:09:28 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	63.102%	50.520	1039.000	1058.000	0.000	104200.000	72700.000	73100.000
2	18:10:54	60.117%	51.510	1004.000	1033.000	0.000	104300.000	74230.000	74470.000
3	18:11:37	57.139%	51.750	1063.000	1077.000	0.000	107600.000	77340.000	77210.000
x		60.119%	51.260	1035.000	1056.000	0.000	105400.000	74760.000	74930.000
σ		2.981%	0.651	29.390	21.880	0.000	1946.000	2365.000	2092.000
%RSD		4.959	1.270	2.839	2.072	0.000	1.847	3.164	2.792

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	2164.000	16350.000	0.000	57900.000	115800.000	118100.000	57.481%	1087.000
2	18:10:54	2142.000	15950.000	0.000	56930.000	115600.000	118800.000	55.478%	1095.000
3	18:11:37	2227.000	16690.000	0.000	59360.000	120500.000	124500.000	52.514%	1111.000
x		2178.000	16330.000	0.000	58060.000	117300.000	120500.000	55.158%	1098.000
σ		44.140	368.600	0.000	1227.000	2759.000	3506.000	2.499%	12.060
%RSD		2.027	2.257	0.000	2.112	2.352	2.910	4.530	1.098

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	570.700	222.100	577.300	1166.000	1527.000	521.800	507.100	253.700
2	18:10:54	572.400	221.200	586.300	1176.000	1508.000	523.600	516.700	256.800
3	18:11:37	581.300	228.200	601.100	1199.000	1543.000	536.500	517.900	259.600
x		574.800	223.800	588.300	1180.000	1526.000	527.300	513.900	256.700
σ		5.701	3.846	12.030	16.960	17.480	8.050	5.916	2.950
%RSD		0.992	1.718	2.045	1.437	1.146	1.527	1.151	1.149

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	261.000	549.300	540.600	42.130	11.680	12.230	0.000	1409.000
2	18:10:54	259.700	547.200	543.100	42.890	11.170	12.160	0.000	1414.000
3	18:11:37	262.800	556.600	553.200	43.100	11.250	12.430	0.000	1437.000
x		261.200	551.000	545.600	42.710	11.360	12.270	0.000	1420.000
σ		1.587	4.898	6.667	0.511	0.275	0.137	0.000	14.850
%RSD		0.608	0.889	1.222	1.197	2.423	1.117	0.000	1.046

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	64.885%	1037.000	1064.000	62.214%	53.080	53.150	55.260	48.610
2	18:10:54	65.812%	1052.000	1076.000	62.729%	53.490	52.520	54.990	48.620
3	18:11:37	65.173%	1056.000	1096.000	62.179%	53.870	53.420	55.360	49.340
x		65.290%	1048.000	1079.000	62.374%	53.480	53.030	55.200	48.850
σ		0.475%	10.130	16.200	0.308%	0.393	0.462	0.190	0.417
%RSD		0.727	0.967	1.501	0.493	0.734	0.871	0.345	0.854

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	66.124%	2068.000	524.700	523.600	1364.000	2219.000	78.147%	80.173%
2	18:10:54	67.438%	2066.000	521.700	524.300	1386.000	2221.000	80.372%	82.022%
3	18:11:37	65.983%	2109.000	533.300	540.100	1292.000	2267.000	80.302%	82.173%
x		66.515%	2081.000	526.600	529.300	1347.000	2236.000	79.607%	81.456%
σ		0.803%	24.450	6.030	9.346	49.170	27.360	1.265%	1.114%
%RSD		1.207	1.175	1.145	1.766	3.649	1.224	1.589	1.368

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	18:10:11	50.610	51.890	21.430	23.070	22.340	74.261%
2	18:10:54	51.570	52.530	21.400	23.110	22.310	77.129%
3	18:11:37	52.680	53.880	22.000	23.670	22.860	76.852%
x		51.620	52.770	21.610	23.280	22.500	76.080%
σ		1.033	1.014	0.339	0.333	0.308	1.582%
%RSD		2.002	1.922	1.568	1.429	1.369	2.079

180-26669-A-25-B MSD 11/14/2013 6:14:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	60.996%	50.390	996.800	1033.000	0.000	105200.000	73220.000	73030.000
2	18:15:41	59.058%	49.810	1011.000	1038.000	0.000	104900.000	73330.000	72550.000
3	18:16:24	57.242%	51.030	1043.000	1045.000	0.000	106400.000	75180.000	75620.000
x		59.099%	50.410	1017.000	1039.000	0.000	105500.000	73910.000	73740.000
σ		1.877%	0.612	23.450	6.042	0.000	845.800	1100.000	1654.000
%RSD		3.176	1.213	2.306	0.582	0.000	0.802	1.488	2.243
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	2092.000	15920.000	0.000	56740.000	114300.000	118000.000	55.635%	1048.000
2	18:15:41	2102.000	15920.000	0.000	55440.000	113100.000	117100.000	54.907%	1043.000
3	18:16:24	2173.000	16270.000	0.000	55760.000	116100.000	118700.000	53.289%	1067.000
x		2123.000	16040.000	0.000	55980.000	114500.000	117900.000	54.610%	1053.000
σ		43.720	202.300	0.000	678.600	1504.000	827.000	1.201%	12.220
%RSD		2.060	1.262	0.000	1.212	1.314	0.701	2.199	1.160
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	536.000	217.900	572.700	1135.000	1512.000	364.300	503.800	251.100
2	18:15:41	535.200	216.100	571.800	1141.000	1496.000	450.500	494.100	246.900
3	18:16:24	540.900	217.500	571.900	1152.000	1506.000	463.200	501.900	254.200
x		537.300	217.200	572.100	1143.000	1505.000	426.000	499.900	250.700
σ		3.102	0.959	0.501	8.780	7.992	53.810	5.135	3.656
%RSD		0.577	0.441	0.088	0.768	0.531	12.630	1.027	1.458
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	252.700	527.400	521.700	40.130	11.240	11.290	0.000	1389.000
2	18:15:41	249.900	527.400	524.800	40.890	11.640	11.560	0.000	1389.000
3	18:16:24	255.300	537.300	531.400	41.070	11.060	11.740	0.000	1394.000
x		252.600	530.700	526.000	40.700	11.310	11.530	0.000	1391.000
σ		2.715	5.728	4.985	0.496	0.297	0.226	0.000	2.617
%RSD		1.075	1.079	0.948	1.218	2.625	1.956	0.000	0.188
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	63.514%	1023.000	1041.000	60.873%	52.790	51.950	54.150	48.100
2	18:15:41	63.400%	1028.000	1059.000	60.616%	52.340	51.770	52.830	47.700
3	18:16:24	63.527%	1031.000	1052.000	60.091%	52.140	52.330	53.960	48.270
x		63.480%	1027.000	1051.000	60.527%	52.420	52.020	53.640	48.020
σ		0.070%	4.181	9.007	0.398%	0.336	0.283	0.711	0.294
%RSD		0.110	0.407	0.857	0.658	0.640	0.545	1.326	0.613
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:14:58	63.979%	2032.000	515.700	517.500	1902.000	2185.000	76.446%	78.168%
2	18:15:41	65.114%	2035.000	511.200	513.100	1698.000	2164.000	78.109%	79.534%
3	18:16:24	65.046%	2030.000	511.700	515.400	1282.000	2179.000	78.184%	80.171%
x		64.713%	2032.000	512.900	515.300	1627.000	2176.000	77.580%	79.291%
σ		0.637%	2.741	2.494	2.179	315.900	10.560	0.982%	1.023%
%RSD		0.984	0.135	0.486	0.423	19.410	0.485	1.266	1.290
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	18:14:58	50.860	51.570	21.080	22.780	21.930	72.602%		
2	18:15:41	51.570	52.630	21.290	23.060	22.070	74.414%		
3	18:16:24	51.610	52.810	21.410	22.790	22.070	74.884%		
x		51.350	52.330	21.260	22.880	22.030	73.967%		
σ		0.421	0.672	0.167	0.158	0.080	1.205%		
%RSD		0.820	1.284	0.784	0.692	0.361	1.629		

180-26669-G-25-B PDS 11/14/2013 6:19:01 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	61.038%	49.700	1028.000	1024.000	0.000	100700.000	71130.000	70550.000
2	18:20:27	57.662%	49.350	997.000	1034.000	0.000	103000.000	72990.000	72110.000
3	18:21:10	57.057%	48.070	1000.000	1026.000	0.000	100200.000	71790.000	71070.000
x		58.586%	49.040	1009.000	1028.000	0.000	101300.000	71970.000	71240.000
σ		2.145%	0.859	17.230	5.093	0.000	1504.000	943.200	793.200
%RSD		3.662	1.751	1.709	0.495	0.000	1.485	1.311	1.113
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	2067.000	15620.000	0.000	55940.000	110900.000	113100.000	54.855%	1042.000
2	18:20:27	2102.000	15620.000	0.000	56050.000	113100.000	114800.000	53.162%	1034.000
3	18:21:10	2078.000	15560.000	0.000	54970.000	110400.000	114000.000	52.283%	1029.000
x		2082.000	15600.000	0.000	55650.000	111500.000	114000.000	53.433%	1035.000
σ		18.160	36.910	0.000	592.200	1407.000	831.700	1.307%	6.525
%RSD		0.872	0.237	0.000	1.064	1.262	0.730	2.446	0.631
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	543.500	213.600	547.200	1113.000	1465.000	407.400	501.500	249.000
2	18:20:27	533.700	213.100	547.900	1099.000	1451.000	471.700	496.000	246.400
3	18:21:10	513.500	212.400	549.400	1097.000	1406.000	452.800	491.400	248.700
x		530.200	213.000	548.100	1103.000	1441.000	444.000	496.300	248.000
σ		15.310	0.596	1.123	8.785	30.550	33.070	5.101	1.417
%RSD		2.887	0.280	0.205	0.797	2.121	7.448	1.028	0.571
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	252.800	536.100	533.600	41.250	11.140	12.510	0.000	1354.000
2	18:20:27	249.700	533.700	527.700	41.430	11.290	11.920	0.000	1370.000
3	18:21:10	254.200	537.000	529.200	41.310	11.270	11.570	0.000	1357.000
x		252.200	535.600	530.200	41.330	11.240	12.000	0.000	1360.000
σ		2.300	1.709	3.083	0.091	0.083	0.476	0.000	8.313
%RSD		0.912	0.319	0.582	0.221	0.740	3.966	0.000	0.611
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	62.577%	998.300	1020.000	60.190%	51.640	51.570	53.010	47.490
2	18:20:27	62.047%	1006.000	1026.000	59.929%	51.670	51.140	52.910	47.960
3	18:21:10	62.166%	1014.000	1035.000	59.467%	51.960	51.320	53.120	47.660
x		62.264%	1006.000	1027.000	59.862%	51.760	51.340	53.020	47.700
σ		0.278%	8.000	7.220	0.366%	0.180	0.218	0.104	0.242
%RSD		0.447	0.795	0.703	0.611	0.349	0.424	0.196	0.507
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	18:19:44	63.897%	2001.000	493.100	497.900	1959.000	2122.000	76.040%	77.311%
2	18:20:27	64.275%	1996.000	496.400	500.400	1879.000	2126.000	77.485%	79.443%
3	18:21:10	63.757%	2003.000	503.600	502.700	2026.000	2132.000	77.825%	79.407%
x		63.976%	2000.000	497.700	500.300	1955.000	2127.000	77.117%	78.720%
σ		0.268%	3.715	5.383	2.392	73.430	4.728	0.948%	1.220%
%RSD		0.419	0.186	1.082	0.478	3.757	0.222	1.229	1.550
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	18:19:44	51.750	52.740	20.680	21.910	21.390	72.196%		
2	18:20:27	51.560	52.560	20.620	22.470	21.480	74.400%		
3	18:21:10	51.620	52.880	20.670	22.620	21.510	74.835%		
x		51.640	52.730	20.660	22.330	21.460	73.810%		
σ		0.094	0.163	0.032	0.376	0.064	1.415%		
%RSD		0.181	0.310	0.155	1.683	0.296	1.917		

180-26669-A-29-A 11/14/2013 7:09:13 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	69.709%	-0.220	50.090	50.650	0.000	43010.000	29250.000	29460.000
2	19:10:39	68.857%	-0.180	51.000	50.080	0.000	44770.000	29840.000	29790.000
3	19:11:22	66.629%	-0.253	46.590	50.290	0.000	45820.000	31100.000	30930.000
x		68.398%	-0.217	49.220	50.340	0.000	44540.000	30060.000	30060.000
σ		1.591%	0.036	2.328	0.292	0.000	1420.000	943.300	772.600
%RSD		2.326	16.620	4.729	0.580	0.000	3.189	3.138	2.570

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	120.600	9833.000	0.000	5499.000	64610.000	65870.000	59.731%	6.091
2	19:10:39	123.700	10040.000	0.000	5457.000	66460.000	67620.000	59.410%	5.759
3	19:11:22	124.000	10180.000	0.000	5687.000	68950.000	70370.000	57.515%	5.786
x		122.800	10020.000	0.000	5548.000	66670.000	67950.000	58.886%	5.879
σ		1.898	174.800	0.000	122.500	2175.000	2268.000	1.198%	0.184
%RSD		1.546	1.744	0.000	2.208	3.263	3.338	2.034	3.136

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	0.480	1.916	9.548	170.900	485.500	0.246	0.891	2.739
2	19:10:39	1.027	1.855	9.543	168.400	458.900	0.271	0.778	2.308
3	19:11:22	0.962	1.953	9.754	171.000	452.000	0.256	0.900	2.297
x		0.823	1.908	9.615	170.100	465.500	0.258	0.856	2.448
σ		0.299	0.049	0.120	1.498	17.730	0.013	0.068	0.252
%RSD		36.310	2.590	1.251	0.881	3.809	4.858	7.981	10.300

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	2.626	19.590	19.970	0.614	-0.005	0.331	0.000	368.700
2	19:10:39	2.314	19.560	19.570	0.130	-0.251	0.451	0.000	374.000
3	19:11:22	2.215	19.590	20.180	0.005	-0.011	0.420	0.000	368.900
x		2.385	19.580	19.910	0.250	-0.089	0.400	0.000	370.500
σ		0.214	0.018	0.308	0.321	0.141	0.062	0.000	3.008
%RSD		8.991	0.092	1.547	128.800	158.500	15.560	0.000	0.812

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	67.003%	0.880	0.932	64.901%	-0.103	-0.101	0.002	-0.006
2	19:10:39	67.609%	0.506	0.571	65.232%	-0.106	-0.108	0.019	0.004
3	19:11:22	68.159%	0.365	0.383	65.593%	-0.106	-0.105	-0.004	0.003
x		67.590%	0.584	0.629	65.242%	-0.105	-0.105	0.006	0.000
σ		0.578%	0.266	0.279	0.346%	0.002	0.004	0.012	0.006
%RSD		0.855	45.610	44.360	0.531	1.694	3.447	199.000	11710.000

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	67.115%	0.860	0.504	0.510	81.880	81.470	75.926%	77.580%
2	19:10:39	68.245%	0.585	0.337	0.336	81.990	81.270	77.229%	78.577%
3	19:11:22	68.837%	0.347	0.269	0.257	81.660	80.830	77.914%	78.972%
x		68.066%	0.597	0.370	0.368	81.840	81.190	77.023%	78.376%
σ		0.875%	0.257	0.121	0.130	0.168	0.329	1.010%	0.717%
%RSD		1.286	42.960	32.650	35.230	0.206	0.405	1.311	0.915

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:09:56	0.095	0.103	0.350	0.374	0.361	75.603%
2	19:10:39	0.056	0.052	0.358	0.336	0.354	75.614%
3	19:11:22	0.036	0.042	0.376	0.368	0.360	76.287%
x		0.062	0.066	0.361	0.359	0.359	75.835%
σ		0.030	0.033	0.013	0.021	0.004	0.392%
%RSD		47.740	49.290	3.670	5.727	1.114	0.517

CCV 993939 11/14/2013 7:14:00 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	89.163%	107.700	107.700	108.400	0.000	49970.000	50580.000	49790.000
2	19:15:26	89.192%	110.100	109.000	105.700	0.000	49850.000	50430.000	49940.000
3	19:16:10	87.793%	108.500	109.300	106.300	0.000	50160.000	51130.000	51130.000
x		88.716%	108.790%	108.656%	106.788%	0.000	99.985%	101.432%	100.570%
σ		0.800%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.902	1.099	0.774	1.302	0.000	0.317	0.724	1.456

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	497.000	5013.000	0.000	50470.000	51170.000	50820.000	78.417%	99.280
2	19:15:26	474.500	5050.000	0.000	50570.000	51450.000	50900.000	78.980%	100.600
3	19:16:10	505.500	5090.000	0.000	50950.000	52220.000	51520.000	80.157%	100.500
x		98.458%	101.018%	0.000	101.325%	103.227%	102.160%	79.185%	100.124%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.888%	n/a
%RSD		3.251	0.761	0.000	0.494	1.055	0.753	1.121	0.734

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	103.400	104.100	510.400	25890.000	25420.000	103.100	104.900	104.400
2	19:15:26	103.100	102.100	512.000	25820.000	25470.000	102.100	101.900	104.200
3	19:16:10	102.800	103.900	511.700	26060.000	25650.000	102.000	103.700	104.800
x		103.086%	103.358%	102.270%	103.700%	102.047%	102.407%	103.496%	104.483%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.309	1.053	0.156	0.467	0.477	0.589	1.458	0.313

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	103.900	105.800	106.200	102.400	105.500	105.000	0.000	97.390
2	19:15:26	104.900	106.100	104.200	103.700	106.000	106.100	0.000	98.250
3	19:16:10	105.000	106.600	105.700	104.000	105.500	105.200	0.000	97.530
x		104.580%	106.171%	105.404%	103.378%	105.680%	105.439%	0.000	97.723%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.603	0.375	1.000	0.851	0.255	0.547	0.000	0.471

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	79.553%	98.040	100.200	72.072%	106.600	107.100	104.800	105.800
2	19:15:26	81.162%	99.960	101.800	73.980%	106.100	106.800	105.600	106.000
3	19:16:10	82.378%	99.980	102.600	74.754%	107.000	106.900	106.500	105.600
x		81.031%	99.325%	101.531%	73.602%	106.567%	106.933%	105.632%	105.786%
σ		1.417%	n/a	n/a	1.380%	n/a	n/a	n/a	n/a
%RSD		1.748	1.124	1.241	1.875	0.466	0.141	0.800	0.184

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	73.427%	98.700	99.960	99.150	101.600	103.800	75.218%	75.257%
2	19:15:26	74.888%	98.800	100.400	100.400	102.000	102.300	76.831%	77.015%
3	19:16:10	75.730%	99.700	100.100	99.800	101.900	103.400	77.684%	77.923%
x		74.682%	99.068%	100.165%	99.799%	101.815%	103.187%	76.578%	76.732%
σ		1.165%	n/a	n/a	n/a	n/a	n/a	1.252%	1.355%
%RSD		1.560	0.560	0.250	0.645	0.208	0.754	1.635	1.766

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:14:43	100.400	101.900	103.200	103.300	103.600	71.350%
2	19:15:26	102.500	104.100	105.100	104.900	105.300	71.602%
3	19:16:10	103.600	104.600	105.300	105.800	105.700	72.738%
x		102.168%	103.523%	104.539%	104.679%	104.863%	71.897%
σ		n/a	n/a	n/a	n/a	n/a	0.739%
%RSD		1.583	1.377	1.121	1.191	1.068	1.028

CCB6 11/14/2013 7:22:11 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	102.793%	-0.375	5.474	5.062	0.000	-0.124	1.184	1.492
2	19:23:37	100.849%	-0.349	4.606	4.842	0.000	-0.002	1.230	1.405
3	19:24:20	100.133%	-0.309	4.397	4.275	0.000	-0.276	1.565	1.183
x		101.258%	-0.344	4.826	4.727	0.000	-0.134	1.326	1.360
σ		1.376%	0.033	0.571	0.406	0.000	0.137	0.208	0.160
%RSD		1.359	9.638	11.830	8.589	0.000	102.500	15.680	11.730
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	0.154	-0.492	0.000	0.115	-0.109	6.208	90.513%	0.044
2	19:23:37	0.180	-0.051	0.000	1.212	2.826	5.867	87.972%	0.032
3	19:24:20	0.212	-0.110	0.000	0.315	7.586	6.077	88.420%	-0.002
x		0.182	-0.218	0.000	0.547	3.434	6.051	88.968%	0.025
σ		0.029	0.240	0.000	0.584	3.883	0.172	1.356%	0.024
%RSD		16.200	110.100	0.000	106.800	113.100	2.843	1.524	97.360
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	-0.014	-0.061	0.118	-0.630	1.392	0.003	0.017	-0.012
2	19:23:37	-0.024	-0.063	0.106	-2.517	2.030	0.004	0.009	-0.004
3	19:24:20	-0.021	-0.072	0.096	-3.015	0.698	0.005	0.001	-0.004
x		-0.020	-0.065	0.107	-2.054	1.373	0.004	0.009	-0.007
σ		0.005	0.006	0.011	1.258	0.667	0.001	0.008	0.005
%RSD		25.130	8.710	10.220	61.250	48.540	29.460	90.490	68.820
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	-0.027	0.576	0.569	-0.094	-0.334	-0.331	0.000	0.005
2	19:23:37	-0.004	0.586	0.466	-0.204	-0.222	-0.749	0.000	0.001
3	19:24:20	-0.005	0.543	0.555	-0.253	-0.290	-0.866	0.000	0.004
x		-0.012	0.569	0.530	-0.184	-0.282	-0.649	0.000	0.003
σ		0.013	0.023	0.056	0.082	0.056	0.281	0.000	0.002
%RSD		109.400	4.016	10.540	44.590	19.990	43.360	0.000	62.290
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	86.171%	0.117	0.133	85.777%	-0.109	-0.112	0.084	0.053
2	19:23:37	86.615%	0.142	0.108	85.951%	-0.104	-0.099	0.014	0.017
3	19:24:20	86.804%	0.133	0.077	85.666%	-0.106	-0.101	0.112	0.075
x		86.530%	0.131	0.106	85.798%	-0.106	-0.104	0.070	0.048
σ		0.325%	0.012	0.028	0.144%	0.003	0.007	0.051	0.030
%RSD		0.375	9.421	26.440	0.167	2.354	6.496	72.350	61.420
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:22:54	85.808%	-0.103	-0.025	-0.029	0.004	-0.008	84.371%	84.766%
2	19:23:37	85.544%	-0.129	-0.007	-0.029	0.025	-0.006	85.932%	85.424%
3	19:24:20	85.388%	-0.137	-0.014	-0.039	0.010	-0.012	85.454%	86.121%
x		85.580%	-0.123	-0.015	-0.033	0.013	-0.009	85.252%	85.437%
σ		0.212%	0.018	0.009	0.006	0.011	0.003	0.800%	0.677%
%RSD		0.248	14.250	58.070	18.330	82.350	39.290	0.939	0.793
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	19:22:54	0.012	0.014	0.060	0.068	0.060	85.316%		
2	19:23:37	0.013	0.012	0.065	0.066	0.066	85.245%		
3	19:24:20	0.013	0.010	0.069	0.054	0.057	84.517%		
x		0.013	0.012	0.065	0.063	0.061	85.026%		
σ		0.000	0.002	0.004	0.008	0.005	0.443%		
%RSD		3.805	15.840	6.624	12.280	7.401	0.521		

180-26669-A-30-A 11/14/2013 7:27:01 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	72.957%	-0.272	42.970	44.240	0.000	44770.000	23300.000	23330.000
2	19:28:26	65.381%	-0.287	44.840	45.330	0.000	46110.000	24170.000	24130.000
3	19:29:10	66.339%	-0.277	41.650	43.520	0.000	43470.000	23550.000	23690.000
x		68.226%	-0.279	43.150	44.360	0.000	44780.000	23670.000	23720.000
σ		4.125%	0.008	1.604	0.911	0.000	1320.000	452.400	399.500
%RSD		6.047	2.760	3.717	2.054	0.000	2.948	1.911	1.685

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	23.220	9392.000	0.000	7393.000	67060.000	68220.000	61.341%	1.893
2	19:28:26	23.960	9741.000	0.000	7518.000	68430.000	69460.000	59.343%	1.777
3	19:29:10	22.680	9525.000	0.000	7336.000	66900.000	68530.000	58.950%	1.855
x		23.290	9553.000	0.000	7416.000	67460.000	68740.000	59.878%	1.842
σ		0.642	175.900	0.000	93.560	844.100	647.300	1.282%	0.059
%RSD		2.757	1.842	0.000	1.262	1.251	0.942	2.141	3.208

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	0.369	0.909	52.960	241.200	489.500	0.316	2.143	2.935
2	19:28:26	0.896	0.872	53.620	240.000	486.200	0.294	2.141	3.027
3	19:29:10	0.691	0.915	53.150	236.000	465.400	0.294	2.078	2.940
x		0.652	0.899	53.250	239.100	480.400	0.302	2.121	2.967
σ		0.266	0.023	0.339	2.710	13.090	0.013	0.037	0.052
%RSD		40.800	2.598	0.637	1.134	2.725	4.265	1.728	1.754

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	3.093	11.230	10.960	0.172	-0.270	-0.181	0.000	265.800
2	19:28:26	2.979	11.220	10.950	0.260	-0.383	-0.182	0.000	266.200
3	19:29:10	2.791	11.500	10.730	-0.038	-0.275	0.083	0.000	266.200
x		2.954	11.320	10.880	0.131	-0.309	-0.093	0.000	266.100
σ		0.153	0.158	0.127	0.153	0.064	0.153	0.000	0.273
%RSD		5.175	1.395	1.171	116.500	20.650	163.600	0.000	0.103

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	69.899%	4.237	4.191	67.586%	-0.089	-0.088	-0.045	-0.023
2	19:28:26	69.102%	4.389	4.338	66.919%	-0.094	-0.091	-0.082	-0.048
3	19:29:10	68.918%	4.308	4.308	66.486%	-0.088	-0.090	-0.053	-0.037
x		69.306%	4.311	4.279	66.997%	-0.090	-0.090	-0.060	-0.036
σ		0.521%	0.076	0.078	0.554%	0.003	0.002	0.020	0.013
%RSD		0.752	1.772	1.824	0.827	3.817	1.985	32.850	35.290

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	71.137%	0.388	0.152	0.145	139.800	139.000	78.892%	80.534%
2	19:28:26	70.987%	0.252	0.136	0.126	138.800	137.500	80.360%	82.481%
3	19:29:10	70.112%	0.211	0.141	0.147	139.100	137.300	81.260%	83.146%
x		70.745%	0.284	0.143	0.139	139.300	137.900	80.171%	82.054%
σ		0.554%	0.092	0.008	0.012	0.506	0.942	1.195%	1.357%
%RSD		0.783	32.530	5.780	8.466	0.363	0.683	1.491	1.654

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:27:43	0.021	0.022	0.306	0.314	0.301	77.241%
2	19:28:26	0.016	0.014	0.321	0.299	0.293	79.339%
3	19:29:10	0.015	0.014	0.301	0.302	0.306	79.823%
x		0.017	0.017	0.309	0.305	0.300	78.801%
σ		0.003	0.005	0.010	0.008	0.007	1.372%
%RSD		17.640	26.640	3.218	2.562	2.167	1.742

180-26669-A-34-A 11/14/2013 7:31:47 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	71.003%	-0.310	43.000	45.450	0.000	43360.000	22670.000	22720.000
2	19:33:13	65.088%	-0.318	44.770	45.840	0.000	44850.000	23660.000	23480.000
3	19:33:56	60.261%	-0.388	44.550	48.310	0.000	45560.000	24410.000	24030.000
x		65.451%	-0.339	44.100	46.530	0.000	44590.000	23580.000	23410.000
σ		5.380%	0.043	0.965	1.548	0.000	1123.000	868.800	659.700
%RSD		8.220	12.600	2.188	3.328	0.000	2.518	3.685	2.818

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	17.750	9375.000	0.000	7455.000	67820.000	69070.000	58.565%	1.321
2	19:33:13	17.630	9533.000	0.000	7298.000	67930.000	69560.000	56.009%	1.467
3	19:33:56	17.680	9783.000	0.000	7472.000	69170.000	70130.000	55.401%	1.430
x		17.690	9564.000	0.000	7408.000	68310.000	69590.000	56.659%	1.406
σ		0.062	205.900	0.000	96.110	748.000	530.600	1.679%	0.076
%RSD		0.350	2.152	0.000	1.297	1.095	0.762	2.964	5.379

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	0.241	0.962	52.790	225.200	470.500	0.277	2.093	2.836
2	19:33:13	-0.822	0.891	53.600	227.400	471.100	0.278	2.060	2.846
3	19:33:56	-0.052	0.989	53.060	226.900	462.700	0.280	1.985	2.882
x		-0.211	0.948	53.150	226.500	468.100	0.278	2.046	2.855
σ		0.549	0.050	0.414	1.148	4.717	0.001	0.055	0.024
%RSD		260.300	5.314	0.779	0.507	1.008	0.512	2.700	0.846

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	2.787	12.760	12.040	0.336	-0.532	0.157	0.000	269.700
2	19:33:13	2.790	12.850	12.560	-0.148	-0.475	0.131	0.000	272.900
3	19:33:56	3.115	12.870	12.840	0.024	-0.314	-0.050	0.000	274.700
x		2.897	12.830	12.480	0.071	-0.440	0.079	0.000	272.400
σ		0.189	0.063	0.405	0.246	0.113	0.113	0.000	2.525
%RSD		6.509	0.488	3.246	347.000	25.720	142.500	0.000	0.927

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	65.145%	4.300	4.465	63.705%	-0.091	-0.087	-0.022	-0.008
2	19:33:13	65.223%	4.449	4.476	63.739%	-0.085	-0.086	-0.040	-0.026
3	19:33:56	64.384%	4.480	4.484	62.340%	-0.085	-0.087	-0.050	-0.026
x		64.917%	4.410	4.475	63.261%	-0.087	-0.086	-0.038	-0.020
σ		0.463%	0.096	0.010	0.798%	0.004	0.001	0.014	0.010
%RSD		0.714	2.176	0.222	1.262	4.190	0.752	37.460	52.130

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	67.553%	0.157	0.149	0.121	139.100	140.700	77.576%	78.429%
2	19:33:13	67.614%	0.101	0.146	0.143	139.700	138.700	78.672%	80.173%
3	19:33:56	66.577%	0.033	0.155	0.146	143.900	143.800	78.744%	80.373%
x		67.248%	0.097	0.150	0.137	140.900	141.100	78.331%	79.658%
σ		0.582%	0.062	0.005	0.014	2.617	2.554	0.654%	1.069%
%RSD		0.865	63.790	3.157	9.973	1.857	1.810	0.835	1.342

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:32:30	0.015	0.015	0.161	0.163	0.162	75.338%
2	19:33:13	0.014	0.017	0.154	0.172	0.157	77.313%
3	19:33:56	0.015	0.014	0.153	0.152	0.153	77.880%
x		0.015	0.015	0.156	0.162	0.157	76.844%
σ		0.000	0.002	0.004	0.010	0.005	1.334%
%RSD		2.250	10.040	2.698	6.349	2.893	1.736

MB 180-89655/1-A 11/14/2013 7:40:38 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	79.346%	-0.358	1.944	1.988	0.000	16.080	11.810	10.860
2	19:42:05	77.647%	-0.365	1.725	1.599	0.000	15.600	10.590	11.050
3	19:42:47	75.579%	-0.353	2.080	1.524	0.000	16.290	10.490	11.000
x		77.524%	-0.359	1.916	1.704	0.000	15.990	10.960	10.970
σ		1.887%	0.006	0.179	0.249	0.000	0.353	0.732	0.096
%RSD		2.434	1.771	9.337	14.630	0.000	2.208	6.677	0.876

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	2.057	4.000	0.000	9.615	44.210	42.110	72.425%	0.104
2	19:42:05	1.750	3.815	0.000	8.331	54.660	44.680	71.026%	-0.002
3	19:42:47	1.946	4.180	0.000	8.769	39.940	44.680	69.736%	0.092
x		1.918	3.998	0.000	8.905	46.270	43.820	71.063%	0.065
σ		0.155	0.183	0.000	0.653	7.575	1.486	1.345%	0.058
%RSD		8.084	4.568	0.000	7.332	16.370	3.392	1.893	89.210

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	0.010	0.346	0.087	-4.626	1.361	0.003	0.076	0.279
2	19:42:05	0.218	0.321	0.085	-6.873	0.856	0.002	0.071	0.303
3	19:42:47	0.188	0.329	0.093	-5.236	1.539	0.001	0.112	0.267
x		0.139	0.332	0.088	-5.578	1.252	0.002	0.087	0.283
σ		0.113	0.013	0.004	1.162	0.354	0.001	0.023	0.018
%RSD		81.350	3.927	4.979	20.830	28.270	42.440	26.030	6.428

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	0.284	2.192	1.877	-0.043	-0.357	-0.366	0.000	0.110
2	19:42:05	0.285	2.211	2.274	-0.303	-0.386	-0.709	0.000	0.110
3	19:42:47	0.227	2.134	1.902	-0.106	-0.585	-0.453	0.000	0.109
x		0.265	2.179	2.018	-0.151	-0.443	-0.510	0.000	0.110
σ		0.033	0.040	0.223	0.136	0.124	0.178	0.000	0.000
%RSD		12.420	1.832	11.040	90.110	27.990	34.930	0.000	0.272

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	75.219%	0.005	0.008	75.337%	-0.117	-0.114	0.005	-0.014
2	19:42:05	74.492%	-0.022	-0.017	75.048%	-0.108	-0.113	-0.050	-0.033
3	19:42:47	74.669%	-0.016	-0.035	74.681%	-0.115	-0.107	-0.041	-0.049
x		74.793%	-0.011	-0.015	75.022%	-0.113	-0.111	-0.028	-0.032
σ		0.379%	0.014	0.022	0.329%	0.004	0.004	0.030	0.017
%RSD		0.507	132.700	149.800	0.438	3.955	3.192	104.100	54.890

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	77.286%	4.199	-0.030	-0.039	0.253	0.279	83.488%	84.018%
2	19:42:05	77.221%	4.273	-0.026	-0.040	0.257	0.267	83.588%	84.863%
3	19:42:47	76.620%	4.293	-0.025	-0.038	0.273	0.250	84.693%	85.901%
x		77.042%	4.255	-0.027	-0.039	0.261	0.266	83.923%	84.927%
σ		0.367%	0.050	0.003	0.001	0.011	0.015	0.669%	0.943%
%RSD		0.477	1.167	10.060	3.284	4.125	5.495	0.797	1.111

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:41:21	0.011	0.008	0.085	0.081	0.079	84.253%
2	19:42:05	0.005	0.006	0.076	0.079	0.077	85.344%
3	19:42:47	0.007	0.007	0.072	0.073	0.071	86.702%
x		0.008	0.007	0.078	0.078	0.076	85.433%
σ		0.003	0.001	0.007	0.004	0.004	1.227%
%RSD		33.960	13.960	8.756	5.525	5.442	1.436

MB 180-89656/1-A 11/14/2013 7:45:25 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	88.100%	-0.338	1.234	1.119	0.000	16.450	15.080	13.860
2	19:46:51	88.250%	-0.351	1.013	1.007	0.000	17.090	14.700	14.290
3	19:47:34	88.386%	-0.371	0.812	0.661	0.000	17.170	13.940	14.410
x		88.246%	-0.353	1.020	0.929	0.000	16.900	14.580	14.190
σ		0.143%	0.017	0.211	0.239	0.000	0.391	0.583	0.287
%RSD		0.162	4.729	20.730	25.720	0.000	2.316	3.999	2.020

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	1.534	2.980	0.000	7.917	54.220	53.260	82.214%	0.324
2	19:46:51	1.577	3.243	0.000	7.209	54.460	52.790	81.046%	0.282
3	19:47:34	1.531	3.312	0.000	7.832	52.480	56.020	82.508%	0.197
x		1.547	3.178	0.000	7.653	53.720	54.020	81.922%	0.268
σ		0.025	0.176	0.000	0.386	1.082	1.744	0.773%	0.065
%RSD		1.640	5.526	0.000	5.048	2.015	3.229	0.944	24.230

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	0.003	-0.030	0.080	-3.450	1.915	0.008	0.085	0.182
2	19:46:51	-0.028	-0.052	0.067	-4.396	1.567	0.007	0.081	0.207
3	19:47:34	-0.053	-0.067	0.058	-5.117	2.176	0.004	0.105	0.192
x		-0.026	-0.050	0.068	-4.321	1.886	0.006	0.090	0.194
σ		0.028	0.019	0.011	0.836	0.305	0.002	0.013	0.013
%RSD		109.300	37.550	15.860	19.350	16.200	36.270	13.920	6.532

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	0.174	2.156	2.138	-0.160	-0.228	-0.439	0.000	0.128
2	19:46:51	0.200	2.266	2.043	-0.046	-0.368	-0.274	0.000	0.133
3	19:47:34	0.193	2.132	2.027	-0.082	-0.341	-0.328	0.000	0.133
x		0.189	2.184	2.069	-0.096	-0.312	-0.347	0.000	0.131
σ		0.013	0.072	0.060	0.058	0.074	0.084	0.000	0.002
%RSD		6.886	3.285	2.909	60.110	23.810	24.300	0.000	1.883

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	80.916%	0.163	0.130	81.370%	-0.116	-0.117	-0.026	-0.023
2	19:46:51	81.522%	0.120	0.093	81.674%	-0.116	-0.111	-0.012	-0.020
3	19:47:34	82.735%	0.108	0.082	81.968%	-0.117	-0.112	0.000	-0.006
x		81.724%	0.130	0.102	81.671%	-0.117	-0.113	-0.012	-0.016
σ		0.926%	0.029	0.025	0.299%	0.001	0.003	0.013	0.009
%RSD		1.133	22.290	24.970	0.366	0.503	2.787	105.000	56.120

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	81.262%	4.053	-0.036	-0.059	0.282	0.280	84.575%	84.932%
2	19:46:51	82.727%	4.082	-0.049	-0.044	0.323	0.263	85.632%	86.504%
3	19:47:34	83.939%	4.097	-0.040	-0.051	0.273	0.299	87.041%	87.669%
x		82.643%	4.078	-0.042	-0.051	0.292	0.281	85.749%	86.368%
σ		1.340%	0.022	0.007	0.008	0.027	0.018	1.238%	1.373%
%RSD		1.622	0.551	15.810	14.610	9.097	6.360	1.443	1.590

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:46:08	0.009	0.006	0.039	0.037	0.037	85.703%
2	19:46:51	0.008	0.007	0.038	0.037	0.035	86.055%
3	19:47:34	0.006	0.005	0.038	0.034	0.034	86.885%
x		0.008	0.006	0.038	0.036	0.035	86.214%
σ		0.002	0.001	0.000	0.001	0.001	0.606%
%RSD		20.650	18.750	1.191	4.030	4.156	0.703

LCS 180-89655/2-A 11/14/2013 7:50:11 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	66.626%	43.790	851.200	836.000	0.000	45830.000	48560.000	48610.000
2	19:51:37	62.000%	43.450	825.300	854.800	0.000	45620.000	49430.000	49050.000
3	19:52:21	58.774%	44.700	840.100	880.500	0.000	46900.000	51360.000	50940.000
x		62.467%	43.980	838.900	857.100	0.000	46120.000	49780.000	49540.000
σ		3.947%	0.645	12.970	22.340	0.000	684.200	1435.000	1238.000
%RSD		6.318	1.468	1.546	2.606	0.000	1.484	2.883	2.499

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	1921.000	3018.000	0.000	45850.000	50510.000	51290.000	58.171%	1002.000
2	19:51:37	1938.000	3113.000	0.000	46370.000	50620.000	51530.000	56.752%	984.800
3	19:52:21	1986.000	3123.000	0.000	46370.000	51570.000	52300.000	55.605%	999.700
x		1949.000	3085.000	0.000	46190.000	50900.000	51700.000	56.843%	995.400
σ		33.730	57.740	0.000	298.900	580.400	525.400	1.286%	9.219
%RSD		1.731	1.872	0.000	0.647	1.140	1.016	2.262	0.926

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	524.200	206.100	511.400	1033.000	1203.000	423.100	483.600	240.200
2	19:51:37	513.500	205.300	510.700	1005.000	1157.000	455.200	468.000	235.800
3	19:52:21	523.000	205.100	513.500	1028.000	1180.000	430.700	469.300	233.600
x		520.200	205.500	511.900	1022.000	1180.000	436.300	473.600	236.600
σ		5.898	0.512	1.453	15.160	22.990	16.730	8.650	3.372
%RSD		1.134	0.249	0.284	1.484	1.948	3.835	1.826	1.425

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	244.700	461.700	453.600	34.820	8.326	9.020	0.000	979.300
2	19:51:37	241.600	461.400	460.900	34.510	8.392	7.833	0.000	983.200
3	19:52:21	240.200	460.200	462.700	34.370	8.324	8.853	0.000	986.600
x		242.200	461.100	459.000	34.570	8.347	8.569	0.000	983.100
σ		2.304	0.745	4.795	0.232	0.039	0.642	0.000	3.659
%RSD		0.952	0.162	1.045	0.670	0.465	7.496	0.000	0.372

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	63.696%	977.800	983.800	63.973%	49.360	48.770	48.340	42.180
2	19:51:37	63.670%	978.100	986.700	64.231%	49.660	48.520	47.450	41.440
3	19:52:21	64.379%	981.600	987.200	64.021%	49.930	49.210	47.910	41.960
x		63.915%	979.200	985.900	64.075%	49.650	48.830	47.900	41.860
σ		0.402%	2.120	1.879	0.137%	0.287	0.349	0.446	0.380
%RSD		0.629	0.217	0.191	0.214	0.578	0.715	0.931	0.908

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	67.562%	1903.000	449.600	450.300	1865.000	1867.000	79.700%	81.146%
2	19:51:37	67.979%	1912.000	450.400	454.000	1767.000	1888.000	82.079%	84.409%
3	19:52:21	68.273%	1910.000	452.500	453.700	1805.000	1858.000	83.289%	85.212%
x		67.938%	1908.000	450.800	452.700	1812.000	1871.000	81.689%	83.589%
σ		0.357%	4.547	1.480	2.096	49.210	15.630	1.826%	2.154%
%RSD		0.526	0.238	0.328	0.463	2.715	0.836	2.235	2.577

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:50:54	48.250	49.090	19.750	21.660	20.660	75.115%
2	19:51:37	48.630	49.590	19.840	21.570	20.730	77.934%
3	19:52:21	48.780	49.910	19.910	21.650	20.780	78.817%
x		48.560	49.530	19.830	21.620	20.720	77.289%
σ		0.274	0.415	0.082	0.049	0.060	1.934%
%RSD		0.564	0.838	0.415	0.226	0.290	2.502

LCS 180-89656/2-A 11/14/2013 7:54:25 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	86.841%	47.800	935.300	910.600	0.000	49620.000	48660.000	47820.000
2	19:55:51	88.324%	47.350	887.300	888.400	0.000	47360.000	47650.000	47160.000
3	19:56:34	86.628%	46.640	899.100	884.500	0.000	48050.000	48080.000	48030.000
x		87.264%	47.260	907.300	894.500	0.000	48340.000	48130.000	47670.000
σ		0.924%	0.588	25.020	14.060	0.000	1159.000	506.400	452.500
%RSD		1.059	1.245	2.758	1.572	0.000	2.396	1.052	0.949

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	1894.000	2391.000	0.000	48490.000	50050.000	49620.000	79.318%	959.300
2	19:55:51	1880.000	2399.000	0.000	47730.000	49510.000	49080.000	81.814%	934.900
3	19:56:34	1890.000	2380.000	0.000	47600.000	49030.000	48360.000	81.834%	929.300
x		1888.000	2390.000	0.000	47940.000	49530.000	49020.000	80.989%	941.200
σ		7.035	9.485	0.000	481.900	511.400	629.200	1.447%	15.960
%RSD		0.373	0.397	0.000	1.005	1.033	1.284	1.786	1.696

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	510.000	200.300	499.000	1030.000	1215.000	496.700	497.600	249.000
2	19:55:51	503.600	197.400	490.400	1011.000	1216.000	495.900	485.200	247.000
3	19:56:34	502.700	194.400	485.100	1017.000	1194.000	482.000	474.000	241.100
x		505.400	197.400	491.500	1019.000	1208.000	491.500	485.600	245.700
σ		3.982	2.928	7.012	9.809	12.500	8.264	11.840	4.129
%RSD		0.788	1.484	1.426	0.962	1.034	1.681	2.437	1.681

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	246.800	470.300	475.100	35.310	8.353	8.829	0.000	963.900
2	19:55:51	246.500	468.400	466.100	34.480	8.157	7.712	0.000	963.800
3	19:56:34	241.800	463.800	458.800	33.900	8.381	7.866	0.000	949.400
x		245.000	467.500	466.700	34.560	8.297	8.136	0.000	959.000
σ		2.823	3.322	8.169	0.710	0.122	0.606	0.000	8.340
%RSD		1.152	0.711	1.750	2.055	1.473	7.445	0.000	0.870

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	78.479%	974.300	999.900	75.427%	45.030	44.340	47.540	43.190
2	19:55:51	81.183%	972.900	996.700	77.234%	44.700	44.410	47.930	43.870
3	19:56:34	82.110%	960.400	977.600	78.229%	44.000	44.040	47.280	42.650
x		80.591%	969.200	991.400	76.964%	44.580	44.260	47.580	43.240
σ		1.887%	7.656	12.050	1.420%	0.523	0.196	0.327	0.614
%RSD		2.341	0.790	1.216	1.846	1.173	0.444	0.688	1.420

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	77.326%	1923.000	458.700	456.900	1294.000	1976.000	82.035%	83.211%
2	19:55:51	79.379%	1927.000	460.900	460.300	1114.000	1981.000	85.039%	85.784%
3	19:56:34	80.996%	1893.000	449.100	449.600	1302.000	1950.000	86.273%	87.104%
x		79.233%	1914.000	456.200	455.600	1237.000	1969.000	84.449%	85.366%
σ		1.839%	18.470	6.300	5.451	106.600	16.680	2.180%	1.980%
%RSD		2.321	0.965	1.381	1.196	8.619	0.847	2.581	2.319

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	19:55:08	50.020	50.920	19.940	21.650	20.810	75.871%
2	19:55:51	50.580	51.010	20.180	21.560	20.880	77.431%
3	19:56:34	49.850	50.870	19.830	21.350	20.640	78.276%
x		50.150	50.930	19.980	21.520	20.780	77.192%
σ		0.386	0.068	0.176	0.158	0.125	1.220%
%RSD		0.769	0.133	0.881	0.734	0.600	1.581

180-26836-A-2-A 11/14/2013 8:02:36 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	73.139%	-0.331	40.430	41.000	0.000	519.300	3133.000	3147.000
2	20:04:02	69.139%	-0.282	39.580	39.450	0.000	503.600	3154.000	3113.000
3	20:04:45	68.098%	-0.313	37.400	39.470	0.000	539.500	3385.000	3300.000
x		70.125%	-0.309	39.140	39.980	0.000	520.800	3224.000	3187.000
σ		2.662%	0.025	1.561	0.887	0.000	18.020	140.100	100.200
%RSD		3.796	8.081	3.989	2.220	0.000	3.460	4.344	3.144

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	156.900	1014.000	0.000	21750.000	10250.000	10040.000	66.473%	13.950
2	20:04:02	155.400	915.100	0.000	21590.000	10330.000	10090.000	65.515%	12.800
3	20:04:45	162.200	949.900	0.000	22990.000	11140.000	10940.000	58.713%	14.040
x		158.200	959.600	0.000	22110.000	10570.000	10350.000	63.567%	13.600
σ		3.538	49.990	0.000	767.900	490.300	504.400	4.231%	0.693
%RSD		2.237	5.209	0.000	3.473	4.638	4.871	6.655	5.098

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	-0.211	0.282	85.060	331.500	362.400	0.224	1.443	16.630
2	20:04:02	-1.008	0.340	84.110	327.300	363.300	0.216	1.458	16.740
3	20:04:45	-0.719	0.269	91.080	350.200	389.900	0.240	1.624	17.200
x		-0.646	0.297	86.750	336.300	371.900	0.227	1.508	16.860
σ		0.404	0.038	3.777	12.170	15.630	0.012	0.100	0.304
%RSD		62.480	12.650	4.353	3.617	4.204	5.268	6.655	1.804

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	16.810	94.320	96.200	0.128	-0.222	-0.034	0.000	70.950
2	20:04:02	16.990	95.040	94.250	0.042	-0.103	-0.128	0.000	71.340
3	20:04:45	17.380	99.470	99.700	0.040	-0.269	-0.369	0.000	71.650
x		17.060	96.280	96.720	0.070	-0.198	-0.177	0.000	71.310
σ		0.292	2.789	2.759	0.050	0.085	0.173	0.000	0.350
%RSD		1.712	2.897	2.853	71.290	43.150	97.710	0.000	0.491

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	71.314%	2.001	1.937	70.556%	0.372	0.405	-0.033	-0.061
2	20:04:02	71.748%	1.897	1.940	70.102%	0.098	0.083	-0.054	-0.130
3	20:04:45	71.331%	1.781	1.964	70.243%	-0.016	0.001	-0.058	-0.054
x		71.465%	1.893	1.947	70.300%	0.151	0.163	-0.048	-0.082
σ		0.246%	0.110	0.014	0.233%	0.200	0.214	0.013	0.042
%RSD		0.344	5.824	0.740	0.331	132.100	131.000	27.560	51.610

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	72.790%	30.020	0.363	0.367	20.800	20.440	84.036%	85.395%
2	20:04:02	73.078%	25.540	0.379	0.387	20.590	21.150	86.011%	87.721%
3	20:04:45	73.119%	24.030	0.365	0.345	20.470	20.470	85.733%	87.854%
x		72.996%	26.530	0.369	0.366	20.620	20.680	85.260%	86.990%
σ		0.180%	3.120	0.009	0.021	0.169	0.402	1.069%	1.383%
%RSD		0.246	11.760	2.325	5.642	0.818	1.943	1.254	1.590

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:03:19	0.043	0.053	0.356	0.366	0.353	82.799%
2	20:04:02	0.046	0.055	0.379	0.358	0.370	85.193%
3	20:04:45	0.051	0.052	0.374	0.385	0.363	85.095%
x		0.047	0.053	0.370	0.370	0.362	84.362%
σ		0.004	0.002	0.012	0.014	0.009	1.355%
%RSD		7.767	3.086	3.227	3.735	2.356	1.606

180-26836-A-2-A SD@5 11/14/2013 8:07:24 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	86.095%	-0.351	11.450	11.530	0.000	94.030	611.000	612.600
2	20:08:50	77.808%	-0.345	12.310	12.120	0.000	97.630	628.100	628.600
3	20:09:33	78.777%	-0.348	10.870	11.200	0.000	94.080	631.800	631.300
x		80.893%	-0.348	11.540	11.620	0.000	95.250	623.600	624.200
σ		4.530%	0.003	0.723	0.467	0.000	2.066	11.060	10.080
%RSD		5.600	0.942	6.260	4.017	0.000	2.169	1.773	1.615

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	31.420	246.400	0.000	4588.000	2139.000	2010.000	73.214%	2.669
2	20:08:50	31.820	258.900	0.000	4521.000	2035.000	2009.000	72.297%	2.720
3	20:09:33	32.040	252.200	0.000	4502.000	2007.000	1983.000	71.595%	2.548
x		31.760	252.500	0.000	4537.000	2060.000	2000.000	72.369%	2.645
σ		0.314	6.261	0.000	45.240	69.480	15.300	0.812%	0.089
%RSD		0.989	2.479	0.000	0.997	3.372	0.765	1.122	3.348

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	0.133	0.060	17.270	61.900	73.530	0.045	0.252	3.548
2	20:08:50	0.013	0.069	16.980	60.550	72.020	0.055	0.259	3.495
3	20:09:33	-0.292	0.086	17.330	60.470	70.300	0.050	0.292	3.508
x		-0.048	0.072	17.200	60.970	71.950	0.050	0.268	3.517
σ		0.219	0.013	0.185	0.802	1.612	0.005	0.021	0.028
%RSD		451.700	18.260	1.074	1.316	2.241	9.917	7.968	0.790

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	3.519	21.940	22.320	-0.029	-0.393	-0.173	0.000	14.390
2	20:08:50	3.654	21.550	22.070	-0.103	-0.362	-0.293	0.000	14.360
3	20:09:33	3.527	21.460	21.890	0.071	-0.369	-0.383	0.000	14.330
x		3.567	21.650	22.090	-0.021	-0.375	-0.283	0.000	14.360
σ		0.076	0.252	0.220	0.087	0.016	0.105	0.000	0.029
%RSD		2.129	1.165	0.998	426.000	4.286	37.150	0.000	0.203

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	76.123%	0.319	0.347	76.420%	-0.105	-0.104	-0.085	-0.065
2	20:08:50	76.123%	0.310	0.330	76.465%	-0.111	-0.112	-0.081	-0.063
3	20:09:33	76.295%	0.307	0.317	76.344%	-0.109	-0.108	-0.066	-0.066
x		76.180%	0.312	0.332	76.410%	-0.108	-0.108	-0.077	-0.065
σ		0.099%	0.006	0.015	0.061%	0.003	0.004	0.010	0.002
%RSD		0.130	1.911	4.574	0.080	2.645	3.690	12.590	2.684

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	79.019%	4.438	0.054	0.054	4.107	3.985	84.932%	86.472%
2	20:08:50	78.457%	4.454	0.063	0.036	4.436	4.051	85.353%	87.414%
3	20:09:33	78.394%	4.333	0.054	0.054	4.305	4.221	86.153%	87.263%
x		78.623%	4.409	0.057	0.048	4.282	4.086	85.480%	87.050%
σ		0.344%	0.066	0.005	0.011	0.166	0.122	0.620%	0.506%
%RSD		0.438	1.489	8.717	22.000	3.875	2.978	0.726	0.582

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:08:07	0.019	0.018	0.085	0.094	0.083	85.627%
2	20:08:50	0.019	0.019	0.084	0.090	0.080	86.795%
3	20:09:33	0.014	0.018	0.074	0.086	0.078	87.890%
x		0.018	0.018	0.081	0.090	0.080	86.771%
σ		0.003	0.001	0.006	0.004	0.002	1.132%
%RSD		17.000	3.922	7.530	4.330	3.045	1.304

180-26836-A-2-B MS 11/14/2013 8:12:12 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	67.751%	43.150	848.900	856.700	0.000	44750.000	50640.000	50650.000
2	20:13:38	64.650%	41.880	854.500	869.800	0.000	45650.000	51830.000	51550.000
3	20:14:22	62.107%	42.560	880.100	882.800	0.000	45830.000	52570.000	52750.000
x		64.836%	42.530	861.200	869.800	0.000	45410.000	51680.000	51650.000
σ		2.827%	0.634	16.660	13.070	0.000	577.700	975.700	1049.000
%RSD		4.360	1.491	1.935	1.502	0.000	1.272	1.888	2.032
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	2222.000	6081.000	0.000	68620.000	60980.000	61690.000	57.824%	981.800
2	20:13:38	2260.000	6065.000	0.000	68230.000	60170.000	62120.000	57.087%	983.100
3	20:14:22	2315.000	6193.000	0.000	69020.000	61640.000	62350.000	55.988%	985.300
x		2266.000	6113.000	0.000	68620.000	60930.000	62050.000	56.966%	983.400
σ		46.580	69.860	0.000	394.600	734.200	339.000	0.924%	1.773
%RSD		2.056	1.143	0.000	0.575	1.205	0.546	1.622	0.180
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	514.700	204.600	581.400	1385.000	1583.000	420.400	474.900	254.100
2	20:13:38	517.900	201.200	583.700	1368.000	1560.000	393.400	466.100	244.700
3	20:14:22	510.700	203.000	588.300	1389.000	1567.000	407.100	473.000	247.700
x		514.400	202.900	584.500	1381.000	1570.000	406.900	471.300	248.800
σ		3.595	1.713	3.478	11.300	11.880	13.520	4.612	4.781
%RSD		0.699	0.844	0.595	0.819	0.756	3.322	0.979	1.922
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	257.300	537.200	533.000	34.150	8.475	8.372	0.000	999.300
2	20:13:38	249.700	530.100	535.000	33.890	8.535	9.456	0.000	1016.000
3	20:14:22	249.800	535.000	536.200	33.400	7.986	7.929	0.000	1014.000
x		252.300	534.100	534.800	33.810	8.332	8.585	0.000	1010.000
σ		4.400	3.657	1.613	0.381	0.301	0.786	0.000	9.136
%RSD		1.744	0.685	0.302	1.128	3.614	9.150	0.000	0.905
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	66.766%	936.800	957.800	64.015%	48.500	48.340	46.740	41.910
2	20:13:38	67.221%	950.400	970.700	63.777%	49.000	48.820	47.080	42.000
3	20:14:22	66.850%	952.900	967.400	63.439%	48.960	48.580	47.870	42.460
x		66.946%	946.700	965.300	63.744%	48.820	48.580	47.230	42.120
σ		0.242%	8.652	6.700	0.289%	0.279	0.236	0.581	0.293
%RSD		0.361	0.914	0.694	0.454	0.571	0.485	1.230	0.695
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:12:55	67.634%	1869.000	437.200	443.800	1821.000	1872.000	79.954%	81.564%
2	20:13:38	68.351%	1873.000	439.800	440.200	1836.000	1888.000	81.715%	83.404%
3	20:14:22	67.568%	1885.000	445.000	447.900	1777.000	1871.000	81.999%	84.060%
x		67.851%	1876.000	440.700	444.000	1811.000	1877.000	81.223%	83.009%
σ		0.434%	8.430	3.937	3.835	30.700	9.289	1.108%	1.294%
%RSD		0.640	0.449	0.893	0.864	1.695	0.495	1.364	1.558
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	20:12:55	48.350	48.930	19.520	21.090	20.390	74.957%		
2	20:13:38	48.610	49.450	19.820	21.380	20.560	76.968%		
3	20:14:22	48.370	49.530	19.970	21.450	20.680	77.826%		
x		48.440	49.310	19.770	21.300	20.540	76.584%		
σ		0.149	0.325	0.227	0.191	0.147	1.472%		
%RSD		0.307	0.660	1.147	0.897	0.716	1.922		

180-26836-A-2-C MSD 11/14/2013 8:17:00 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	61.709%	44.980	931.100	929.600	0.000	47980.000	54330.000	54790.000
2	20:18:26	60.034%	45.020	913.200	933.800	0.000	47280.000	54150.000	54330.000
3	20:19:09	60.987%	43.560	894.100	904.600	0.000	46450.000	53690.000	53520.000
x		60.910%	44.520	912.800	922.700	0.000	47240.000	54060.000	54210.000
σ		0.840%	0.834	18.520	15.780	0.000	766.700	328.400	645.800
%RSD		1.379	1.874	2.029	1.710	0.000	1.623	0.608	1.191

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	2419.000	6677.000	0.000	71960.000	62350.000	63310.000	57.726%	1003.000
2	20:18:26	2424.000	6661.000	0.000	70950.000	62500.000	63770.000	56.356%	997.800
3	20:19:09	2346.000	6563.000	0.000	70700.000	63680.000	65280.000	56.557%	1006.000
x		2396.000	6634.000	0.000	71200.000	62840.000	64120.000	56.879%	1002.000
σ		43.850	61.900	0.000	668.900	731.900	1034.000	0.740%	4.263
%RSD		1.830	0.933	0.000	0.940	1.165	1.612	1.301	0.425

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	516.100	204.000	604.300	1440.000	1604.000	430.000	471.800	254.000
2	20:18:26	528.900	207.500	597.000	1426.000	1602.000	453.700	475.400	255.500
3	20:19:09	523.100	203.700	599.600	1410.000	1609.000	425.400	469.600	250.800
x		522.700	205.100	600.300	1426.000	1605.000	436.400	472.300	253.400
σ		6.408	2.099	3.725	15.030	3.576	15.150	2.926	2.413
%RSD		1.226	1.024	0.621	1.054	0.223	3.473	0.620	0.952

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	255.600	544.300	547.700	34.930	8.376	9.731	0.000	1029.000
2	20:18:26	256.400	546.200	545.500	34.430	8.441	8.853	0.000	1032.000
3	20:19:09	257.500	542.800	539.400	34.610	8.326	8.669	0.000	1032.000
x		256.500	544.400	544.200	34.650	8.381	9.084	0.000	1031.000
σ		0.949	1.699	4.308	0.252	0.058	0.567	0.000	1.921
%RSD		0.370	0.312	0.792	0.727	0.687	6.245	0.000	0.186

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	66.703%	963.400	988.200	63.964%	49.510	49.730	47.610	41.930
2	20:18:26	66.297%	971.000	979.200	63.435%	49.400	49.110	47.760	42.210
3	20:19:09	66.875%	974.800	993.500	63.359%	49.800	49.370	48.710	42.020
x		66.625%	969.700	987.000	63.586%	49.570	49.400	48.030	42.050
σ		0.297%	5.785	7.263	0.329%	0.208	0.312	0.595	0.139
%RSD		0.445	0.597	0.736	0.518	0.419	0.632	1.238	0.332

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	68.064%	1928.000	449.600	452.400	1919.000	1917.000	80.668%	82.634%
2	20:18:26	67.860%	1928.000	455.000	457.200	1810.000	1935.000	81.809%	84.038%
3	20:19:09	68.055%	1933.000	453.400	456.900	1865.000	1917.000	82.688%	84.582%
x		67.993%	1929.000	452.700	455.500	1865.000	1923.000	81.722%	83.752%
σ		0.115%	2.699	2.777	2.692	54.700	10.070	1.013%	1.005%
%RSD		0.170	0.140	0.614	0.591	2.934	0.524	1.239	1.201

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:17:43	49.160	50.060	20.280	21.780	21.020	76.185%
2	20:18:26	50.020	50.800	20.460	21.990	21.230	77.909%
3	20:19:09	49.750	51.190	20.330	21.810	21.130	78.651%
x		49.640	50.680	20.360	21.860	21.130	77.582%
σ		0.436	0.573	0.093	0.112	0.103	1.265%
%RSD		0.878	1.130	0.459	0.514	0.488	1.630

CCV 993939 11/14/2013 8:21:47 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	86.093%	106.600	112.300	111.600	0.000	49710.000	48840.000	48420.000
2	20:23:13	86.032%	105.100	111.500	109.700	0.000	48350.000	48150.000	47510.000
3	20:23:56	85.199%	107.400	110.700	108.000	0.000	50580.000	49910.000	49830.000
x		85.775%	106.361%	111.470%	109.753%	0.000	99.099%	97.931%	97.177%
σ		0.499%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.582	1.128	0.701	1.665	0.000	2.270	1.810	2.412

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	477.400	4843.000	0.000	48540.000	49500.000	48390.000	81.228%	95.070
2	20:23:13	477.600	4810.000	0.000	48050.000	48550.000	48480.000	83.002%	94.440
3	20:23:56	514.800	4981.000	0.000	50630.000	50650.000	50270.000	80.859%	97.680
x		97.981%	97.558%	0.000	98.148%	99.128%	98.092%	81.696%	95.731%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.146%	n/a
%RSD		4.397	1.858	0.000	2.788	2.121	2.172	1.402	1.794

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	98.900	97.670	491.300	24710.000	24470.000	98.220	99.480	100.900
2	20:23:13	98.690	98.220	488.300	24660.000	24660.000	99.380	99.260	101.400
3	20:23:56	101.600	102.000	504.000	25380.000	25220.000	101.600	102.800	104.100
x		99.736%	99.286%	98.907%	99.659%	99.124%	99.737%	100.498%	102.089%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		1.640	2.359	1.679	1.604	1.568	1.726	1.946	1.685

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	100.000	102.100	102.900	101.000	103.900	103.500	0.000	97.320
2	20:23:13	102.300	103.600	104.200	102.500	104.900	103.800	0.000	97.960
3	20:23:56	103.700	105.200	106.600	105.700	107.100	106.100	0.000	99.990
x		101.984%	103.638%	104.542%	103.031%	105.305%	104.483%	0.000	98.424%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		1.811	1.484	1.781	2.319	1.525	1.371	0.000	1.416

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	80.781%	98.350	100.700	74.060%	105.500	105.900	105.300	105.600
2	20:23:13	81.665%	99.540	102.000	75.307%	106.200	106.300	105.300	105.400
3	20:23:56	81.466%	103.200	106.000	75.255%	107.700	107.400	108.000	107.300
x		81.304%	100.356%	102.894%	74.874%	106.444%	106.540%	106.158%	106.081%
σ		0.464%	n/a	n/a	0.705%	n/a	n/a	n/a	n/a
%RSD		0.570	2.500	2.655	0.942	1.059	0.723	1.465	0.975

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	75.678%	98.840	100.400	100.900	101.300	102.500	79.256%	79.682%
2	20:23:13	76.929%	99.620	101.500	101.300	102.200	103.200	81.371%	81.928%
3	20:23:56	77.555%	101.900	102.900	103.000	104.200	105.300	81.075%	82.151%
x		76.721%	100.113%	101.578%	101.730%	102.572%	103.685%	80.567%	81.254%
σ		0.955%	n/a	n/a	n/a	n/a	n/a	1.145%	1.366%
%RSD		1.245	1.572	1.208	1.061	1.453	1.388	1.421	1.681

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:22:30	102.100	103.600	104.700	104.200	104.500	74.913%
2	20:23:13	102.800	104.200	105.200	106.300	105.800	76.184%
3	20:23:56	105.500	106.800	108.500	108.000	108.400	76.189%
x		103.468%	104.833%	106.129%	106.161%	106.203%	75.762%
σ		n/a	n/a	n/a	n/a	n/a	0.735%
%RSD		1.737	1.612	1.946	1.825	1.855	0.971

CCB7 11/14/2013 8:29:58 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	101.917%	-0.398	6.601	6.171	0.000	-0.249	0.739	0.535
2	20:31:24	100.050%	-0.418	6.491	5.895	0.000	-0.284	0.384	0.668
3	20:32:07	100.042%	-0.418	4.924	5.273	0.000	-0.311	0.817	0.693
x		100.670%	-0.412	6.005	5.780	0.000	-0.281	0.647	0.632
σ		1.080%	0.012	0.938	0.460	0.000	0.031	0.231	0.085
%RSD		1.073	2.862	15.620	7.954	0.000	11.140	35.650	13.440

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	0.174	-0.879	0.000	2.501	3.342	2.685	87.317%	0.058
2	20:31:24	0.166	-0.737	0.000	1.703	1.396	3.060	87.708%	0.683
3	20:32:07	0.203	-0.763	0.000	1.253	3.867	2.962	86.732%	0.004
x		0.181	-0.793	0.000	1.819	2.868	2.903	87.252%	0.249
σ		0.020	0.075	0.000	0.632	1.302	0.195	0.491%	0.377
%RSD		10.850	9.511	0.000	34.750	45.390	6.709	0.563	151.800

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	-0.018	-0.056	0.099	-1.582	3.487	0.004	-0.007	-0.005
2	20:31:24	-0.017	-0.065	0.109	-2.562	1.721	0.003	-0.003	-0.011
3	20:32:07	0.009	-0.070	0.099	-3.683	1.401	0.003	0.001	-0.009
x		-0.009	-0.063	0.103	-2.609	2.203	0.003	-0.003	-0.008
σ		0.015	0.007	0.006	1.051	1.123	0.000	0.004	0.003
%RSD		178.800	10.990	5.628	40.300	50.990	15.190	142.200	41.460

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	-0.015	0.640	0.490	-0.025	-0.076	0.014	0.000	0.002
2	20:31:24	-0.008	0.690	0.511	-0.095	-0.025	-0.071	0.000	0.004
3	20:32:07	-0.004	0.639	0.611	-0.089	-0.060	-0.355	0.000	0.006
x		-0.009	0.656	0.538	-0.070	-0.054	-0.137	0.000	0.004
σ		0.006	0.029	0.065	0.039	0.026	0.193	0.000	0.002
%RSD		62.910	4.399	12.010	55.540	48.610	140.500	0.000	49.200

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	83.993%	0.188	0.246	83.891%	-0.109	-0.108	0.014	0.005
2	20:31:24	86.291%	0.172	0.144	86.092%	-0.112	-0.103	0.037	0.016
3	20:32:07	86.208%	0.119	0.139	86.263%	-0.113	-0.107	-0.006	-0.008
x		85.498%	0.160	0.176	85.415%	-0.111	-0.106	0.015	0.004
σ		1.303%	0.036	0.061	1.323%	0.002	0.002	0.022	0.012
%RSD		1.525	22.650	34.300	1.549	1.844	2.178	145.800	276.100

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	84.354%	-0.068	0.066	0.061	0.014	0.001	84.394%	84.735%
2	20:31:24	86.247%	-0.086	0.070	0.050	-0.006	-0.010	87.518%	87.718%
3	20:32:07	86.887%	-0.113	0.067	0.055	-0.012	-0.004	87.672%	87.892%
x		85.829%	-0.089	0.068	0.055	-0.001	-0.004	86.528%	86.782%
σ		1.317%	0.023	0.002	0.005	0.014	0.006	1.850%	1.775%
%RSD		1.534	25.340	3.368	9.774	1413.000	136.400	2.138	2.045

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:30:41	0.061	0.061	0.055	0.058	0.053	85.060%
2	20:31:24	0.045	0.046	0.057	0.059	0.055	87.001%
3	20:32:07	0.035	0.040	0.061	0.068	0.058	88.331%
x		0.047	0.049	0.058	0.062	0.055	86.797%
σ		0.013	0.011	0.003	0.005	0.003	1.645%
%RSD		28.020	22.140	5.036	8.735	5.089	1.895

CRI 1011230 11/14/2013 8:34:48 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	99.808%	0.742	9.450	9.228	0.000	91.870	101.200	99.120
2	20:36:14	97.376%	0.697	9.260	9.084	0.000	94.120	102.000	101.000
3	20:36:58	94.686%	0.808	9.151	9.342	0.000	96.030	105.600	103.900
x		97.290%	74.871%	185.739%	184.362%	0.000	94.004%	102.938%	101.341%
σ		2.562%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.633	7.454	1.629	1.406	0.000	2.215	2.292	2.382
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	34.760	503.200	0.000	102.100	114.000	106.200	94.391%	4.964
2	20:36:14	35.130	512.900	0.000	102.300	111.200	101.500	92.983%	5.015
3	20:36:58	35.250	511.200	0.000	103.700	103.000	109.200	93.557%	4.736
x		116.813%	101.817%	0.000	102.697%	109.378%	105.643%	93.644%	98.107%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.708%	n/a
%RSD		0.734	1.019	0.000	0.854	5.223	3.658	0.756	3.028
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	0.953	1.996	4.973	42.560	52.210	0.495	1.080	2.104
2	20:36:14	0.976	2.011	5.129	43.650	51.290	0.503	1.060	2.192
3	20:36:58	0.971	1.953	5.058	43.210	51.880	0.529	1.055	2.148
x		96.647%	99.337%	1010.661%	86.284%	103.584%	101.865%	106.496%	107.395%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		1.266	1.506	1.552	1.273	0.905	3.503	1.256	2.061
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	2.202	6.481	6.431	0.911	4.855	4.730	0.000	4.865
2	20:36:14	2.296	6.378	6.547	1.066	4.817	5.029	0.000	4.803
3	20:36:58	2.168	6.376	6.662	0.935	4.899	4.661	0.000	4.871
x		111.097%	128.233%	130.932%	97.107%	97.140%	96.135%	0.000	96.925%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		2.989	0.935	1.765	8.596	0.845	4.069	0.000	0.780
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	92.766%	4.669	4.749	86.741%	1.071	1.020	1.055	1.054
2	20:36:14	92.317%	4.997	4.770	85.759%	1.060	1.092	1.032	1.118
3	20:36:58	92.180%	4.721	4.899	85.594%	1.060	1.037	1.072	1.131
x		92.421%	95.913%	96.119%	86.032%	106.363%	104.970%	105.290%	110.115%
σ		0.307%	n/a	n/a	0.620%	n/a	n/a	n/a	n/a
%RSD		0.332	3.679	1.685	0.721	0.616	3.609	1.921	3.733
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:35:31	86.951%	5.031	2.071	2.070	10.530	10.510	87.247%	87.777%
2	20:36:14	86.136%	5.061	2.109	2.172	10.460	10.700	87.705%	88.141%
3	20:36:58	86.485%	5.239	2.099	2.134	10.390	10.900	87.733%	87.745%
x		86.524%	102.203%	104.638%	106.261%	104.610%	107.055%	87.561%	87.888%
σ		0.409%	n/a	n/a	n/a	n/a	n/a	0.273%	0.220%
%RSD		0.473	2.200	0.951	2.410	0.699	1.828	0.312	0.250
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	20:35:31	1.046	1.035	1.057	1.102	1.075	90.526%		
2	20:36:14	1.046	1.080	1.062	1.153	1.109	88.284%		
3	20:36:58	1.035	1.069	1.085	1.186	1.118	88.128%		
x		104.223%	106.147%	106.821%	114.698%	110.071%	88.979%		
σ		n/a	n/a	n/a	n/a	n/a	1.342%		
%RSD		0.629	2.178	1.420	3.715	2.096	1.508		

180-26744-A-1-E 11/14/2013 8:44:27 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	71.643%	6.774	16.130	17.220	0.000	958.000	25150.000	24840.000
2	20:45:52	66.878%	7.022	17.470	17.260	0.000	982.400	25870.000	25900.000
3	20:46:35	67.287%	6.781	17.400	17.720	0.000	965.100	25670.000	25780.000
x		68.603%	6.859	17.000	17.400	0.000	968.500	25560.000	25500.000
σ		2.641%	0.141	0.755	0.275	0.000	12.540	370.900	577.500
%RSD		3.850	2.062	4.439	1.580	0.000	1.295	1.451	2.264

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	88550.000	4335.000	0.000	9048.000	15630.000	14990.000	74.742%	708.900
2	20:45:52	91440.000	4337.000	0.000	9041.000	15750.000	14620.000	72.718%	703.800
3	20:46:35	91460.000	4438.000	0.000	9045.000	15420.000	15080.000	70.684%	712.200
x		90480.000	4370.000	0.000	9045.000	15600.000	14890.000	72.715%	708.300
σ		1674.000	58.740	0.000	3.742	169.400	241.200	2.029%	4.197
%RSD		1.850	1.344	0.000	0.041	1.086	1.620	2.790	0.593

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	203.900	175.700	8852.000	358500.000	373000.000	122.700	235.500	171.200
2	20:45:52	205.000	171.400	8778.000	356100.000	368900.000	120.500	233.000	171.300
3	20:46:35	202.700	173.700	8807.000	358400.000	375300.000	121.200	234.400	171.100
x		203.900	173.600	8812.000	357600.000	372400.000	121.500	234.300	171.200
σ		1.123	2.125	37.050	1360.000	3263.000	1.089	1.214	0.100
%RSD		0.551	1.224	0.420	0.380	0.876	0.896	0.518	0.058

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	174.300	598.000	599.700	83.910	1.931	4.420	0.000	193.800
2	20:45:52	174.200	594.500	600.800	83.030	1.691	4.553	0.000	196.000
3	20:46:35	174.400	601.500	597.700	83.810	1.842	4.958	0.000	198.100
x		174.300	598.000	599.400	83.580	1.821	4.644	0.000	196.000
σ		0.116	3.491	1.562	0.485	0.121	0.280	0.000	2.167
%RSD		0.066	0.584	0.261	0.580	6.641	6.035	0.000	1.106

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	0.000	8.017	8.175	69.988%	0.050	-0.018	2.357	1.929
2	20:45:52	0.000	7.919	8.179	68.420%	0.064	-0.023	2.260	1.978
3	20:46:35	0.000	8.152	8.246	67.551%	0.067	-0.028	2.301	1.936
x		0.000	8.029	8.200	68.653%	0.060	-0.023	2.306	1.948
σ		0.000	0.117	0.040	1.235%	0.009	0.005	0.048	0.026
%RSD		0.000	1.458	0.487	1.799	15.510	21.590	2.098	1.348

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	72.901%	26.820	1.870	1.887	953.200	951.000	88.558%	88.262%
2	20:45:52	72.136%	26.720	1.880	1.808	957.800	952.000	89.446%	89.222%
3	20:46:35	72.065%	26.290	1.861	1.876	957.400	949.300	88.489%	89.061%
x		72.367%	26.610	1.871	1.857	956.100	950.800	88.831%	88.848%
σ		0.463%	0.282	0.010	0.043	2.524	1.357	0.534%	0.514%
%RSD		0.640	1.059	0.517	2.325	0.264	0.143	0.601	0.579

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:45:09	1.002	1.055	149.200	148.200	148.700	74.554%
2	20:45:52	1.054	1.056	150.400	149.100	150.100	75.421%
3	20:46:35	1.047	1.034	149.600	148.600	149.300	75.290%
x		1.034	1.048	149.700	148.600	149.400	75.088%
σ		0.028	0.013	0.621	0.489	0.709	0.467%
%RSD		2.715	1.213	0.415	0.329	0.474	0.622

180-26836-A-2-D 11/14/2013 8:49:13 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	83.757%	-0.356	30.930	31.530	0.000	539.000	3078.000	2975.000
2	20:50:39	81.025%	-0.340	30.430	31.120	0.000	527.400	3069.000	3022.000
3	20:51:22	82.011%	-0.360	30.890	32.290	0.000	541.400	3090.000	2992.000
x		82.264%	-0.352	30.750	31.650	0.000	535.900	3079.000	2996.000
σ		1.383%	0.011	0.275	0.593	0.000	7.468	10.550	24.000
%RSD		1.682	3.034	0.893	1.872	0.000	1.393	0.343	0.801

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	145.700	767.400	0.000	23010.000	10520.000	9978.000	71.704%	12.500
2	20:50:39	144.000	748.700	0.000	22510.000	10360.000	9806.000	73.576%	11.980
3	20:51:22	141.600	768.200	0.000	22420.000	10270.000	10030.000	73.131%	11.780
x		143.800	761.400	0.000	22650.000	10380.000	9937.000	72.804%	12.080
σ		2.075	11.050	0.000	315.900	128.900	115.700	0.978%	0.372
%RSD		1.443	1.452	0.000	1.395	1.242	1.164	1.343	3.076

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	-0.468	-1.416	84.770	339.400	380.000	0.226	1.538	18.240
2	20:50:39	-0.437	-1.351	83.910	319.500	358.900	0.223	1.439	17.830
3	20:51:22	-0.499	-1.335	84.680	323.100	358.400	0.238	1.485	17.930
x		-0.468	-1.367	84.450	327.300	365.800	0.229	1.487	18.000
σ		0.031	0.043	0.471	10.620	12.300	0.008	0.050	0.215
%RSD		6.685	3.114	0.558	3.245	3.363	3.466	3.350	1.195

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	18.170	95.100	96.560	-0.011	-0.106	-0.441	0.000	70.320
2	20:50:39	17.910	95.170	95.730	0.132	-0.142	-0.151	0.000	70.920
3	20:51:22	18.490	95.870	98.230	0.191	-0.099	-0.121	0.000	71.320
x		18.190	95.380	96.840	0.104	-0.116	-0.238	0.000	70.860
σ		0.290	0.427	1.275	0.104	0.023	0.177	0.000	0.505
%RSD		1.593	0.448	1.316	99.690	20.170	74.410	0.000	0.713

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	74.411%	2.224	2.144	73.275%	-0.103	-0.109	0.069	-0.032
2	20:50:39	75.411%	2.082	2.077	73.676%	-0.104	-0.103	0.057	-0.010
3	20:51:22	76.420%	2.035	2.020	75.523%	-0.112	-0.103	0.069	0.050
x		75.414%	2.114	2.081	74.158%	-0.107	-0.105	0.065	0.003
σ		1.005%	0.098	0.062	1.199%	0.005	0.003	0.007	0.042
%RSD		1.332	4.655	2.975	1.617	4.858	3.061	11.100	1611.000

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	74.836%	19.800	0.201	0.203	20.740	20.930	79.947%	80.896%
2	20:50:39	77.179%	19.840	0.189	0.183	20.380	20.890	82.819%	84.024%
3	20:51:22	77.286%	20.370	0.186	0.173	20.380	20.610	83.215%	84.038%
x		76.434%	20.000	0.192	0.187	20.500	20.810	81.994%	82.986%
σ		1.384%	0.317	0.008	0.015	0.206	0.173	1.783%	1.810%
%RSD		1.811	1.587	4.185	8.155	1.004	0.831	2.175	2.181

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:49:56	0.032	0.031	0.346	0.323	0.332	78.488%
2	20:50:39	0.035	0.030	0.349	0.342	0.341	80.472%
3	20:51:22	0.029	0.032	0.327	0.325	0.332	81.065%
x		0.032	0.031	0.341	0.330	0.335	80.008%
σ		0.003	0.001	0.012	0.010	0.005	1.350%
%RSD		7.972	2.301	3.555	3.137	1.484	1.687

180-26836-A-2-D SD@5 11/14/2013 8:54:00 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	89.381%	-0.386	8.905	7.805	0.000	98.840	602.800	598.700
2	20:55:26	87.462%	-0.403	6.897	7.433	0.000	97.440	613.700	601.900
3	20:56:08	88.588%	-0.446	8.153	7.301	0.000	97.760	608.200	602.800
x		88.477%	-0.411	7.985	7.513	0.000	98.010	608.200	601.200
σ		0.964%	0.031	1.014	0.261	0.000	0.737	5.415	2.160
%RSD		1.090	7.530	12.700	3.478	0.000	0.752	0.890	0.359

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	29.110	166.000	0.000	4536.000	2043.000	1957.000	78.902%	2.507
2	20:55:26	28.910	162.600	0.000	4516.000	2098.000	1965.000	78.998%	2.235
3	20:56:08	29.840	164.000	0.000	4544.000	2054.000	1996.000	78.491%	2.381
x		29.280	164.200	0.000	4532.000	2065.000	1972.000	78.797%	2.374
σ		0.489	1.708	0.000	14.550	29.440	20.660	0.270%	0.136
%RSD		1.672	1.040	0.000	0.321	1.426	1.047	0.342	5.739

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	-0.155	-0.398	16.410	56.440	69.340	0.043	0.295	3.696
2	20:55:26	-0.095	-0.344	16.480	57.240	70.200	0.048	0.251	3.660
3	20:56:08	-0.149	-0.354	16.680	58.630	71.390	0.040	0.265	3.792
x		-0.133	-0.365	16.530	57.440	70.310	0.044	0.271	3.716
σ		0.033	0.029	0.141	1.112	1.032	0.004	0.023	0.069
%RSD		24.500	7.819	0.852	1.935	1.468	9.674	8.400	1.844

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	3.815	21.530	21.500	-0.041	-0.090	-0.277	0.000	14.140
2	20:55:26	3.602	21.540	21.420	-0.116	-0.237	-0.730	0.000	14.010
3	20:56:08	3.851	21.910	21.560	0.025	-0.186	-0.095	0.000	14.120
x		3.756	21.660	21.490	-0.044	-0.171	-0.367	0.000	14.090
σ		0.135	0.218	0.075	0.071	0.075	0.327	0.000	0.073
%RSD		3.590	1.007	0.348	160.500	43.830	89.060	0.000	0.518

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	79.358%	0.341	0.359	79.105%	-0.115	-0.118	0.005	0.009
2	20:55:26	80.546%	0.356	0.319	80.022%	-0.115	-0.113	0.030	0.019
3	20:56:08	80.648%	0.281	0.306	80.566%	-0.114	-0.110	-0.038	-0.040
x		80.184%	0.326	0.328	79.898%	-0.115	-0.113	-0.001	-0.004
σ		0.717%	0.040	0.028	0.738%	0.001	0.004	0.035	0.031
%RSD		0.895	12.230	8.403	0.924	0.494	3.570	3432.000	778.300

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	80.049%	3.719	0.012	0.002	3.926	4.246	82.170%	82.702%
2	20:55:26	81.098%	3.867	0.026	0.015	4.148	4.066	84.168%	84.418%
3	20:56:08	81.910%	3.818	0.016	0.008	4.086	4.061	84.947%	85.652%
x		81.019%	3.801	0.018	0.008	4.053	4.124	83.762%	84.257%
σ		0.933%	0.075	0.007	0.007	0.114	0.106	1.432%	1.482%
%RSD		1.152	1.985	39.540	81.510	2.821	2.558	1.710	1.759

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	20:54:43	0.020	0.021	0.063	0.061	0.063	82.758%
2	20:55:26	0.015	0.014	0.076	0.070	0.071	83.928%
3	20:56:08	0.012	0.014	0.067	0.055	0.063	84.837%
x		0.016	0.017	0.068	0.062	0.066	83.841%
σ		0.004	0.004	0.007	0.008	0.004	1.042%
%RSD		28.100	23.530	9.675	12.490	6.768	1.243

180-26836-A-2-E MS 11/14/2013 8:58:47 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	91.424%	45.550	877.900	872.300	0.000	46340.000	47900.000	47880.000
2	21:00:13	85.800%	46.670	911.000	906.100	0.000	48880.000	50570.000	50480.000
3	21:00:56	89.240%	45.380	880.500	880.700	0.000	47720.000	49640.000	49490.000
x		88.821%	45.870	889.800	886.400	0.000	47640.000	49370.000	49280.000
σ		2.835%	0.699	18.390	17.600	0.000	1271.000	1357.000	1314.000
%RSD		3.192	1.525	2.067	1.986	0.000	2.667	2.748	2.667
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	2143.000	5103.000	0.000	69930.000	58790.000	58920.000	80.005%	941.000
2	21:00:13	2267.000	5325.000	0.000	72050.000	60270.000	60100.000	79.751%	952.200
3	21:00:56	2235.000	5215.000	0.000	71590.000	59560.000	59330.000	80.518%	937.700
x		2215.000	5215.000	0.000	71190.000	59540.000	59450.000	80.091%	943.600
σ		64.490	110.900	0.000	1116.000	739.900	599.100	0.391%	7.561
%RSD		2.911	2.126	0.000	1.568	1.243	1.008	0.488	0.801
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	497.900	192.500	560.400	1347.000	1587.000	476.900	475.500	261.500
2	21:00:13	506.900	195.800	572.600	1372.000	1574.000	482.700	482.200	263.100
3	21:00:56	506.000	194.000	576.600	1380.000	1591.000	492.400	487.200	260.900
x		503.600	194.100	569.900	1367.000	1584.000	484.000	481.700	261.800
σ		4.937	1.658	8.432	17.400	8.807	7.858	5.862	1.120
%RSD		0.980	0.854	1.480	1.273	0.556	1.624	1.217	0.428
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	262.500	549.000	549.700	35.090	9.013	8.642	0.000	1021.000
2	21:00:13	266.800	552.200	556.300	35.860	8.877	9.620	0.000	1041.000
3	21:00:56	262.500	549.400	553.600	35.180	8.348	8.719	0.000	1021.000
x		263.900	550.200	553.200	35.380	8.746	8.994	0.000	1028.000
σ		2.454	1.755	3.291	0.422	0.351	0.543	0.000	11.890
%RSD		0.930	0.319	0.595	1.193	4.019	6.043	0.000	1.157
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	77.839%	954.100	976.500	74.158%	46.180	46.550	47.020	42.860
2	21:00:13	79.086%	972.600	998.500	74.997%	46.820	46.810	47.850	42.890
3	21:00:56	81.208%	960.200	984.700	77.250%	46.460	46.300	47.540	42.770
x		79.377%	962.300	986.500	75.468%	46.490	46.560	47.470	42.840
σ		1.703%	9.408	11.090	1.599%	0.322	0.256	0.421	0.064
%RSD		2.146	0.978	1.124	2.119	0.692	0.549	0.888	0.149
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	20:59:30	76.004%	1851.000	450.800	448.100	1714.000	1973.000	79.751%	79.841%
2	21:00:13	77.597%	1883.000	457.800	455.500	1696.000	2007.000	81.642%	82.759%
3	21:00:56	79.233%	1864.000	452.900	451.000	1336.000	1992.000	84.544%	84.575%
x		77.611%	1866.000	453.800	451.500	1582.000	1991.000	81.979%	82.392%
σ		1.615%	16.010	3.612	3.770	213.700	17.100	2.414%	2.388%
%RSD		2.080	0.858	0.796	0.835	13.510	0.859	2.945	2.898
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	20:59:30	48.010	48.990	19.460	20.910	20.170	73.982%		
2	21:00:13	49.540	49.950	20.090	21.430	20.750	75.520%		
3	21:00:56	49.120	49.910	20.000	21.420	20.680	76.812%		
x		48.890	49.620	19.850	21.250	20.530	75.438%		
σ		0.787	0.545	0.338	0.296	0.315	1.416%		
%RSD		1.610	1.099	1.701	1.394	1.535	1.878		

180-26836-A-2-F MSD 11/14/2013 9:03:34 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	94.851%	46.580	883.700	871.900	0.000	46790.000	48490.000	48110.000
2	21:05:00	91.804%	46.160	924.800	913.900	0.000	47580.000	48380.000	47980.000
3	21:05:43	91.846%	45.730	868.100	863.200	0.000	45830.000	47670.000	47800.000
x		92.834%	46.160	892.200	883.000	0.000	46740.000	48180.000	47970.000
σ		1.747%	0.425	29.290	27.070	0.000	875.000	444.600	154.700
%RSD		1.882	0.920	3.283	3.066	0.000	1.872	0.923	0.323

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	2136.000	5459.000	0.000	70210.000	59080.000	57390.000	84.016%	925.400
2	21:05:00	2138.000	5456.000	0.000	71060.000	58770.000	57580.000	84.392%	925.700
3	21:05:43	2128.000	5432.000	0.000	69260.000	58400.000	57270.000	84.592%	926.100
x		2134.000	5449.000	0.000	70180.000	58750.000	57410.000	84.333%	925.700
σ		5.250	14.700	0.000	904.000	343.900	157.400	0.292%	0.307
%RSD		0.246	0.270	0.000	1.288	0.585	0.274	0.347	0.033

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	491.100	190.300	550.900	1329.000	1547.000	480.300	480.100	258.400
2	21:05:00	492.500	187.700	552.000	1324.000	1535.000	478.500	476.200	257.900
3	21:05:43	488.300	188.300	552.300	1308.000	1527.000	479.500	470.500	257.400
x		490.600	188.800	551.700	1320.000	1536.000	479.500	475.600	257.900
σ		2.131	1.360	0.722	11.060	10.330	0.905	4.822	0.474
%RSD		0.434	0.720	0.131	0.838	0.672	0.189	1.014	0.184

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	261.600	534.200	537.100	34.500	8.886	8.565	0.000	994.600
2	21:05:00	260.700	536.900	538.500	34.980	8.725	8.526	0.000	1003.000
3	21:05:43	257.500	531.800	536.100	34.570	8.413	7.939	0.000	1007.000
x		259.900	534.300	537.200	34.680	8.675	8.343	0.000	1002.000
σ		2.142	2.530	1.198	0.263	0.240	0.351	0.000	6.381
%RSD		0.824	0.473	0.223	0.757	2.770	4.202	0.000	0.637

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	81.442%	936.300	965.400	77.580%	44.800	44.930	46.010	41.610
2	21:05:00	82.342%	949.300	973.100	77.933%	45.140	45.200	45.900	42.410
3	21:05:43	82.341%	941.700	966.200	78.486%	44.940	44.980	46.080	41.920
x		82.042%	942.400	968.200	78.000%	44.960	45.040	45.990	41.980
σ		0.520%	6.503	4.210	0.456%	0.172	0.140	0.091	0.407
%RSD		0.633	0.690	0.435	0.585	0.381	0.310	0.197	0.970

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	79.753%	1807.000	435.500	434.900	1581.000	1927.000	81.621%	82.069%
2	21:05:00	80.727%	1829.000	438.900	438.200	1373.000	1948.000	84.079%	84.684%
3	21:05:43	81.065%	1831.000	441.200	440.900	1187.000	1951.000	84.257%	85.581%
x		80.515%	1822.000	438.500	438.000	1380.000	1942.000	83.319%	84.111%
σ		0.681%	13.030	2.835	3.014	197.100	13.370	1.473%	1.825%
%RSD		0.846	0.715	0.647	0.688	14.280	0.688	1.768	2.169

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:04:17	47.750	48.230	19.260	20.570	19.840	74.662%
2	21:05:00	47.920	48.700	19.470	20.840	20.140	76.323%
3	21:05:43	48.240	48.820	19.330	20.870	20.150	76.971%
x		47.970	48.580	19.350	20.760	20.050	75.985%
σ		0.246	0.310	0.105	0.164	0.179	1.191%
%RSD		0.513	0.637	0.541	0.790	0.894	1.567

180-26744-A-1-F 11/14/2013 9:11:43 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	89.748%	5.905	20.150	19.880	0.000	900.700	21020.000	20790.000
2	21:13:09	83.099%	6.033	19.180	19.600	0.000	888.900	20820.000	20610.000
3	21:13:52	78.779%	5.707	18.320	19.160	0.000	893.400	20960.000	20730.000
x		83.875%	5.882	19.220	19.550	0.000	894.300	20930.000	20710.000
σ		5.526%	0.164	0.918	0.365	0.000	5.926	103.300	95.570
%RSD		6.588	2.789	4.777	1.868	0.000	0.663	0.493	0.462

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	73640.000	4193.000	0.000	8256.000	14170.000	13050.000	89.602%	679.400
2	21:13:09	73130.000	4149.000	0.000	8054.000	13880.000	12820.000	83.687%	665.200
3	21:13:52	72920.000	4101.000	0.000	7949.000	13820.000	12730.000	80.025%	673.500
x		73230.000	4148.000	0.000	8086.000	13950.000	12860.000	84.438%	672.700
σ		368.100	45.740	0.000	155.800	185.700	164.100	4.833%	7.129
%RSD		0.503	1.103	0.000	1.927	1.331	1.275	5.723	1.060

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	157.500	157.600	8097.000	270000.000	279000.000	109.800	202.200	157.600
2	21:13:09	154.500	158.500	8091.000	270100.000	279400.000	107.800	199.800	152.200
3	21:13:52	156.000	157.800	8081.000	269500.000	280100.000	108.300	199.300	152.100
x		156.000	158.000	8090.000	269900.000	279500.000	108.600	200.400	154.000
σ		1.529	0.495	8.117	307.000	568.800	1.054	1.564	3.160
%RSD		0.980	0.314	0.100	0.114	0.203	0.971	0.780	2.053

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	157.200	545.400	553.100	57.350	1.446	3.877	0.000	167.000
2	21:13:09	154.000	549.800	552.800	56.620	1.117	3.891	0.000	167.500
3	21:13:52	154.400	549.800	557.100	56.620	1.276	3.966	0.000	168.100
x		155.200	548.300	554.400	56.870	1.280	3.912	0.000	167.500
σ		1.771	2.526	2.404	0.419	0.164	0.048	0.000	0.552
%RSD		1.141	0.461	0.434	0.737	12.840	1.226	0.000	0.330

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	0.000	5.664	5.895	77.981%	0.019	-0.050	2.143	1.857
2	21:13:09	0.000	5.839	5.948	73.755%	0.015	-0.050	2.319	1.893
3	21:13:52	0.000	5.811	6.053	72.023%	0.020	-0.049	2.361	2.020
x		0.000	5.771	5.965	74.586%	0.018	-0.050	2.274	1.923
σ		0.000	0.094	0.080	3.064%	0.003	0.001	0.115	0.086
%RSD		0.000	1.631	1.345	4.109	15.870	1.177	5.071	4.447

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	79.628%	11.280	0.321	0.286	888.000	890.000	86.763%	85.607%
2	21:13:09	76.702%	10.830	0.289	0.315	884.500	885.300	84.542%	84.083%
3	21:13:52	74.732%	10.370	0.277	0.292	890.900	890.600	84.316%	84.282%
x		77.021%	10.830	0.296	0.298	887.800	888.600	85.207%	84.657%
σ		2.463%	0.453	0.023	0.015	3.230	2.876	1.352%	0.829%
%RSD		3.198	4.183	7.641	5.136	0.364	0.324	1.587	0.979

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:12:26	0.856	0.851	120.500	118.800	119.600	74.945%
2	21:13:09	0.833	0.880	121.600	120.400	121.400	73.514%
3	21:13:52	0.839	0.846	122.400	121.600	122.000	73.409%
x		0.843	0.859	121.500	120.300	121.000	73.956%
σ		0.012	0.018	0.970	1.399	1.265	0.858%
%RSD		1.379	2.090	0.798	1.163	1.046	1.160

CCV 993939 11/14/2013 9:16:30 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	82.954%	104.500	102.800	104.100	0.000	51430.000	49160.000	48620.000
2	21:17:55	83.863%	107.100	97.920	98.240	0.000	51140.000	49150.000	48420.000
3	21:18:38	83.577%	105.100	104.700	102.600	0.000	51170.000	49830.000	49580.000
x		83.465%	105.585%	101.812%	101.656%	0.000	102.496%	98.757%	97.744%
σ		0.465%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		0.557	1.270	3.433	3.000	0.000	0.311	0.795	1.270

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	506.100	4952.000	0.000	51310.000	50950.000	50220.000	78.775%	99.420
2	21:17:55	502.500	4850.000	0.000	50110.000	50840.000	49830.000	79.160%	96.790
3	21:18:38	509.500	5009.000	0.000	50960.000	50580.000	50290.000	79.099%	97.580
x		101.208%	98.740%	0.000	101.578%	101.582%	100.227%	79.011%	97.933%
σ		n/a	n/a	0.000	n/a	n/a	n/a	0.207%	n/a
%RSD		0.685	1.638	0.000	1.213	0.375	0.496	0.262	1.378

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	100.300	99.910	494.800	25090.000	24940.000	102.200	101.800	102.900
2	21:17:55	99.960	99.860	495.200	25000.000	24850.000	101.200	100.800	101.600
3	21:18:38	99.110	101.100	501.100	25140.000	25200.000	101.200	100.900	101.500
x		99.804%	100.305%	99.400%	100.317%	99.982%	101.535%	101.149%	101.978%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.633	0.724	0.711	0.278	0.717	0.593	0.579	0.804

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	102.900	104.300	105.200	103.000	105.700	105.600	0.000	97.790
2	21:17:55	102.200	106.100	104.700	101.500	104.500	104.600	0.000	97.960
3	21:18:38	102.400	105.700	104.400	103.000	105.000	104.800	0.000	97.940
x		102.476%	105.373%	104.763%	102.522%	105.047%	105.015%	0.000	97.898%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		0.349	0.862	0.413	0.841	0.542	0.495	0.000	0.094

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	78.933%	97.790	100.100	72.173%	105.800	106.800	105.900	106.000
2	21:17:55	80.899%	99.380	101.700	73.142%	107.100	105.900	106.200	106.000
3	21:18:38	81.526%	101.000	103.200	73.682%	105.700	106.600	106.700	106.200
x		80.453%	99.392%	101.668%	72.999%	106.189%	106.421%	106.266%	106.070%
σ		1.353%	n/a	n/a	0.765%	n/a	n/a	n/a	n/a
%RSD		1.682	1.612	1.525	1.048	0.718	0.424	0.402	0.135

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	74.581%	99.420	101.000	100.900	103.300	102.800	77.868%	78.272%
2	21:17:55	75.952%	100.300	100.600	100.600	102.300	102.500	79.369%	80.444%
3	21:18:38	76.340%	100.100	101.600	101.300	101.500	104.500	79.637%	81.068%
x		75.625%	99.938%	101.094%	100.910%	102.410%	103.277%	78.958%	79.928%
σ		0.924%	n/a	n/a	n/a	n/a	n/a	0.954%	1.468%
%RSD		1.222	0.452	0.514	0.368	0.878	1.019	1.208	1.837

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:17:13	101.600	102.200	103.700	103.800	104.100	73.966%
2	21:17:55	102.300	104.200	105.300	105.300	105.400	74.638%
3	21:18:38	102.900	104.100	105.500	104.800	105.600	75.296%
x		102.253%	103.515%	104.837%	104.626%	105.030%	74.633%
σ		n/a	n/a	n/a	n/a	n/a	0.665%
%RSD		0.628	1.065	0.944	0.745	0.806	0.891

CCB8 11/14/2013 9:24:41 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	95.428%	-0.365	3.345	3.188	0.000	1.368	0.718	0.677
2	21:26:07	93.647%	-0.394	3.490	3.426	0.000	1.083	0.609	0.598
3	21:26:49	93.330%	-0.373	3.229	3.043	0.000	1.080	0.865	0.640
x		94.135%	-0.377	3.355	3.219	0.000	1.177	0.731	0.638
σ		1.131%	0.015	0.131	0.193	0.000	0.165	0.128	0.040
%RSD		1.202	3.922	3.906	6.007	0.000	14.050	17.560	6.206
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	0.270	-0.831	0.000	3.535	-0.030	2.112	86.983%	0.014
2	21:26:07	0.242	-1.124	0.000	3.227	2.471	2.261	85.686%	0.045
3	21:26:49	0.291	-0.792	0.000	2.425	1.911	2.445	87.231%	0.033
x		0.268	-0.916	0.000	3.062	1.451	2.272	86.633%	0.031
σ		0.025	0.182	0.000	0.573	1.312	0.167	0.830%	0.016
%RSD		9.217	19.830	0.000	18.710	90.480	7.339	0.958	51.350
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	-0.031	-0.071	0.116	-1.742	2.994	0.003	-0.004	-0.014
2	21:26:07	-0.039	-0.080	0.121	-2.802	2.054	0.004	-0.007	-0.014
3	21:26:49	-0.013	-0.061	0.094	-3.019	1.812	0.002	-0.019	-0.018
x		-0.028	-0.071	0.110	-2.521	2.287	0.003	-0.010	-0.015
σ		0.014	0.010	0.014	0.684	0.625	0.001	0.008	0.002
%RSD		49.200	13.620	13.010	27.120	27.310	32.350	78.890	16.300
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	-0.016	0.667	0.614	0.044	-0.174	0.340	0.000	0.006
2	21:26:07	-0.015	0.633	0.602	-0.083	-0.088	-0.346	0.000	0.001
3	21:26:49	-0.008	0.592	0.563	-0.154	-0.112	-0.467	0.000	0.005
x		-0.013	0.630	0.593	-0.064	-0.125	-0.158	0.000	0.004
σ		0.004	0.038	0.027	0.100	0.044	0.436	0.000	0.002
%RSD		34.810	5.990	4.475	155.600	35.630	276.400	0.000	56.920
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	84.122%	0.039	0.023	84.256%	-0.107	-0.111	0.041	0.023
2	21:26:07	85.697%	0.020	0.025	85.499%	-0.110	-0.109	-0.022	-0.023
3	21:26:49	86.133%	0.026	0.020	85.759%	-0.112	-0.107	0.063	0.046
x		85.317%	0.028	0.023	85.171%	-0.110	-0.109	0.028	0.016
σ		1.058%	0.010	0.003	0.804%	0.002	0.002	0.044	0.035
%RSD		1.240	34.290	11.380	0.943	2.134	1.896	159.500	224.000
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:25:23	84.759%	0.239	-0.031	-0.020	-0.007	-0.004	85.066%	84.615%
2	21:26:07	86.056%	0.239	-0.015	-0.023	0.000	-0.005	86.789%	87.489%
3	21:26:49	86.287%	0.228	-0.022	-0.030	-0.000	-0.010	87.434%	87.983%
x		85.701%	0.235	-0.023	-0.024	-0.002	-0.006	86.430%	86.696%
σ		0.823%	0.006	0.008	0.005	0.004	0.003	1.224%	1.819%
%RSD		0.961	2.700	34.120	20.410	176.800	50.720	1.417	2.098
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	21:25:23	0.009	0.009	0.016	0.017	0.014	86.418%		
2	21:26:07	0.008	0.009	0.019	0.015	0.015	86.858%		
3	21:26:49	0.010	0.008	0.016	0.016	0.015	87.419%		
x		0.009	0.009	0.017	0.016	0.015	86.898%		
σ		0.001	0.001	0.001	0.001	0.001	0.502%		
%RSD		7.409	7.235	8.120	5.086	4.197	0.578		

180-26663-AO-12-A 11/14/2013 9:29:30 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	80.019%	-0.399	8.172	8.125	0.000	273.700	4.036	4.099
2	21:30:56	73.923%	-0.348	8.030	8.246	0.000	283.400	4.110	4.287
3	21:31:39	69.320%	-0.383	7.606	8.603	0.000	287.000	3.831	4.076
x		74.421%	-0.377	7.936	8.325	0.000	281.400	3.992	4.154
σ		5.367%	0.026	0.295	0.249	0.000	6.874	0.144	0.116
%RSD		7.212	7.017	3.713	2.985	0.000	2.443	3.620	2.781
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	2.561	16.830	0.000	16.150	86.040	80.090	72.619%	0.133
2	21:30:56	2.374	15.430	0.000	13.040	89.840	78.350	69.749%	0.148
3	21:31:39	2.497	16.000	0.000	11.620	99.790	77.380	69.381%	0.043
x		2.477	16.090	0.000	13.610	91.890	78.610	70.583%	0.108
σ		0.095	0.703	0.000	2.317	7.100	1.372	1.773%	0.056
%RSD		3.837	4.372	0.000	17.030	7.727	1.745	2.512	52.190
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	-0.925	0.750	0.108	-0.275	3.577	0.003	0.021	0.364
2	21:30:56	-0.174	0.665	0.103	-3.256	1.230	0.001	0.039	0.328
3	21:31:39	0.037	0.691	0.121	-4.107	-0.077	0.002	0.020	0.272
x		-0.354	0.702	0.111	-2.546	1.577	0.002	0.027	0.321
σ		0.506	0.043	0.009	2.013	1.851	0.001	0.010	0.046
%RSD		142.800	6.131	8.280	79.050	117.400	45.410	39.040	14.480
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	0.329	5.907	5.711	0.049	-0.362	0.022	0.000	0.112
2	21:30:56	0.316	5.544	5.790	-0.082	-0.165	0.039	0.000	0.122
3	21:31:39	0.258	5.786	5.862	-0.023	-0.319	-0.461	0.000	0.121
x		0.301	5.746	5.788	-0.018	-0.282	-0.133	0.000	0.118
σ		0.038	0.185	0.075	0.065	0.103	0.284	0.000	0.006
%RSD		12.550	3.219	1.300	354.200	36.720	213.200	0.000	4.700
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	75.986%	0.031	0.052	77.493%	-0.062	-0.066	-0.059	-0.045
2	21:30:56	75.823%	0.001	0.023	76.378%	-0.071	-0.069	-0.021	-0.028
3	21:31:39	75.787%	0.032	0.005	76.196%	-0.068	-0.068	-0.003	-0.006
x		75.865%	0.021	0.027	76.689%	-0.067	-0.067	-0.028	-0.026
σ		0.106%	0.018	0.024	0.702%	0.005	0.001	0.028	0.020
%RSD		0.139	82.850	89.300	0.916	7.152	1.829	102.600	75.300
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:30:13	78.704%	2.840	-0.013	-0.022	0.053	0.059	84.408%	85.790%
2	21:30:56	78.469%	2.039	-0.016	-0.017	0.080	0.063	87.317%	88.511%
3	21:31:39	78.262%	1.379	-0.016	-0.025	0.067	0.059	88.240%	89.412%
x		78.479%	2.086	-0.015	-0.021	0.067	0.060	86.655%	87.904%
σ		0.221%	0.732	0.001	0.004	0.014	0.002	2.000%	1.886%
%RSD		0.282	35.070	9.761	20.230	20.520	3.453	2.308	2.146
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	21:30:13	0.002	0.006	0.048	0.037	0.039	85.599%		
2	21:30:56	0.001	0.004	0.042	0.030	0.036	88.910%		
3	21:31:39	0.006	0.003	0.030	0.034	0.031	90.594%		
x		0.003	0.004	0.040	0.034	0.035	88.368%		
σ		0.003	0.001	0.009	0.003	0.004	2.541%		
%RSD		93.600	32.000	23.160	10.200	12.110	2.876		

180-26665-U-6-A 11/14/2013 9:34:18 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	77.136%	-0.404	7.284	7.539	0.000	252.500	7.643	7.677
2	21:35:44	70.518%	-0.351	8.598	8.461	0.000	268.700	9.314	8.737
3	21:36:27	70.996%	-0.408	7.331	7.966	0.000	263.500	8.625	8.051
x		72.883%	-0.388	7.738	7.989	0.000	261.600	8.527	8.155
σ		3.691%	0.032	0.746	0.462	0.000	8.282	0.840	0.538
%RSD		5.064	8.155	9.636	5.780	0.000	3.166	9.849	6.596
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	4.136	18.100	0.000	14.940	67.630	77.020	69.931%	0.123
2	21:35:44	4.562	22.040	0.000	17.880	88.410	85.230	63.675%	0.189
3	21:36:27	4.238	19.400	0.000	14.280	80.050	75.690	67.764%	0.218
x		4.312	19.840	0.000	15.700	78.700	79.310	67.123%	0.176
σ		0.222	2.009	0.000	1.915	10.460	5.166	3.177%	0.049
%RSD		5.152	10.120	0.000	12.200	13.290	6.514	4.733	27.600
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	-0.147	0.675	0.489	1.111	5.298	0.011	0.129	0.343
2	21:35:44	-0.686	0.672	0.533	2.311	5.656	0.014	0.167	0.355
3	21:36:27	-0.569	0.659	0.521	-0.567	4.246	0.010	0.153	0.299
x		-0.467	0.669	0.514	0.952	5.067	0.011	0.150	0.332
σ		0.284	0.008	0.022	1.446	0.733	0.002	0.019	0.030
%RSD		60.710	1.267	4.362	151.900	14.460	20.290	12.950	8.920
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	0.343	7.664	7.887	-0.098	-0.283	0.043	0.000	0.136
2	21:35:44	0.364	7.788	7.816	-0.499	-0.277	-0.531	0.000	0.133
3	21:36:27	0.318	7.536	7.744	-0.164	-0.327	-0.418	0.000	0.146
x		0.342	7.662	7.816	-0.254	-0.296	-0.302	0.000	0.138
σ		0.023	0.126	0.071	0.215	0.028	0.304	0.000	0.007
%RSD		6.725	1.643	0.910	84.900	9.330	100.700	0.000	5.311
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	74.730%	0.014	-0.014	74.929%	-0.096	-0.096	0.032	0.020
2	21:35:44	75.229%	0.001	-0.009	75.197%	-0.088	-0.089	-0.047	-0.028
3	21:36:27	75.339%	0.006	-0.031	75.421%	-0.093	-0.099	0.004	0.003
x		75.099%	0.007	-0.018	75.182%	-0.092	-0.095	-0.004	-0.002
σ		0.325%	0.006	0.011	0.246%	0.004	0.005	0.040	0.025
%RSD		0.432	90.950	63.230	0.328	4.560	5.142	1016.000	1546.000
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:35:01	76.706%	0.714	-0.010	-0.032	0.099	0.087	85.311%	86.747%
2	21:35:44	77.587%	0.697	-0.014	-0.015	0.111	0.074	86.704%	87.874%
3	21:36:27	76.977%	0.592	-0.010	-0.016	0.107	0.098	87.495%	88.660%
x		77.090%	0.667	-0.011	-0.021	0.106	0.086	86.503%	87.760%
σ		0.451%	0.066	0.002	0.010	0.006	0.012	1.106%	0.961%
%RSD		0.585	9.921	20.870	45.480	6.116	14.120	1.278	1.095
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	21:35:01	0.003	0.004	0.195	0.179	0.188	87.406%		
2	21:35:44	0.004	0.003	0.177	0.182	0.185	89.434%		
3	21:36:27	0.001	0.002	0.184	0.180	0.182	89.926%		
x		0.003	0.003	0.185	0.180	0.185	88.922%		
σ		0.002	0.001	0.009	0.001	0.003	1.336%		
%RSD		56.250	37.600	4.949	0.783	1.596	1.502		

180-26715-G-1-A 11/14/2013 9:39:07 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	74.254%	-0.358	6.011	6.426	0.000	9.068	2.822	2.492
2	21:40:33	68.796%	-0.388	5.846	7.376	0.000	9.039	2.915	2.631
3	21:41:16	68.192%	-0.341	5.788	6.548	0.000	8.618	2.551	2.704
x		70.414%	-0.362	5.882	6.783	0.000	8.908	2.762	2.609
σ		3.339%	0.024	0.115	0.517	0.000	0.252	0.189	0.108
%RSD		4.742	6.585	1.962	7.617	0.000	2.830	6.850	4.121
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	3.019	13.690	0.000	8.454	19.480	20.830	69.128%	0.237
2	21:40:33	3.024	14.330	0.000	8.438	28.950	19.880	67.304%	0.156
3	21:41:16	3.126	14.650	0.000	7.065	17.130	22.130	66.723%	0.164
x		3.056	14.220	0.000	7.986	21.850	20.950	67.718%	0.186
σ		0.060	0.492	0.000	0.797	6.261	1.127	1.255%	0.045
%RSD		1.971	3.458	0.000	9.985	28.650	5.382	1.853	24.000
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	-0.220	0.546	0.089	-1.774	2.693	0.002	0.030	0.091
2	21:40:33	-0.440	0.616	0.084	-1.718	1.760	0.003	0.042	0.094
3	21:41:16	-1.273	0.465	0.073	-2.801	2.154	0.003	0.028	0.110
x		-0.644	0.542	0.082	-2.098	2.202	0.003	0.033	0.098
σ		0.555	0.076	0.008	0.610	0.469	0.000	0.007	0.010
%RSD		86.200	13.990	9.545	29.070	21.270	15.410	22.390	9.989
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	0.134	4.330	4.329	0.192	-0.430	-0.447	0.000	0.040
2	21:40:33	0.115	4.197	4.382	-0.288	-0.288	-0.388	0.000	0.036
3	21:41:16	0.096	4.323	4.160	-0.239	-0.143	-0.373	0.000	0.051
x		0.115	4.283	4.290	-0.112	-0.287	-0.402	0.000	0.042
σ		0.019	0.075	0.116	0.264	0.143	0.039	0.000	0.008
%RSD		16.730	1.747	2.702	236.000	49.970	9.741	0.000	18.150
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	76.128%	-0.028	-0.032	76.144%	-0.097	-0.093	-0.045	-0.038
2	21:40:33	75.419%	-0.037	-0.029	75.070%	-0.091	-0.096	-0.045	-0.048
3	21:41:16	75.251%	-0.026	-0.024	75.030%	-0.093	-0.093	-0.061	-0.048
x		75.599%	-0.030	-0.028	75.415%	-0.094	-0.094	-0.050	-0.045
σ		0.466%	0.006	0.004	0.632%	0.003	0.002	0.010	0.005
%RSD		0.616	19.840	14.910	0.838	3.043	2.171	19.050	11.980
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:39:50	78.055%	0.674	-0.019	-0.038	0.076	0.060	87.595%	89.237%
2	21:40:33	78.492%	0.570	-0.014	-0.027	0.079	0.051	89.738%	91.190%
3	21:41:16	78.174%	0.532	-0.019	-0.028	0.057	0.081	89.885%	92.015%
x		78.240%	0.592	-0.017	-0.031	0.070	0.064	89.073%	90.814%
σ		0.226%	0.073	0.003	0.006	0.012	0.015	1.282%	1.427%
%RSD		0.288	12.410	18.300	20.110	16.860	23.630	1.439	1.571
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	21:39:50	0.004	0.005	0.069	0.069	0.064	89.556%		
2	21:40:33	0.003	0.005	0.073	0.080	0.072	90.794%		
3	21:41:16	0.003	0.002	0.066	0.073	0.068	91.919%		
x		0.003	0.004	0.069	0.074	0.068	90.756%		
σ		0.000	0.001	0.004	0.006	0.004	1.182%		
%RSD		9.488	37.620	5.228	7.873	6.224	1.303		

180-26715-G-3-A 11/14/2013 9:43:55 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	69.164%	-0.328	13.340	16.030	0.000	7019.000	64680.000	64510.000
2	21:45:20	65.836%	-0.395	15.220	15.910	0.000	7113.000	66560.000	66010.000
3	21:46:03	63.698%	-0.381	15.490	16.640	0.000	7063.000	66830.000	67700.000
x		66.233%	-0.368	14.680	16.190	0.000	7065.000	66020.000	66070.000
σ		2.754%	0.035	1.169	0.391	0.000	47.360	1169.000	1594.000
%RSD		4.158	9.615	7.959	2.413	0.000	0.670	1.770	2.413

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	3.603	5214.000	0.000	1823.000	209900.000	212600.000	59.840%	0.593
2	21:45:20	3.424	5252.000	0.000	1831.000	210900.000	214600.000	60.034%	0.734
3	21:46:03	3.480	5433.000	0.000	1831.000	213200.000	215400.000	59.829%	0.815
x		3.502	5300.000	0.000	1828.000	211300.000	214200.000	59.901%	0.714
σ		0.091	117.100	0.000	4.936	1657.000	1446.000	0.116%	0.112
%RSD		2.611	2.209	0.000	0.270	0.784	0.675	0.193	15.730

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	-0.309	0.717	10.760	70.450	767.300	0.366	-0.177	1.814
2	21:45:20	-0.526	0.863	10.620	70.830	753.900	0.329	-0.115	1.884
3	21:46:03	0.152	0.962	10.590	70.310	732.100	0.369	0.043	1.900
x		-0.228	0.848	10.660	70.530	751.100	0.355	-0.083	1.866
σ		0.346	0.123	0.088	0.270	17.790	0.022	0.114	0.046
%RSD		152.200	14.540	0.824	0.383	2.369	6.284	136.700	2.444

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	2.316	325.300	324.400	0.041	0.015	0.522	0.000	2443.000
2	21:45:20	2.366	324.000	323.300	0.802	-0.005	0.577	0.000	2455.000
3	21:46:03	2.187	326.200	326.300	0.742	0.013	0.355	0.000	2448.000
x		2.290	325.200	324.700	0.528	0.007	0.485	0.000	2449.000
σ		0.093	1.122	1.476	0.423	0.011	0.115	0.000	6.278
%RSD		4.046	0.345	0.455	80.080	145.100	23.800	0.000	0.256

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	70.060%	0.067	0.057	66.567%	-0.105	-0.097	-0.102	-0.088
2	21:45:20	70.162%	0.048	0.044	67.131%	-0.100	-0.102	-0.056	-0.049
3	21:46:03	70.611%	0.074	0.052	67.171%	-0.095	-0.097	-0.072	-0.048
x		70.278%	0.063	0.051	66.956%	-0.100	-0.099	-0.077	-0.062
σ		0.293%	0.013	0.007	0.338%	0.005	0.003	0.023	0.023
%RSD		0.417	21.470	13.340	0.504	4.790	2.791	29.950	36.720

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	71.171%	0.466	0.069	0.153	46.760	47.330	83.391%	84.995%
2	21:45:20	71.223%	0.417	0.076	0.186	47.580	47.330	83.789%	86.097%
3	21:46:03	71.903%	0.356	0.074	0.192	46.820	47.460	84.763%	86.670%
x		71.432%	0.413	0.073	0.177	47.060	47.370	83.981%	85.921%
σ		0.408%	0.055	0.004	0.021	0.460	0.079	0.706%	0.851%
%RSD		0.572	13.390	5.051	11.880	0.977	0.166	0.841	0.991

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:44:37	0.069	0.071	0.189	0.172	0.175	77.917%
2	21:45:20	0.068	0.073	0.171	0.186	0.177	79.312%
3	21:46:03	0.071	0.073	0.165	0.164	0.170	80.132%
x		0.069	0.072	0.175	0.174	0.174	79.120%
σ		0.001	0.001	0.012	0.011	0.004	1.120%
%RSD		1.516	1.282	7.055	6.272	2.189	1.415

180-26715-G-3-A SD@5 11/14/2013 9:48:42 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	78.393%	-0.389	4.067	4.058	0.000	1385.000	12770.000	12590.000
2	21:50:07	77.832%	-0.391	4.303	3.813	0.000	1398.000	12940.000	12810.000
3	21:50:50	76.096%	-0.383	3.433	3.950	0.000	1408.000	12930.000	12980.000
x		77.440%	-0.388	3.934	3.941	0.000	1397.000	12880.000	12790.000
σ		1.198%	0.004	0.450	0.123	0.000	11.800	98.800	195.900
%RSD		1.546	1.032	11.430	3.120	0.000	0.845	0.767	1.531

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	2.236	1066.000	0.000	371.000	39910.000	40290.000	72.613%	0.133
2	21:50:07	2.179	1079.000	0.000	382.000	40990.000	41480.000	71.389%	0.149
3	21:50:50	2.258	1071.000	0.000	373.700	40290.000	40430.000	71.862%	0.165
x		2.225	1072.000	0.000	375.600	40400.000	40730.000	71.954%	0.149
σ		0.041	6.634	0.000	5.755	550.100	653.800	0.617%	0.016
%RSD		1.822	0.619	0.000	1.532	1.362	1.605	0.858	10.770

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	0.104	0.166	2.092	12.030	161.400	0.071	0.033	0.596
2	21:50:07	0.196	0.192	2.161	10.130	157.500	0.072	0.006	0.589
3	21:50:50	-0.257	0.199	2.119	10.220	156.700	0.071	0.018	0.611
x		0.014	0.186	2.124	10.790	158.500	0.071	0.019	0.598
σ		0.239	0.017	0.035	1.069	2.512	0.000	0.014	0.011
%RSD		1682.000	9.324	1.648	9.906	1.585	0.603	73.650	1.877

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	0.663	71.610	72.550	-0.326	-0.253	-0.568	0.000	485.500
2	21:50:07	0.692	72.620	73.910	-0.064	-0.227	-0.282	0.000	491.800
3	21:50:50	0.741	71.920	72.930	-0.035	-0.393	-0.270	0.000	494.900
x		0.699	72.050	73.130	-0.141	-0.291	-0.374	0.000	490.700
σ		0.039	0.520	0.701	0.160	0.089	0.169	0.000	4.774
%RSD		5.618	0.722	0.959	113.400	30.670	45.160	0.000	0.973

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	76.283%	-0.056	-0.047	74.819%	-0.109	-0.113	-0.056	-0.036
2	21:50:07	76.321%	-0.041	-0.036	75.139%	-0.111	-0.110	-0.030	-0.023
3	21:50:50	76.363%	-0.048	-0.048	76.070%	-0.110	-0.109	-0.055	-0.036
x		76.323%	-0.048	-0.043	75.342%	-0.110	-0.111	-0.047	-0.032
σ		0.040%	0.008	0.007	0.650%	0.001	0.002	0.015	0.008
%RSD		0.052	15.970	15.650	0.862	0.720	1.907	31.310	23.810

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	77.592%	-0.136	-0.006	-0.015	9.543	9.572	84.403%	86.180%
2	21:50:07	78.510%	-0.126	-0.001	-0.017	9.425	9.341	86.504%	88.077%
3	21:50:50	77.920%	-0.114	-0.007	-0.014	9.449	9.615	86.776%	87.860%
x		78.007%	-0.125	-0.004	-0.015	9.472	9.509	85.894%	87.372%
σ		0.465%	0.011	0.003	0.001	0.062	0.147	1.299%	1.039%
%RSD		0.596	8.785	76.360	8.713	0.655	1.552	1.512	1.189

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:49:24	0.012	0.014	0.107	0.121	0.114	84.674%
2	21:50:07	0.014	0.017	0.122	0.129	0.124	86.325%
3	21:50:50	0.012	0.016	0.118	0.117	0.116	86.067%
x		0.013	0.015	0.116	0.122	0.118	85.688%
σ		0.001	0.001	0.008	0.006	0.005	0.888%
%RSD		10.480	9.493	6.579	5.173	4.131	1.037

180-26885-G-1-A 11/14/2013 9:53:29 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	67.283%	-0.392	3.227	4.258	0.000	4604.000	27520.000	27020.000
2	21:54:54	60.709%	-0.350	3.997	3.853	0.000	4570.000	28180.000	28150.000
3	21:55:37	60.215%	-0.364	3.138	3.828	0.000	4460.000	27640.000	27610.000
x		62.736%	-0.368	3.454	3.980	0.000	4545.000	27780.000	27600.000
σ		3.946%	0.021	0.472	0.241	0.000	74.940	349.600	566.000
%RSD		6.290	5.752	13.660	6.060	0.000	1.649	1.259	2.051
Run	**Time**	**27Al**	**28Si**	**37Cl**	**39K**	**43Ca**	**44Ca**	**45Sc**	**47Ti**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	341.900	5710.000	0.000	1522.000	219100.000	222900.000	58.532%	2.911
2	21:54:54	352.700	5844.000	0.000	1526.000	222500.000	226300.000	55.967%	2.952
3	21:55:37	353.400	5914.000	0.000	1509.000	219400.000	224500.000	55.938%	3.139
x		349.400	5823.000	0.000	1519.000	220300.000	224600.000	56.813%	3.001
σ		6.426	103.800	0.000	9.059	1895.000	1674.000	1.489%	0.121
%RSD		1.839	1.782	0.000	0.597	0.860	0.746	2.621	4.044
Run	**Time**	**51V**	**52Cr**	**55Mn**	**56Fe**	**57Fe**	**59Co**	**60Ni**	**63Cu**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	0.595	1.517	41.220	534.800	1272.000	1.290	0.662	4.362
2	21:54:54	0.661	1.559	41.450	544.300	1254.000	1.324	0.531	4.302
3	21:55:37	0.458	1.446	41.160	534.500	1203.000	1.289	0.875	4.117
x		0.571	1.507	41.280	537.900	1243.000	1.301	0.689	4.260
σ		0.103	0.057	0.152	5.560	35.720	0.020	0.174	0.128
%RSD		18.080	3.766	0.369	1.034	2.873	1.512	25.200	2.996
Run	**Time**	**65Cu**	**66Zn**	**68Zn**	**75As**	**78Se**	**82Se**	**83Kr**	**88Sr**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	4.634	832.100	836.900	0.734	-0.344	-0.031	0.000	1299.000
2	21:54:54	4.651	834.000	836.600	0.692	-0.438	0.176	0.000	1307.000
3	21:55:37	4.529	828.600	829.600	0.728	-0.222	-0.073	0.000	1316.000
x		4.605	831.600	834.300	0.718	-0.335	0.024	0.000	1308.000
σ		0.066	2.758	4.150	0.023	0.109	0.134	0.000	8.666
%RSD		1.434	0.332	0.497	3.166	32.460	554.800	0.000	0.663
Run	**Time**	**89Y**	**95Mo**	**98Mo**	**103Rh**	**107Ag**	**109Ag**	**111Cd**	**114Cd**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	67.359%	0.135	0.127	63.903%	-0.097	-0.096	0.046	0.041
2	21:54:54	66.655%	0.114	0.115	62.785%	-0.096	-0.099	-0.061	-0.023
3	21:55:37	65.981%	0.069	0.121	62.519%	-0.102	-0.107	-0.024	-0.011
x		66.665%	0.106	0.121	63.069%	-0.098	-0.101	-0.013	0.002
σ		0.689%	0.034	0.006	0.734%	0.003	0.006	0.055	0.034
%RSD		1.033	31.930	4.910	1.165	3.173	5.480	411.800	1385.000
Run	**Time**	**115In**	**118Sn**	**121Sb**	**123Sb**	**135Ba**	**137Ba**	**159Tb**	**165Ho**
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:54:11	67.958%	0.366	0.073	0.115	108.700	107.600	79.085%	80.946%
2	21:54:54	68.353%	0.351	0.057	0.124	108.000	108.000	80.506%	82.040%
3	21:55:37	67.410%	0.347	0.087	0.123	108.600	108.400	81.058%	82.602%
x		67.907%	0.355	0.072	0.120	108.400	108.000	80.217%	81.863%
σ		0.474%	0.010	0.015	0.005	0.397	0.433	1.018%	0.842%
%RSD		0.698	2.761	20.470	4.031	0.366	0.401	1.269	1.029
Run	**Time**	**203Tl**	**205Tl**	**206Pb**	**207Pb**	**208Pb**	**209Bi**		
		ppb	ppb	ppb	ppb	ppb	ppb		
1	21:54:11	0.091	0.103	0.517	0.506	0.507	75.649%		
2	21:54:54	0.101	0.104	0.521	0.506	0.510	77.144%		
3	21:55:37	0.098	0.104	0.521	0.501	0.514	77.474%		
x		0.097	0.104	0.520	0.504	0.510	76.756%		
σ		0.005	0.001	0.002	0.003	0.004	0.972%		
%RSD		5.084	0.685	0.469	0.660	0.720	1.267		

180-26885-G-2-A 11/14/2013 9:58:15 PM

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	62.020%	-0.351	3.417	3.240	0.000	4612.000	28380.000	27780.000
2	21:59:41	58.578%	-0.369	3.598	3.522	0.000	4757.000	29230.000	29080.000
3	22:00:24	58.907%	-0.322	3.406	3.616	0.000	4634.000	28480.000	27820.000
x		59.835%	-0.347	3.474	3.459	0.000	4668.000	28690.000	28220.000
σ		1.899%	0.024	0.108	0.196	0.000	78.140	465.300	740.000
%RSD		3.174	6.877	3.107	5.653	0.000	1.674	1.622	2.622

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	346.300	5900.000	0.000	1554.000	221700.000	225400.000	55.974%	3.583
2	21:59:41	355.300	6060.000	0.000	1554.000	228200.000	233900.000	53.877%	5.215
3	22:00:24	340.000	5734.000	0.000	1496.000	218900.000	227400.000	54.072%	3.088
x		347.200	5898.000	0.000	1535.000	223000.000	228900.000	54.641%	3.962
σ		7.668	162.900	0.000	33.590	4773.000	4412.000	1.158%	1.113
%RSD		2.209	2.761	0.000	2.189	2.141	1.928	2.120	28.090

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	1.000	1.553	41.510	522.900	1238.000	1.301	0.770	3.536
2	21:59:41	0.304	1.500	42.380	530.300	1234.000	1.310	0.787	3.560
3	22:00:24	1.048	1.546	41.450	516.900	1179.000	1.236	0.718	3.607
x		0.784	1.533	41.780	523.300	1217.000	1.282	0.758	3.568
σ		0.416	0.029	0.521	6.728	32.980	0.040	0.036	0.037
%RSD		53.100	1.883	1.247	1.286	2.710	3.151	4.769	1.025

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	4.063	849.300	848.600	-0.055	-0.330	0.058	0.000	1309.000
2	21:59:41	4.079	850.800	857.100	-0.093	-0.371	0.479	0.000	1315.000
3	22:00:24	4.039	838.400	845.700	0.861	-0.569	-0.138	0.000	1308.000
x		4.060	846.200	850.500	0.238	-0.423	0.133	0.000	1310.000
σ		0.020	6.766	5.924	0.540	0.128	0.315	0.000	4.028
%RSD		0.498	0.800	0.697	227.200	30.200	237.000	0.000	0.307

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	65.005%	0.065	0.083	62.310%	-0.104	-0.098	-0.002	0.028
2	21:59:41	64.977%	0.088	0.070	62.024%	-0.105	-0.103	-0.026	0.003
3	22:00:24	65.326%	0.046	0.093	61.775%	-0.106	-0.102	-0.024	-0.002
x		65.102%	0.066	0.082	62.036%	-0.105	-0.101	-0.017	0.010
σ		0.194%	0.021	0.012	0.268%	0.001	0.003	0.013	0.016
%RSD		0.298	31.850	14.140	0.431	0.759	2.859	77.470	167.100

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	65.981%	0.204	0.025	0.105	104.000	103.100	78.092%	79.596%
2	21:59:41	66.723%	0.241	0.018	0.095	103.500	103.900	78.819%	81.165%
3	22:00:24	66.696%	0.236	0.022	0.103	102.400	102.200	79.680%	81.948%
x		66.467%	0.227	0.022	0.101	103.300	103.100	78.864%	80.903%
σ		0.421%	0.020	0.004	0.005	0.804	0.856	0.795%	1.197%
%RSD		0.633	8.856	16.810	5.319	0.778	0.830	1.008	1.480

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	21:58:58	0.089	0.092	0.461	0.458	0.474	74.507%
2	21:59:41	0.095	0.096	0.490	0.467	0.472	76.510%
3	22:00:24	0.088	0.094	0.467	0.440	0.460	76.953%
x		0.091	0.094	0.473	0.455	0.469	75.990%
σ		0.003	0.002	0.015	0.014	0.008	1.303%
%RSD		3.725	1.910	3.246	3.002	1.669	1.715

CCV 993939 11/14/2013 10:03:03 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	80.112%	104.000	93.620	95.280	0.000	49630.000	50080.000	49490.000
2	22:04:28	76.941%	106.600	98.860	97.620	0.000	50670.000	50690.000	50180.000
3	22:05:11	78.824%	104.000	99.530	97.520	0.000	48300.000	49390.000	49610.000
x		78.626%	104.884%	97.335%	96.809%	0.000	99.069%	100.106%	99.516%
σ		1.595%	n/a	n/a	n/a	0.000	n/a	n/a	n/a
%RSD		2.028	1.458	3.324	1.366	0.000	2.408	1.297	0.745

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	510.300	5013.000	0.000	50040.000	50470.000	51120.000	71.410%	97.840
2	22:04:28	522.200	5140.000	0.000	50610.000	52020.000	52130.000	72.125%	99.310
3	22:05:11	508.800	5002.000	0.000	50020.000	51620.000	52200.000	74.055%	98.690
x		102.750%	101.035%	0.000	100.443%	102.740%	103.630%	72.530%	98.611%
σ		n/a	n/a	0.000	n/a	n/a	n/a	1.368%	n/a
%RSD		1.424	1.520	0.000	0.666	1.560	1.168	1.886	0.747

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	102.800	104.300	519.300	25990.000	26060.000	104.400	103.500	105.000
2	22:04:28	102.700	102.400	515.600	25770.000	25800.000	102.600	102.200	104.600
3	22:05:11	103.200	104.000	514.200	25880.000	25830.000	102.800	101.400	103.200
x		102.893%	103.555%	103.277%	103.521%	103.601%	103.280%	102.363%	104.257%
σ		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
%RSD		0.291	0.937	0.509	0.428	0.544	0.954	1.039	0.884

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	105.900	107.400	108.500	105.700	109.300	109.700	0.000	102.300
2	22:04:28	103.800	107.400	107.500	105.500	107.700	109.300	0.000	102.800
3	22:05:11	103.600	107.300	108.600	106.000	109.700	108.900	0.000	102.500
x		104.435%	107.368%	108.171%	105.776%	108.918%	109.322%	0.000	102.559%
σ		n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a
%RSD		1.251	0.070	0.564	0.241	0.957	0.351	0.000	0.247

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	72.508%	100.000	100.900	70.414%	106.300	105.400	106.100	106.800
2	22:04:28	73.867%	102.700	102.800	71.453%	105.300	106.000	106.000	105.600
3	22:05:11	75.007%	103.500	104.600	72.800%	105.200	105.300	105.800	106.400
x		73.794%	102.070%	102.758%	71.555%	105.607%	105.563%	105.973%	106.268%
σ		1.251%	n/a	n/a	1.196%	n/a	n/a	n/a	n/a
%RSD		1.695	1.768	1.793	1.672	0.592	0.371	0.130	0.614

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	72.237%	98.950	101.600	101.900	102.800	101.900	78.033%	79.109%
2	22:04:28	74.448%	98.390	101.100	101.500	101.800	102.400	80.306%	80.895%
3	22:05:11	75.701%	99.460	101.400	101.300	102.400	103.200	81.872%	82.862%
x		74.129%	98.933%	101.361%	101.543%	102.344%	102.464%	80.070%	80.956%
σ		1.754%	n/a	n/a	n/a	n/a	n/a	1.931%	1.877%
%RSD		2.366	0.541	0.274	0.304	0.482	0.637	2.411	2.319

Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	22:03:46	100.600	102.500	103.500	103.700	103.600	75.868%
2	22:04:28	103.000	103.800	105.200	104.600	105.100	76.847%
3	22:05:11	101.800	102.600	104.400	104.700	105.000	78.891%
x		101.781%	102.970%	104.377%	104.339%	104.546%	77.202%
σ		n/a	n/a	n/a	n/a	n/a	1.543%
%RSD		1.154	0.707	0.809	0.564	0.794	1.998

CCB9 11/14/2013 10:11:13 PM QC Status: PASS (Initial: PASS)

User Pre-dilution: 1.000

Run	Time	6Li	9Be	10B	11B	13C	23Na	25Mg	26Mg
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	94.494%	-0.392	0.557	0.476	0.000	0.348	0.546	0.534
2	22:12:39	88.652%	-0.422	0.322	0.306	0.000	0.350	0.828	0.653
3	22:13:21	91.589%	-0.438	-0.036	0.237	0.000	0.124	0.777	0.586
x		91.578%	-0.417	0.281	0.340	0.000	0.274	0.717	0.591
σ		2.921%	0.023	0.298	0.123	0.000	0.130	0.150	0.060
%RSD		3.190	5.588	106.400	36.190	0.000	47.560	20.920	10.070

Run	Time	27Al	28Si	37Cl	39K	43Ca	44Ca	45Sc	47Ti
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	0.223	-0.982	0.000	3.228	-0.937	1.814	81.194%	0.010
2	22:12:39	0.245	-0.669	0.000	1.998	0.673	1.915	79.855%	0.001
3	22:13:21	0.268	-1.159	0.000	2.036	0.656	1.318	80.269%	0.032
x		0.245	-0.937	0.000	2.421	0.131	1.683	80.439%	0.014
σ		0.023	0.248	0.000	0.700	0.924	0.320	0.686%	0.016
%RSD		9.206	26.470	0.000	28.900	708.500	18.990	0.852	114.100

Run	Time	51V	52Cr	55Mn	56Fe	57Fe	59Co	60Ni	63Cu
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	-0.015	-0.076	0.081	-3.142	2.785	0.002	0.000	-0.002
2	22:12:39	0.010	-0.085	0.079	-3.146	1.753	0.006	-0.001	-0.014
3	22:13:21	-0.012	-0.066	0.081	-4.874	1.579	0.004	-0.014	-0.012
x		-0.006	-0.076	0.080	-3.721	2.039	0.004	-0.005	-0.009
σ		0.013	0.010	0.002	0.999	0.652	0.002	0.008	0.006
%RSD		229.900	12.810	1.879	26.850	31.970	42.130	152.900	64.820

Run	Time	65Cu	66Zn	68Zn	75As	78Se	82Se	83Kr	88Sr
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	-0.002	0.669	0.519	-0.077	-0.127	-0.246	0.000	0.004
2	22:12:39	-0.024	0.668	0.542	-0.015	-0.199	0.082	0.000	0.003
3	22:13:21	0.000	0.527	0.507	-0.001	-0.104	-0.087	0.000	0.007
x		-0.009	0.622	0.523	-0.031	-0.144	-0.084	0.000	0.005
σ		0.013	0.082	0.018	0.041	0.050	0.164	0.000	0.002
%RSD		152.900	13.180	3.374	130.500	34.490	196.600	0.000	39.410

Run	Time	89Y	95Mo	98Mo	103Rh	107Ag	109Ag	111Cd	114Cd
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	79.738%	0.082	0.094	80.849%	-0.116	-0.115	0.028	0.020
2	22:12:39	80.751%	0.079	0.058	80.881%	-0.116	-0.110	-0.016	-0.014
3	22:13:21	81.023%	0.027	0.022	81.841%	-0.109	-0.112	-0.035	-0.022
x		80.504%	0.063	0.058	81.191%	-0.114	-0.112	-0.008	-0.005
σ		0.677%	0.031	0.036	0.564%	0.004	0.003	0.032	0.022
%RSD		0.841	49.780	62.230	0.694	3.403	2.409	422.700	403.400

Run	Time	115In	118Sn	121Sb	123Sb	135Ba	137Ba	159Tb	165Ho
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	81.058%	-0.145	-0.040	-0.055	-0.015	-0.004	82.117%	82.754%
2	22:12:39	82.164%	-0.175	-0.036	-0.047	-0.005	-0.008	84.446%	84.982%
3	22:13:21	82.277%	-0.179	-0.045	-0.053	0.003	-0.007	86.044%	86.147%
x		81.833%	-0.167	-0.040	-0.052	-0.006	-0.006	84.202%	84.627%
σ		0.673%	0.018	0.005	0.004	0.009	0.002	1.974%	1.724%
%RSD		0.823	11.080	11.790	7.746	153.100	32.180	2.345	2.038

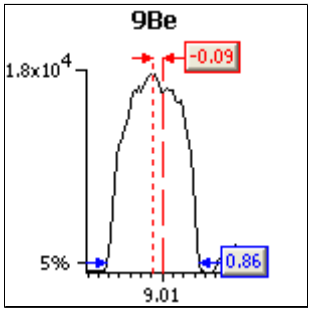
Run	Time	203Tl	205Tl	206Pb	207Pb	208Pb	209Bi
		ppb	ppb	ppb	ppb	ppb	ppb
1	22:11:56	0.003	0.008	0.051	0.051	0.046	86.872%
2	22:12:39	0.005	0.005	0.051	0.047	0.050	87.190%
3	22:13:21	0.001	0.006	0.047	0.051	0.048	87.050%
x		0.003	0.006	0.050	0.050	0.048	87.037%
σ		0.002	0.001	0.002	0.002	0.002	0.159%
%RSD		65.360	22.450	4.142	4.579	3.746	0.183

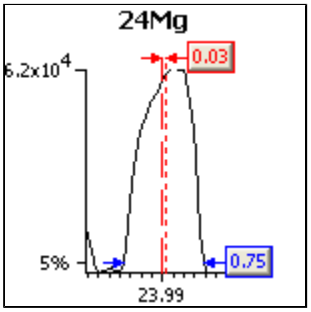
Performance Report

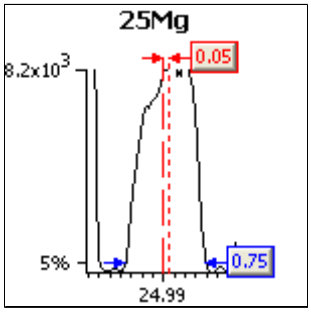
Sample details
Sample name : ITUNE
Acquired at : 11/14/2013 9:56:40 AM
Report name : EPA ILMO5.2/6020A 2.1 [3/15/2013 11:49:53 AM]

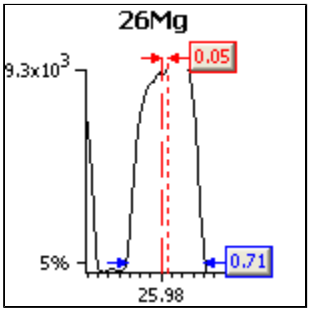
Mass Calibration verification

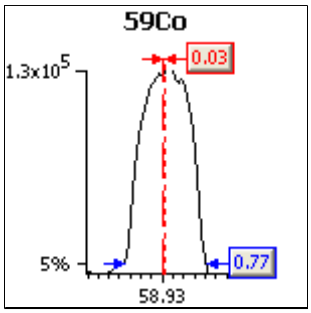
Acquisition parameters
Sweeps : 25
Dwell : 2.0 mSecs
Point spacing : 0.02 amu
Peak width measured at 5% of the peak maximum

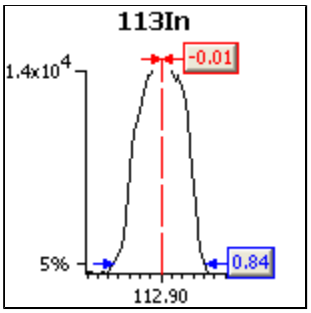


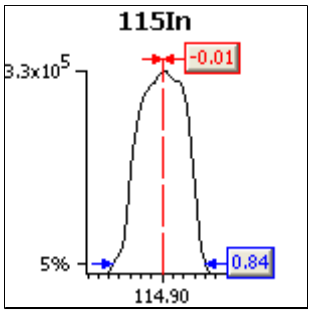


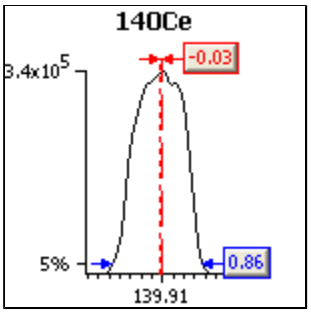


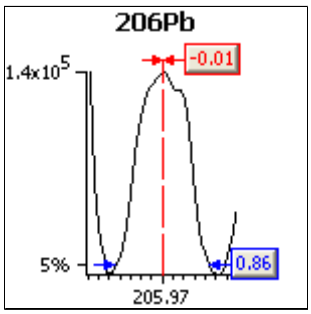


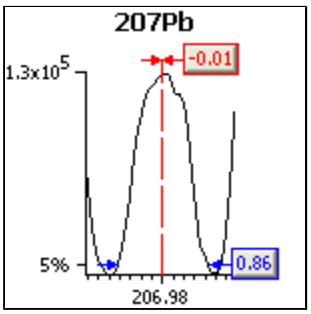


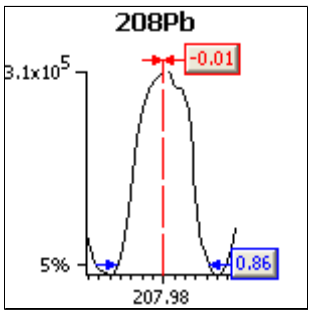












Analyte	Limits			Results	
	Max. width	Min. width	Max. error	Peak width	Peak error
9Be	0.90	0.45	0.10	0.86	-0.09
24Mg	0.90	0.45	0.10	0.75	0.03
25Mg	0.90	0.45	0.10	0.75	0.05
26Mg	0.90	0.45	0.10	0.71	0.05
59Co	0.90	0.45	0.10	0.77	0.03
113In	0.90	0.45	0.10	0.84	-0.01
115In	0.90	0.45	0.10	0.84	-0.01
140Ce	0.90	0.45	0.10	0.86	-0.03
206Pb	0.90	0.45	0.10	0.86	-0.01
207Pb	0.90	0.45	0.10	0.86	-0.01
208Pb	0.90	0.45	0.10	0.86	-0.01

Sample details
Sample name : ITUNE
Acquired at : 11/14/2013 9:56:40 AM
Report name : EPA ILMO5.2/6020A 2.1 [3/15/2013 11:49:53 AM]

Tune conditions

Major	
Extraction	-102
Lens 1	2.0
Focus	25.1
D1	-49.4
Pole Bias	-1.0
Hexapole Bias	-4.0
Nebuliser	0.77
Sampling Depth	150

Minor	
Lens 2	-29.0
Lens 3	-187.5
Forward power	1302
Horizontal	75
Vertical	515
D2	-198
DA	-80.0
Cool	13.0
Auxiliary	0.90

Global	
Standard resolution	n/a
High resolution	n/a
Analogue Detector	n/a
PC Detector	n/a

Add. Gases	
He/H2	0.00
He/NH3	0.00

Sensitivity and stability results

Acquisition parameters
Sweeps : 150

Run	Time	5Bkg	9Be	24Mg	25Mg	26Mg	56Ar O	59Co	137Ba++
Dwell (mSecs)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limits	%RSD	-	5.0%	5.0%	5.0%	5.0%	-	5.0%	-
	Countrate	-	>500	>500	>500	>500	-	>5000	-
1	9:57:28 AM	0	15886	58947	7752	9623	276464	131727	1
2	9:58:53 AM	0	15719	59151	8027	9735	272636	131227	1
3	10:00:18 AM	0	15316	59132	8223	9625	275407	132215	1
4	10:01:43 AM	0	15678	58996	7849	9814	275953	132297	0
5	10:03:08 AM	1	15528	58963	7847	9704	274690	130836	1
x		0	15625	59038	7940	9700	275030	131660	1
σ		0.21	215.02	96.48	186.79	80.23	1491.21	629.43	0.56
%RSD		69.769	1.376	0.163	2.353	0.827	0.542	0.478	69.722

Run	Time	138Ba++	101Bkg	113In	115In	138Ba	140Ce	156Ce O	206Pb
Dwell (mSecs)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limits	%RSD	-	-	5.0%	5.0%	-	5.0%	-	5.0%
	Countrate	-	-	>200	>5000	-	>10000	-	>500
1	9:57:28 AM	12	0	14304	328284	1165	340232	5298	143966
2	9:58:53 AM	11	0	14387	333778	1170	347465	5394	147115
3	10:00:18 AM	11	0	14733	339996	1211	352337	5324	149413
4	10:01:43 AM	10	0	14640	336866	1191	351514	5348	148235
5	10:03:08 AM	12	0	14340	331037	1155	341826	5242	144646
x		11	0	14481	333992	1179	346675	5321	146675
σ		0.79	0.09	192.85	4627.72	22.50	5502.93	56.52	2322.60
%RSD		7.015	72.436	1.332	1.386	1.909	1.587	1.062	1.584

Run	Time	207Pb	208Pb	220Bkg
Dwell (mSecs)		0.0	0.0	0.0
Limits	%RSD	5.0%	5.0%	-
	Countrate	>500	>500	<2500
1	9:57:28 AM	128972	310604	0
2	9:58:53 AM	132835	320067	0
3	10:00:18 AM	135056	325077	0
4	10:01:43 AM	133922	323168	0
5	10:03:08 AM	130811	314632	0
x		132319	318710	0
σ		2439.25	6012.19	0.05
%RSD		1.843	1.886	70.711

Ratio results

Run	Time	156Ce O/140Ce
Ratio limits		<0.0500
1	9:57:28 AM	0
2	9:58:53 AM	0

3	10:00:18 AM	0
4	10:01:43 AM	0
5	10:03:08 AM	0
x		0.0154
σ		0.00
%RSD		1.2788

Result : The performance report passed.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89482 Batch Start Date: 11/12/13 10:10 Batch Analyst: Rosenbaum, Ron

Batch Method: 3050B Batch End Date: 11/12/13 12:30

Lab Sample ID	Client Sample ID	Method Chain	Basis	CalcMsg	InitialAmount	FinalAmount	MTAPITTICPMS 00016	MTAPITTMSA 00017	MTAPITTMSC 00023
MB 180-89482/1		3050B, 6020A		CALC NOT SET TO RUN	00001.12 g	100 mL			
LCS 180-89482/2		3050B, 6020A		CALC NOT SET TO RUN	00001.03 g	100 mL	1 mL	1 mL	1 mL
LCSD 180-89482/3		3050B, 6020A		CALC NOT SET TO RUN	00000.99 g	100 mL	1 mL	1 mL	1 mL
180-26836-A-1-B	PRE-EXPOSURE WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00000.96 g	100 mL			
180-26836-A-3-B	POST-EXPOSURE CONTROL WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00001.04 g	100 mL			
180-26836-A-4-B	POST-EXPOSURE 27106 WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00000.98 g	100 mL			
PB 180-89081/4-A		3050B, 6020A		CALC NOT SET TO RUN	00001.01 g	100 mL			

Batch Notes	

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89486 Batch Start Date: 11/12/13 10:10 Batch Analyst: Rosenbaum, Ron

Batch Method: 3050B Batch End Date: 11/12/13 11:45

Lab Sample ID	Client Sample ID	Method Chain	Basis	CalcMsg	InitialAmount	FinalAmount	MTAPITTICPMS 00016	MTAPITTMSA 00017	MTAPITTMSC 00023
MB 180-89486/1		3050B, 6020A		CALC NOT SET TO RUN	00001.05 g	100 mL			
LCS 180-89486/2		3050B, 6020A		CALC NOT SET TO RUN	00001.02 g	100 mL	1 mL	1 mL	1 mL
LCSD 180-89486/3		3050B, 6020A		CALC NOT SET TO RUN	00001.07 g	100 mL	1 mL	1 mL	1 mL
180-26836-A-1-B	PRE-EXPOSURE WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00000.98 g	100 mL			
180-26836-A-3-B	POST-EXPOSURE CONTROL WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00001.04 g	100 mL			
180-26836-A-4-B	POST-EXPOSURE 27106 WORMS	3050B, 6020A	T	CALC NOT SET TO RUN	00001.01 g	100 mL			
PB 180-89081/4-A		3050B, 6020A		CALC NOT SET TO RUN	00001.01 g	100 mL			

Batch Notes	

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89655 Batch Start Date: 11/13/13 15:00 Batch Analyst: Haluck, Caitlyn

Batch Method: 3050B Batch End Date: 11/13/13 17:00

Lab Sample ID	Client Sample ID	Method Chain	Basis	CalcMsg	NominalRLWgt	InitialAmount	FinalAmount	MTAPITTICPMS 00016	MTAPITTMSA 00017
MB 180-89655/1		3050B, 6020A		NO %SOLIDS FOUND		00001.06 g	100 mL		
LCS 180-89655/2		3050B, 6020A		NO %SOLIDS FOUND		00001.04 g	100 mL	1 mL	1 mL
180-26836-A-2	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	INITIAL<NOMINAL	6.9434 g	00001.00 g	100 mL		
180-26836-A-2 MS	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	NO %SOLIDS FOUND		00001.02 g	100 mL	1 mL	1 mL
180-26836-A-2 MSD	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	NO %SOLIDS FOUND		00001.04 g	100 mL	1 mL	1 mL

Lab Sample ID	Client Sample ID	Method Chain	Basis	MTAPITTMSC 00023					
MB 180-89655/1		3050B, 6020A							
LCS 180-89655/2		3050B, 6020A		1 mL					
180-26836-A-2	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T						
180-26836-A-2 MS	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	1 mL					
180-26836-A-2 MSD	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	1 mL					

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89655 Batch Start Date: 11/13/13 15:00 Batch Analyst: Haluck, Caitlyn

Batch Method: 3050B Batch End Date: 11/13/13 17:00

Batch Notes	
Analyst	CEH
Balance ID	P1856710
Batch Comment	METALS A6
Blank Soil Lot Number	973290
First End time	1700
Filter Paper Lot Number	9517770B
Hydrogen peroxide lot number	10ML 1012554
Lot # of hydrochloric acid	10ML 973235
Logbook ID for diluted Nitric	10ML 1007200
Lot # of Nitric Acid	5ML 973232
Hot Block ID number	#10
Nominal Amount Used	1.0 g
Oven, Bath or Block Temperature 1	97 Degrees C
Pipette ID	L1201611U
Perform Calculation (0=No, 1=Yes)	1
Snap Cap Lot #	130817
First Start time	1500
Temperature	97 Degrees C
ID number of the thermometer	IP9 (0.0) D4
Digestion Tube/Cup Lot #	1303205
Uncorrected Temperature	97 Celsius

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89656 Batch Start Date: 11/13/13 15:00 Batch Analyst: Haluck, Caitlyn

Batch Method: 3050B Batch End Date: 11/13/13 17:00

Lab Sample ID	Client Sample ID	Method Chain	Basis	CalcMsg	NominalRLWgt	InitialAmount	FinalAmount	MTAPITTICPMS 00016	MTAPITTMSA 00017
MB 180-89656/1		3050B, 6020A		NO %SOLIDS FOUND		00001.12 g	100 mL		
LCS 180-89656/2		3050B, 6020A		NO %SOLIDS FOUND		00001.01 g	100 mL	1 mL	1 mL
180-26836-A-2	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	INITIAL<NOMINAL	6.9434 g	00001.01 g	100 mL		
180-26836-A-2 MS	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	NO %SOLIDS FOUND		00001.02 g	100 mL	1 mL	1 mL
180-26836-A-2 MSD	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	NO %SOLIDS FOUND		00001.03 g	100 mL	1 mL	1 mL

Lab Sample ID	Client Sample ID	Method Chain	Basis	MTAPITTMSC 00023					
MB 180-89656/1		3050B, 6020A							
LCS 180-89656/2		3050B, 6020A		1 mL					
180-26836-A-2	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T						
180-26836-A-2 MS	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	1 mL					
180-26836-A-2 MSD	FOOD-FERMENTED F10-008 PREPPED	3050B, 6020A	T	1 mL					

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

METALS BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89656 Batch Start Date: 11/13/13 15:00 Batch Analyst: Haluck, Caitlyn

Batch Method: 3050B Batch End Date: 11/13/13 17:00

Batch Notes	
Analyst	CEH
Balance ID	P1856710
Batch Comment	METALS A6
Blank Soil Lot Number	973290
First End time	1730
Filter Paper Lot Number	9517770B
Hydrogen peroxide lot number	10ML 1012554
Logbook ID for diluted Nitric	10ML 1007199
Lot # of Nitric Acid	5ML 969834
Hot Block ID number	#10
Nominal Amount Used	1.0 g
Oven, Bath or Block Temperature 1	97 Degrees C
Pipette ID	L1201611U
Perform Calculation (0=No, 1=Yes)	1
Snap Cap Lot #	130817
First Start time	1530
Temperature	97 Degrees C
ID number of the thermometer	IP9 (0.0) D4
Digestion Tube/Cup Lot #	1303205
Uncorrected Temperature	97 Celsius

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY

COVER PAGE
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG No.:

Project: Tissue 60280653-105-022

Client Sample ID	Lab Sample ID
PRE-EXPOSURE WORMS	180-26836-1
FOOD-FERMENTED F10-008 PREPPED	180-26836-2
POST-EXPOSURE CONTROL WORMS	180-26836-3
POST-EXPOSURE 27106 WORMS	180-26836-4

Comments:

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Solid Instrument ID: NOEQUIP

Method: 2540G RL Date: 01/31/2010 13:27

Analyte	Wavelength/ Mass	RL (%)	
Percent Moisture		0.1	

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Solid Instrument ID: NOEQUIP

Method: 2540G XRL Date: 01/31/2010 13:31

Analyte	Wavelength/ Mass	XRL (%)	
Percent Moisture		0.1	

9-IN
DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Tissue Instrument ID: NOEQUIP

Method: 2540G RL Date: 01/31/2010 13:27

Analyte	Wavelength/ Mass	RL (%)	
Percent Moisture		0.1	

9-IN
CALIBRATION BLANK DETECTION LIMITS
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job Number: 180-26836-1

SDG Number:

Matrix: Tissue Instrument ID: NOEQUIP

Method: 2540G XRL Date: 01/31/2010 13:31

Analyte	Wavelength/ Mass	XRL (%)	
Percent Moisture		0.1	

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: NOEQUIP Method: 2540G

Start Date: 11/06/2013 19:41 End Date: 11/06/2013 19:41

Lab Sample ID	D / F	Type	Time	Analytes																				
				Moist																				
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
180-26836-2	1	T	19:41	X																				
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					
ZZZZZZ			19:41																					

Prep Types

T = Total/NA

13-IN
ANALYSIS RUN LOG
GENERAL CHEMISTRY

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Instrument ID: NOEQUIP Method: 2540G

Start Date: 11/13/2013 17:49 End Date: 11/13/2013 17:49

Lab Sample ID	D / F	Type	Time	Analytes																			
				Moist																			
ZZZZZZ			17:49																				
ZZZZZZ			17:49																				
ZZZZZZ			17:49																				
ZZZZZZ			17:49																				
180-26836-1	1	T	17:49	X																			
180-26836-3	1	T	17:49	X																			
180-26836-4	1	T	17:49	X																			

Prep Types

T = Total/NA

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89011 Batch Start Date: 11/06/13 19:41 Batch Analyst: McLaughlin, Jeremiah W

Batch Method: 2540G Batch End Date: 11/07/13 12:13

Lab Sample ID	Client Sample ID	Method Chain	Basis	DISH#	DishWeight	SampleMassWet	SampleMassDry		
180-26836-A-2	FOOD-FERMENTED F10-008 PREPPED	2540G	T	P8334 0.1220	2.62 g	6.30 g	3.15 g		

Batch Notes	
Balance ID	1126472457 No Unit
Date samples were placed in the oven	11/6/13
Oven Temp when samples are put in oven	105 Degrees C
Time samples were place in the oven	20:03
Date samples were removed from oven	11/07/13
Oven Temp when samples removed from oven	104 Degrees C
Time Samples were removed from oven	11:08
Oven ID	5005
ID number of the thermometer	WET-34
Uncorrected In Temperature	105 Celsius
Uncorrected Out Temperature	104 Celsius

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

GENERAL CHEMISTRY BATCH WORKSHEET

Lab Name: TestAmerica Pittsburgh Job No.: 180-26836-1

SDG No.:

Batch Number: 89697 Batch Start Date: 11/13/13 18:00 Batch Analyst: Wolfe, Adam

Batch Method: 2540G Batch End Date: 11/14/13 08:20

Lab Sample ID	Client Sample ID	Method Chain	Basis	DISH#	DishWeight	SampleMassWet	SampleMassDry		
180-26836-A-1	PRE-EXPOSURE WORMS	2540G	T	P4799 0.1215	2.63 g	3.85 g	2.83 g		
180-26836-A-3	POST-EXPOSURE CONTROL WORMS	2540G	T	P5729 0.1214	2.60 g	3.56 g	2.78 g		
180-26836-A-4	POST-EXPOSURE 27106 WORMS	2540G	T	P1421 0.1181	2.60 g	4.86 g	3.00 g		

Batch Notes	
Balance ID	1126472457 No Unit
Date samples were placed in the oven	11/13/13
Oven Temp when samples are put in oven	105 Degrees C
Time samples were place in the oven	1700
Date samples were removed from oven	11/14/13
Oven Temp when samples removed from oven	105 Degrees C
Time Samples were removed from oven	0820
Oven ID	5005
ID number of the thermometer	WET - 34
Uncorrected In Temperature	105 Celsius
Uncorrected Out Temperature	105 Celsius

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Shipping and Receiving Documents

TestAmerica Pittsburgh
301 Alpha Drive

Pittsburgh, PA 15238
Phone: 412.963.7058 Fax: 412.963.2470

Chain of Custody Record

003614

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager: Anita Rehner	Site Contact: Anita Rehner	Date: 11/04/13	COC No:
Company Name: AECOM	Tel/Fax: 970-416-0916 ext 303	Lab Contact: Carrie Gamber	Carrier: FEDEX	1 of 1 COCs
Address: 4303 West Laporte Avenue	Analysis Turnaround Time			Sampler:
City/State/Zip: Fort Collins, CO 80521	☒ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: 970-416-0916	TAT if different from Below _____			Walk-in Client:
Fax: 970-490-2963	☒ 2 weeks ☐ 1 week ☐ 2 days ☐ 1 day			Lab Sampling:
Project Name: 60280653-105-022				SDG No.:
Site:				
P O #				

180-26836 Chain of Custody

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Antimony, Lead, Arsenic	Moisture	Sample Specific Notes:
Pre-exposure worms	10/04/13	1130	G	Tissue	1	N		X	X	
Food-fermented F10-008 prepped	11/01/13	~~1532~~ 1530	G	Tissue	1	N		X	X	
Post-exposure Control worms	11/01/13	1520	G	Tissue	1	N		X	X	
Post-exposure 27106 worms	11/01/13	1520	G	Tissue	1	N		X	X	

Page 398 of 400

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☒ Disposal by Lab ☒ Archive for 1 Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: _____ Corr'd: _____ | Therm ID No.: _____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Anita Rehner	AECOM	11/04/13 1430	[signature]	TAP	11-5-13 8:50
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

DAR 11/01/13 E

From: (970) 416-0916
Anita Rehner
AECOM Environment
4303 West LaPorte Avenue

Fort Collins, CO 80521

Origin ID: FTCA

FedEx Express

J13201306280326

Ship Date: 04NOV13
ActWgt: 7.5 LB
CAD: 5719242/INET3430

Delivery Address Bar Code

180-26836 Waybill

Ref # 60280653-105-022
Invoice #
PO #
Dept #

SHIP TO: (412) 963-7058 BILL SENDER

Carrie Gamber
Test America
301 Alpha Drive

PITTSBURGH, PA 15238

TRK# 0201 **7970 7232 1030**

TUE - 05 NOV 10:30A
PRIORITY OVERNIGHT
DSR
15238
PA-US
PIT

NC AGCA

Uncorrected temp 3.1 °C
Thermometer ID H3
CF .4 Initials m.l.
PT-WI-SR-001 effective 7/26/13

51AG1/D5E6/1A9E

After printing this label:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

Warning: Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com.FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery,misdelivery,or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim.Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental,consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss.Maximum for items of extraordinary value is $1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

Login Sample Receipt Checklist

Client: AECOM, Inc.

Job Number: 180-26836-1

Login Number: 26836

List Source: TestAmerica Pittsburgh

List Number: 1

Creator: Watson, Debbie

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Attachment D
Disposal Information

Attachment D
Waste Disposal Information
Cleanup Action Report
Lot 4 Chromium Site
Former Mutual Materials Brick Plant Property, Newcastle, WA

Date In	Ticket Number	Job #	Weigh In (Tons)	Weigh Out (Tons)	Total Weight (Tons)
4/6/2015	921735	LW-15080	94960	39420	27.77
4/6/2015	921737	LW-15080	91880	35640	28.12
4/6/2015	921744	LW-15080	106320	40900	32.71
4/6/2015	921752	LW-15080	89640	39120	25.26
4/6/2015	921754	LW-15080	91640	35620	28.01
				Total Weight	**141.87**