Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Prepared for

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List of Abbreviations and Acronyms

Acronym/Abbreviation	**Definition**
1,2-DCA	1,2-Dichloroethane
AO	Agreed Order
ARAR	Applicable, Relevant, and Appropriate Requirement
ASTM	American Society of Testing and Materials
BEHP	bis(2-Ethylhexyl)phthalate
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAP	Cleanup Action Plan
CES	Concise Explanatory Statement and Responsiveness Summary for the Amendment of Chapter 173-340 WAC, Model Toxics Control Act Cleanup Regulation
CLARC	Cleanup Levels and Risk Calculation
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CRZ	Contamination reduction zone
CSM	Conceptual Site Model
DCA	Disproportionate cost analysis
DQO	Data quality objective
EDD	Electronic data deliverable

Acronym/Abbreviation	**Definition**
EIM	Environmental Information Management
EZ	Exclusion zone
FAA	Federal Aviation Administration
GPS	Global Positioning System
HASP	Health and Safety Plan
HSA	Hollow-stem auger
HSO	Health and Safety Officer
KCHA	King County Housing Authority
MS/MSD	Matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
Mueller	The Mueller Group
Nautilus	Nautilus Environmental
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachlorethene
PCP	Pentachlorophenol
PM	Project Manager
Port	Port of Seattle
PPE	Personal protective equipment
PQL	Practical quantitation limit
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RAO	Remedial action objective
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
SIM	Select ion monitoring
Site	Lora Lake Apartments Site
SR518	State Route 518
SS	Site Supervisor
STIA	Seattle-Tacoma International Airport
SVOC	Semivolatile organic compound
SZ	Support zone
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TEE	Terrestrial Ecological Evaluation
TEF	Toxic equivalency factor

Acronym/Abbreviation	**Definition**
TEQ	Toxic equivalent
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
VCP	Voluntary Cleanup Program
VOC	Volatile organic compound
WAC	Washington Administrative Code
WSDOE	Washington State Department of Ecology
WSDOT	Washington State Department of Transportation

1.0 Introduction

1.1 BACKGROUND AND OVERVIEW

This document presents the Draft Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Lora Lake Apartments Site (Site), located at 15001 Des Moines Memorial Drive in Burien, Washington (Figure 1.1), near the northwest corner of Seattle-Tacoma International Airport (STIA). The Site is the location of a former apartment building complex that was developed in 1987, under previous ownership, for use as residential housing. The Port of Seattle (Port), current owner of the Site, demolished the apartment building complex in two phases of work. Six buildings were demolished in 2007 to accommodate operation of the recently constructed 3rd Runway. The remaining buildings were demolished in 2009. The Port is currently planning, in conjunction with the City of Burien, to redevelop the city block (of which the Site is a part), for airport-compatible commercial or light industrial use. The Site is zoned Airport Industrial 1 by the City of Burien.

In 1986, prior to construction of the apartment building complex, Golder Associates (Golder) conducted environmental investigations to identify and address contamination in preparation for purchase and redevelopment of the property. Golder conducted additional investigations and environmental management activities on behalf of the developer in advance of and during construction of the apartment complex, through 1987. Additional environmental investigations were conducted in 2007 by GeoScience Management and in 2008 by AECOM (formerly ENSR) to assist the Port to prepare for demolition of the apartment building complex and potential redevelopment of the property. As part of this process, a Voluntary Cleanup Program (VCP) application was filed with the Washington State Department of Ecology (WSDOE) in April 2008. After reporting the results of the 2008 investigations, the Port and WSDOE decided to move forward with development of an Agreed Order (AO) to identify remediation requirements for the Site.

The Port and WSDOE entered into Agreed Order No. DE 6703 on July 10, 2009 (WSDOE 2009). The AO Scope of Work requires the Port to prepare an RI/FS Work Plan, conduct a Remedial Investigation (RI) and Feasibility Study (FS), and prepare a RI/FS Report pursuant to Washington Administrative Code (WAC) 173-340-350 in a manner that complies with requirements of the Model Toxics Control Act (MTCA) cleanup regulation, Chapter 173-340 WAC (WSDOE 2007b). On behalf of the Port, AECOM completed an interim action in summer 2009 to support demolition of the apartment building complex structures. A second interim action, conducted in late 2009 and early 2010, will enable evaluation of the chemical quality of stormwater and sediments that are conveyed through the Site's existing stormwater drainage system. Remedial investigation work is scheduled to begin in spring 2010 and the final RI/FS Report is due for submittal to WSDOE in early 2012.

The objective of the RI/FS for this Site is to complete a comprehensive site-wide evaluation that will allow for recommendation of a cleanup alternative that will meet MTCA criteria and be consistent with the Port's future redevelopment goals. The Port will collect additional data to complete a full characterization of site soil and groundwater and to evaluate off-site contaminant migration pathways. Applicable remedial technologies for soil and groundwater will be evaluated and coordinated to develop remedial alternatives. Remedial alternatives will be evaluated against MTCA criteria in the feasibility study phase of the project and a preferred cleanup alternative will be identified in the RI/FS Report.

1.2 WORK PLAN PURPOSE AND ORGANIZATION

The purpose of this RI/FS Work Plan is to document the scope, technical approach, and implementation details for completing the RI/FS. Following approval of the final RI/FS Report, the Port anticipates negotiating a follow-on AO or Consent Decree with WSDOE to develop and implement the Cleanup Action Plan (CAP).

This RI/FS Work Plan complies with MTCA requirements and incorporates existing information collected as part of previous environmental investigation efforts at the Site. The remainder of the RI/FS Work Plan is organized as follows:

- **Section 2.0—Site Description:** Provides information on the location, ownership, historical and future land use, and physical setting of the Site; including descriptions of local and regional geology, the origin of Lora Lake, and groundwater use within the site area.
- **Section 3.0—Regulatory Framework:** Presents the current regulatory framework, AO and MTCA requirements for the Site, as well as screening levels and other applicable or relevant and appropriate requirements (ARARs).
- **Section 4.0—Summary of Prior Investigations:** Presents a summary of previous environmental investigations that have occurred at the Site in chronological order.
- **Section 5.0—Interim Actions:** Discusses results of the Apartment Building Demolition Interim Action completed in summer 2009 and the approach for the Stormwater Interim Action currently being performed and scheduled for completion by spring 2010.
- **Section 6.0—RI/FS Objectives:** Describes the objectives of the RI/FS, including development of remedial action objectives, completion of site characterization, identification of MTCA remedial action and source control requirements, and evaluation of remedial alternatives in the context of future land use.
- **Section 7.0—Conceptual Model and Data Gaps:** Presents the preliminary Conceptual Site Model (CSM) based on existing data, identifies the site

contaminants of concern (COCs) and exposure pathways, and delineates the site areas of concern and associated data gaps.

- **Section 8.0—Proposed Supplementary Site Investigation:** Details the approach for collecting supplemental data to fill data gaps in soil and groundwater identified in Section 7.0, and references additional project plans including the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP).
- **Section 9.0—RI/FS Preparation Methodology:** Defines the specific tasks of the RI/FS that will be completed per MTCA requirements, and presents the anticipated schedule for WSDOE review and public involvement.
- **Section 10.0—Project Team and Responsibilities:** Identifies the project team members, including the technical consultant, subconsultants, and site owner. This section presents the associated responsibilities for project team members throughout the RI/Fs process.
- **Section 11.0—References:** Presents the sources cited in this RI/FS Work Plan.

2.0 Site Description

2.1 LOCATION, SITE OWNERSHIP, AND SITE HISTORY

2.1.1 Location

The Site is located in Burien, Washington at 15001 Des Moines Memorial Drive. The Site occupies approximately 8.3 acres of currently vacant land that is bounded to the north by State Route 518 (SR518), to the east and southeast by Des Moines Memorial Drive, to the west by 8th Avenue South, and to the south by an open area that was the former Seattle City Light Sunnydale substation and other open land parcels that have been cleared from prior industrial and commercial land use (Figure 2.1). Land use to the west and north of the Site is primarily residential and light commercial. The area of the STIA located just southeast of Des Moines Memorial Drive is reserved for habitat mitigation associated with development of the STIA 3rd Runway.

A parcel of land located directly east of the Site is owned and maintained by the Washington State Department of Transportation (WSDOT) as part of the highway interchange system. The street right-of-ways are owned by the City of SeaTac to the southeast of Des Moines Memorial Drive and by the City of Burien to the northwest.

Lora Lake is located within a secured fence on a Port-owned land parcel to the south of the WSDOT property (across Des Moines Memorial Drive from the Site). The lake is part of a series of habitat mitigation areas developed by the Port in compliance with permit conditions associated with construction of the 3rd Runway. The mitigation area is designated in the Natural Resource Mitigation Plan for STIA as the Miller Creek/Lora Lake Upland Buffer and Flood Plain Zone (Parametrix 2001). The Site and surrounding land parcels are located within the Miller Creek Watershed. Headwaters of Miller Creek flow south (from north of STIA) along the west side of the airport, through a series of Port-owned habitat mitigation properties established during construction of the 3rd Runway, before turning west, crossing Highway 509, and eventually draining to Puget Sound.

2.1.2 Historical Site Ownership and Land Use

There is little information regarding site history prior to 1940, when the property served as an orchard, farm, and private residence. A 1936 aerial photograph shows multiple residential structures within the current property footprint and rows of trees and other vegetation (Appendix A; AECOM 2009b). Precursor roadways to 8th Avenue South and Des Moines Memorial Drive were also present in 1936. Lora Lake is not present in the 1936 aerial photograph; the future location of the lake appears to be farm land, bordered by residential homes to the north.

The Site was first converted to industrial use in the early to mid-1940s, when the Novak family purchased the property and established the Novak Barrel Cleaning Company. The 1946 aerial image shows the presence of an industrial building in the central portion of the Site (Appendix A; AECOM 2009a). AECOM also identified a small pond feature located east of the industrial building and labeled it as a “potential drum cleanout pond” in the 1946 aerial. The relationship between the potential drum cleanout pond and barrel washing operations is unknown. Several smaller parcels, apparently used as residences, surround the Novak Barrel Cleaning Company (Figure 2.2). Lora Lake also appears in the 1946 aerial photograph. The lake was created by peat mining activities performed sometime between 1936 and 1946, likely by the Hi-Line Leaf Mold Products Company (AECOM 2009b).

The Novak Barrel Cleaning Company continued operations at the Site until the 1960s when the property became the Burien Auto Wrecking facility. The Site was operated as an auto wrecking facility from the 1960s through the 1980s, as shown on the aerial photographs from 1980 and 1985. The industrial building constructed by the Novak Barrel Cleaning Company remained on the property; however the potential drum cleanout pond appears to have been filled in by 1980. The yard was unpaved and utilized primarily for end-of-life vehicle storage. The auto wrecking facility did not occupy the entire Site, as shown on Figure 2.2. Residential homes are visible along the north boundary of the current property footprint in the 1980 aerial photograph. The same photograph shows paved areas to the east and south of the facility. In the 1980 aerial photograph Lora Lake appears larger than in the 1946 aerial photograph. It also appears that peat mining activities had ceased, as single family homes were present along the western and northern shorelines of the lake.

The 1985 aerial photograph indicates that the auto wrecking yard had ceased operations and vacated the Site, leaving only the few remaining buildings and fences as markers of the past industrial operations. The residences shown in the 1980 aerial photograph to the north and surrounding Lora Lake are still present in the 1985 aerial, as is the industrial building originally constructed by the Novak Barrel Cleaning Company.

The property was purchased for residential development by The Mueller Group (Mueller) in 1986. Mueller constructed the Lora Lake Apartments at the Site in 1987. Prior to development of the apartment complex, Mueller contracted with Golder to conduct a geotechnical investigation at the Site. Golder excavated 20 exploratory test pits. During this investigation, Golder observed contaminated material in a concrete waste pit located in the central portion of the Site, in the area of the former barrel washing facilities. A sample of this contaminated material was collected and analyzed for metals, cyanide, phenol, total solids, volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs). Cadmium, lead, benzene, ethylbenzene, methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), and xylenes were detected in the sample. Following a review of the sample results, Golder recommended removal of contaminated soil.

In March 1987, Chemical Waste Management, on behalf of Mueller, remediated the contaminated soils recommended for removal by Golder. Approximately 140 cubic yards of soil was excavated from the concrete waste pit area, in the vicinity of the former recreation building.

During soil removal and confirmation sampling activities, an area of soil contamination not previously identified (approximately 400 square feet) was encountered directly west of the concrete waste pit area. This contamination was discovered during the review of the results from four samples collected in this area during excavation (results not reported in Golder documents). Golder returned to the Site to further characterize this contaminated area, and discovered that the Site construction contractor (Chemical Waste Management) had excavated the newly discovered contaminated area to a depth of approximately 4.5 feet below the confirmation sample depth. Golder discovered a concrete sump surrounded by contaminated soil. Analytical samples were collected from the excavation sidewalls and floor. Upon completion of excavation and sample collection, Golder issued the results of the investigation and cleanup to WSDOE (Golder 1987). An "Opinion" letter was then issued by WSDOE to Mueller in December 1987 stating that no additional cleanup actions were required. The WSDOE letter stated that the Golder cleanup had been performed "…in a professional manner using environmentally sound criteria which will protect the Public. At this time, no additional investigation is required." (WSDOE 1987).

Apartment construction activities comprised regrading, paving, landscaping and construction of multi-story residential buildings, recreational areas, and in-ground pools. The configuration of the completed apartment building development is shown in the 1992 and 2004 aerial photographs presented in Appendix A, and in Figure 2.1.The existing stormwater drainage system for the Site was also constructed in 1987 as part of the apartment building development. It is unknown whether the City of Burien's main drainage line already existed in this area and drained to Lora Lake, or if the extension to Lora Lake was installed at the time that the Lora Lake Apartments were constructed.

The Equitable Life Insurance Society of the US acquired the property in September 1988 and sold it to Santa Anita Realty Enterprises, Incorporated in July 1991. Pacific Gulf Properties acquired the property in November 1993, and sold the property to the Port in 1998.

2.1.3 Recent Site Ownership and Land Use

The Site is currently owned by the Port. At the time of property transfer to the Port, the Lora Lake Apartment complex consisted of 22 occupied apartment buildings. All tenants of the apartment complex were relocated by the Port in 1999 to accommodate the planned construction of the 3rd Runway at STIA. Runway construction was delayed by litigation, and in 2000, the Port and the King County Housing Authority (KCHA) entered the Housing Cooperation Agreement, temporarily transferring ownership of the apartment complex to KCHA for use as low income housing until 2005. The agreement was later amended to extend KCHA ownership until 2007. Disputes about the potential for long-term residential use of the property delayed final transfer of the property back to the Port until 2008.

The Port entered an RI/FS AO for the Lora Lake Apartments property with WSDOE in July 2009. The apartment buildings were demolished in August and September 2009 as part of an AO Interim Action.

2.2 FUTURE LAND USE

The Port's current objective for the Site is to complete the AO obligations, conduct appropriate remediation of site contamination, and, in conjunction with the City of Burien, plan for and redevelop the city block (of which the Site is a part) for airport-compatible commercial or light industrial-use.

The Federal Aviation Administration (FAA) defines restrictions on allowable development and structures for runway and runway approach safety areas (AC/150 5300-13). Figure 2.3 shows where the FAA's Runway Protection & Approach Transition Zones for STIA overlay the Site. Portions of the Site are located within the Controlled Activity Area and the Extended Object Free Area as shown in Figure 2.3. Future site development will comply with the FAA restrictions for these areas and will be coordinated during the design phase of site redevelopment.

2.3 PHYSICAL SETTING, SITE GEOLOGY, AND HYDROGEOLOGY

The Site is located in the Puget Sound Lowlands, within the Miller Creek Watershed, just northwest of the STIA. The site perimeter is directly bound by roadways on three sides, with some open lots to the south that have recently been cleared of commercial buildings. The site topography gradually slopes to the southeast with steeper slopes located adjacent to Des Moines Memorial Drive and from the Highway 518 embankment to the north, as shown on Figure 2.3. Existing site topography was created during the construction of the apartment building complex in 1987. To the southeast of the existing site boundary, the topography continues to gradually slope towards Lora Lake, a man-made water body resulting from peat mining activities that occurred sometime from the late 1930s through the 1950s.

An active City of Burien stormwater system runs through the Site. This system collects surface road runoff and stormwater from residential and commercial areas upgradient of the Site, collects surface water runoff from the Site, connects to the adjacent Des Moines Memorial Drive drainage system downgradient of the Site, and discharges to an outfall located in Lora Lake. A detailed description of the existing stormwater drainage system is provided in Section 5.0, along with discussion of the Stormwater Investigation Interim Action currently being conducted and planned for completion in spring 2010.

AECOM completed a Terrestrial Ecological Evaluation (TEE) for the Site as part of their Summary Report and concluded that the Site, as it is currently defined in the AO, satisfies WSDOE's exclusion criteria per WAC 173-340-7491(b), and further ecological evaluation at the Site is not required as part of the RI/FS process (AECOM 2009b). The TEE is described in additional detail in Section 7.1.2.3.

The regional geology and hydrogeology has been previously studied, and the following description is summarized from a regional Groundwater Study Report for STIA that was provided to and reviewed by WSDOE as part of a STIA Groundwater Study AO (Aspect and S. S. Papadopulos 2005). The regional geology is characterized by Vashon glacial and non-glacial deposits that overlay Puget Group sedimentary and volcanic basement rocks. The surface geologic unit in the vicinity of the Site is composed of Pleistocene advance and recessional outwash deposits of moderate to well sorted sand and gravel, with varying thickness up to 30 feet. Vashon glacial deposits overlay Pre-Frasier lacustrine sediments, which contain peat layers. The STIA Groundwater Study identified up to six separate aquifer units in the region with scattered, laterally discontinuous areas of perched groundwater (Aspect and S. S. Papadopulos 2005).

2.3.1 Site Geology

The site geology has been determined by previous environmental investigations (GeoScience Management 2008 and ENSR|AECOM 2008a). A total of 22 soil borings were completed in 2007 and early 2008 to characterize subsurface physical and environmental conditions within the Site. A total of 16 shallow borings (less than 20 feet in depth) were advanced with a Geoprobe or hand auger, and 6 deep borings (approximately 20 to 30 feet in depth) were advanced with a hollow-stem auger (HSA) drill rig for monitoring well installation.

In August 2008, 5 additional monitoring wells (approximately 20 to 25 feet in depth) were installed east of Des Moines Memorial Drive, downgradient of the Site, as part of a supplemental groundwater investigation effort (ENSR|AECOM 2008b).

Data collected from soil borings and monitoring well installations indicate that the subsurface geology at the Site consists of a discontinuous fill layer that overlays advance and/or recessional glacial outwash deposits of sand and gravel with occasional silt lenses. The fill unit is observed to have a variable thickness of up to 15 feet, but is absent within the northern portion of the Site. The fill is composed of medium dense to dense, fine to coarse grained sand with rounded gravel. The underlying native glacial outwash deposits are variable in thickness and were observed at depths of approximately 30 feet below ground surface (bgs). The glacial outwash deposit is characterized as dense to very dense, fine to course grained sand, with gravels up to 2 inches in diameter.

Native glacial outwash deposits are present at the surface in the northern part of the Site. The surface topography across the remainder of the Site reflects significant regrading that was performed during construction of the apartment complex. The majority of the current site surface consists of asphalt paving, concrete paving, and a smaller amount of landscaped areas. Though the apartment buildings were demolished as part of an interim action completed in summer 2009, building foundations and site paving remain intact.

2.3.2 Site Hydrogeology

As part of initial and supplemental groundwater investigations completed by AECOM in 2008, a network of 11 groundwater monitoring wells were installed and monitored within the site boundary and east of Des Moines Memorial Drive at depths ranging from approximately 15 to 30 feet bgs (AECOM 2009b). Groundwater contour maps were generated using water level measurements collected as part of three field monitoring events that were completed between March and December 2008 (ENSR|AECOM 2008b and AECOM 2009a). Results of the groundwater monitoring indicate that groundwater generally flows to the southeast, from the Site towards Lora Lake.

Groundwater at the Site is encountered at depths ranging from approximately 6 to 20 feet bgs in on-site wells, within the native glacial outwash deposits and some site fill materials. Groundwater in off-site wells was observed at depths ranging from approximately 10 to 15 feet bgs. Groundwater flow at the Site is generally to the east, and southeast. The results of groundwater monitoring events completed as part of initial and supplemental investigation efforts conducted by AECOM indicate that groundwater fluctuations are consistent between site wells. The consistent fluctuations suggest that the groundwater at the Site does not represent isolated, perched lenses, but is continuous in the vicinity of the Site.

Drinking water supply for residences and business surrounding the Site is provided primarily by the City of Seattle’s municipal drinking water system. The closest groundwater supply/extraction wells are located approximately 1 and 2 miles to the northeast of the Site and are occasionally used for drinking water supply in the summer months when the municipal supply is low. These wells are screened into the deeper regional aquifer units, located several hundred feet below ground surface, and are not believed to have hydrologic connection to the near-surface shallow aquifers.

2.3.3 Lora Lake Property

The Lora Lake Property is located to the east and southeast of the Site, across Des Moines Memorial Drive. The Lora Lake Property is owned by the Port, and is part of the Miller Creek/Lora Lake Upland Buffer and Flood Plain Zone mitigation area required by the Natural Resources Mitigation Plan for expansion of the STIA and construction of the 3rd Runway. This property accepts groundwater and stormwater flow from the Site. The same glacial outwash deposits (and some similar alluvial deposits) observed at the Site are also present at this property, but are overlain by localized fill material. The glacial outwash deposits extend to depths of 20 feet bgs or deeper. The overlying fill within the

Lora Lake Property has a variable thickness of up to 12 feet and is characterized as a brown or orange-brown medium dense to very dense, fine to coarse grained sand with some rounded gravel. Lora Lake is a man-made surface water feature that was constructed on this property as a result of peat mining in the area sometime after 1936, as indicated by aerial photographs in Appendix A. Consistent with airport safety considerations and mitigation area restrictive covenants required by the Natural Resources Mitigation Plan, public access to Lora Lake and the property is prohibited, and the area is protected within a fenced perimeter.

Lora Lake receives stormwater runoff from the Site, City of Burien residential and commercial areas upgradient of the Site, and surrounding roadways downgradient of the Site through a single outfall located at the northwestern edge of the lake. An overflow discharge pipe is present at the east end of the lake, which discharges lake water to the adjacent Miller Creek surface water body when lake surface levels are elevated. Lora Lake also receives groundwater input from the Site and surrounding area, as discussed in Section 2.3.2.

WAC 173-201A-600(1) requires that water quality in Lora Lake be protected for salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values. At the same time, Miller Creek, to which Lora Lake discharges, has been closed to consumptive use (Water Resource Inventory Area (WRIA-9) WAC 173-509(040); WSDOE 1988). Federally mandated restrictive covenants provide that the lake will remain Port of Seattle property with strictly enforced public access prohibitions.

3.0 Regulatory Framework

3.1 REGULATORY FRAMEWORK

In April 2008, the Port and KCHA filed a VCP application to enter WSDOE's voluntary cleanup process for the Site. In September 2008, the Port filed a Modified Voluntary Cleanup Program application that removed KCHA from the process. The VCP application identified polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH; diesel range, gasoline range, and heavy oil range) and dioxins as site soil contaminants and PAHs, TPH, dioxins, arsenic, PCE, TCE, and 1,2-dichloroethane (1,2-DCA) as site groundwater contaminants. Following completion of additional soil, groundwater, and sub-slab vapor investigations conducted by AECOM in 2008, WSDOE and the Port agreed to move forward with remediation planning under an AO, and the Site was removed from the VCP register in January 2009.

The Lora Lake Apartments Site RI/FS will be completed according to procedures and guidance provided in MTCA WAC 173-340. Under MTCA, a RI/FS is required to be developed once a site is prioritized for remedial action (WAC 173-340-350; WSDOE 2007b). The purpose of the RI/FS Report is to recommend a cleanup action, as described in WAC 173-340-360 through 173-340-390, based on the collection, development, and evaluation of a sufficient site-specific data set.

3.2 AGREED ORDER AND MODEL TOXICS CONTROL ACT REQUIREMENTS

The Port's obligation under the AO includes the determination by WSDOE that the Port (as the owner of the Site and the performing party) must conduct a formal RI/FS addressing site soil and groundwater that will develop and evaluate remedial alternatives to enable a final cleanup action for the Site. According to the AO, the RI/FS is to be performed in accordance with WAC 173-340, and specifically 173-340-350, to achieve the site-specific remedial action objectives (RAOs).

The AO also directs the Port to prepare and submit to WSDOE prior to the RI/FS Work Plan public comment period, a final Sampling and Analysis Plan (SAP) in accordance with WAC 173-340-820 requirements, and a site-specific Health and Safety Plan (HASP) consistent with WAC 173-340-350 and WAC 173-340-810.

Previous remedial investigations conducted by GeoScience Management and AECOM were incorporated into Exhibit B of the AO. Additional chemical data collected as part of supplemental investigations at the Site will be submitted to WSDOE's Environmental Information Management (EIM) System at least 7 days prior to the due date of the WSDOE Review Draft RI/FS Report. During the development of the RI/FS, the Port is required to submit monthly progress reports summarizing activities, data reports and raw data, problems or anticipated problems in meeting the schedule or the RI/FS objectives, solutions developed, and anticipated future work.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND CLEANUP LEVELS

Compliance with ARARs is a MTCA threshold requirement, and must be met by all proposed remedial alternatives. Under WAC 173-340-350 and WAC 173-340-170, the term “applicable requirements” refers to regulatory cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a COC, remedial action, location, or other circumstance at the Site. The “relevant and appropriate” requirements are regulatory requirements or guidance that do not apply to the Site under law, but have been determined to be appropriate for use by WSDOE.

ARARs are often categorized as chemical-specific, location-specific, or action-specific. Chemical-specific ARARs include regulatory cleanup levels for the relevant COCs. Location-specific ARARs include any regulations or guidance relevant to a specific location at the Site. Action-specific ARARs include regulations or guidance governing any activities proposed to remediate the Site. Chemical-, location-, and action-specific ARARs that may be directly relevant to the development and evaluation of remedial alternatives will be presented as an appendix in the WSDOE Review Draft RI/FS Report.

The primary cleanup regulations that apply to this Site are the Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC, Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC (WSDOE 2006), and federal surface water quality ARARs for protection of the adjacent groundwater receiving water body, Lora Lake. Site-specific cleanup levels, and remediation levels as appropriate, will be proposed in the RI/FS report. For the remedial investigation phase of the project, the Work Plan QAPP establishes analytical methods and the associated low-level practical quantitation limits (PQLs; Appendix B). The analytical methods identified in this Work Plan QAPP will generate the lowest technically reliable PQLs, thereby minimizing the possibility that the PQLs will be greater than the future site cleanup levels.

As part of this remedial investigation, dioxins[1] will be analyzed in surface and subsurface soil samples collected from on-site and off-site locations using a tiered approach, as described in Section 8.0. Existing site dioxin soil data collected from areas not affected by previous regrading and development activities, and from areas where fill is not present, show dioxin soil concentrations ranging from 0.08 ng/kg to 9.9 ng/kg. This range is within the lower end of the range of Washington State urban background toxic equivalent (TEQ) concentrations (0.133 to 19.5 ng/kg) provided in the *Concise Explanatory Statement and Responsiveness Summary for the Amendment of Chapter 173-340 WAC, Model Toxics Control Act Cleanup Regulation* (CES; WSDOE 2007a,

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[1] The term “dioxins,” in the context of this Work Plan, includes the group of 17 chlorinated dibenzo-p-dioxins and dibenzofurans congeners, as presented in WAC 173-340-900 Table 708-1 (WSDOE 2007a).

p. 83). It is not anticipated that the site cleanup level for dioxins in soil will be greater than the urban background TEQ concentration of 7.7 ng/kg listed in the CES (WSDOE 2007a). Therefore, the dioxin TEQ soil concentration that will be used in the RI/FS field investigation to trigger analysis of archived soil samples for dioxins is 7.0 ng/kg. As part of the RI, empirical site soil and groundwater data will be used to evaluate whether the soil to groundwater pathway is protected.

4.0 Summary of Prior Investigations

4.1 ENVIRONMENTAL INVESTIGATIONS

This section provides a summary of the environmental investigations completed at the Site since 2007 in preparation for redevelopment. Data tables of the analytical results from the 2007 GeoScience Management investigation and the AECOM 2008 investigations are summarized below and provided in Appendix C.

4.1.1 GeoScience Management Focused Subsurface Investigation, July to November 2007

In 2007, GeoScience Management conducted a focused soil and groundwater investigation to further evaluate the area previously remediated by Golder in 1987. The Port initiated this activity in support of anticipated future site redevelopment. GeoScience Management issued the results of the investigation to the Port in a letter report dated April 2008 (GeoScience Management 2008).

GeoScience Management investigated the vicinity of the former historical site operations from July through December 2007. During preparation of this RI/FS Work Plan and review this investigation report and other existing site maps and reports, it was discovered that the location of the Golder soil excavation depicted in the GeoScience Management report was approximately 50 feet to the northeast of the location as described and presented in the Golder 1987 report figures. The location of the extent of soil excavation, based on the Golder report, is correctly presented in Figure 2.2. The evaluation of nature and extent of site contamination, and evaluation of site COCs, as discussed in this report, was conducted using the corrected excavation location, so that borings and monitoring wells are shown accurately with respect to previous excavation locations.

As part of the GeoScience Management investigation, nine temporary soil borings (LLP-1 through LLP-9) were advanced within the study area, and a permanent groundwater well (MW-1) was installed northeast of the former recreation building. The location of the soil borings and groundwater well are noted in Figure 4.1.

GeoScience Management collected eight soil and seven groundwater samples from these soil borings. Samples were selectively analyzed for benzene, toluene, ethylbenzene, xylenes (BTEX), TPH (diesel range, heavy oil range, and gasoline range), VOCs, semivolatile organic compounds (SVOCs), PCBs, and metals. Two soil samples and one groundwater sample were collected from the permanent well, MW-1, and selectively analyzed for VOCs, SVOCs, and dioxins. Surface soil samples were not collected in this investigation; samples were generally collected from 2 feet bgs or deeper, with the majority of samples collected between 6 to 6.5 feet bgs and between 14 to 17 feet bgs.

GeoScience Management analytical results were compared to the most stringent MTCA cleanup levels, Method A or B, (hereafter, GeoScience Management LLA screening levels). The analytical results reported limited exceedances of the GeoScience Management LLA screening levels, with soil and groundwater samples generally containing low levels of metals, TPH, VOCs, SVOCs, and dioxins.

Two soil samples and four groundwater samples were analyzed for metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). In addition, two soil samples were analyzed for arsenic only. The only exceedances of the GeoScience Management LLA screening levels were arsenic in groundwater from Locations LLP-4 and LLP-9. Lead was detected in the groundwater sample collected from Location LLP-4 at a concentration less than the GeoScience Management LLA screening level. All other groundwater results were less than laboratory detection limits. Concentrations of lead, chromium, and barium were detected in soil samples collected from LLP-4 and LLP-5 at levels less than the GeoScience Management LLA screening levels. All other soil results were less than the laboratory detection limits.

TPH exceedances of GeoScience Management LLA screening levels were noted at depth in the soil sample collected at 14.5 feet bgs from LLP-4. For groundwater, samples were collected from four soil borings (LLP-4, LLP-5, LLP-8, and LLP-9), as well as both groundwater samples collected from MW-1 in November and December 2007. Detected TPH concentrations exceeded the groundwater GeoScience Management LLA screening level in samples collected from LLP-4 and both samples collected from MW-1.

Exceedances of GeoScience Management LLA screening levels were noted for xylenes and naphthalene in only one location at the Site, the soil sample collected from LLP-4 at a depth of 14.5 feet bgs. All other VOC concentrations in soil and groundwater were less than the GeoScience Management LLA screening levels. All SVOC concentrations in soil and groundwater were less than the GeoScience Management LLA screening levels, with the exception of pentachlorophenol (PCP) detected in groundwater in Soil Boring LLP-4 and Monitoring Well MW-1. In Well MW-1, bis(2-ethylhexl)phthalate (BEHP) was detected at a concentration exceeding the GeoScience Management LLA screening level. Exceedances of GeoScience Management LLA screening levels by carcinogenic polycyclic aromatic hydrocarbons (cPAHs) were noted in both groundwater and soil at depth in Boring LLP-4 and Well MW-1, located adjacent to each other. While cPAHs were detected at low levels in several other soil and groundwater samples, concentrations were less than GeoScience Management LLA screening levels.

Dioxins were detected in two soil samples that were both collected from MW-1 at depths of 7 feet bgs and 14 feet bgs with TEQ concentrations greater than the GeoScience Management LLA screening level. The dioxin TEQ concentration for the single groundwater sample from MW-1 analyzed for dioxins also exceeded the groundwater GeoScience Management LLA screening level.

Generally, GeoScience Management LLA screening level exceedances were observed within the former barrel washing area, in Soil Boring LLP-4 and Well MW-1. The analytes that exceeded the GeoScience Management LLA screening level are TPH, VOCs (naphthalene and xylenes), PCP, cPAHs, and dioxins. Site contamination did not include PCBs or metals (with the exception of arsenic and lead).

4.1.2 AECOM Soil, Groundwater, and Sub-slab Air Investigation, March/April 2008

AECOM completed a site-wide sampling and investigation program in 2008 to further delineate soil, groundwater, and soil vapor contamination at the Site. This investigation has been summarized in the Soil, Groundwater, and Sub-slab Air Investigation report, issued in June 2008 to the Port (ENSR|AECOM 2008a). As mentioned above, the location of the Golder soil excavation was depicted in the GeoScience Management and AECOM report figures approximately 50 feet to the northeast of the location as illustrated and described by Golder (Golder 1987).

In this investigation, a total of 44 shallow and deep soil samples were collected from 13 locations across the Site. Soil samples were collected from 0 to 0.5 feet bgs and 1.5 to 2 feet bgs in all of the locations, and samples were collected at depths of 7 and 14 feet bgs at 8 of the locations. In five of these locations, groundwater wells were installed to investigate shallow groundwater. All soil and groundwater sampling locations associated with this investigation are noted in Figure 4.1. Groundwater flows in a southeasterly direction at the Site, and well locations were selected to yield one upgradient well (MW-2), three downgradient wells (MW-4 through MW-6), and one cross gradient well (MW-3). Soil samples were also collected for chemical testing from these wells during installation. Soil samples were analyzed for total metals, VOCs, SVOCs, PCBs, TPH, and dioxins and furans. Groundwater samples were analyzed for dissolved metals, VOCs, SVOCs, TPH, and dioxins and furans. Physical parameters such as total suspended solids, total organic carbon (TOC), turbidity, and pH were not analyzed.

AECOM analytical results were compared to the most stringent MTCA cleanup levels (Method A or B) based on protection of human health via direct contact with soils and potential consumption of groundwater (hereafter, AECOM LLA screening levels).

Metals contamination was found to be limited in both soil and groundwater (dissolved phase) across the Site. Arsenic was detected in nearly all soil samples, but at low concentrations (typical concentration approximately 7 mg/kg) that are assumed to be representative of background conditions. Additionally, arsenic was detected at concentrations exceeding the AECOM LLA screening level in three groundwater wells. Lead was detected in three soil samples at levels greater than the AECOM LLA screening level.

VOCs at the Site were not detected in soil and were not detected (or detected at concentrations less than AECOM LLA screening levels) in groundwater with the exception of TCE and PCE. TCE and PCE were detected at low levels in two wells; with concentrations exceeding AECOM LLA screening levels in MW-1.

SVOCs were generally not detected at the Site, with the exception of PCP and cPAHs exceeding AECOM LLA screening levels. PCP was detected at concentrations exceeding the AECOM LLA screening level in one surface soil sample and two groundwater samples.

In the March groundwater monitoring event, cPAHs were detected in all on-site wells analyzed for cPAHs (MW-1, MW-2, MW-3, MW-4, and MW-5), with the exception of MW-6; however, the method reporting limit was greater than the AECOM LLA screening level. The groundwater sample from MW-1 showed the highest TEQ concentration (1.0 µg/L) that was greater than the AECOM LLA screening level of 0.012 µg/L. In the August monitoring event, the individual cPAHs were not detected at levels greater than the reporting limits (0.016 µg/L) in any of the samples and were therefore not evaluated in the context of toxicity equivalencies (WAC 173-340-708(8)(e)). The AECOM LLA screening level was slightly exceeded by cPAH TEQs in soil samples collected from MW-4, MW-5, and LL-08.

PCBs were analyzed in three soil samples collected from Location LL-08, near an electrical transformer. Concentrations of total PCBs were less than the AECOM LLA screening level.

TPH (diesel range, heavy oil range, and gasoline range) were not detected in soil at concentrations that exceeded AECOM LLA screening levels. However, diesel and heavy oil range TPH were detected in groundwater at concentrations exceeding the AECOM LLA screening levels in two groundwater wells (MW-1 and MW-6). AECOM suggested that the source for the contamination in MW-6 is potentially off-site and different from the source of contamination in MW-1, as the chromatographic fingerprints of the samples are different (ENSR|AECOM 2008a). However, groundwater samples were not collected to confirm an off-site petroleum source.

Dioxin concentrations detected in soil at the Site were calculated using one-half of the method detection limit for undetected congeners. Calculation of the TEQ in accordance with WAC 173-340-708(8)(d) in each sample indicated exceedances of the AECOM LLA screening level in 10 samples located across the Site. The calculation of dioxin TEQ concentrations was performed using the World Health Organization 2005 Toxic Equivalency Factors (TEFs; van den Berg et al. 2006), as presented in WAC 173-340-900, Table 708-1 (WSDOE 2007b). The highest concentrations were observed in the area of the former barrel washing facility. Dioxin TEQ detected concentrations exceeded the AECOM LLA screening level, which was a modified MTCA Method B (carcinogen) screening level of 5.83 pg/L in one well, MW-1. The highest dioxin TEQ concentration in groundwater (234 pg/L) was detected in the groundwater sample collected from MW-1. In general, soil and groundwater contamination was observed most commonly in the presumed source area northwest of the recreation building. COCs were detected primarily in groundwater samples collected from MW-1, including the only detections greater than AECOM LLA screening levels on the Site for PCE, TCE, and dioxins.

A sub-slab vapor investigation was also conducted by AECOM that sampled and analyzed soil vapor beneath eight on-site buildings, including the Recreation Center building (designated REC. BLDG. on Figure 4.2), for VOCs. The vapor sample results were compared to MTCA Method B screening levels for ambient air. Of the samples collected, low concentrations of dichloroflouromethane and methylene chloride were found in three samples at levels less than the U. S. Environmental Protection Agency (USEPA) guidance screening levels for shallow soil vapor published in the 2002 *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (USEPA 2002). Results of the sub-slab soil vapor investigation conducted by AECOM determined that the concentrations of VOCs in soil gas at the Site are not at levels expected to affect the indoor air quality at the Site.

4.1.3 AECOM Supplemental Groundwater Investigation, August 2008

In August 2008, AECOM completed a supplemental groundwater investigation to further characterize site groundwater and evaluate potential migration of contamination in groundwater downgradient (to the southeast), and outside the site boundary (ENSR/AECOM 2008a). In this investigation, four additional monitoring wells (MW-8 through MW-11) were installed to the east and southeast of the Site, on the properties directly east of Des Moines Memorial Drive. AECOM planned to install Monitoring Well MW-7 during the same event. A delay in obtaining legal access to the drilling location prevented installation of the well until October 22, 2008. The MW-7 well log record is provided in the Summary Report issued by AECOM in September 2009 (AECOM 2009b).

Monitoring well locations are shown on Figure 4.1. Upon installation of the wells, groundwater samples were collected from the four newly installed wells (MW-8 through MW-11) and three existing wells located on the Site (MW-3, MW-4, and MW-5). MW-6 was also scheduled for additional groundwater sampling, but insufficient groundwater was present in the well at the time of the investigation. Groundwater samples were analyzed for dissolved metals, TPH, SVOCs, and PCP.

The only metal analyte detected in groundwater was arsenic, consistent with the previous groundwater investigation. As in the previous groundwater sampling, the detected arsenic concentrations are consistent with regional natural background levels.

PCP was detected in one on-site groundwater sample from Well MW-5 at a concentration greater than the AECOM LLA screening level. TPH and cPAHs were not detected in any of the monitoring wells.

Dioxin TEQ concentrations exceeded the AECOM LLA screening level in only one well, MW-10. However, laboratory method blank contamination was observed in this sample and, therefore, the laboratory qualified the results, indicating that they may not be accurate.

AECOM's supplemental groundwater investigation suggests that groundwater contamination is associated with the area of historical operations around MW-1 and LLP-4, within the site boundary, and does not appear to be migrating off-site. However, additional groundwater monitoring will be conducted as part of the RI/FS to verify the earlier data (refer to Section 8.0).

4.1.4 AECOM Groundwater Sampling Event, December 2008

A third groundwater sampling event was completed by AECOM in December 2008. Prior to this event, MW-7 was installed in the right-of-way east of Des Moines Memorial Drive (Figure 4.1). During this event, two on-site wells (MW-2 and MW-6) and two off-site wells (MW-7 and MW-10) were sampled. The groundwater was analyzed selectively for dissolved metals, TPH, PCP, and dioxins and furans. Dissolved metals and TPH were analyzed in MW-6 and MW-7, PCP in MW-2, MW-6, and MW-7, and dioxins and furans were analyzed in all four wells. Uncertainty regarding groundwater samples being representative of groundwater quality at MW-6 exists due to the observation that groundwater parameters were unable to be equalized prior to sampling the well location. During this investigation, no contaminants were detected at concentrations greater than AECOM LLA screening levels except for TPH in Well MW-6.

4.1.5 AECOM Summary Report—2008 Investigations and Data Gap Evaluation, September 2009

In September 2009, AECOM submitted a document summarizing the available information on historical land use, remediation actions, and AECOM investigations conducted at the Site in 2008. This report briefly summarizes investigations carried out in the past (1986 through 2007) by other consultants (Golder and GeoScience Management), and presents a detailed discussion of the AECOM site investigations beginning in March 2008 (discussed above in Sections 4.1.3 to 4.1.5). Based on the information summarized in the report, AECOM presents a preliminary CSM that considers the nature and extent of site contamination, environmental fate and transport, potential exposure pathways, and potential receptors. Finally, the summary report identifies data gaps at the Site, and suggests potential future investigations to address these data gaps.

5.0 Interim Actions

The Port has agreed to conduct two interim actions under the existing AO at the Site prior to completion of the additional remedial investigations discussed in this Work Plan. Both interim actions are to be carried out pursuant to WAC 173-340-430(1)(a). The interim actions include the following:

- Demolition of all remaining structures associated with the Lora Lake apartment building complex with additional measures to prevent contaminant migration (described below in Section 5.1).
- Completion of a stormwater system investigation (described below in Section 5.2) to evaluate the chemical quality of stormwater, stormwater solids, and catch basin sediments in the existing on-site stormwater conveyance system that discharges to Lora Lake.

Completion of these interim actions provide the Port with a safe and secure site during completion of the remedial investigation supplemental field activities and throughout development of the RI/FS Report, and allow for incorporation of the results of the stormwater investigation into the remedial investigation.

5.1 LORA LAKE APARTMENT BUILDING COMPLEX INTERIM ACTION

The Port completed apartment building demolition as described in the Interim Action Demolition Work Plan (AECOM 2009a). The Lora Lake Apartments were demolished in August and September 2009 to eliminate the public safety and security issues associated with vacated buildings (vagrant occupation, illicit activities and the threat of arson), and to reduce human health risks associated with unauthorized presence on the Site. As outlined in the Work Plan, the Port implemented protective measures to minimize disturbance to site soils and potential contaminant migration during demolition activities.

5.1.1 Apartment Building Demolition

The apartment building demolition interim action conducted in 2009 demolished 16 unoccupied buildings that were vacated in 2008. Six more buildings were previously demolished as part of a construction effort to comply with FAA flight path requirements for the STIA 3rd Runway expansion. The locations of the demolished buildings are shown on Figure 5.1. No aboveground structures remain at the Site.

Following completion of aboveground building demolition activities, intact in-ground foundation structures were secured by construction fencing, in-ground pools were filled with gravel, and a small amount of soil was excavated in order to access and cut utility lines. The existing stormwater system is currently active, but the building foundation drains were permanently plugged prior to building demolition. Surface water at the Site, including runoff from the remaining building foundations, is either captured by the active stormwater system, or infiltrates into the subsurface. Substantial ponding in building foundations since building demolition has not been observed. The Site is currently surrounded by a secure chain-link fence, which remains locked at all times.

5.1.2 Protective Measures Implemented for Worker Safety and Contaminant Migration Control

Protective measures were taken during completion of the apartment building demolition interim action to protect site workers from any exposures to contaminated materials and to prevent potential migration of contaminants from the Site during and after the demolition activities are complete.

5.1.2.1 Site Soil Protective Measures

The following protection measures were implemented to address soil migration concerns during the building demolition activities:

- All storm drain catch basins were blocked prior to the start of demolition activities. Stormwater and construction water were captured and managed on-site for disposal at a WSDOE-approved disposal facility.
- A silt fence was installed along the eastern property boundary that borders Des Moines Memorial Drive to prevent potential soil migration at the bottom of the sloped eastern hillside.
- Soils excavated for disconnection of site utilities were stored on-site, and replaced as backfill after utility services were disconnected. The disturbed areas were covered with jute mat to reduce the potential for soil erosion. Excavations in paved surface areas were patched with asphalt once the site utilities were disconnected.
- Dust suppression was conducted with water mists during building demolition activities.

5.1.2.2 Air Monitoring

The Port performed ambient air monitoring to evaluate the effectiveness of water misting during demolition. The air monitoring confirmed that ambient air quality was not adversely impacted and any fugitive dust generated during demolition activities remained on-site.

5.1.2.3 Contaminated Soil Isolation and Worker Safety

Protective measures that were implemented to isolate contaminated soil prior to the start of demolition activities and to provide protection for site workers are described below:

- Barriers were constructed in exposed soil/vegetation areas to prevent workers and equipment from disturbing or coming in contact with contaminated soils during demolition activities.
- Access for workers and equipment was restricted to paved surface areas only.
- Visual inspection of all vehicles entering and leaving the construction site was conducted on a daily basis to ensure that construction debris and soils were not transported off-site.

The apartment building demolition interim action was completed in September 2009. Construction activities were conducted in accordance with the WSDOE-approved Interim Action Demolition Work Plan (AECOM 2009a).

5.2 STORMWATER INVESTIGATION INTERIM ACTION

In August 2009, WSDOE requested that an additional interim action be conducted pursuant to WAC 173-340-430(1)(a) to investigate the potential for contaminant migration via drainage of stormwater through the existing site stormwater conveyance system and discharge to off-site receptors, including Lora Lake.

The objective of this Stormwater Investigation Interim Action is to assess whether the Site adversely impacts stormwater quality by potential contamination from the existing storm drain system. The Port will meet this objective by characterizing the quality of stormwater and stormwater solids entering and exiting the Site, as well as characterizing on-site catch basin sediments. This work was originally planned to be included in the RI/FS Work Plan and implemented during the wet season of 2010 to 2011. However, in response to concerns expressed by the Public, the Port agreed to WSDOE's request to conduct the stormwater investigation as an early interim action. The Stormwater Investigation Interim Action is currently being performed and is scheduled for completion in spring 2010 (Floyd|Snider and Taylor Associates, Inc. 2009).

5.2.1 Existing Storm Drainage System

There are two primary storm drainage lines that collect and convey site stormwater, the main conveyance line and secondary conveyance line (Figure 5.2). The main conveyance line is owned by the City of Burien and collects stormwater from roadways and major arterials serving typical residential and commercial properties. The main conveyance line and its collected flow enters the Site at the western boundary just south of the former Building P footprint, and conveys water eastward across the Site. Current and historical inputs into this main line comprise former roof drains, parking lot drains, and various other surface drains. Three detention tanks located in the northwest and one in the southeast regions of the Site control flows into this main line. Several stormwater vaults located along the main conveyance line contain oil water separators and debris and flow control structures. The main conveyance line exits the Site at the eastern property boundary, adjacent to Des Moines Memorial Drive, just north of the former Building C footprint. The Stormwater Investigation Interim Action is designed to, if necessary, distinguish storm system contamination representative of input from the Site versus contaminants that may be associated with the larger municipal stormwater drainage system.

The secondary conveyance line collects and conveys stormwater in the northeast area of the Site (refer to Figure 5.2). The easternmost point for stormwater flow into this line is a catch basin located just east of former Building T. Current and historical stormwater inputs from the Site to this catch basin comprise surface drains, roof drains, and a small concrete detention pond adjacent to former Building A. Stormwater in this secondary line is generally conveyed to the east. The secondary line exits the Site at the eastern boundary, near the Des Moines Memorial Drive intersection with the main site driveway (South 149th Place). Stormwater flows from this point are conveyed to the south and join the main conveyance where it exits the Site.

Stormwater flows in the main and secondary conveyance lines become commingled with road surface runoff from Des Moines Memorial Drive upon the exiting the Site, are conveyed beneath Des Moines Memorial Drive, and are discharged from an outfall on the western shore of Lora Lake. Site stormwater is discharged to Lora Lake under a Phase II National Pollutant Discharge Elimination System Municipal Stormwater Permit.

5.2.2 Stormwater Investigation Interim Action Scope and Schedule

The scope of the Stormwater Investigation Interim Action consists of the following activities:

- Collect stormwater samples and flow monitoring data at locations where stormwater enters and leaves the Site, and analyze the samples for site COCs.
- Collect catch basin sediment samples and analyze sediment samples for site COCs.
- Complete stormwater line TV inspections using an in-pipe video camera.
- Remove sediment from the storm drainage system using vactor methods.
- Following sediment removal, collect stormwater samples at locations where stormwater enters and leaves the Site, for a total of up to 10 qualifying storm

events, or fewer as approved by WSDOE. Analyze the samples for site COCs.

- Collect stormwater solids using sediment traps and analyze for site COCs. Stormwater sediment traps will be installed at the start of the interim action and will collect sediment for a period that ends no later than May 2010.

Stormwater flow monitoring and field sampling activities, as described in the sections below, are being conducted by Taylor Associates, Inc. Data validation, evaluation, and reporting to WSDOE is being completed by Floyd|Snider, the RI/FS consultant for the Port. Floyd|Snider will produce a series of interim data reports throughout the investigation, and a final data report upon completion of interim action investigation activities. Detailed information regarding the scope of the Stormwater Investigation Interim Action, sampling activities, analytical testing, reporting, and key personnel involved in the interim action is provided in the Stormwater Interim Action Work Plan (Floyd|Snider and Taylor Associates, Inc. 2009).

5.2.3 Interim Action Sampling Locations and Analytical Testing

The following sections describe the locations selected for stormwater sampling and monitoring, stormwater solids sampling, and sediment sampling, along with the analytical testing that will be performed at each type of sampling location. Sampling locations are presented on Figure 5.2.

5.2.3.1 Stormwater Sampling and Flow Monitoring

Stormwater flow conditions will be monitored, and samples will be collected at three locations to characterize the inlet and outlet flows at the Site. Stormwater samples will be collected as composite and grab samples and analyzed for the following:

- PAHs and PCP
- Arsenic (total and dissolved)
- Dioxin and furans
- VOCs (PCE, TCE, and 1,2-DCA)
- TPH (oil and diesel range)
- Total suspended solids
- pH (field measurement)

5.2.3.2 Stormwater Solids Sampling

In-line sediment traps, designed to collect stormwater solids, have been positioned at catch basin locations CB4505, CB5945, and CB4555. An attempt will also be made to install a sediment trap in Catch Basin 4857 (from the inlet pipe carrying stormwater from the Site) once sediment removal and video inspection activities have been completed in February 2010. These locations were selected using a similar rationale as the stormwater sampling and flow monitoring locations. Stormwater solids samples will be analyzed for the following:

- PAHs and PCP
- Arsenic and lead
- Dioxin and furans
- TPH (oil and diesel range)
- VOCs (PCE, TCE, and 1,2-DCA)
- Total solids
- TOC

5.2.3.3 Catch Basin Sediment Sampling

Catch basin sediment sampling was conducted in January 2010. Sediment samples were collected at CB-31A, CS/CB-19, CB-12, and CS/CB-2 to characterize COCs from the inlet, outlet, and key junctions within the main and secondary drainage systems within the Site. During an initial in-line video inspection of the stormwater pipe segment directly upgradient of CB4857, sediment was observed at the bottom of the inlet pipe to CB4857. A sediment sample was also collected from this inlet pipe, directly upgradient of CB4857. Enough sediment volume was collected from the inlet pipe to CB4857 to enable analysis for all site COCs, except for VOCs. Catch basin sediment samples were analyzed for the following:

- PAHs and PCP
- Arsenic and lead
- Dioxin and furans
- TPH (oil and diesel range)
- VOCs (PCE, TCE, and 1,2-DCA)
- Total solids
- TOC

5.2.4 Stormwater Investigation Interim Action Reporting

Results of the Stormwater Investigation Interim Action will be presented in a series of progress reports. These reports will include a preliminary assessment of stormwater quality. If stormwater quality does not meet standards, data variability will also be assessed. As necessary, the Port will provide recommendations for modifying the sample collection program, including the need and rationale for increasing or decreasing the number of events. The Port will prepare a final stormwater investigation data report following completion of all required monitoring and sampling activities. This final report will be included as an appendix to the Lora Lake Apartments RI/FS Report.

Evaluation of the Stormwater Investigation Interim Action data will be completed to assist the Port with understanding the integrity of the existing system and the potential for the system to convey site-specific contamination to the discharge location in Lora Lake. If these data suggest off-site contaminant migration, the Port will work with WSDOE to determine the appropriate investigations of Lora Lake and to determine the appropriate management of the stormwater conveyance system through the Site.

6.0 Lora Lake Apartments RI/FS Objectives

The purpose of the Lora Lake Apartments RI/FS is to conduct a comprehensive evaluation of the property and define a preferred remedial action for the Site that achieves MTCA compliance. The RI/FS work will be designed to meet the following objectives:

- Define RAOs, ARARs, remediation levels (if appropriate), and cleanup levels appropriate to the Site.
- Complete a full characterization of soil, groundwater, and current stormwater quality and evaluate potential contaminant migration pathways.
- Evaluate remedial actions for site soil and groundwater, identify and screen applicable remedial technologies, develop remedial alternatives, and evaluate remedial alternatives to recommend a preferred alternative that is compatible with future site use.
- Collect, develop, and evaluate sufficient information regarding the Site to enable selection of a cleanup action under WAC 173-340-360 through 173-340-390.

These primary RI/FS objectives are discussed further in the following sections.

6.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The RI/FS will define preliminary RAOs for the Site as a mechanism for meeting the requirements of the MTCA Cleanup Regulations (Chapter 173-340 WAC; WSDOE 2007b). RAOs must be achieved by the cleanup action to ensure substantive compliance with ARARs and comply with the cleanup goals established for the Site. RAOs are simple statements that clearly define what the remedy must accomplish to address the concerns identified in the CSM. RAOs are used to facilitate development and evaluation of remedial alternatives. Preliminary RAOs for the Site include the following:

- Remediate soil and groundwater to meet MTCA cleanup standards and other standards applicable to the Site.
- Control off-site contaminant migration pathways.
- Select remedial actions that can be implemented and effectively maintained in conjunction with the anticipated future site use.

These preliminary RAOs will be developed further in the RI/FS Report, following completion of remedial investigation activities and interim actions.

6.2 COMPLETE SITE CHARACTERIZATION

Complete site characterization will enable a comprehensive understanding of the existing nature and extent of contamination at the Site. This site characterization will inform development of an updated CSM that will define potential contaminated media, potential contaminant migration pathways, and routes of exposure. Site characterization will further define site COCs, and identify areas of concern at the Site relative to cleanup standards.

This Work Plan proposes additional data collection actions to fill existing data gaps and complete site characterization. The proposed Remedial Investigation Supplemental Site Investigation is detailed in Section 8.0. The stormwater investigation and building demolition interim actions are discussed in Section 5.0.

6.3 DEFINE AND EVALUATE MTCA REMEDIAL ACTIONS

6.3.1 Model Toxics Control Act and State Dangerous Waste Act Compliance

The RI/FS will define remedial alternatives for soil and groundwater (and potentially stormwater) at the Site that meet MTCA requirements and can be implemented and maintained, given the anticipated future use at the Site. This will include evaluating soil direct contact risks, soil to groundwater leaching concerns, soil and groundwater quality, and off-site migration of contaminated soil, groundwater, and stormwater. Other evaluations will be performed as appropriate. Remedial alternatives will also include performance of soil characterization consistent with WAC 173-303, and evaluation of disposal options appropriate to the particular alternative elements and specific soil conditions. Remedial alternatives identified in the RI/FS will be evaluated and screened according to the criteria and process detailed in WAC 173-340-360.

6.3.2 Off-site Migration Pathways

The RI/FS will evaluate potential migration pathways identified in the CSM including soil leaching to groundwater, off-site migration of contaminated groundwater, and stormwater conveyance. Evaluation of migration pathways will be mindful of off-site receptors, including residences, public right-of-ways, and Lora Lake. The RI/FS will evaluate the potential for off-site contaminant migration and determine actions necessary to control contaminant migration.

6.3.3 Define and Evaluate Remedial Alternatives

The RI/FS will define and evaluate comprehensive remedial alternatives for remediation of the Site. Technology screening and remedial alternative evaluation methodologies will be completed according to the procedures and requirements presented in MTCA

Regulation, Chapter 173-340 WAC (WSDOE 2007b), and are defined further in Section 9.0.

The RI/FS will include evaluation of a permanent remedy, as defined by MTCA, as a baseline for comparison of all other proposed remedial alternatives. Following the disproportionate cost analysis (DCA), the RI/FS will select a preferred remedial alternative for WSDOE consideration.

6.4 DEFINE SOURCE CONTROL REQUIREMENTS

The sources of the contamination currently located in the core portion of the Site are associated with industrial operations that have long since been discontinued. The only remaining “source” of core area contamination is the potential release of contaminants from currently impacted media to other media. Evaluation of the potential for current conditions to represent contamination sources and evaluation of associated source control methods is part of the scope of the RI.

Evaluation of source control, as related to stormwater conveyance, is being completed as part of the Stormwater Investigation Interim Action.

The source of diesel range hydrocarbons in groundwater in the northeast corner of the Site discovered by previous investigations has not yet been identified and will be an objective of additional data collection activities that are described in Section 8.0. If an ongoing source of diesel contamination, such as an existing underground storage tank, is identified during additional investigations, source control actions will be evaluated for this area.

6.5 ADDRESS FUTURE LAND USE

The RI/FS will define and evaluate remedial alternatives in the context of the Port’s anticipated future land use, namely, as a portion of a Burien city block to be redeveloped for uses permitted for land zoned Airport Industrial 1 by the City of Burien. Zoning restrictions for Airport Industrial 1 zones are described in Section 19.15.070 of the City of Burien Municipal Code (City of Burien 2010).The Port and the City of Burien are currently engaged in a planning process to achieve this redevelopment, which will generate benefits for the Port, the City of Burien, and the local community. The site AO and follow-on remediation are well-coordinated with the planning process, assuring that future site use is compatible with the proposed remedial actions, and vice versa.

7.0 Conceptual Site Model, Contaminants of Concern, and Data Gaps

7.1 PRELIMINARY CONCEPTUAL SITE MODEL

A preliminary CSM, developed by AECOM on behalf of the Port in 2009 as part of the Summary Report (AECOM 2009a), is presented in Figure 7.1. Following completion of the supplemental data collection activities described in this Work Plan, the CSM will be updated as part of the RI/FS. The preliminary CSM developed by AECOM is based on findings from previous site investigations and remedial actions. The preliminary CSM assists in identification of remaining data gaps at the Site. When these data gaps are filled and the CSM is updated, it will inform decisions regarding selection of appropriate remedial actions for the Site.

7.1.1 Existing Subsurface Conditions

As discussed in Section 2.0, the past operational uses of the Site consisted of residential apartments, an auto wrecking yard, a barrel washing facility, and single-family residences along the northern portion of the Site. Site operations and grading activities modified the topography and resulted in varying subsurface conditions. Investigations conducted at the Site indicated the following general subsurface conditions:

- A fill unit consisting of sands with silt and gravel is present in varying thicknesses (4 to 7 feet) across the central and southern portions of the Site. Previous investigations described the fill as native material, which was excavated and reworked during site regrading activities.
- The fill unit is not present in the northern portions of the Site, where previous land uses were limited to single family residences, and barrel washing and auto wrecking activities were not conducted. In these areas, native sand with gravel is present from the ground surface through the total depths of existing site borings.
- A number of borings installed by GeoScience Management in 2007 encountered a 1-foot-thick layer of dark gray to black sand with abundant roots, substantial organic matter, and occasional debris immediately below the fill unit. GeoScience Management interpreted this layer as the site land surface at the time of industrial operations, prior to apartment construction. This layer also contained an oil-like odor in a number of borings located around the former Recreation Center building (refer to Boring Locations LLP-2, LLP-3, LLP-4, and LLP-7 on Figure 4.1).
- Native material encountered beneath the fill unit consists of poorly graded and well graded sands with infrequent silt lenses. This layer extends past the deepest boring depth of 28 feet bgs installed during previous investigations.

- Groundwater was encountered at depths ranging from 6 to 20 feet bgs during drilling and monitoring events. This range is consistent with the substantial elevation difference in ground surface across the Site. Groundwater elevation data collected from site monitoring wells in 2008 indicate that the groundwater table elevation fluctuates between 2 to 3 feet seasonally and generally flows to the southeast (towards Lora Lake) on a year-round basis.

7.1.2 Contaminant Transport and Exposure Routes

Contaminants in soils and groundwater at the Site have the potential to migrate through a number of processes, resulting in exposure to human and/or ecological receptors. Potential routes of exposure were identified by AECOM in the Summary Report (AECOM 2009b). The routes discussed in the Summary Report are summarized in the following sections.

Primary groundwater and soil to surface water pathways and routes of exposure are being investigated as a key component and data gap of the RI/FS. Secondary pathways, such as surface water to sediments, will be evaluated and discussed in greater detail following completion of the Stormwater Investigation Interim Action, as described in Section 5.0 and the Remedial Investigation Supplemental Site Investigation, as described in Section 8.0. Data from these investigations will inform the evaluation of the potential exposure routes resulting from ongoing contaminant migration from the Site, which may include evaluation of impacts to off-site receptors such as surface water, or sediments in Lora Lake. Section 8.7 discusses the potential for secondary pathway evaluation in greater detail. These investigations, in combination with the investigation described in this Work Plan, will provide sufficient data to evaluate potential ongoing off-site pathways from the Site.

7.1.2.1 Primary Transport Pathways

Contaminants in soil and groundwater at the Site have the potential to migrate through natural mechanisms that may result in exposure to human and ecological receptors. The primary migration pathways consist of the following:

- **Soil to Groundwater.** Historical releases of contamination to the ground surface or to the subsurface during historical site operations can present a continued release, or leaching, of contaminants entrained in soil to the groundwater table. The existing site data indicate that this has occurred and may continue to occur in the vicinity of former site operations (MW-1) and other impacted areas, such as MW-6 for diesel range and heavy oil range hydrocarbons in the northeast corner and MW-5 for PCP. The soil to groundwater pathway will be fully evaluated in the RI/FS.
- **Groundwater to Surface Water.** Lora Lake is located to the southeast of the Site, across Des Moines Memorial Drive. Contaminated groundwater in the shallow water table beneath the Site has the potential to migrate through

groundwater flow. Previous groundwater sampling conducted in monitoring wells along the property line and downgradient from the Site, across Des Moines Memorial Drive between the Site and Lora Lake indicates groundwater contamination at the site boundary, but not in monitoring wells east of Des Moines Memorial Drive, between the Site and Lora Lake. Additional data collection, as described in this Work Plan, will provide a comprehensive seasonal evaluation of groundwater quality conditions at the Site and in downgradient wells between the Site and Lora Lake. The groundwater to surface water pathway will be fully evaluated in the RI/FS.

- **Stormwater to Surface Water.** Stormwater at the Site flows into a large City of Burien municipal storm drainage system that enters the Site from the west (upgradient) and collects runoff from Des Moines Memorial Drive after leaving the Site on the east, before discharging to Lora Lake. Insufficient data are currently available to evaluate this migration pathway; therefore, a Stormwater Investigation Interim Action, being conducted between the winter of 2009 and the spring of 2010, will enable evaluation of the stormwater to surface water pathway in the RI/FS. The stormwater system that collects surface runoff from the Site also collects substantial inputs from the surrounding residential neighborhoods, roadways, and major arterials—including Des Moines Memorial Drive and SR518. Stormwater discharged from the outfall in Lora Lake is commingled with these other sources; inputs from the Site represent a subset of the discharge volume. Section 5.0 discusses the existing storm drainage system and the plan for data collection during the interim action process.

7.1.2.2 Secondary Transport Pathways

Secondary migration pathways, or pathways that include transport of contamination through multiple individual pathways, will be evaluated in the RI/FS following completion of data collection described in this Work Plan and the Stormwater Investigation Interim Action. Secondary pathways at this Site may consist of surface soil to surface water via transport of surface soils through the storm drainage system, or groundwater to sediments through groundwater to surface water partitioning to sediments. Insufficient data are available to evaluate these pathways at the current time, and will be fully evaluated in the RI/FS.

7.1.2.3 Potential Receptors and Routes of Exposure

Potential receptors to contamination in soil and groundwater at the Site include both human and ecological receptors. The Site is currently vacant and fenced; however, human access to the Site is not completely restricted. Potential receptors include trespassers, site workers, and future site operators. The RI/FS will evaluate potential receptors and routes of exposure based on future site use, as well as existing conditions.

An evaluation of Lora Lake may be conducted if the additional data regarding contaminant migration collected as part of the Stormwater Investigation Interim Action and this Work Plan indicate potential ongoing contaminant migration to Lora Lake.

The potential routes of human exposure to contaminated soil and groundwater at the Site consist of direct contact with soils or groundwater, incidental ingestion of soils or groundwater, or inhalation of soil particles or contaminant vapors. Control of these exposure routes will be evaluated in the RI/FS, and will be included in the development of remedial actions for the Site.

The potential routes of ecological exposure to contaminated soil and groundwater at the Site currently consist of ingestion and inhalation of contaminated soil and groundwater. A preliminary TEE was conducted by AECOM as part of the Summary Report, and will be updated as part of the RI/FS. The initial TEE indicated that the Site does not provide significant ecological habitat, and due to the proposed future land use and the exclusion criteria in MTCA (WAC 173-340-7491), no further ecological assessment is necessary (AECOM 2009b). However, since the redevelopment plan is currently unknown, the TEE process will be re-evaluated and summarized in the RI/FS to evaluate if there will be significant ecological habitat once development plans are available. Future site redevelopment must comply with FAA regulation AC/150 5300-13 (USDOT FAA 1989) for the portions of the Site that fall within the runway protection zone (Figure 2.3). This regulation states that future site uses within these areas must not attract wildlife.

7.1.3 Soil Vapor

In April of 2008, AECOM conducted a sub-slab vapor evaluation, collecting samples from beneath the slabs of eight on-site buildings, including the Recreation Center building. Figure 4.2 presents the vapor sample collection locations. Of the eight samples collected, quality assurance data indicated leaks in the sampling apparatus for three of the eight samples. These samples were determined not to be representative of sub-slab conditions. The remaining five samples were compared to USEPA guidance for screening level concentrations of shallow soil vapor concentrations protective of indoor air quality, assuming an attenuation factor of 0.1 between soil gas and indoor air (AECOM 2009b). Of the analytes tested, none of the samples contained concentrations of VOCs greater than the USEPA screening values. However, AECOM vapor samples were not analyzed for benzene, TCE, and 1,2-DCA, which are contaminants now known to be present at the Site. The RI/FS will therefore evaluate the potential for benzene, TCE, and 1,2-DCA vapor migration. Existing soil data and additional soil and groundwater testing proposed under this Work Plan will provide sufficient data to conduct a conceptual screening of vapor intrusion potential.

7.2 CONTAMINANTS OF CONCERN

Previous investigations at the Site analyzed a number of soil and groundwater samples for a range of contaminants. Results from these events were used to determine COCs for the Site, as well as to determine a preliminary CSM, and begin to evaluate the nature and extent of contaminated media at the Site. COC PQLs associated with the analytical methods to be used during the Remedial Investigation Supplemental Site Investigation are presented in the QAPP (Appendix B). Laboratory methods were chosen to ensure that the PQLs will be less than the future site cleanup levels so that no data evaluation issues arise during cleanup level development in the RI/FS.

The following sections describe the analytical testing conducted during the two previous environmental site investigations (AECOM 2009a and GeoScience Management 2008) and the resulting COC identification for site soils and groundwater. Table 7.1 presents the analytes tested in each media during the previous investigations. Boring and monitoring well locations from these previous investigations are shown in Figure 4.1. The previous site investigations established site screening levels as the more stringent of MTCA cleanup levels (Method A or B), based on protection of human health via direct contact with soils and potential consumption of groundwater. References to these investigation-specific screening levels are described in Section 4.1 and associated numerical values are provided in the Appendix C data tables.

The 2007 GeoScience Management investigation focused on the area of the Site adjacent to the former Lora Lake Apartments Recreation Center building. This area was the location of a former concrete waste pit associated with barrel washing, and a concrete sump during historical site operations. GeoScience Management installed nine Geoprobe borings in the vicinity of the recreation building, and collected soil and groundwater samples for laboratory analytical testing. One boring location was completed as Monitoring Well MW-1. Two groundwater sampling events were conducted at MW-1 in November and December of 2007.

In 2008, AECOM conducted a soil, groundwater, and vapor investigation, and a supplemental groundwater investigation. That work consisted of installing Monitoring Wells MW-2 through MW-11, and collecting soil samples from the monitoring well borings and seven additional boring locations. The vapor sampling is discussed in Section 7.1.3 above. The soil investigation was conducted site-wide, and included installation of off-site downgradient monitoring wells, located along the east side of Des Moines Memorial Drive, between the Site and Lora Lake. A total of three groundwater monitoring events were conducted between March and December 2008. The results of these investigations are summarized in the following sections.

7.2.1 Carcinogenic Polycyclic Aromatic Hydrocarbons[2]

Both the GeoScience Management and AECOM investigations evaluated cPAH concentrations in the context of TEQs (WAC 173-340-708(8)(e)). In both investigations, the calculation of cPAH TEQ concentrations was performed using the Cal-EPA 2005 TEFs (Cal-EPA 2005), as presented in Table 708-2 of WAC 173-340-900.

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[2] The term “cPAHs” in the context of this Work Plan, includes the group of seven cPAHs presented in Table 708-2 of WAC 173-340-900 (WSDOE 2007b).

As part of the 2007 GeoScience Management investigation, the following samples were analyzed for cPAHs and other SVOCs with USEPA Method 8270D-Select Ion Monitoring (SIM) for low-level analyses:

- Soil samples from two soil borings (LLP-4 and LLP-5) and from two depths during the installation of MW-1 (7 and 14 feet bgs).
- Groundwater samples from four borings (LLP-4, LLP-5, LLP-8, and LLP-9) and from MW-1.

The TEQ concentrations for cPAHs in soil samples exceeded the GeoScience Management LLA screening level of 0.137 mg/kg in samples collected from LLP-4 and MW-1, with a maximum detected TEQ concentration of 0.76 mg/kg in LLP-4. The TEQ concentrations for cPAHs in groundwater samples exceeded the GeoScience Management LLA screening level of 0.012 µg/L in samples collected from LLP-4, LLP-5, and MW-1, with a maximum detected TEQ concentration of 0.407 µg/L in MW-1.

During the AECOM 2008 groundwater investigation (with monitoring events in March, August, and December) groundwater samples collected from on-site and downgradient wells in March and August were analyzed for cPAHs using USEPA Method 8270C (in March) and USEPA Method 8270-SIM low-level analyses (in August). In the March monitoring event, cPAHs were detected in on-site Wells MW-1, MW-2, MW-3, MW-4 and MW-5; however, the method reporting limit was greater than the AECOM LLA screening level. The highest TEQ concentration in a groundwater sample from MW-1 was 1.0 µg/L, which is greater than the AECOM LLA screening level of 0.012 µg/L. The March monitoring results indicated exceedances of the AECOM LLA screening level in all monitoring wells with the exception of MW-6. However, all results were J-flagged (estimated) because the method reporting limit for USEPA Method 8270 exceeded the AECOM LLA screening level. In the August monitoring event, the individual cPAHs were not detected at concentrations greater than reporting limits (0.016 µg/L) in any of the samples and were therefore not evaluated using toxicity equivalencies (WAC 173-340-708(8)(e)). Use of the USEPA Method 8270D-SIM during the August sampling event provided data with a lower reporting limit closer to the AECOM LLA screening level, which were not J-flagged, and therefore are a more reliable indicator of actual concentrations.

These results, as well as the hydrophobic nature of cPAHs (or natural resistance to dissolving in water), suggest that groundwater impacts from cPAHs were limited to the area near the Recreation Center building in the historical source area. Samples from the December 2008 monitoring event were not analyzed for cPAHs.

As part of the AECOM 2008 soil investigation and installation of monitoring wells, soils were analyzed for cPAHs using USEPA Method 8270. The TEQ concentrations for cPAHs slightly exceeded the AECOM LLA screening level of 137 µg/kg in the following samples:

- MW-4 and MW-5 surface soil samples (0 to 0.5 foot).

- MW-5 soil sample collected from 11.5 to 13 feet.
- LL-08 soil sample collected from 2 to 4 feet.

The range of cPAH TEQ concentrations that exceeded the AECOM LLA screening level was 144 to 243 µg/kg.

The cPAH TEQ concentrations presented in the AECOM investigation reports were calculated assuming one-half of the method reporting limit for non-detected compounds. The approach of assuming one-half of the method reporting limit for non-detected compounds or setting non-detect compounds to zero for the calculation of cPAH and dioxin TEQ concentrations will be important in the evaluating the Remedial Investigation Supplemental Site Investigation data. Since the future site-specific cleanup levels may be near the method reporting limits, the assumption of non-detect compounds being equal to one-half of the method reporting limit may result in slight exceedances of the cleanup levels, which could artificially increase the extent of cPAH contamination and cleanup of the Site. The proposed method for TEQ calculation in the RI/FS is discussed in Section 8.0.

Therefore, based on previous site investigations, cPAHs are retained as site COCs for additional characterization in soil and groundwater as part of the Remedial Investigation Supplemental Investigation field activities (Section 8.0).

7.2.2 Dioxins[3]

Both the GeoScience Management and AECOM calculation of dioxin TEQ concentrations were performed using the World Health Organization 2005 TEFs (van den Berg et al. 2006), as presented in Table 708-1 of WAC 173-340-900.

During the 2007 GeoScience Management investigation, the following samples were analyzed for dioxins using USEPA Method 8290: soil samples collected from the installation of MW-1 at two depths (7 feet bgs and 14 feet bgs) and a groundwater sample collected from MW-1. The detected dioxin TEQ concentrations in both soil samples from MW-1 (1,290 ng/kg and 302 ng/kg) exceeded the GeoScience Management LLA screening level of 11 ng/kg. The MW-1 groundwater sample dioxin TEQ concentration of 105 pg/L also exceeded the groundwater GeoScience Management LLA screening level of 5.83 pg/L.

During the AECOM 2008 groundwater investigation, with monitoring events in March, August, and December, dioxins were analyzed for in groundwater samples collected from on-site and downgradient wells during all three monitoring events using USEPA Method 8290. In the AECOM Summary Report, the modified MTCA Method B (carcinogenic) cleanup level of 5.83 pg/L was used for the AECOM LLA screening level

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[3] The term “dioxins” in the context of this Work Plan, includes the group of 17 chlorinated dibenzo-p-dioxins and dibenzofurans congeners as presented in Table 708-1 of WAC 173-340-900 (WSDOE 2007b).

(AECOM 2009b). WSDOE does not have a standard MTCA Method B groundwater cleanup level for dioxins, but the regulations (WAC-173-340-720(3)(b)) stipulate that the groundwater cleanup level should defer to the maximum contaminant level for the most toxic congener (2,3,7,8-tetrachlorodibenzo-p-dioxin) that is protective of human health via consumption of site groundwater without exceeding the acceptable cancer risk level of 10^{-5} (WSDOE 2005 and 2007b). The maximum contaminant level for dioxins in groundwater is 30 pg/L, which is higher than the modified MTCA Method B dioxin groundwater cleanup level calculated using MTCA Equation 720-2 (with a risk level of 10^{-5}). Therefore, the modified MTCA Method B dioxin groundwater cleanup level of 5.83 pg/L was used as the dioxin groundwater screening level in the previous AECOM environmental investigations and is used below in the summary of dioxin data collected by AECOM.

Dioxin TEQ detected concentrations exceeded the AECOM LLA screening level of 5.83 pg/L in two wells, MW-1 and MW-10. The highest dioxin TEQ concentration in groundwater (234 pg/L) was detected in the groundwater sample collected from MW-1. During the August 2008 groundwater monitoring event, dioxins exceeded the AECOM LLA screening level in MW-10; however, subsequent monitoring in December 2008 resulted in a dioxin TEQ concentration of 0.32 pg/L, less than the AECOM LLA screening level and there were no other groundwater samples that exceeded the AECOM LLA screening level. Additionally, many of the congeners detected in the MW-10 groundwater sample were U-flagged (undetected) during data validation due the fact there was contamination in the method blank. These results, as well as the hydrophobic nature of dioxins (or natural resistance to dissolving in water), suggest that groundwater impacts from dioxins were limited to the area near the Recreation Center building and within the historical source area where contaminated soils were previously excavated. However, dioxins in groundwater are retained as a site COC and will be analyzed for as part of the Remedial Investigation Supplemental Site Investigation to confirm this assumption that dioxin contamination in groundwater is limited to the historical source area in the central portion of the Site.

As part of the AECOM 2008 soil investigation and installation of monitoring wells, soils were analyzed for dioxins using USEPA Method 8290. Dioxins exceeded the AECOM LLA screening level of 11 ng/kg in soil samples collected from 10 locations throughout the Site. The highest TEQs were associated with shallow soil samples from MW-4 and MW-5, along the eastern edge of the Site and from LL-01 and LL-10, near the recreation building in the historical source area where contaminated soils were previously excavated.

The dioxin TEQ concentrations presented in AECOM investigation reports were calculated assuming one-half of the method reporting limit for non-detected compounds. The approach of assuming one-half of the method reporting limit for non-detected compounds or setting non-detect compounds to zero for the calculation of dioxin TEQ concentrations will be important in evaluating the Remedial Investigation Supplemental Site Investigation data. Since the future site-specific cleanup levels may be near the method reporting limits, the assumption of non-detect compounds being equal to one-half of the method reporting limit may result in slight exceedances of the cleanup levels, which could artificially increase the extent of dioxin contamination and cleanup of the Site. The proposed method for TEQ calculation in the RI/FS is discussed in Section 8.0.

Based on previous site investigations, dioxins are retained as site COCs for additional characterization in soil and groundwater as part of the Remedial Investigation Supplemental Site Investigation.

7.2.3 Metals

The 2007 GeoScience Management investigation analyzed two soil samples and four groundwater samples collected from Geoprobe locations for the Resource Conservation and Recovery Act 8 metals list—arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. In addition, two additional soil samples were analyzed for arsenic only. Of the analytes tested, the only exceedance of the GeoScience Management LLA screening levels was arsenic in groundwater from Locations LLP-4 and LLP-9 at 65 µg/L and 8.1 µg/L, respectively. Lead was detected at a concentration of 1.2 µg/L in the groundwater sample collected from Location LLP-4 and is less than the GeoScience Management LLA screening level. All other groundwater results were less than laboratory detection limits. Concentrations of lead, chromium, and barium were detected in soil samples collected from LLP-4 and LLP-5 at concentrations less than the GeoScience Management LLA screening levels. All other soil results were less than the laboratory detection limits.

In 2008, AECOM analyzed a total of 42 soil samples collected from Geoprobe and monitoring well locations for metals, including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, zinc, and mercury. Arsenic and lead were the only metals detected in site soils at concentrations greater than the AECOM LLA screening levels. Arsenic was detected in all samples, and concentrations ranged from 0.89 to 11.2 mg/kg. The AECOM LLA screening level for arsenic was 20 mg/kg. Detected arsenic concentrations were less than the screening level, and within the range of arsenic regional background concentrations. Lead was detected at concentrations greater than the AECOM LLA screening level of 250 mg/kg in three surface soil samples (between 0 and 2 feet bgs) from sample Locations LL-01, MW-4, and MW-5. The detected lead concentrations for these samples ranged from 265 to 370 mg/kg.

Groundwater samples were collected from site monitoring wells during three sampling events in March, August, and December 2008. Metals analyses conducted during each sampling event included the following constituents: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, zinc, and mercury. Monitoring well sampling varied between events, which are described below:

- **March 2008 Event.** Samples from Monitoring Wells MW-1 through MW-6 were analyzed for the metals listed above. Detections of arsenic concentrations ranged from 1.66 μg/L in MW-6 to 10.5 μg/L in MW-1. The sample collected from MW-1 was the only sample to exceed the AECOM LLA screening level of 5 μg/L. Low level detections of other metals were identified in all sampled wells; however, no other detected concentrations exceeded the AECOM LLA screening levels.

- **August 2008 Event.** Samples from Monitoring Wells MW-3, MW-4, MW-5, and MW-8 through MW-11 were analyzed for the metals listed above, plus nickel, selenium, silver, and thallium. Low-level concentrations of antimony, arsenic, and nickel were detected in all wells at concentrations less than the AECOM LLA screening levels.
- **December 2008 Event.** Samples from Monitoring Wells MW-6 and MW-7 were analyzed for the same list of metals as the August 2008 event. Low-level concentrations of all metals except mercury, selenium, and thallium were detected in at least one of the two wells. All concentrations were less than the AECOM LLA screening levels.

Based on the previous site investigations, lead and arsenic are retained as site COCs for additional characterization in soil. Arsenic is also retained as a COC in groundwater due to the exceedances of arsenic in groundwater at MW-1, LLP-4, and LLP-9.

7.2.4 Petroleum Hydrocarbons

7.2.4.1 Diesel Range and Heavy Oil Range Hydrocarbons

A primary focus of the 2007 GeoScience Management investigation was the analysis of diesel range and heavy oil range hydrocarbons by Method NWTPH-Dx in samples taken from the vicinity of the historical site operations and primary source area of site contamination. The following samples were analyzed for diesel range and heavy oil range hydrocarbons:

- Soil samples collected from five soil boring locations and the installation of MW-1.
- Groundwater samples collected from seven soil boring locations and in samples collected from MW-1 during the November and December 2007 sampling events.

In the soil samples collected from Boring LLP-4 and from MW-1 at 14 feet bgs, diesel range and heavy oil range hydrocarbons exceeded the GeoScience Management LLA screening level of 2,000 mg/kg. Heavy oil range hydrocarbons also exceeded this screening level in the shallow soil sample collected from LLP-2.

In groundwater, heavy oil range hydrocarbons exceeded the GeoScience Management LLA screening level of 500 μg/L in groundwater samples collected from Borings LLP-2, LLP-3, LLP-4, LLP-5, LLP-6, and both groundwater samples collected from MW-1.

Diesel range hydrocarbons exceeded the GeoScience Management LLA screening level in groundwater samples collected from Borings LLP-2, LLP-4, LLP-6 and both groundwater samples collected from MW-1.

During the AECOM 2008 soil investigation and installation of monitoring wells, soil samples from all borings were analyzed for diesel range and heavy oil range hydrocarbons using Method NWTPH-Dx. Diesel range and heavy oil range hydrocarbons were either not detected or were detected at low concentrations less than the AECOM LLA screening levels.

During each of the subsequent three groundwater monitoring events, conducted in March, August, and December 2008, diesel range and heavy oil range hydrocarbons were analyzed in groundwater samples collected from various on-site and downgradient wells. During the March 2008 monitoring event, diesel range and heavy oil range hydrocarbons were detected at concentrations exceeding the AECOM LLA screening level of 500 µg/L in Wells MW-1 and MW-6. As suggested in the AECOM Summary Report, the groundwater flow direction and cross gradient location of MW-6 relative to MW-1 indicate that the source of contamination impacting groundwater quality at MW-1 was not the same as the source of contamination impacting groundwater quality at MW-6 (AECOM 2009b). Diesel range and heavy oil range hydrocarbons also exceeded AECOM LLA screening levels in the December 2008 groundwater sample collected from MW-6. Diesel and heavy oil range hydrocarbons did not exceed AECOM LLA screening levels in any other groundwater samples collected from on-site or downgradient wells during the three monitoring events.

Therefore, based on previous site investigations, diesel range and heavy oil range hydrocarbons are retained as site COCs for additional characterization in soil and groundwater as part of the Remedial Investigation Supplemental Site Investigation.

7.2.4.2 Gasoline Range Hydrocarbons

During the 2007 GeoScience Management investigation, the following samples were analyzed for gasoline range hydrocarbons by Method NWTPH-Gx:

- Soil samples collected from Borings LLP-4 and LLP-5.
- Groundwater samples collected from four soil borings (LLP-4, LLP-5, LLP-8, and LLP-9), as well as two samples collected from MW-1.

The soil sample from Boring LLP-4 contained gasoline range hydrocarbons at a concentration of 1,900 mg/kg, exceeding the GeoScience Management LLA screening level of 100 mg/kg. Gasoline range hydrocarbons were not detected in the soil sample from Boring LLP-5.

The groundwater samples from Boring LLP-4 and MW-1 exceeded the groundwater GeoScience Management LLA screening level of 1,000 µg/L.

During the AECOM 2008 soil investigation and installation of monitoring wells, soil samples collected from all borings were analyzed for gasoline range hydrocarbons using method NWTPH-Gx. Gasoline range hydrocarbons were either not detected, or detected at concentrations less than the AECOM LLA screening level. Gasoline range hydrocarbons were analyzed in groundwater during the first March 2008 groundwater monitoring event and were not detected at concentrations greater than the AECOM LLA screening level in any of the groundwater samples collected from the Site. Existing site data indicate that gasoline range hydrocarbon contamination in groundwater is limited to the historical operations source area in the central portion of the Site, and in the vicinity of the former Recreation Center building (MW-1 and LLP-4).

Based on previous site investigations, gasoline range hydrocarbons are retained as site COCs for additional characterization in soil and groundwater as part of the Remedial Investigation Supplemental Site Investigation.

7.2.5 Polychlorinated Biphenyls

The 2007 GeoScience Management investigation analyzed the following samples for PCBs using USEPA Method 8082 from the nine borings advanced in the vicinity of the Recreation Center building and historical source area: soil samples from Borings LLP-4 and LLP-5 and groundwater samples from Borings LLP-4, LLP-5, LLP-8, and LLP-9. PCBs were not detected in the soil samples at a reporting limit of 56 µg/kg, substantially less than the soil direct contact GeoScience Management LLA screening level of 500 µg/kg. PCBs were also not detected in any of the groundwater samples.

As part of the AECOM site soil investigation, PCBs were analyzed in three soil samples collected from Location LL-08, which is positioned within the vicinity of historical site operations and near a former electrical transformer that would likely be the potential primary source of PCBs to the Site. Concentrations of total PCBs (the sum of specific aroclor concentrations) in these samples were less than the AECOM LLA screening level of 500 µg/kg.

Since PCBs were not detected in soil or groundwater in the GeoScience Management investigation, and were detected in soils at low levels (less than the AECOM LLA screening level) during the AECOM investigation in the area where previous site operations were most likely to be a potential source of PCBs to site soils and groundwater, PCBs are not retained as site COCs.

7.2.6 Semivolatile Organic Compounds

As part of the 2007 GeoScience Management investigation, the following samples were analyzed for SVOCs (PAHs, cPAHs, and miscellaneous SVOCs) by Method 8270-SIM for low-level analyses:

- Soil samples from two soil borings (LLP-4 and LLP-5) and from two depths (7 and 14 feet bgs) during the installation of MW-1.
- Groundwater samples from four borings (LLP-4, LLP-5, LLP-8, and LLP-9) and collected from MW-1 in November and December 2007.

All SVOC concentrations in soil and groundwater were less than the GeoScience Management LLA screening levels, with the exception of PCP that was detected in a groundwater sample collected from Boring LLP-4 (at a concentration of 120 µg/L) and Well MW-1 (at a concentration of 150 µg/L), exceeding the GeoScience Management LLA screening level of 0.73 µg/L. BEHP was detected at a concentration of 14 µg/L in the November 2007 groundwater sample collected from MW-1, slightly exceeding the GeoScience Management LLA screening level of 6.3 µg/L. Naphthalene was detected at a concentration of 7.9 mg/kg in the soil sample collected from LLP-4 at a depth of 14.5 feet bgs, slightly exceeding the GeoScience Management LLA screening level of 5 mg/kg. Neither BEHP nor naphthalene were detected at levels greater than or equal to the GeoScience Management LLA screening levels in other soil or groundwater samples collected from the Site.

During the AECOM 2008 groundwater investigation, with monitoring events in March, August, and December 2008, PCP was the only SVOC (excluding cPAHs, as discussed in Section 7.2.1) detected at concentrations exceeding the AECOM LLA screening level in on-site and downgradient monitoring wells. In the March 2008 monitoring event, PCP was detected in Monitoring Wells MW-1 and MW-5 at concentrations greater than the AECOM LLA screening level of 0.73 µg/L. PCP was not detected at a concentration greater than the method reporting limit in the other on-site analyzed wells (MW-2, MW-3, MW-4, and MW-6). However, the reporting limit in the other wells was greater than the AECOM LLA screening level, so the presence or absence of PCP greater than this level could not be definitively determined in those wells. In the August 2008 monitoring event, PCP was detected at a concentration of 1.5 µg/L in MW-5. This was the only sample to exceed the AECOM LLA screening level and is consistent with the data collected during the initial investigation in which PCP was reported in MW-5 at a concentration of 1.0 µg/L. PCP concentrations were not detected greater than the method reporting limit of 0.5 µg/L in any other samples. In the December 2008 monitoring event, PCP was not detected at concentrations exceeding the AECOM LLA screening level, and samples were analyzed using USEPA Method 8151 rather than USEPA Method 8270, which achieved reporting limits less than the AECOM LLA screening level.

As part of the AECOM 2008 soil investigation and installation of monitoring wells, soils were analyzed for SVOCs using USEPA Method 8270. The majority of SVOCs (PAHs and miscellaneous SVOCs) were not detected, or detected at low levels. All detected SVOC concentrations were less than the AECOM LLA screening levels, with the exception of PCP and cPAHs. PCP was detected at a concentration that exceeded the AECOM LLA screening level in one soil sample. The surface soil sample collected from

MW-4 contained concentrations of PCP at 15,000 µg/kg, greater than the AECOM LLA screening level of 8,300 µg/kg.

Therefore, based on previous site investigations, PAHs (not including cPAHs, which are discussed separately in Section 7.2.1) and other miscellaneous SVOCs are not retained as site COCs. However, PCP is retained as a site COC for additional characterization in soil and groundwater as part of the Remedial Investigation Supplemental Site Investigation.

7.2.7 Volatile Organic Compounds

As part of the 2007 GeoScience Management investigation, the following samples were analyzed for VOCs using USEPA Method 8260B: soil samples from two soil borings, groundwater samples from the same four borings analyzed for PCBs, and groundwater samples collected from MW-1.

All VOCs, including BTEX, PCE, TCE, and 1,2-DCA were primarily not detected in soil and groundwater samples or were detected at low concentrations, less than GeoScience Management LLA screening levels. The only exception was a detection of xylene from Boring LLP-4 at a depth of 14.5 feet bgs with a concentration of 12.5 mg/kg, slightly greater than the GeoScience Management LLA screening level of 9 mg/kg.

As part of the AECOM soil and groundwater investigations, soil and groundwater samples were analyzed for various VOCs using USEPA Method 8260B (AECOM 2009b). Soil samples were analyzed for BTEX. In the AECOM Summary Report, the incorrect AECOM LLA screening level, which was the MTCA Method A benzene soil cleanup level, was presented as 0.03 µg/kg, rather than 30 µg/kg (AECOM 2009b). Therefore, the detected concentrations of benzene in site soil samples do not exceed the AECOM LLA screening level. All VOCs analyzed for in site soil and groundwater samples were not detected or were detected at low concentrations, less than AECOM LLA screening levels. However, PCE, TCE, and 1,2-DCA were not analyzed for in soil samples.

PCE and TCE were detected in one groundwater sample collected from MW-1 at concentrations (0.23 and 0.17 µg/L, respectively) that slightly exceed the AECOM LLA screening levels of 0.08 and 0.11 µg/L, respectively. However, the AECOM LLA screening level, which was the MTCA Method B cleanup level for PCE, was recently revised to 0.49 µg/L from 0.11 µg/L as used in the evaluation of the AECOM data. Therefore, the detected TCE concentration from MW-1 does not exceed the current MTCA Method B cleanup level. PCE, TCE, and 1,2-DCA are also identified in the Lora Lake Apartments Agreed Order as site COCs. PCE was previously detected in two 1987 excavation conformational soil samples (Golder 1987).

Therefore, PCE, TCE, and 1,2-DCA are retained as site COCs for additional characterization in soil and groundwater during the Remedial Investigation Supplemental Site Investigation.

BTEX compounds are not retained as site COCs, but site soil and groundwater samples will be analyzed for BTEX to determine the appropriate gasoline range hydrocarbon cleanup level, as it is dependent on the presence of benzene in impacted media.

7.2.8 Summary of Compounds Retained as Site Contaminants of Concern

Based on the review of the existing site soil and groundwater data, as described in detail above, and in Section 4.0, the following compounds are retained as site COCs for additional characterization in the Remedial Investigation Supplemental Site Investigation:

- cPAHs in soil and groundwater
- Dioxins in soil and groundwater
- Arsenic in soil and groundwater
- Lead in soil
- Diesel range and heavy oil range hydrocarbons in soil and groundwater
- Gasoline range hydrocarbons in soil and groundwater
- PCP in soil and groundwater
- VOCs (PCE, TCE, 1,2-2DCA) in soil and groundwater

Soil and groundwater samples collected as part of the Remedial Investigation Supplemental Site Investigation will also be analyzed for BTEX to determine the appropriate gasoline range hydrocarbon cleanup level in the RI/FS. The proposed Remedial Investigation Supplemental Site Investigation is presented in Section 8.0. Laboratory analytical methods are discussed in the SAP/QAPP (Appendix B).

7.3 DATA GAPS

Multiple data gaps have been identified through previous site investigations, and will be addressed through the investigation activities described in this Work Plan, and the Interim Actions described in Section 5.0. Collection of sufficient data to close the existing data gaps will allow for development of a final CSM, and completion of the RI/FS. The existing data gaps are related to determining the nature and extent of contamination in soils and groundwater at the Site, and site-specific information regarding soil and groundwater characteristics, such as hydraulic conductivity. In addition, data gaps regarding the quality of stormwater discharging from the Site are discussed and are being addressed by the Stormwater Investigation Interim Action described in Section 5.0. The data gaps described below are consistent with those presented by AECOM in the Summary Report, with the addition of stormwater quality. Section 8.0 describes the proposed plan for data collection and addressing the data gaps discussed below.

7.3.1 Stormwater Quality

Stormwater quality at the Site will be investigated by the interim action described in Section 5.0. Evaluation of the storm system is being conducted as a part of the interim action, and will inform the RI/FS for the Site, and may also inform future actions and investigation at the Lora Lake Property, located to the southeast of the Site. The objective of the Stormwater Investigation Interim Action is to evaluate the potential for contaminant migration via drainage of stormwater through the existing site stormwater conveyance system and discharge to off-site receptors, including Lora Lake. Data gaps relative to the storm drainage system will be addressed, as necessary, outside the scope of this Work Plan through the interim action described in Section 5.0. A final stormwater data report will be prepared following completion of the required interim action monitoring and sampling activities. The final report will be included as an appendix to the Lora Lake Apartments RI/FS Report and the investigation data will be used to assess the stormwater transport pathway in the RI/FS.

7.3.2 Shallow Soil Dioxin Extent

Dioxin concentrations exceeding the typical urban background levels have been identified in shallow surface soils throughout the majority of the Site (WSDOE 2007a). The distribution of this contamination in surface soils is assumed to be associated with historical operations at the Site, and regrading activities conducted during construction of the apartment complex that may have reworked the contaminated soils across a larger footprint of the Site. Previous testing has identified the general extent of dioxin contamination in surface soils; however, additional data are required to adequately bound the lateral and vertical extents of contamination across the Site. The specific data gaps relative to dioxin contamination in shallow soils are presented below:

- The lateral extents of dioxin soil contamination along the west, south, and east property boundaries, and north side of the on-site area impacted by dioxins.
- The vertical extents of dioxin soil contamination across the on-site area impacted by dioxins.

There are sufficient data from previous investigations to determine that there is no dioxin contamination in shallow soils in the southern corner of the Site near Monitoring Well MW-3, and the northeastern corner near Boring LL-09 and Well MW-6.

7.3.3 Central and Eastern Source Area Extents

The central and eastern contaminated areas of the Site, including the former Recreation Center building where historical operations were known to involve barrel washing and auto wrecking activities, are considered to be a source area of contamination to both soil and groundwater. It is suspected that regrading activities conducted during apartment building construction reworked contamination around the Site, and may be responsible for extending the area of impacted soils towards the eastern property boundary. Previous investigations identified dioxin, petroleum hydrocarbons, PCP, lead, and cPAHs in soils in the central and eastern source areas, as well as petroleum hydrocarbons, arsenic, dioxin, cPAHs, and PCP in groundwater in these same areas. The specific data gaps relative to soil and groundwater contamination in the central and eastern source areas of the Site are described below:

- The lateral extents of petroleum hydrocarbons, arsenic, cPAHs, and dioxin contamination in groundwater surrounding and downgradient of Monitoring Well MW-1.
- The lateral extents of PCP in groundwater currently generally bounded by Monitoring Wells MW-1 and MW-5 along the eastern property boundary.
- The lateral extents of petroleum hydrocarbon contamination in soils in the upgradient vicinity of Monitoring Well MW-1.
- The lateral extents of PCP in soils in the vicinity of Monitoring Well MW-4, and along the eastern property boundary.
- The lateral extents of lead and cPAH contamination in soils in the vicinity of Monitoring Wells MW-4 and MW-5 along the eastern property boundary.
- The vertical extents of contamination in soils throughout the central and eastern source areas.

Additional data collection will allow for delineation and evaluation of soil and groundwater contamination in the central and eastern source areas. Existing data provide a strong base of information relative to existing conditions, but do not fully define the nature and extent of soil and groundwater contamination throughout these areas.

7.3.4 Northeast Corner Petroleum Hydrocarbon Extents

The northeast corner of the Site has a land use history that varies from that of the larger Site. This area of the property housed multiple single-family residences during the operation of the barrel washing facility and the auto wrecking yard. This area of the Site was generally not used for industrial operations and has a different contaminant signature than the rest of the Site. Given the past use of the northeast corner, there is a potential for contamination from a former heating oil, or private fueling tank, or underground storage tank. Off-site migration of contamination is also a potential source, and will be evaluated by this investigation. During installation of Monitoring Well MW-6, along the eastern property line in the northeast corner of the Site, field indications of petroleum contamination were noted near the water table.

Soil samples collected from the groundwater table interface contained only low-level concentrations of diesel range hydrocarbons at 56 mg/kg. The AECOM LLA screening level and the MTCA Method A cleanup level for diesel range hydrocarbons is 2,000 mg/kg. Additionally, heavy oil range hydrocarbons were detected in soils collected at the ground surface in MW-6 at concentrations significantly less than the AECOM LLA screening level. Groundwater monitoring events conducted as part of the 2008 AECOM investigation encountered concentrations of diesel range hydrocarbons in groundwater greater than the AECOM LLA screening level of 500 µg/L. The specific data gaps relative to groundwater quality and potential soil sources of petroleum contamination to groundwater in the northeast corner are described below:

- The lateral extents of groundwater contamination surrounding Monitoring Well MW-6.
- The upgradient soil sources to groundwater contamination in Monitoring Well MW-6.
- The lateral and vertical extents of any identified soil sources to groundwater quality.
- The soil and groundwater quality conditions upgradient of Monitoring Well MW-6, at the site boundary to identify the potential for on-site migration of contaminants from an off-site source.

Following data collection in the northeast corner, additional investigations may be necessary to pinpoint an on-site source of contamination to groundwater, if data indicate diesel range hydrocarbons in Monitoring Well MW-6 are related to an on-site source.

7.3.5 Site-wide Groundwater Quality and Hydraulic Conductivity

The monitoring well network at the Site was installed in 2008, with the exception of MW-1, which as installed in fall 2007. Groundwater monitoring has been conducted at various combinations of monitoring wells during three sampling events completed by AECOM. A site-wide, comprehensive data set for groundwater quality has not yet been generated, and is a current data gap. The validity of existing data due to suspended solids in samples, laboratory quality control issues, and limited analytical data on a well-by-well basis, are all factors that result in the determination that general groundwater quality is an existing data gap. In addition, detections of contamination in off-site monitoring wells have not been fully confirmed or rejected with additional data collection. An elevated level of dioxin was detected in Monitoring Well MW-10 in August 2008. The well was resampled in December 2008, and the detected dioxin TEQ concentration did not exceed the AECOM LLA screening level and there were no other groundwater samples that exceeded the screening level. Additionally, many of the congeners detected in the August 2008 MW-10 groundwater sample were U-flagged (undetected) during data validation due the fact there was contamination in the dioxin analysis method blank.

In addition to the chemical quality of groundwater, site-specific data have not been collected to evaluate hydrogeologic properties of the subsurface soils present at the Site. Hydraulic conductivity will inform future site evaluations as it will provide site-specific information that could be used in fate and transport modeling and contaminant migration evaluations, if necessary. The site-wide groundwater quality data gaps are presented below:

- Seasonal groundwater quality conditions in all site wells.
- Identification of the absence or presence of COCs in on-site and off-site monitoring wells (especially MW-10).
- Hydraulic conductivity of the subsurface site soils at the groundwater table.

With the completion of the scope of work described in this Work Plan, sufficient data will be available for evaluation and closure of the data gaps described above.

8.0 Proposed Remedial Investigation Supplemental Site Investigation

As described in the previous section, a number of data gaps remain that must be investigated prior to completing the RI/FS. Field investigation and data collection activities will be conducted as part of the remedial investigation at the Site to provide sufficient additional information to address the identified data gaps. Soil and groundwater investigations will be conducted to more adequately define the nature and extent of contamination at the Site. The following sections describe proposed investigation activities to be conducted as part of the Remedial Investigation Supplemental Site Investigation, grouped by contaminant type and physical location.

8.1 REMEDIAL INVESTIGATION SUPPLEMENTAL SITE INVESTIGATION OVERVIEW

Field activities described below will be conducted in coordinated field efforts and will consist of soil boring installation, groundwater monitoring well construction, monitoring well development, groundwater sampling, hydraulic conductivity testing, and bioassay sediment sample collection from Lora Lake. The proposed schedule for completion of these field events is summarized in the schedule table provided in Section 9.3. Data collected during this investigation, combined with data collected during previous site investigations, will be used to develop the RAOs for the Site that will be presented in the RI/FS. The scope of this Work Plan has been developed to provide all necessary data for completion of the RI/FS document; however, additional phases of data collection may be required to complete the RI/FS should the results of the planned data collection identify data gaps that should be filled to develop a satisfactory remedial action. Data collection also may be required during the design process to inform design of the selected remedial action.

The Remedial Investigation Supplemental Site Investigation sampling efforts will include a Shallow Soil Dioxin Investigation, a Central and Eastern Source Area Soil Investigation, a Northeast Corner Petroleum Soil and Groundwater Investigation, and a Lora Lake Bioassay Testing Program. The specific scope of field activities will include installation of 37 soil borings, installation of 3 new groundwater monitoring wells (in addition to the 11 monitoring wells already on-site), completion of 3 rounds of groundwater quality monitoring, completion of hydraulic conductivity slug tests, and collection of surface sediment samples from 4 locations within Lora Lake for bioassay testing. The boring, well, and sediment sampling locations are shown on Figures 8.1 through 8.3. A summary of all proposed chemical analyses at these exploration locations (with the exception of the sediment samples in Lora Lake) is presented in Table 8.1. The number of samples to be collected for each event is presented below:

- A total of 88 soil samples will be collected during installation of the borings and monitoring wells for immediate analysis of site COCs.

- An additional 81 soil samples will be collected and immediately archived for potential future dioxin analysis, using a tiered analysis approach.
- A total of 42 groundwater samples will be collected over a period of 3 quarterly monitoring events to evaluate on-site and off-site groundwater quality.
- Surface sediment samples will be collected from four locations within Lora Lake for bioassay testing.

These sampling efforts will be conducted in several contaminant source areas throughout the Site, and within the vicinity of Lora Lake, as described in Sections 8.2 through 8.7. Details regarding the tiered approach for dioxin analysis of archived soil samples are also provided in the following sections. Each soil sample collected during the Remedial Investigation Supplemental Site Investigation will be field screened to identify potentially contaminated depth intervals using a photoionization detector, visual and olfactory indications of contamination, and sheen testing. Soil from borings and well installations will be photographed and documented on a geologic log form and will be described and classified according to the United Soil Classification System. The sampling methods and procedures to be used during field activities are described in further detail in the Sampling and Analysis Plan (Appendix B). The analytical program for the Remedial Investigation Supplemental Site Investigation is summarized in Table 8.1. The table outlines the analytes to be tested in each investigation area and the specific sampling intervals to be analyzed (and archived) for the various data collection objectives summarized in the following sections.

WAC 173-340-740(7)(f) specifies procedures to be followed when measured chemical concentrations are less than the PQL. Consistent with that regulation's specified procedures and opportunity for alternates, dioxin and cPAH TEQ concentrations for samples collected during the Remedial Investigation Supplemental Site Investigation will be calculated using two methods to substitute quantities for non-detect analytical results (i.e., two censored data set evaluation techniques). The first technique calculates TEQ concentrations by substituting one-half of the method reporting limit for each non-detect value; the second substitutes a value of zero for each non-detect value. As discussed in Sections 7.2.1 and 7.2.2, if the site-specific cleanup levels for dioxins and cPAHs are near the method reporting limits, use of the first approach (substitution of one-half the method reporting limit) may cause the calculated TEQ concentration to exceed a cleanup level due to the arithmetic impact of the substituted congener concentration value, regardless of actual field conditions (i.e., a false-positive report). Using both techniques will assist the Port and WSDOE, during the RI process, to assess the degree to which exceedance of cleanup levels is caused by the values substituted for non-detect data (i.e., the uncertainty in the actual value of congener concentrations that are reported by the laboratory to be less than method reporting limits).

Cleanup levels for the Site will be evaluated in the RI/FS, and are not yet determined for use in this Work Plan. Analytical methods have been selected to achieve the lowest technically possible reporting limits for future evaluation and to compare collected data to the cleanup levels, once they have been determined in the RI/FS. Methods will be selected to provide the lowest possible reporting limits or PQLs, such as use of SIM and low-level analyses for cPAHs, PCP, VOCs, and metals.

8.2 SHALLOW SOIL DIOXIN INVESTIGATION

The approximate extents of dioxin contamination in soil, based on existing data, are shown in Figure 8.1. Shallow soils containing levels of dioxin exceeding the AECOM LLA screening level (11 ng/kg) covers the majority of the Site, excluding the northeast corner and southern portion of the property (ENSR|AECOM 2008b). The extent of dioxin exceedances in shallow soil is consistent with the area of the Site previously used for auto wrecking activities and regrading during construction of the Lora Lake Apartments building complex. The northeastern portion of the Site contained single-family residences until the time of apartment construction, and was not known to be associated with either the former barrel washing or auto wrecking activities. Fill has also not been encountered in existing borings installed in the northeast corner, or in the far southern portion of the Site within the vicinity of Monitoring Wells MW-6 and MW-3.

The current CSM, based on physical and chemical site data and historical potential sources of chemical contamination, includes a working hypothesis that dioxin-impacted soil from historical site operations in the central area of the Site was worked into the fill unit and reworked throughout the impacted area of the Site via regrading during apartment construction. Therefore, the absence of dioxin-impacted soils in areas located outside of earthmoving activities and areas without fill materials—mainly the northeast corner, southern portion of the Site, and off-site—is consistent with the current CSM.

Dioxin analysis will be conducted by Frontier Laboratories using USEPA Method 1613 with a holding time of 1 year. Dioxins are typically analyzed using either USEPA Method 8290 or USEPA Method 1613. Both methods are high-resolution gas chromatography/mass spectrometry, with the following primary differences:

- Analyte recovery limits under Method 8290 are predetermined, while the analyte recovery limits under Method 1613 vary with each sample.
- Method 8290 uses fewer internal standards than Method 1613.
- Method 1613 provides a soil PQL of 0.5 to 5 ng/kg (depending on the specific congener and sample variability), which is less than the selected soil screening level of 7 ng/kg, as discussed in Section 3.3.
- The holding time for Method 1613 is 1 year when samples are frozen.

The Shallow Soil Dioxin Investigation will be conducted to collect samples (for dioxin analysis only) at 24 boring locations as shown on Figure 8.1. The scope of this investigation is described as follows:

- A Geoprobe drill rig will be used to install 8 on-site soil borings (PSB-1 through PSB-8) to a maximum depth of 6 feet bgs.
- A hand auger will be used to install 4 on-site archive soil borings (SSB-13 through SSB-16) to a maximum depth of 2 feet bgs
- A hand auger will be used to install 12 off-site archive soil borings (SSB-1 through SSB-12) to a maximum depth of 2 feet bgs.

Soil samples will be collected at specific depth intervals at each boring location, and will either be immediately analyzed for dioxin concentration or archived for potential future dioxin analysis using a tiered analysis approach. Details regarding the sample depth intervals and tiered analysis approach for the Shallow Soil Dioxin Investigation are provided in Sections 8.2.1 and 8.2.2.

In addition to the Shallow Soil Dioxin Investigation borings, 13 additional soil borings and 3 monitoring wells will be installed as part of the Central and Eastern Source Area Investigation and the Northeast Corner Petroleum Investigation. Soil samples will be collected at these boring and monitoring well locations for analysis of all site COCs (including dioxins). Dioxin data collected from samples at these locations will be used, in conjunction with data collected as part of the Shallow Soil Dioxin Investigation, to adequately delineate the extent of dioxin contamination resulting from previous site activities and historical operations at the Site. Details regarding the Central and Eastern Source Area Investigation and Northeast Corner Petroleum Investigation are provided in Sections 8.3 and 8.4, respectively.

8.2.1 Primary and Secondary Soil Boring Installation, Sampling, and Analysis Approach

8.2.1.1 Primary On-site Soil Borings

To further delineate the extent of shallow soil dioxin contamination within the Site boundary, eight primary on-site soil borings (PSB-1 through PSB-8) will be installed to a maximum depth of 6 feet bgs with a Geoprobe rig around the edge of the approximate extent of dioxin contamination, as shown in Figure 8.1. Primary on-site soil borings will be continuously logged and sampled at discrete intervals to obtain geologic information and physical and chemical properties of the soil.

Soil samples will be collected for analytical testing from the following intervals for consistency with previously collected soil data, for characterization of potential exposure scenarios, and to provide a sufficient depth of investigation to bound the vertical extent of dioxin contamination across the Site:

- 0 to 0.5 foot bgs
- 1.5 to 2.0 feet bgs
- 2.0 to 4.0 feet bgs
- 4.0 to 6.0 feet bgs

Dioxin analysis will be conducted immediately on the two uppermost samples from each primary on-site soil boring location (0 to 0.5 foot and 1.5 to 2.0 feet). Samples collected from the two bottom sampling intervals (2.0 to 4.0 feet and 4.0 to 6.0 feet) will be archived.

Archived primary on-site soil boring samples will be analyzed if the dioxin analysis of the overlying soil sample(s) results in concentrations that exceed the dioxin RI/FS soil screening level of 7.0 ng/kg (refer to Section 3.3). First, the 2.0-to-4.0-foot sample will be analyzed. If that test result is greater than the screening level (i.e., does not indicate a dioxin contamination boundary), then the 4.0-to-6.0-foot sample will be analyzed. In the event that the vertical extent of contamination is not bounded by the bottom sample, the boring location will be considered a data gap for potential future analysis during the RI/FS or design phase of the project. The decision to analyze archived on-site primary boring soil samples will be made by the Port, in consultation with WSDOE. Laboratory analysis, for dioxin testing only, will be conducted by Frontier Laboratories, using USEPA Method 1613, which has a 1-year holding time, allowing for implementation of this tiered approach.

8.2.1.2 Secondary On-site Soil Borings

In addition to the eight primary on-site soil borings described above, four secondary on-site soil borings (SSB-13 through SSB-16) will be installed via hand auger during the same investigation effort, at the locations shown on Figure 8.1. All samples collected from these borings will be archived for potential future dioxin analysis. The purpose of these borings is to provide additional sample data that can be used, if necessary, to further define the lateral extent of on-site shallow soil dioxin contamination following analysis of the primary on-site soil boring samples described above.

Samples at the four secondary on-site soil boring locations will be collected at two depth intervals (0 to 0.5 foot and 1.5 to 2.0 feet bgs). These sample depths reflect existing site data and the preliminary CSM, which indicate that dioxin-impacted soil in these areas was spread primarily across the near-surface depth intervals, and that deeper soil dioxin contamination is likely located within the central and eastern areas of the Site. The decision to analyze the secondary on-site boring samples will be made by the Port, in consultation with WSDOE. In the event that the vertical extent of contamination is not bounded by the bottom sample, then the secondary on-site boring location will be considered a data gap for potential future analysis during the RI/FS or design phase of the project.

8.2.2 Secondary Off-site Boring Installation, Sampling, and Analysis Approach

Twelve secondary off-site soil borings will also be installed to assist in the delineation of the lateral extent of shallow soil dioxin contamination. All samples from the secondary off-site borings will be archived for potential future analysis. The following paragraphs discuss sample collection methods and the analysis rationale for these secondary off-site soil borings.

Secondary off-site soil boring locations (SSB-1 through SSB-12) will be installed to the west, southwest, north, and east of the site property boundary, at the locations shown on Figure 8.1, to delineate the lateral extents of shallow dioxin contamination in soils. These borings will be installed using a hand auger during the Shallow Soil Dioxin Investigation field effort.

Samples will be collected at 2 depth intervals (0 to 0.5 feet and 1.5 to 2.0 feet bgs) from 6 of the 12 secondary off-site soil boring locations (SSB-1 through SSB-6), using the same rationale as described in Section 8.2.1. These samples will be stored by the lab pending receipt and evaluation of the dioxin data from the 8 primary on-site shallow soil boring locations (PSB-1 through PSB-8) and, if analyzed, from the four secondary on-site soil boring locations (SSB-13 through SSB-16). The decision to analyze the secondary off-site boring samples will be made by the Port, in consultation with WSDOE, using the dioxin RI/FS soil screening level discussed in Section 3.3. In the event that the vertical extent of contamination is not bounded by the bottom sample in any secondary off-site boring, that secondary off-site boring location will be considered a data gap for potential future analysis during the RI/FS or design phase of the project.

The need for dioxin analysis at the secondary off-site soil borings located at the eastern property boundary of the Site (along Des Moines Memorial Drive; SSB-7 through SSB-12, shown on Figure 8.1) will be evaluated in two phases, as described below.

If results from the primary on-site Central and Eastern Source Area Investigation soil borings installed along the eastern site boundary (PSB-15, PSB-16, PSB-18, as discussed in Section 8.3) do not bound the lateral extents of shallow soil dioxin contamination, the first row of secondary off-site soil boring samples located along the western side of Des Moines Memorial Drive (SSB-7 through SSB-9) will be analyzed. If detected dioxin concentrations from these secondary off-site soil borings exceed the dioxin RI/FS soil screening level of 7.0 ng/kg and do not bound the lateral extents of dioxin in shallow soil, then the second row of secondary off-site soil borings, located along the eastern side of Des Moines Memorial Drive (SSB-10 through SSB-12), will be analyzed for dioxins.

The purpose of these samples is to help define the lateral extent of off-site dioxin contamination, following analysis of the on-site samples described above. Should results of the off-site sample analyses indicate that dioxin impacts are observed in the deeper (1.5-to-2.0-foot) sample, then a data gap will be identified for future consideration in the RI/FS or design phase of the project.

8.3 CENTRAL AND EASTERN SOURCE AREA INVESTIGATION

Soil and groundwater contamination has been identified by previous site investigations in the central and eastern areas of the Site where historical activities are known to have occurred. Soil excavation activities in this central source area were initially conducted by Mueller in 1987, and multiple previous investigations by GeoSciences Management (2007) and AECOM (2008) have also been conducted. However, additional data collection is required to delineate the vertical and lateral extents of known contamination in the vicinity of the former Recreation Center building, and along the eastern site boundary.

For the Central and Eastern Source Area Investigation, 10 primary on-site subsurface Geoprobe borings will be installed to determine the nature and extent of soil contamination in these areas of the Site. Proposed primary soil boring locations (PSB-9 through PSB-18) are presented on Figure 8.1. Borings will be continuously geologically logged and field screened for the presence of contamination. Observations will be documented on field sampling forms. A total of six depth intervals will be sampled for analytical testing at each primary on-site boring location. The sample intervals are presented below:

- 0 to 0.5 foot bgs
- 1.5 to 2.0 feet bgs
- 2.0 to 4.0 feet bgs
- 4.0 to 6.0 feet bgs
- Fill/native soil contact where distinguishable
- Groundwater table

Samples will be collected at each interval listed above and immediately analyzed for cPAHs, PCP, arsenic, lead, petroleum hydrocarbons (diesel range, heavy oil range, and gasoline range), BTEX compounds, and the VOCs—PCE, TCE, and 1,2-DCA. Refer to Section 7.2.7 for a discussion of the select VOCs retained as site COCs. Additional samples may be collected for analysis if field screening and observations indicate the presence of contamination in other boring depth intervals.

Dioxin analyses will also be performed on the soil samples collected as part of the Central and Eastern Source Area Investigation using the following tiered analytical approach:

- Soil samples will be immediately analyzed for dioxins at all six depth intervals at primary on-site boring locations PSB-15 through PSB-17. All soil samples from these borings will be analyzed for dioxins because of the known vertical extent of dioxin contamination at existing monitoring well locations MW-4 and MW-5.

- Soil samples within the top three depth intervals at primary on-site boring locations PSB-9 through PSB-14 and PSB-18 will be immediately analyzed for dioxins, and samples from the bottom three depth intervals will be archived. If detected dioxin concentrations exceed the dioxin RI/FS soil screening level in the 2.0-to-4.0-foot depth interval at any of these boring locations, then the Port (in consultation with WSDOE) will evaluate the need to analyze the next, deeper, archived sample interval. This process will continue until the vertical extent of dioxin contamination has been delineated or until the bottom sample interval is analyzed for dioxin.

Should results of the tiered sample analyses indicate that dioxin impacts are observed in the bottom sample interval at any Central and Eastern Source Area boring location, a data gap will be identified for future consideration in the RI/FS or design phase of the project.

TOC also will be analyzed on samples taken from the bottom two sample intervals listed above. TOC results will assist with any future site-specific groundwater and transport pathway modeling if necessary.

8.4 NORTHEAST CORNER PETROLEUM HYDROCARBON INVESTIGATION

During installation of Monitoring Well MW-6 in the northeast corner of the Site, petroleum hydrocarbon odors were detected in soils and groundwater around the water table (ENSR|AECOM 2008a). Analytical testing identified low concentrations of residual range organics in surface soils (180 mg/kg) and diesel range hydrocarbons in soils at the water table (56 mg/kg)—concentrations that were significantly less than the AECOM LLA screening level of 2,000 mg/kg. Groundwater analytical results from MW-6 indicated both diesel range hydrocarbons and residual range organics at concentrations of 7,300 µg/L and 890 µg/L respectively. These concentrations are both greater than the groundwater AECOM LLA screening levels and the MTCA Method A cleanup level of 500 µg/L.

This northeast area of the Site was developed with residential housing and is considered separate from the former auto wrecking and barrel washing activity areas. Fill has not been encountered in existing borings installed in the northeast corner. The contamination identified in the northeast corner of the Site is discontinuous from the rest of the Site, and it is assumed that the petroleum contamination observed in MW-6 is from a separate source, potentially a residential heating oil or fuel tank, given the land use history, or an unidentified off-site source.

For the Northeast Corner Petroleum Hydrocarbon Investigation, three primary on-site Geoprobe soil borings, and three groundwater monitoring wells will be installed surrounding, and upgradient of MW-6 to identify a potential source of the petroleum hydrocarbons detected in groundwater in this area, and to delineate the lateral extents of groundwater contamination in MW-6. The following sections describe the proposed investigation activities.

8.4.1 Primary On-site Geoprobe Soil Borings

Three primary on-site Geoprobe soil borings (PSB-19 through PSB-21) will be installed at the locations shown on Figure 8.1, based on the rationale described above. These borings will be installed to an approximate depth of 20 feet bgs and will extend past contact with the groundwater table. Soils will be logged and field screened continuously from the ground surface to the bottom of the boring. The fill unit that exists across the majority of the Site is not present in the northeast corner; therefore, analytical soil samples will not be collected at the geologic contact between fill and native soils, as is proposed for the other on-site borings described in Section 8.3, above. Analytical sample collection in the northeast corner primary on-site borings will include the following:

- Sample collection for dioxin analysis from four surface intervals (identical to dioxin sampling described in Section 8.2 for the on-site Shallow Soil Dioxin Investigation) including 0 to 0.5 foot, 1.5 to 2.0 feet, 2.0 to 4.0 feet, and 4.0 to 6.0 feet.

  The tiered analysis approach for dioxin analysis is consistent with the Shallow Soil Dioxin Investigation approach. The top two surface intervals (0 to 0.5 foot and 1.5 to 2.0 feet) will be immediately analyzed, and the bottom two sample intervals (2.0 to 4.0 feet, and 4.0 to 6.0 feet) will be archived for potential future dioxin analysis, pending the dioxin results of the two surface intervals. The dioxin tiered analysis approach is described in Section 8.2.

- Petroleum hydrocarbon samples will be collected from two to four sample intervals based on field screening indications of soil contamination. Sample collection will consist of a minimum of one sample at the groundwater table, and one sample immediately above the water table in the vadose zone for borings with no indication of petroleum hydrocarbons. Field screening will be conducted to identify contamination and to assist with determining sample intervals to be collected for laboratory analysis. Field screening techniques will be conducted using olfactory and visual indications of contamination, photoionization detector readings for VOC concentrations, and sheen testing. If field screening indicates the presence of petroleum hydrocarbons, a third sample will be collected at the location where field screening indicates the highest level of contamination, and a fourth sample will be collected below the water table, in an attempt to bound the vertical extents of petroleum contamination. Petroleum hydrocarbon samples will be analyzed for gasoline range, diesel range, and heavy oil range petroleum hydrocarbons, as well as BTEX compounds.

- The remaining site COCs—cPAHs, PCP, VOCs (PCE, TCE, and 1,2-DCA), arsenic, and lead—will be analyzed in all soil samples collected from six intervals, including the four dioxin sampling intervals listed above (0 to 0.5 foot, 1.5 to 2.0 feet, 2.0 to 4.0 feet, and 4.0 to 6.0 feet). Additionally, the petroleum hydrocarbon sample interval collected at the water table, and one sample below the water table will also be tested for the remaining site COCs.

- If field observations indicate the presence of contamination in other intervals not sampled as part of the program listed above, additional samples from the potentially contaminated area will be collected and analyzed for the site COCs.
- Samples from the bottom three sample intervals collected for the remaining COC analyses listed above will be analyzed for TOC. TOC results will assist with future site-specific groundwater and transport pathway modeling, if determined to be necessary in the RI/FS or design phases of the project. TOC samples will be collected from the intervals directly above the water table, at the contact with the water table, and below the water table.

Although the contaminant signature in the northeast corner appears to differ from that encountered in other areas of the Site, data for all site COCs will be collected to identify the presence or absence of other contaminants and investigate potential sources of the groundwater contamination identified in MW-6.

8.4.2 Monitoring Well Installation

Three monitoring wells (MW-12 through MW-14) will be installed in the northeast corner to further delineate groundwater impacts in the area, provide increased data coverage along the eastern property boundary, and investigate potential sources to groundwater surrounding and upgradient of MW-6 (Figure 8.2). Soil samples will be collected for analytical testing during monitoring well installation, and groundwater monitoring will be conducted following well completion and well development, as discussed in Section 8.5 below. Groundwater monitoring wells will be installed to approximate depths of 20 feet, and will be screened in the same native aquifer and fill unit as the existing site monitoring well network. The proposed monitoring wells will be installed using a HSA drill rig.

During well installation, soil samples will be collected with the HSA rig using a split-spoon sampler. Split-spoon samples will be collected from the HSA every 2.5 feet from the ground surface, to approximately 20 feet bgs for visual observations, field screening, and geotechnical logging.

The following sampling intervals will be collected (at a minimum) from each well location for chemical testing:

- Four depth intervals will be sampled for dioxin analysis. These intervals will match the dioxin sampling intervals described in Section 8.4.1 above, and the Shallow Soil Dioxin Investigation described in Section 8.2. The two uppermost intervals (0 to 0.5 foot and 1.5 to 2.0 feet) will be immediately analyzed from each boring location, and the bottom two intervals (2.0 to 4.0 feet and 4.0 to 6.0 feet) will be archived for potential future dioxin analysis, using the tiered analysis approach described in Section 8.4.1.

- Four intervals will be sampled for all other site COCs—petroleum hydrocarbons and BTEX compounds, VOCs (PCE, TCE, and 1,2-DCA), arsenic, lead, cPAHs, and PCP. Samples will be collected at the groundwater table, in the vadose zone above the groundwater table, and below the water table to bound extents of vertical contamination. A fourth sample will be collected from any interval where field screening identifies soil contamination. Field screening will be conducted according to the methods discussed in Section 8.4.1, above.
- If field observations indicate the presence of contamination in other intervals not sampled as part of the program listed above, additional samples from the potentially contaminated area will be collected and analyzed for the site COCs.

TOC will be analyzed on samples collected at the groundwater table, in the vadose zone above the groundwater table, and below the water table. TOC results will assist in any future site-specific groundwater and transport pathway modeling if necessary.

8.5 SITE-WIDE GROUNDWATER QUALITY INVESTIGATION

Previous groundwater quality testing at the Site consisted of three sampling events in March, August, and December 2008. These events analyzed a variety of on-site and off-site (downgradient) wells for a variety of chemical constituents. Table 7.1 indicates the analytical testing that was performed for the three groundwater sampling events. To provide a comprehensive data set for groundwater COCs across the Site, 3 quarters of groundwater testing will be conducted on all existing wells (including off-site downgradient wells) and new wells that will be installed as part of the Remedial Investigation Supplemental Site Investigation (refer to Section 8.4.2 and Figure 8.2).

Following the monitoring well installation planned for spring 2010, the first of three groundwater sampling events will be conducted. To gather information on groundwater conditions throughout varying seasons, a second sampling event will be conducted in late summer/early fall (during the dry season), and a third sampling event will be conducted in late winter 2010 to represent the wet season.

During each event, the 14 site monitoring wells (MW-1 through MW-14) will be analyzed for the groundwater COCs as discussed in Section 7.2—arsenic, PCP, VOCs (PCE, TCE, and 1,2-DCA), dioxin/furans, cPAHs, and total petroleum hydrocarbons. Wells will be sampled using low-flow techniques. Field water quality parameters will be collected during purging and sampling, and will be used to determine when steady state conditions have been achieved. Field water quality parameters include turbidity, conductivity, pH, temperature, and dissolved oxygen. In addition to field parameters, and the COCs listed above, each sample will be analyzed for total suspended solids and potentially pH by the analytical laboratory, depending on the field water quality parameters collected. This information will assist with evaluating the groundwater analytical data.

Groundwater samples collected as part of the Remedial Investigation Supplemental Site Investigation for analysis of cPAHs will be analyzed using USEPA Method 8270D-SIM low-level analyses, which allows for achieving the lowest PQL possible for PAHs in groundwater (Appendix B).

Existing monitoring wells will be evaluated for well condition prior to the first round of groundwater monitoring to ascertain if any maintenance activities (such as redevelopment) are required prior to the first sampling event. Wells will be gauged for total depth and visually inspected for damage and cracks in the well casing, as well as indications of surface water intrusion into the monitoring wells. If measurable solids are present in a well, the well will be redeveloped to remove water and fines from the well casing, filter pack, and surrounding formation a minimum of 48 hours prior to the first groundwater monitoring event. Each well will be gauged for depth to water and total depth prior to sample collection during each sampling event.

8.5.1 Monitoring Well Slug Testing

In addition to groundwater analytical sampling, groundwater hydrogeologic data will also be collected as part of this investigation to assist with future evaluation of groundwater contaminant migration and potential transport modeling, if determined to be necessary. Hydraulic conductivity information for the groundwater table will be collected through completion of slug tests in each on-site and off-site (downgradient) monitoring well (MW-1 through MW-14). Slug tests are performed to estimate aquifer hydraulic conductivity in the vicinity of the well.

The data that are collected during a slug test consist of the measurement of hydraulic head (i.e., height of the water column above the transducer) at each time interval after the slug rod is removed. The speed with which the hydraulic head changes over time is used to identify the hydraulic conductivity value for a specific well. Slug testing will be conducted using a PVC rod to displace water from the well, then quickly removing the rod, and measuring the recovery rate of the surrounding water table. Transducers and water level indicators will be used to collect groundwater recovery rate information. A minimum of one test will be performed at each on-site monitoring well location. Field methods for conducting the slug tests, as well as the data methods for estimating the hydraulic conductivities, are included in the QAPP and SAP attached as Appendix B and Appendix D, respectively.

8.6 SURVEY DATA

Following completion of data collection activities, soil boring and monitoring well completion locations will be surveyed to enable conversion of water level data to the NAVD88 vertical datum.

Surveying activities will be conducted compliant with the accuracy specifications outlined in Section VII.I of the Agreed Order, and are discussed in the SAP/QAPP (Appendix B).

8.7 ADDITIONAL PHASES OF DATA COLLECTION

8.7.1 Soil, Groundwater, and Stormwater

As discussed in Section 8.2 above, analytical testing of soil for dioxins in on-site and off-site locations to the east, along Des Moines Memorial Drive will be conducted in a tiered approach, stepping out from the Site. The objective of this tiered approach is to adequately delineate the extent of shallow soils containing dioxin concentrations greater than the dioxin RI/FS soil screening level, as discussed in Section 3.3.

The need for additional investigation activities will be evaluated based on the results of data collection described in this Work Plan, and results of the Stormwater Interim Action data collection activities, as discussed in Section 5.0.

8.7.2 Lora Lake Bioassay Sediment Sample Collection

Members of the public have asked whether site discharges via groundwater and/or stormwater migration have impacted sediments in Lora Lake at levels such that sediment cleanup in the lake would be required under current environmental regulations.

To determine the need for sediment cleanup in water bodies throughout the state, WSDOE's MTCA and Sediment Management Standards (SMS) regulations evaluate sediment quality in the top 10 cm of the sediment column, which is the location of sediment considered to be biologically available.

Lora Lake is a depositional environment, in which the top 10 cm of the sediment column of the lake is representative of recent input of solids to the lake deposited from storm drainage discharges and organic debris. The existing storm drainage system has been in place since the development of the apartment building complex in the late 1980s. As described previously, the existing drainage network that passes through the Site also drains upgradient areas from the City of Burien and Des Moines Memorial Drive before discharging stormwater and suspended sediment to Lora Lake. Solids (including typical roadway sediments and sand from winter road maintenance) have been conveyed through this system to the lake for over 20 years. In addition, leaves and other organic inputs from the vegetation around the lake settle to the bottom, decay, and contribute to the sediment accumulation rate within the lake. Typical sedimentation rates for Puget Sound range from 0.1 to 2.4 cm/year (Carpenter et al. 1985, Shell and Nevissi 1977, Crecelius et al. 1975). Low energy, depositional environments such as a small urban lake like Lora Lake have elevated sedimentation rates, closer to the higher range of those rates that are well documented in the Puget Sound marine environment. If a conservative sedimentation rate of approximately 0.7 to 1.0 cm of material deposited each year is applied to Lora Lake, it can then be concluded that the top 10 cm of lake sediments is associated with recent deposits introduced to the lake sediment column following construction of the Lora Lake Apartments.

Surface sediment samples will be collected from Lora Lake for biological toxicity tests, or bioassay tests. Bioassay test results will be used to determine if the biologically active zone of surface sediments (0 to 10 cm) within Lora Lake results in adverse biological effects. The scope of the sampling and analysis activities for the bioassay investigation in Lora Lake includes the collection of four surface (0 to 10 cm) sediment samples for freshwater bioassay testing. The proposed surface sediment sample locations were selected to meet the project objectives and provide adequate spatial coverage of Lora Lake. Little is known about the existing bathymetry of Lora Lake. The sediment sampling locations located closest to the outfall that drains into Lora Lake and closest to the lake discharge point to Miller Creek, will be positioned in the field as close as possible to the structures, based on access and water depth. The sediment sampling locations were selected with the following rationale and are shown in Figure 8.3:

- Sediment Location 1 (LL-SED-01): Assess biological effects near the discharge point of the stormwater outfall to Lora Lake.
- Sediment Location 2 (LL-SED-02): Bound potential biological effects related to outfall discharge.
- Sediment Location 3 (LL-SED-03): Bound potential biological effects related to outfall discharge.
- Sediment Location 4 (LL-SED-04): Assess biological effects near the outlet point of Lora Lake to Miller Creek.

Bioassay testing will be performed by Nautilus Environmental bioassay laboratory in Tacoma, Washington, according to USEPA (USEPA 2000) and ASTM (2000) guidelines for the *Hyalella azteca* 10-day mortality test and *Chironomus dilutus* 20-day growth and mortality tests. The freshwater bioassay test results will be compared to one-hit and two-hit failure criteria for observed response in the test organisms according to the *Sediment Evaluation Framework for the Pacific Northwest* guidance document (RSET 2009). Test results will be compared to negative control results rather than reference sediment results, as described in the SAP/QAPP. The sediment sample collection procedures, bioassay testing methods, QA/QC procedures, and bioassay decision criteria are described in detail in the SAP/QAPP (Appendix B).

9.0 Remedial Investigation/Feasibility Study Report Preparation Methodology

9.1 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

This section summarizes the tasks to be completed for the development of the RI/FS, and describes the methodology for RI/FS report preparation. The RI/FS report will be organized according to MTCA guidance, and will be developed according to WAC 173-340-350. As stated in MTCA, the purpose of a RI/FS is to collect, develop, and evaluate sufficient information regarding a site to select a cleanup action (WSDOE 2007b). This section describes the activities to be completed to achieve this purpose.

9.1.1 Remedial Investigation Tasks

Remedial investigation tasks will be conducted in accordance with MTCA WAC 173-340-350(7). The first phase of activities to be completed for RI/FS preparation includes additional on-site investigations and data collection to close remaining data gaps. Previous investigation activities conducted at the Site provide a solid base of environmental data regarding the current condition of soil and groundwater quality. However, additional data are needed to more clearly define the full nature and extent of contamination at the Site for both soils and groundwater. Site investigation activities that will be conducted for data gap closure comprise the interim actions discussed in Section 5.0 and proposed additional soil and groundwater data collection detailed in Section 8.0. Once sufficient data have been collected to clearly define the nature and extent of contamination in soil and groundwater, the next phases of the remedial investigation will be conducted, as described below.

Following completion of data collection, an evaluation of transport pathways will be conducted, and the CSM previously developed for the Site by AECOM will be updated. The existing site CSM will be modified to include any new information gathered during the additional data collection activities and the interim actions. Evaluation of transport pathways, potential receptors, and impacts of potential land use decisions will also inform modifications to the CSM. The completed CSM for the Site will be a main component of the RI/FS Report, and will inform the determination of remedial action goals and objectives for site cleanup alternatives.

Upon completion of remedial investigation tasks, site conditions will be well understood with no more data gaps. Data collection and evaluation will inform development of remedial action alternatives that will be developed during the feasibility study process described below.

9.1.2 Feasibility Study Tasks

Feasibility study tasks will be conducted according to MTCA WAC 173-340-350 (8). The feasibility study will develop and evaluate remedial action alternatives for the Site to propose a preferred cleanup action for WSDOE consideration. The tasks involved with completing the feasibility study comprise developing cleanup levels and, if appropriate, remediation levels for impacted media and COCs identified in the remedial investigation, developing remedial action goals and objectives, and evaluating ARARs (i.e., identification of applicable local, state and federal laws). Next, the feasibility study will compile, evaluate, and screen multiple cleanup action alternatives that meet the threshold requirements and other requirements outlined by MTCA (WAC 173-340-360(2)). These alternatives will be evaluated in comparison to a baseline permanent cleanup solution to ascertain the alternative that provides the greatest level of benefit for the associated cost. This process will be conducted according to the DCA procedure discussed in WAC 173-340-360(3)(e). This process will weigh the level of protectiveness, permanence, effectiveness, implementability, and management of risks provided by each alternative in comparison to the cost of implementation. Upon completion of the DCA process, a preferred remedial alternative will be selected and proposed to WSDOE as the Preferred Remedial Alternative for the Site.

9.2 RI/FS REPORT PREPARATION

A RI/FS Report will be prepared, meeting the requirements described in WAC 173-340-350. The Draft RI/FS document will be reviewed by the Port, and then submitted to WSDOE for review and comment. Following receipt of WSDOE's comments, the document will be revised to incorporate comments, and submitted again to WSDOE as a Draft Final document for public comment. The Public will be given a 30-day review period to comment on the document, at which time, public comments will be incorporated into the document during development of the Final RI/FS document.

Chemical data collected during remedial investigation activities will be submitted to WSDOE in the EIM System format in accordance with current WSDOE requirements and stipulations written in the AO.

9.3 SCHEDULE

The AO requirements for developing the RI/FS will be accomplished according to the schedule presented below (which is based on the schedule included in the site AO).

Document	Date	Notes
Monthly Progress Reports	On the 15th of the month following the reporting month	Progress report requirements are detailed in the AO.

Document	**Date**	**Notes**
Progress Meetings	Quarterly	Quarterly meetings will be held to discuss project progress and assess any required adjustments based on data receipt and evaluation.
Agency Review Draft RI/FS Work Plan	December 4, 2009	135 days following the effective date of the AO.
Stormwater Sampling Interim Data Report 1	30 days after receipt of final analytical results from the 2ndsecond qualifying stormwater drainage event—February 2010.	Includes results from the 1st and 2nd stormwater sampling events.
Stormwater Sampling Interim Data Report 2	30 days after receipt of final analytical results from the catch basin sampling event—February 2010.	Includes results of the catch basin sampling event.
Stormwater Sampling Final Report	30 days after receipt of final analytical results from the last qualifying stormwater drainage event—summer 2010.	Includes results of the 3rd through 10th stormwater sampling events.
Public Review Draft RI/FS Work Plan	Spring 2010	30 days following WSDOE review of the RI/FS Work Plan.
RI/FS Work Plan Public Comment (30-day Public Comment Period)	Spring 2010	Public comment period begins 30 days following submittal of the Public Review RI/FS Work Plan.
Final RI/FS Work Plan	Late spring 2010	30 days following completion of the public comment period.
Remedial Investigation Supplemental Site Investigation Field Work	- Soil boring and monitoring well installation—late spring–summer 2010[1] - Groundwater Monitoring—late spring 2010–winter 2010/2011[1] - Lora Lake sediment sampling—late fall 2010[1]	365 days following submittal of the Final RI/FS Work Plan.

Document	**Date**	**Notes**
Agency Review Draft RI/FS	Late August 2011	90 days following completion of remedial investigations.
Public Review Draft RI/FS	Late October 2011	30 days following WSDOE review of the Draft RI/FS (assumes 30-day WSDOE review period).
RI/FS Public Comment (30 day Public Comment Period)	Late November to late December 2011	Public comment period begins 30 days following submittal of the Public Review Draft RI/FS.
Final RI/FS Issuance	Late January 2012	30 days following completion of the public comment period.

Note:

1 The Port will notify the WSDOE Project Manager at least 30 days prior to the earliest anticipated date of each sampling event included in the RI program. A minimum 10-day notice also will be provided once the field schedule for each sampling event is finalized.

9.4 PUBLIC INVOLVEMENT

Public involvement is a key part of the RI/FS process, and providing the Public with an opportunity to review site documents, and provide comments and feedback is managed by WSDOE. Public concern raised during review of site documents, including this RI/FS Work Plan, and the RI/FS document will be incorporated into final versions of each document. The Port and Floyd|Snider will provide assistance to WSDOE to conduct public involvement processes to the greatest degree possible, and understand the importance of public involvement in the RI/FS process.

10.0 Project Team and Responsibilities

10.1 WASHINGTON STATE DEPARTMENT OF ECOLOGY

WSDOE is responsible for the regulatory oversight of the project. The role of WSDOE includes review and approval of documents including this RI/FS Work Plan and the RI/FS Report. Mr. David South is the Site Project Manager for WSDOE, and is responsible for implementation of the AO in place for the Site. WSDOE will review work plans and reports related to the RI/FS, and will determine if all requirements of the AO and MTCA are met.

In addition, WSDOE is the lead party for public involvement activities during the RI/FS process, including public comment periods on RI/FS documents. A Communications Manager from WSDOE will be assigned to the project, and will be responsible for public relations and outreach in coordination with the Port. Public outreach often includes participation at public meetings, development of project fact sheets and information, and direct involvement with the community.

10.2 PORT OF SEATTLE

The Port is the current land owner and responsible party named by the AO. The Port is responsible for overall project direction and oversight. The Port provides site access for investigation activities, and conducts tasks necessary to support the planning and performance of RI/FS tasks. Mr. Don Robbins is the Project Manager for the Site, and Mr. Paul Agid is the Environmental Program Supervisor for the Port.

10.3 THE FLOYD|SNIDER TEAM

Floyd|Snider contracted with the Port in 2009 to provide technical consultant services to the Port for completion of the site RI/FS. Floyd|Snider is responsible for project planning, technical analysis, authorship, and WSDOE coordination necessary to produce the RI/FS document in a manner consistent with the AO and WSDOE requirements. In addition, Floyd|Snider will perform data management and quality control tasks for analytical data collected during RI/FS investigations. Mr. Matt Woltman, PE, is the Floyd|Snider Project Manager.

10.3.1 EnviroIssues

EnviroIssues will work as subconsultant to Floyd|Snider, providing support during the public involvement process as necessary. EnviroIssues is a public relations firm that provides public involvement, facilitation, and communications services in support of complex, sensitive, and often controversial environmental projects. Penny Mabie, Senior Associate, is the main contact at EnviroIssues.

10.3.2 Analytical Resources, Inc.

Analytical Resources, Inc. (ARI) in Tukwila, WA, will work as subcontractor to Floyd|Snider providing primary laboratory chemical testing. ARI will test soil and groundwater samples collected during the RI/FS, and stormwater samples collected during implementation of the Stormwater Investigation Interim Action discussed in Section 5.0. ARI is responsible for compliance with the quality control requirements outlined in the project SAP/ QAPP (Appendix B). For specialty dioxin analyses, ARI will contract with Frontier Analytical Laboratory.

10.3.3 Frontier Analytical Laboratory

Frontier Analytical Laboratory, in El Dorado Hills, CA, will provide specialty dioxin/furan analytical testing of soil and groundwater samples collected during remedial investigation field activities, as well as stormwater samples collected during implementation of the Stormwater Investigation Interim Action at the Site. Frontier Analytical Laboratory will subcontract to ARI, and will be responsible for compliance with the quality control requirements outlined in the project SAP/QAPP (Appendix B).

10.3.4 Nautilus Environmental

Nautilus Environmental (Nautilus), in Tacoma, WA, will conduct all Lora Lake sediment bioassay tests. Nautilus is responsible for compliance with the quality control requirements outlined in the project SAP/QAPP (Appendix B), as well as the bioassay testing requirements described in USEPA and ASTM guidance documents (USEPA 2000, ASTM 2000).

10.3.5 EcoChem, Inc.

EcoChem, Inc., in Seattle, WA, specializes in environmental quality assurance and will assist Floyd|Snider with higher level data validation and quality assurance evaluations. EcoChem, Inc. will be responsible for determining the validity of collected analytical data in accordance with the analytical methods and data quality review guidance and documenting the results of data validation evaluations. Data quality review procedures and descriptions of the level of data validation to be performed on analytical data are provided in detail in the QAPP (Appendix B).

11.0 References

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Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Tables

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Table 7.1
Previous Analytical Summary[1]

Analyses	2008 AECOM Investigations		2007 GeoScience Management Investigation	
	Soil	Groundwater	Soil	Groundwater
Priority Pollutant Metals Arsenic, Selenium, Cadmium, Chromium, Copper, Lead, Antimony, Silver, Thallium, Zinc, Beryllium, Mercury, Nickel	X			
Metals (various) Antimony , Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Zinc, Mercury		X		
Metals (RCRA 8)[2] Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver			X	X
Polychlorinated Biphenyl Aroclors	X		X	X
Volatile Organic Compounds	X	X	X	X
Volatile Organic Compounds (Select Ion Monitoring—Low Level)		X		
Semivolatile Organic Compounds	X	X		
Semivolatile Organic Compounds (Select Ion Monitoring—Low Level)		X	X	X
Total Petroleum Hydrocarbons Diesel Range, Heavy Oil Range, Gasoline Range	X	X	X	X
Dioxin / Furans	X	X	X	X
Carcinogenic Polycyclic Aromatic Hydrocarbons	X	X	X	X
Total Organic Carbon	X			
Total Suspended Solids		X		
Hardness		X		
pH		X		
Turbidity		X		

Notes:
1 X indicates that some samples were analyzed for the identified analyte groups, but does not indicate that the analysis was performed on all samples collected as part of the investigation.
2 Analyses were total metals in soil, dissolved metals in groundwater.

Abbreviation:
RCRA Resource Conservation and Recovery Act

Table 8.1
Remedial Investigation Supplemental Site Investigation Sample Analytical Program

	Site Contaminant of Concern Analyses												
			TPH										
Supplemental Investigation and Sampling Depths	**cPAH**	**PCP**	**Diesel Range**	**Heavy Oil Range**	**Gasoline Range**	**BTEX**	**Arsenic**	**Lead**	**Dioxins**	**VOCs[1]**	**TOC**	**TSS**	**pH**
Shallow Soil Dioxin Investigation—Primary On-site Borings PSB-1 to PSB-8 (Work Plan Section 8.2.1.1)													
0–0.5 feet bgs									X				
1.5–2 feet bgs									X				
2–4 feet bgs									X—archived[2]				
4–6 feet bgs									X—archived[2]				
Shallow Soil Dioxin Investigation—Secondary Off-site and Secondary On-site Borings SSB-1 to SSB-16 (Work Plan Sections 8.2.1.2 and 8.2.2)													
0–0.5 feet bgs									X—archived[3]				
1.5–2 feet bgs									X—archived[3]				
Central and Eastern Source Area Investigation- Primary Borings PSB-9 to PSB-18 (Work Plan Section 8.3)													
0–0.5 feet bgs	X	X	X	X	X	X	X	X	X	X			
1.5–2 feet bgs	X	X	X	X	X	X	X	X	X	X			
2–4 feet bgs	X	X	X	X	X	X	X	X	X	X			
4–6 feet bgs	X	X	X	X	X	X	X	X	X—archived[2,4]	X			
Fill / native soil contact where distinguishable	X	X	X	X	X	X	X	X	X—archived[2,4]	X	X		
Groundwater Table	X	X	X	X	X	X	X	X	X—archived[2,4]	X	X		
Northeast Corner Petroleum Investigation- Primary Borings PSB-19 to PSB-21 (Work Plan Section 8.4.1)													
0–0.5 feet bgs	X	X					X	X	X	X			
1.5–2 feet bgs	X	X					X	X	X	X			
2–4 feet bgs	X	X					X	X	X—archived[2]	X			
4–6 feet bgs	X	X					X	X	X—archived[2]	X			
Above Groundwater Table			X	X	X	X				X	X		
Groundwater Table	X	X	X	X	X	X	X	X		X	X		
Below Groundwater Table	X	X	X—Field Screening			X	X	X		X	X		
Highest Field Indication of Contamination[5]			X—Field Screening										
Northeast Corner Petroleum Investigation—Well Installation Borings MW-12 to MW-14 (Work Plan Section 8.4.2)													
0–0.5 feet bgs									X				
1.5–2 feet bgs									X				
2–4 feet bgs									X—archived[2]				
4–6 feet bgs									X—archived[2]				
Above Groundwater Table	X	X	X	X	X	X	X	X		X	X		
Groundwater Table	X	X	X	X	X	X	X	X		X	X		
Below Groundwater Table	X	X	X	X	X	X	X	X		X	X		
Highest Field Indication of Contamination[5]	X	X	X	X	X	X	X	X		X			
Site-wide Groundwater Quality Investigation—Groundwater Monitoring Events (Section 8.5) MW-1 to MW-14													
All Three Monitoring Events	X	X	X	X	X	X	X		X	X		X	X

Notes:

1 Tetrachloroethene, trichloroethene, 1,2-dichloroethane.

2 The lower two soil sample intervals will be archived immediately following collection. Completion of dioxin analyses on these samples is contingent on sample results of top intervals.

3 Soil samples will be archived immediately following collection. Dioxin analyses will be contingent on adjacent sample results for on-site borings.

4 Dioxins will be analyzed and not archived in all sample intervals for Primary Borings PSB-15, PSB-16, and PSB-17, located adjacent to MW-4 and MW-5.

5 The highest field indication of contamination interval may be one of the upper four identified sample intervals, and will be determined in the field based on field screening indications.

Abbreviations:

bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylene
cPAH	Carcinogenic polycyclic aromatic hydrocarbons
PCP	Pentachlorophenol
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
VOC	Volatile organic compounds

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Figures

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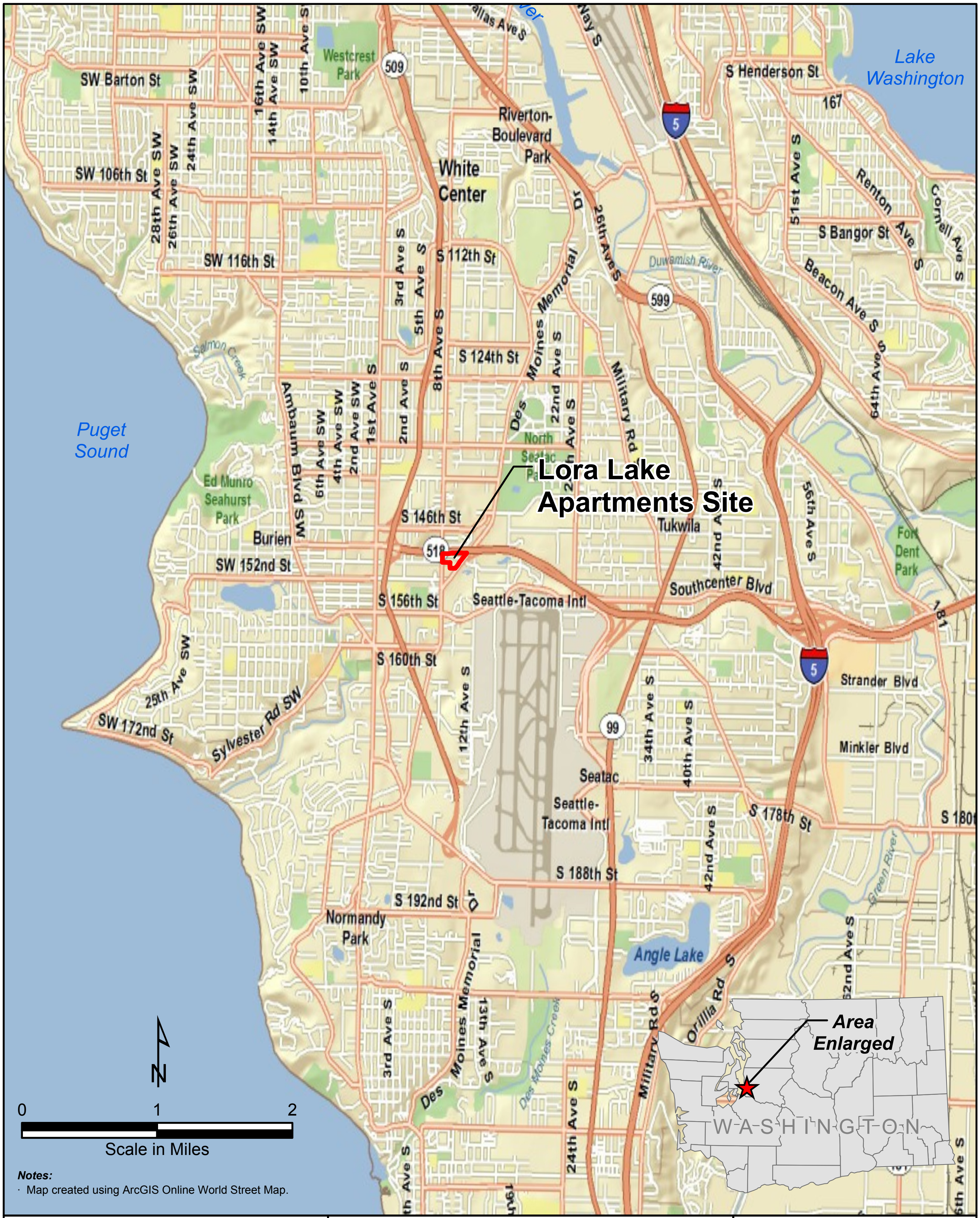

Notes:
- Map created using ArcGIS Online World Street Map.

FLOYD | SNIDER strategy ▪ science ▪ engineering	**Remedial Investigation/ Feasibility Study Work Plan Port of Seattle Lora Lake Apartments Burien, Washington**	Figure 1.1 Vicinity Map

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Date: 3/23/2010

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Legend

☐ Former Locations of Buildings and Structures[1]

☐ Relevant Tax Parcels

- - Lora Lake Apartments Site Property Boundary[2]

Notes:

1. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.
2. Lora Lake Apartments Site Property Boundary provided by AECOM.

· Tax parcel data provided by King County GIS.
· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Remedial Investigation/Feasibility Study Work Plan
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Figure 2.1
Site Plan Map

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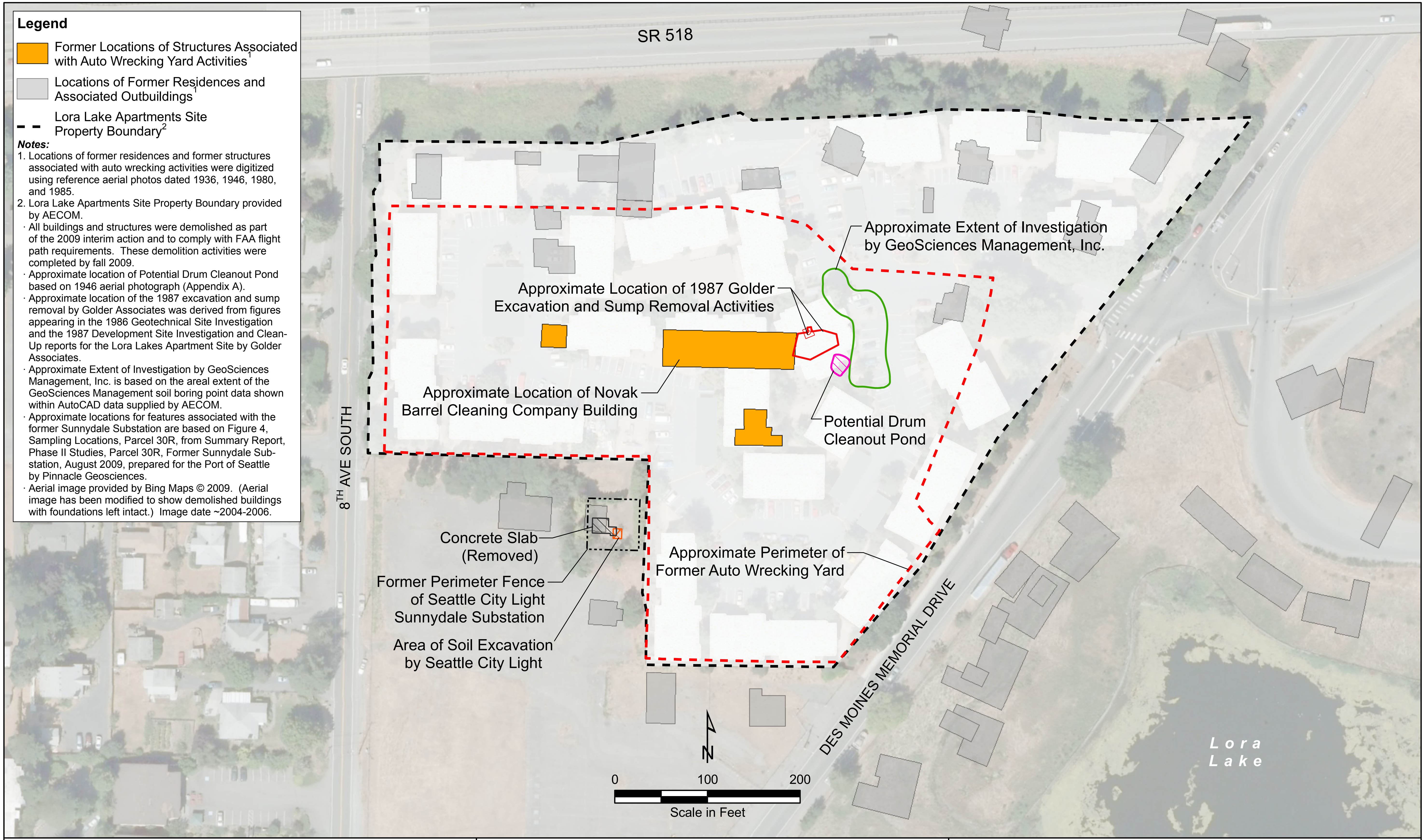

Legend

🟧 Former Locations of Structures Associated with Auto Wrecking Yard Activities[1]

⬜ Locations of Former Residences and Associated Outbuildings[1]

- - Lora Lake Apartments Site Property Boundary[2]

Notes:

1. Locations of former residences and former structures associated with auto wrecking activities were digitized using reference aerial photos dated 1936, 1946, 1980, and 1985.
2. Lora Lake Apartments Site Property Boundary provided by AECOM.

· All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.

· Approximate location of Potential Drum Cleanout Pond based on 1946 aerial photograph (Appendix A).

· Approximate location of the 1987 excavation and sump removal by Golder Associates was derived from figures appearing in the 1986 Geotechnical Site Investigation and the 1987 Development Site Investigation and Clean-Up reports for the Lora Lakes Apartment Site by Golder Associates.

· Approximate Extent of Investigation by GeoSciences Management, Inc. is based on the areal extent of the GeoSciences Management soil boring point data shown within AutoCAD data supplied by AECOM.

· Approximate locations for features associated with the former Sunnydale Substation are based on Figure 4, Sampling Locations, Parcel 30R, from Summary Report, Phase II Studies, Parcel 30R, Former Sunnydale Substation, August 2009, prepared for the Port of Seattle by Pinnacle Geosciences.

· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Figure 2.2
Summary of Historical Site Uses

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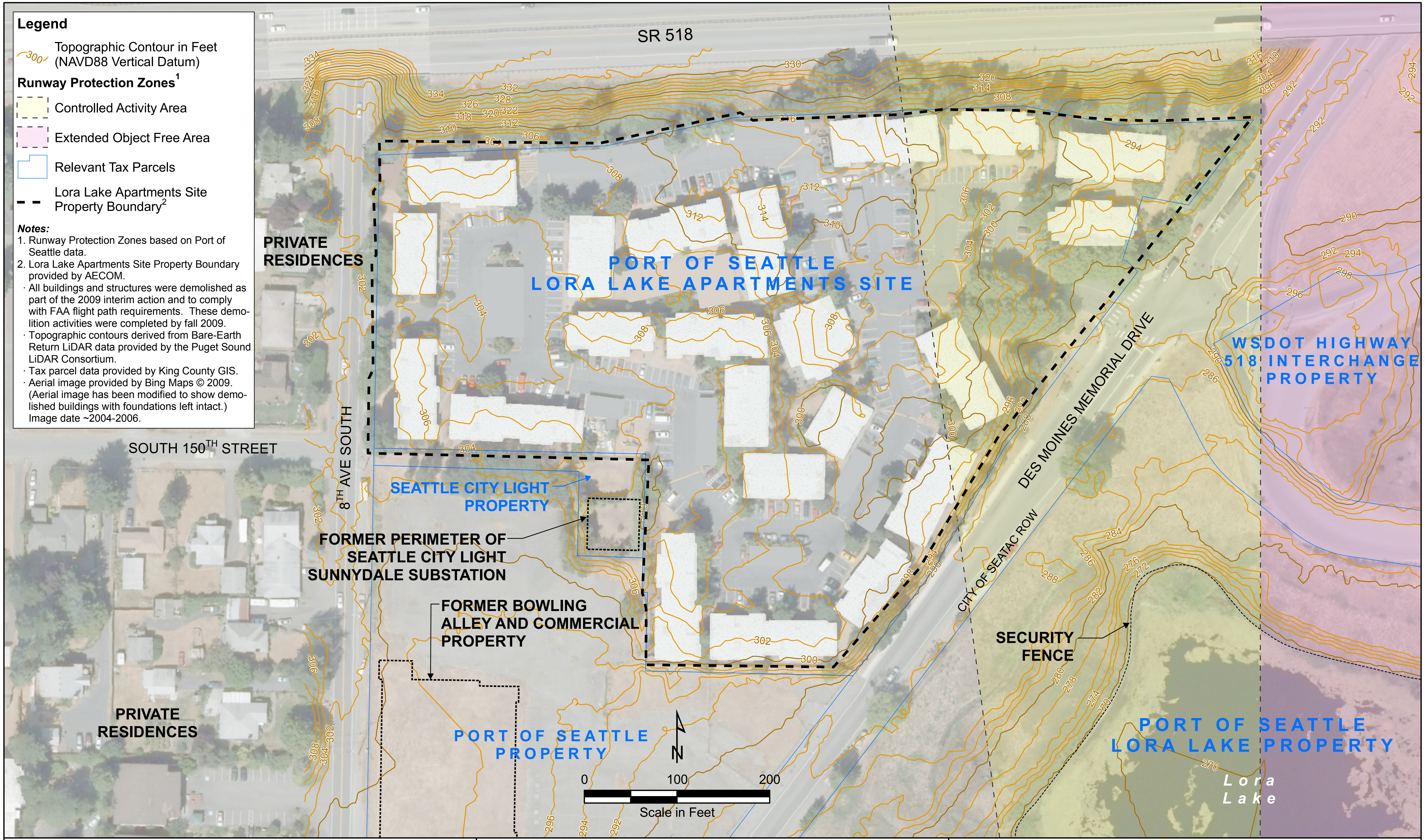

Legend

300 Topographic Contour in Feet (NAVD88 Vertical Datum)

Runway Protection Zones[1]

- Controlled Activity Area
- Extended Object Free Area
- Relevant Tax Parcels
- Lora Lake Apartments Site Property Boundary[2]

Notes:

1. Runway Protection Zones based on Port of Seattle data.
2. Lora Lake Apartments Site Property Boundary provided by AECOM.

- All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.
- Topographic contours derived from Bare-Earth Return LiDAR data provided by the Puget Sound LiDAR Consortium.
- Tax parcel data provided by King County GIS.
- Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Figure 2.3
Site Topography

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Legend

Geoscience Management Investigation Locations (2007)

MW-1 (20') Monitoring Well Location, Designation, and Depth

LLP-8 (20') Soil Boring Location, Designation, and Depth

AECOM Investigation Locations (2008)

MW-3 (25.5') Monitoring Well Location, Designation, and Depth

LL-12 (15') Geoprobe Location, Designation, and Depth

🟥 Approximate Location of 1987 Golder Excavation and Sump Removal Activities[1]

🟩 Approximate Extent of Investigation by GeoSciences Management, Inc.[2]

☐ Former Locations of Buildings and Structures[3]

- - Lora Lake Apartments Site Property Boundary[4]

Notes:

1. Approximate location of the 1987 excavation and sump removal by Golder Associates was derived from figures appearing in the 1986 Geotechnical Site Investigation and the 1987 Development Site Investigation and Clean-Up reports for the Lora Lakes Apartment Site by Golder Associates.
2. Approximate Extent of Investigation by GeoSciences Management, Inc. is based on the areal extent of the GeoSciences Management soil boring point data shown within AutoCAD data supplied by AECOM.
3. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.
4. Lora Lake Apartments Site Property Boundary provided by AECOM.

· Locations of Golder test pits and excavation confirmation samples are not shown.

· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Figure 4.1
Previous Soil and Groundwater Investigations
Sample Location Map

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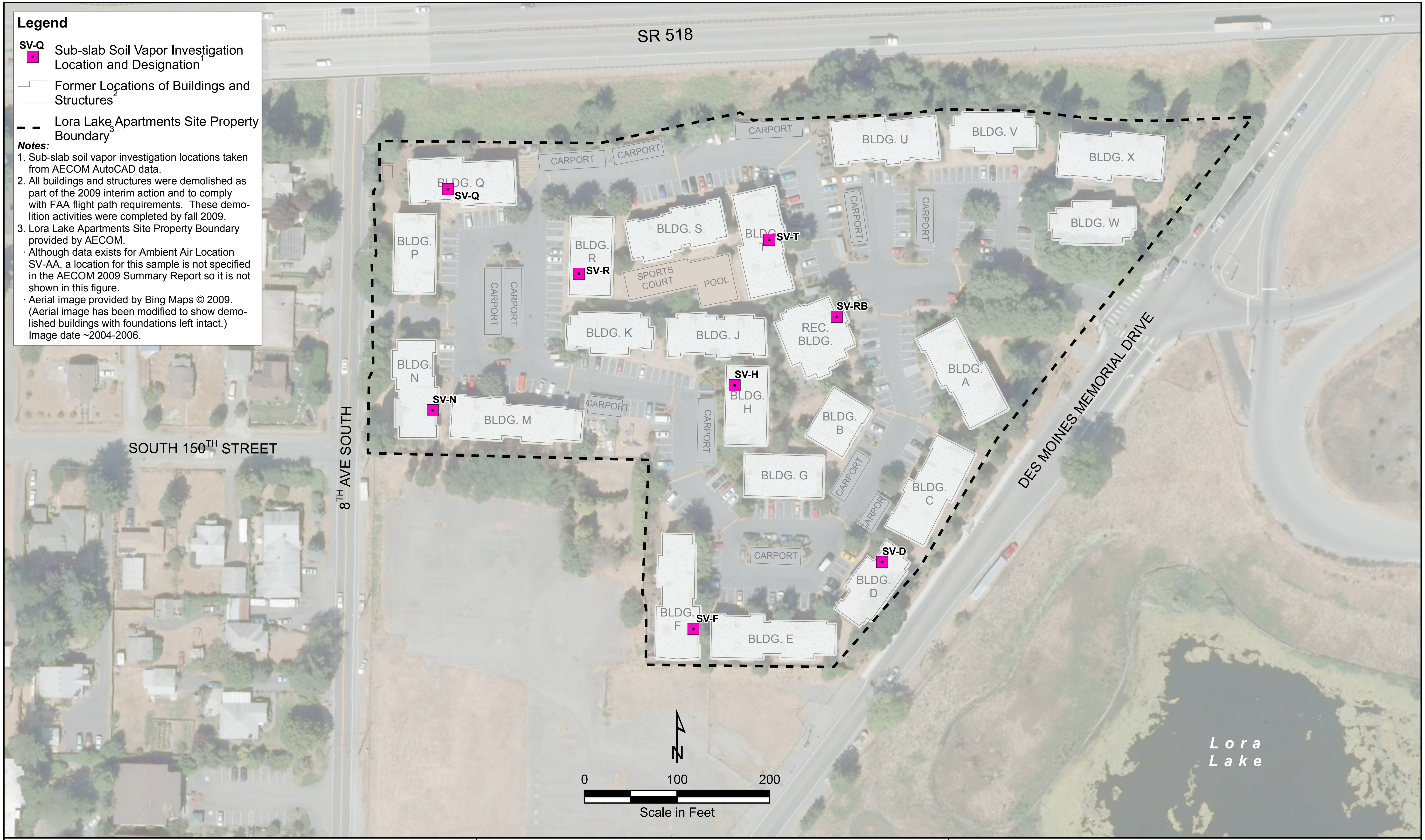

Legend

- SV-Q ■ Sub-slab Soil Vapor Investigation Location and Designation[1]
- ☐ Former Locations of Buildings and Structures[2]
- – – Lora Lake Apartments Site Property Boundary[3]

Notes:

1. Sub-slab soil vapor investigation locations taken from AECOM AutoCAD data.
2. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.
3. Lora Lake Apartments Site Property Boundary provided by AECOM.

· Although data exists for Ambient Air Location SV-AA, a location for this sample is not specified in the AECOM 2009 Summary Report so it is not shown in this figure.

· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Figure 4.2
Previous Soil Vapor Investigation
Sample Location Map

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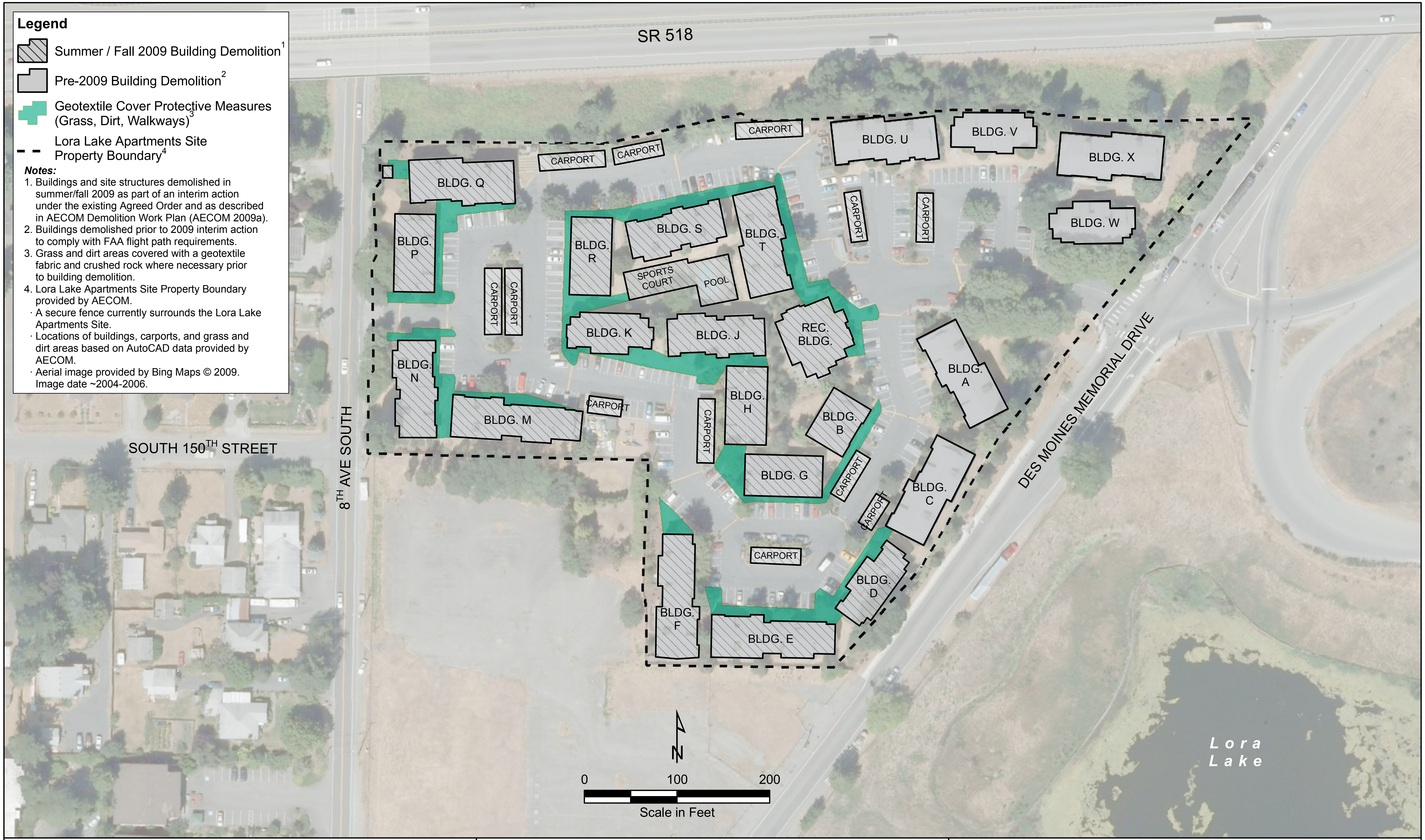

Legend

▨ Summer / Fall 2009 Building Demolition[1]

▭ Pre-2009 Building Demolition[2]

🟩 Geotextile Cover Protective Measures (Grass, Dirt, Walkways)[3]

- - Lora Lake Apartments Site Property Boundary[4]

Notes:

1. Buildings and site structures demolished in summer/fall 2009 as part of an interim action under the existing Agreed Order and as described in AECOM Demolition Work Plan (AECOM 2009a).
2. Buildings demolished prior to 2009 interim action to comply with FAA flight path requirements.
3. Grass and dirt areas covered with a geotextile fabric and crushed rock where necessary prior to building demolition.
4. Lora Lake Apartments Site Property Boundary provided by AECOM.

· A secure fence currently surrounds the Lora Lake Apartments Site.

· Locations of buildings, carports, and grass and dirt areas based on AutoCAD data provided by AECOM.

· Aerial image provided by Bing Maps © 2009. Image date ~2004-2006.

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Figure 5.1
Apartment Building Demolition
Interim Action Map

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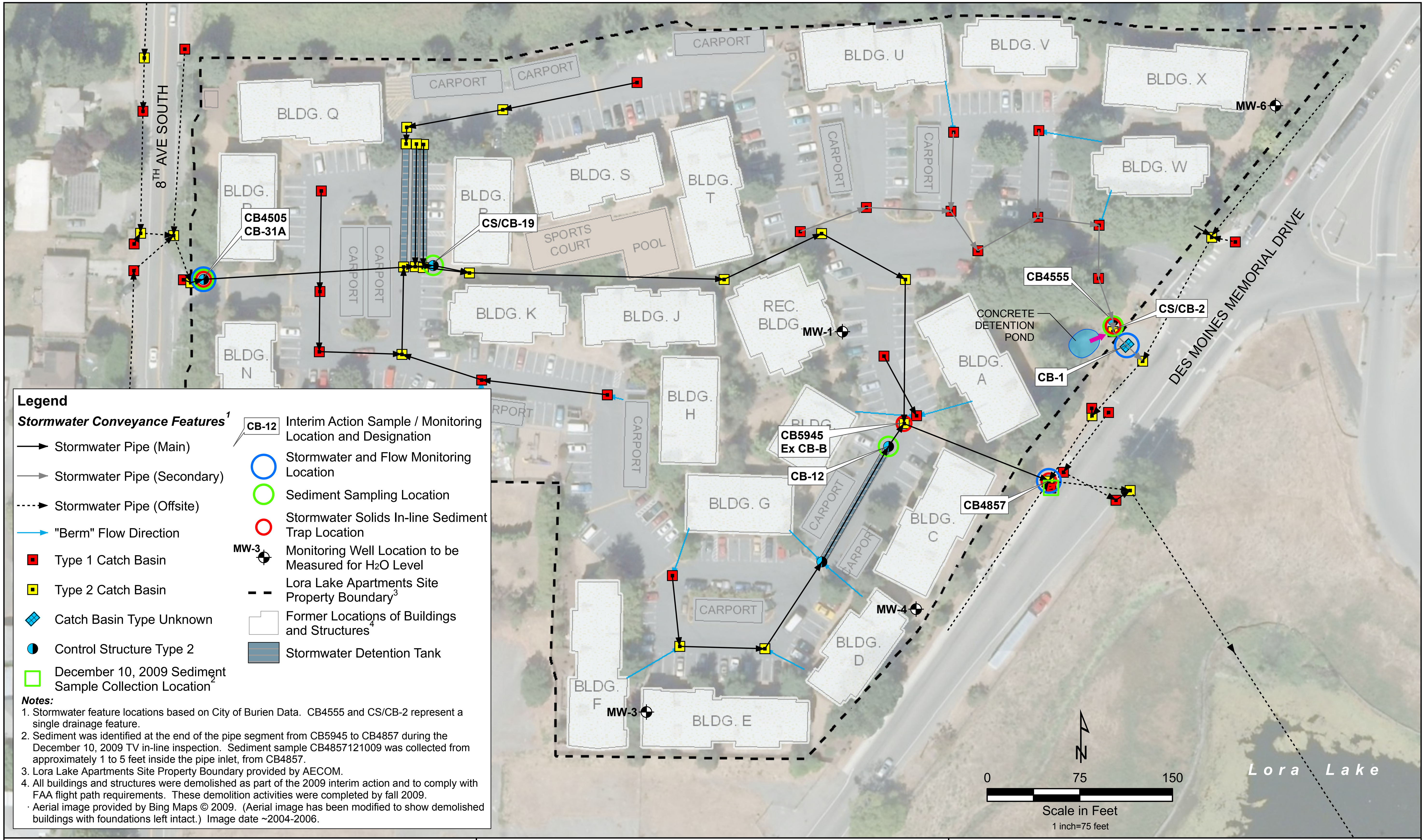

Legend

Stormwater Conveyance Features[1]

- → Stormwater Pipe (Main)
- → Stormwater Pipe (Secondary)
- ⋯→ Stormwater Pipe (Offsite)
- → "Berm" Flow Direction
- 🟥 Type 1 Catch Basin
- 🟨 Type 2 Catch Basin
- ◆ Catch Basin Type Unknown
- ◐ Control Structure Type 2
- ☐ December 10, 2009 Sediment Sample Collection Location[2]
- CB-12 Interim Action Sample / Monitoring Location and Designation
- ○ Stormwater and Flow Monitoring Location
- ○ Sediment Sampling Location
- ○ Stormwater Solids In-line Sediment Trap Location
- MW-3 ⊕ Monitoring Well Location to be Measured for H_2O Level
- ‒ ‒ Lora Lake Apartments Site Property Boundary[3]
- ☐ Former Locations of Buildings and Structures[4]
- ▨ Stormwater Detention Tank

Notes:

1. Stormwater feature locations based on City of Burien Data. CB4555 and CS/CB-2 represent a single drainage feature.
2. Sediment was identified at the end of the pipe segment from CB5945 to CB4857 during the December 10, 2009 TV in-line inspection. Sediment sample CB4857121009 was collected from approximately 1 to 5 feet inside the pipe inlet, from CB4857.
3. Lora Lake Apartments Site Property Boundary provided by AECOM.
4. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.

· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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Figure 5.2
Stormwater Sample Locations
Interim Action Map

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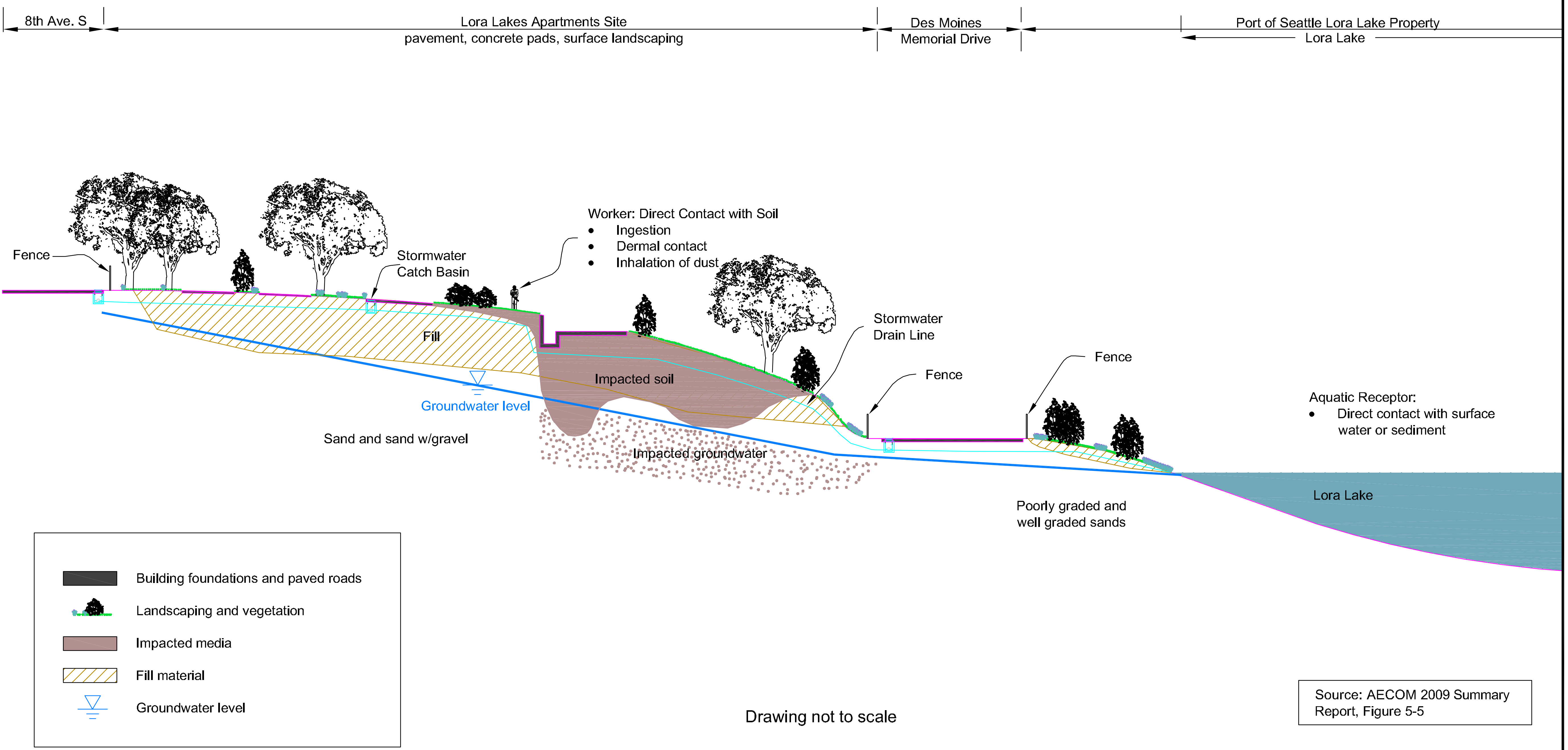

Drawing not to scale

Source: AECOM 2009 Summary Report, Figure 5-5

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

CONCEPTUAL SITE MODEL
SHOWING POTENTIAL
MIGRATION AND
EXPOSURE PATHWAYS

DATE: 7/29/09 DRWN: E.M./SEA **FIGURE 5-5**

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Figure 7.1
Preliminary Conceptual Site Model Showing
Potential Migration and Exposure Pathways

Legend

Proposed RI Supplemental Boring Locations

- PSB-4 — Primary Shallow Soil Dioxin Investigation Borings – Samples Analyzed for Dioxins Only (8).
- PSB-10 — Primary Central and Eastern Source Area Investigation Boring – Samples Analyzed for All Site COCs (10).
- PSB-19 — Primary NE Corner Petroleum Investigation Boring – Samples Analyzed for All Site COCs (3)[1]
- SSB-6 — Secondary Shallow Soil Dioxin Investigation Boring – Samples Archived for Potential Dioxins Analysis (13).
- SSB-10 — Secondary Shallow Soil Investigation Boring – Samples Archived for Potential Dioxins Analysis Pending Results of SSB-7 through SSB-9 (3).
- MW-14 — Subsurface Soil Boring and Monitoring Well Completion Analyzed for All Site COCs (3)

Existing Sampling Locations

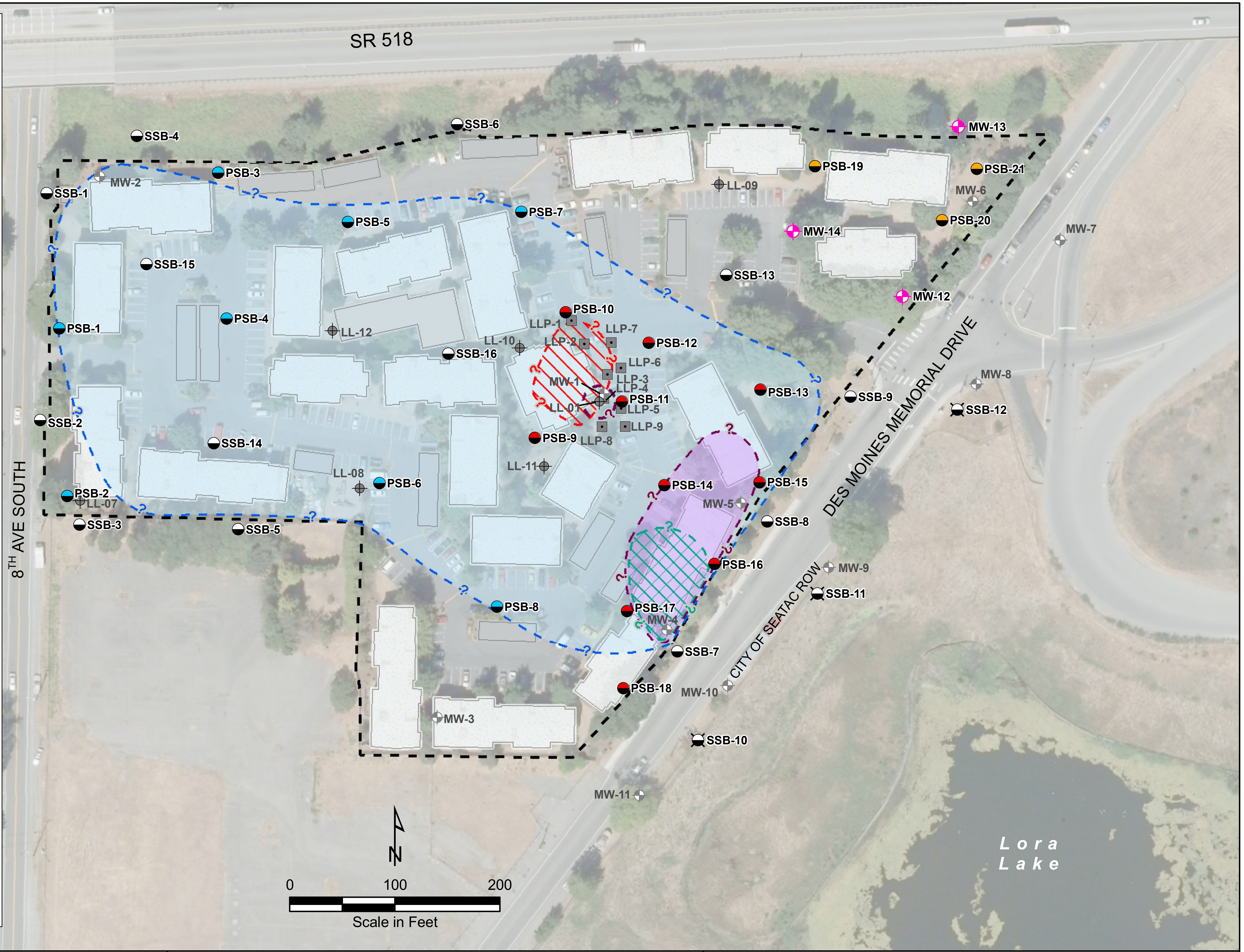
- MW-2 — Monitoring Well Location (2007, 2008)
- LL-12 — Geoprobe Location (2008)
- LLP-8 — Geoprobe Location (2007)

Plume Locations (AECOM 2009)

- Dioxin in Soil
- Lead and cPAH in Soil
- Lead in Soil
- PCP in Soil
- TPH-Dx in Soil
- Former Locations of Buildings and Structures[2]
- Lora Lake Apartments Site Property Boundary[3]

Notes:

1. Borings installed for delineation of TPH source area.
- Existing locations of monitoring wells, soil borings, and plumes based on AECOM Summary Report (AECOM 2009b).
2. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demoition activities were completed by fall 2009.
3. Lora Lake Apartments Site Property Boundary provided by AECOM.
- All proposed locations by Floyd|Snider are approximate and are subject to change.
- Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.



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Remedial Investigation/Feasibility Study Work Plan
Port of Seattle
Lora Lake Apartments
Burien, Washington

Figure 8.1
Proposed Soil Boring Locations and
Approximate Extents of Soil Contamination

File: F:\projects\POS-LLA\GIS\MXD\Public Review DRAFT RIFS\Figure 8.1 (Proposed SB Locations and Approx Extents of Soil Contamination).mxd
Date: 3/23/2010

PUBLIC REVIEW DRAFT

Legend

🞧 Proposed Monitoring Well Completion Analyzed for all Site COCs (3)

Existing Locations

MW-1 🞧 Monitoring Well Location (2007, 2008)

LL-12 ⊕ Geoprobe Location (2008)

LLP-7 ▪ Geoprobe Location (2007)

Plume Locations (AECOM 2009)

🟧 TPH-Dx, Arsenic, cPAH, and Dioxin in Groundwater

▨ PCP in Groundwater

▧ TPH-Dx in Groundwater

☐ Former Locations of Buildings and Structures[1]

- - Lora Lake Apartments Site Property Boundary[2]

Notes:

1. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demolition activities were completed by fall 2009.
2. Lora Lake Apartments Site Property Boundary provided by AECOM.

· RI Supplemental Site Investigation will include three monitoring events for a monitoring well network composed of all site monitoring wells and select off-site downgradient monitoring wells. Proposed groundwater chemical analysis includes all site COCs.

· Existing locations of monitoring wells, soil borings, and plumes based on AECOM Summary Report (AECOM 2009b).

· All proposed locations by Floyd|Snider are approximate and are subject to change.

· Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

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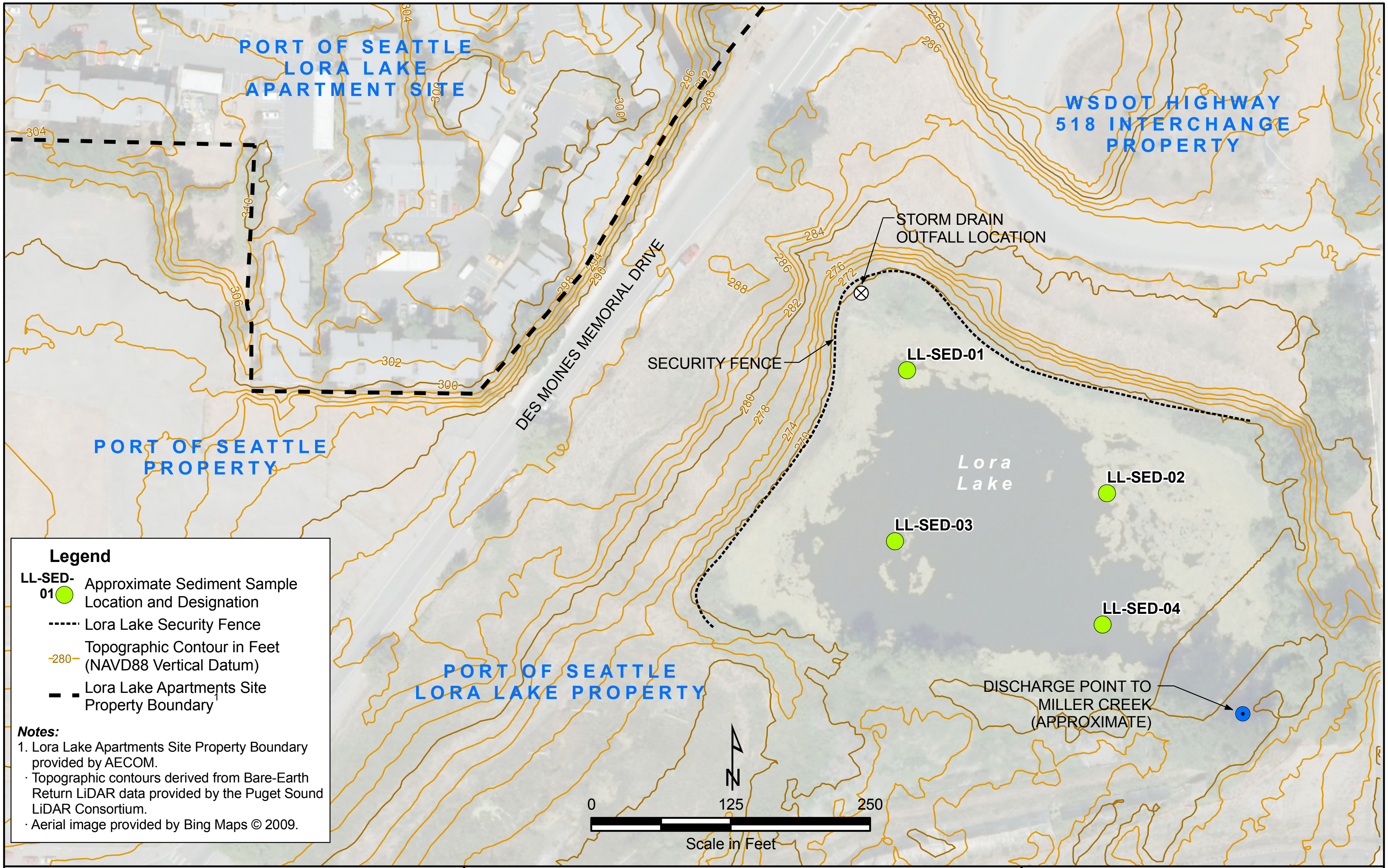
Remedial Investigation/Feasibility Study Work Plan
Port of Seattle
Lora Lake Apartments
Burien, Washington

Figure 8.2
Proposed Monitoring Well Locations and
Approximate Extents of Groundwater Contamination

File: F:\projects\POS-LLA\GIS\MXD\Public Review DRAFT RIFS\Figure 8.2 (MW Locations and Approx Extents of GW Contamination).mxd
Date: 3/23/2010

PUBLIC REVIEW DRAFT



Legend

LL-SED-01 ●	Approximate Sediment Sample Location and Designation
------	Lora Lake Security Fence
-280-	Topographic Contour in Feet (NAVD88 Vertical Datum)
▬ ▬	Lora Lake Apartments Site Property Boundary[1]

Notes:

1. Lora Lake Apartments Site Property Boundary provided by AECOM.
- Topographic contours derived from Bare-Earth Return LiDAR data provided by the Puget Sound LiDAR Consortium.
- Aerial image provided by Bing Maps © 2009.

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Remedial Investigation/Feasibility Study Work Plan
Port of Seattle
Lora Lake Apartments
Burien, Washington

Figure 8.3
Proposed Lora Lake Sediment Bioassay Sampling Locations

File: F:\projects\POS-LLA\GIS\MXD\Public Review DRAFT RIFS\Figure 8.3 (Proposed Lora Lake Sediment Bioassay Sampling Locations).mxd
Date: 3/24/2010

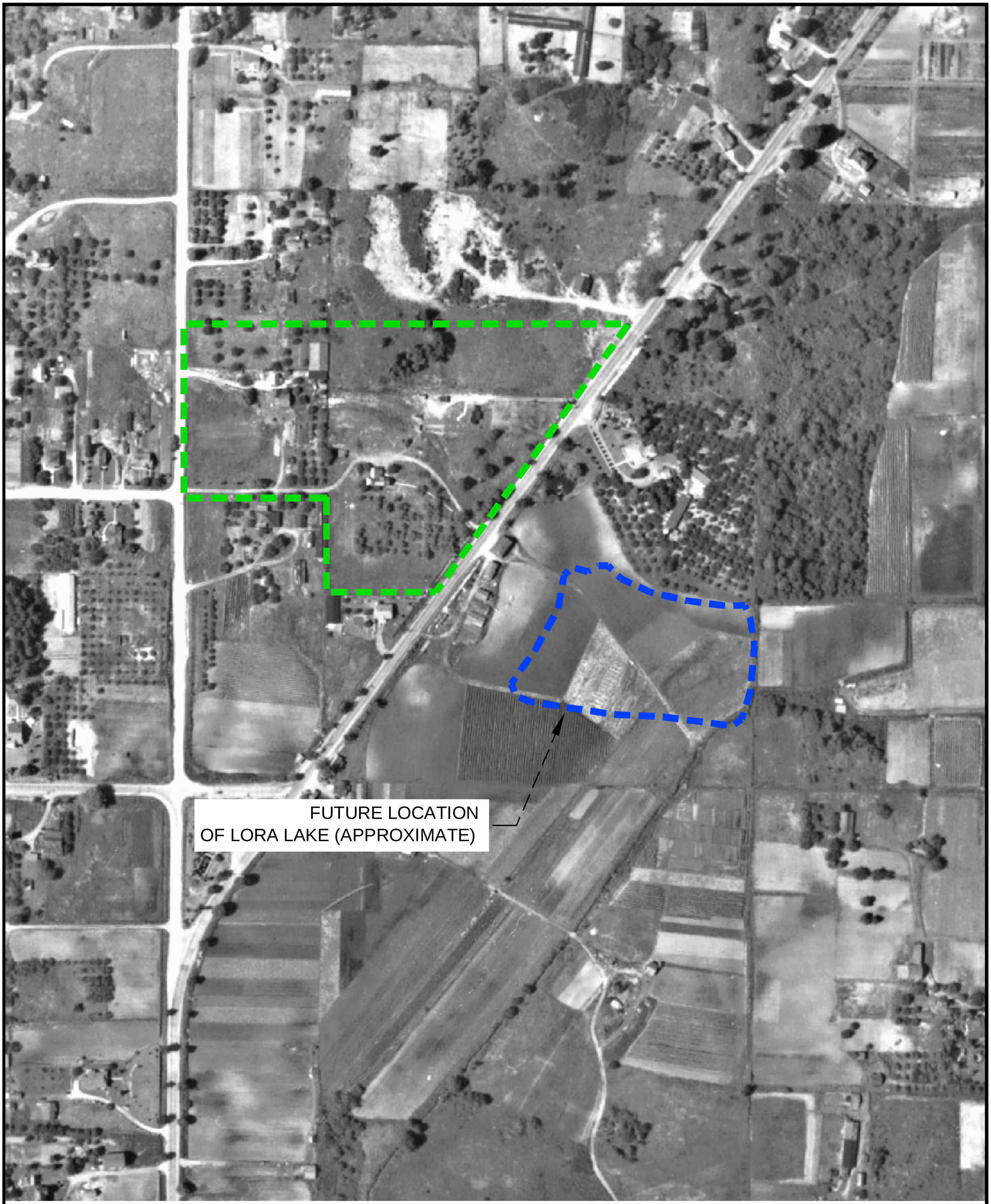
PUBLIC REVIEW DRAFT

Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Appendix A
Historical Site Photos

PUBLIC REVIEW DRAFT



🟩 🟩 🟩 🟩 **APPROXIMATE PROPERTY BOUNDARY**

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1936

DATE: 5/18/09 DRWN: E.M./SEA

FIGURE

File: L:\Lora Lake\AERIAL_PHOTOS(b).dwg Layout: 1936 User: MarshallE Plotted: May 18, 2009 - 2:34pm Xref's:

▬ ▬ ▬ ▬ **APPROXIMATE PROPERTY BOUNDARY**

AECOM

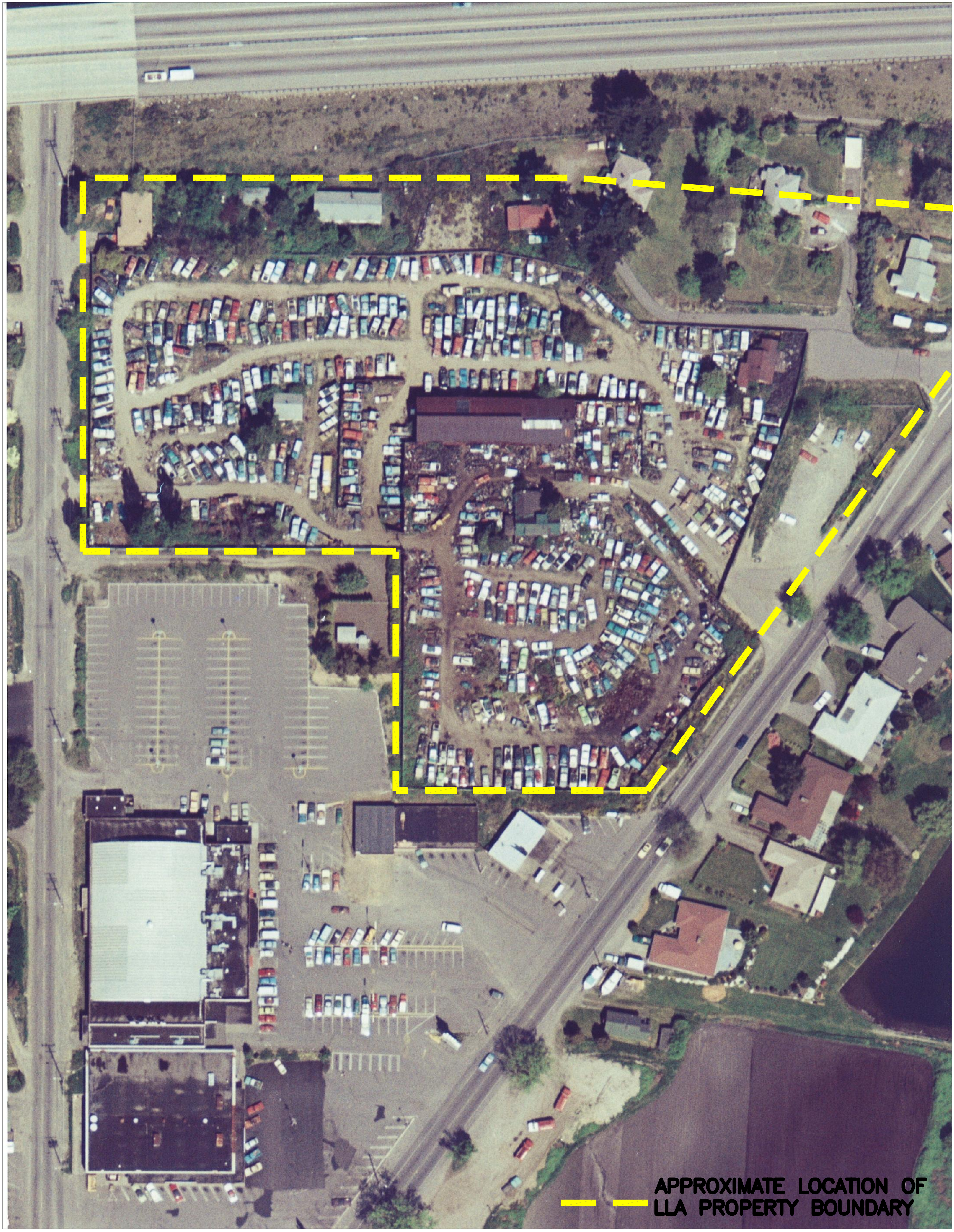
LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1946

DATE: 3/24/09 DRWN: E.M./SEA

FIGURE

File: L:\Lora Lake\AERIAL_PHOTOS(b).dwg Layout: 1946 User: MarshallE Plotted: Mar 24, 2009 - 8:25am Xref's:



ENSR | AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

DATE: 06/23/08 DRWN: E.M./SEA

AERIAL PHOTOGRAPH 1980
BURIEN AUTO WRECKING

FIGURE

File: L:\Lora Lake\AERIAL_PHOTOS.dwg Layout: 1980 User: emarshall Plotted: Jun 23, 2008 - 2:23pm Xref's:

🟩 🟩 🟩 🟩 **APPROXIMATE PROPERTY BOUNDARY**

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1985

DATE: 02/16/09
DRWN: E.M./SEA

FIGURE

File: L:\Lora Lake\AERIAL_PHOTOS(b).dwg Layout: 1985 User: MarshallE Plotted: Feb 17, 2009 - 3:31pm Xref's:

🟩🟩🟩🟩 **APPROXIMATE PROPERTY BOUNDARY**

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1992

DATE: 02/16/09	DRWN: E.M./SEA		**FIGURE**

File: L:\Lora Lake\AERIAL_PHOTOS(b).dwg Layout: 1992 User: MarshallE Plotted: Feb 17, 2009 - 3:31pm Xref's:

File: L:\Lora Lake\AERIAL_PHOTOS(b).dwg Layout: 2004 User: MarshallE Plotted: Feb 17, 2009 - 3:31pm Xref's:

▬ ▬ ▬ ▬ **APPROXIMATE PROPERTY BOUNDARY**

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 2004

DATE: 02/16/09 DRWN: E.M./SEA

FIGURE

Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

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1.0 Project Description

This Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the proposed Remedial Investigation Supplemental Site Investigation activities to be conducted as part of the RI/FS for the Lora Lake Apartments Site (Site) located in Burien, Washington (Figure B.1).

This SAP/QAPP provides guidance to field personnel involved in the Remedial Investigation Supplemental Site Investigation field activities to ensure that data quality is maintained. Any future changes to the Remedial Investigation Supplemental Site Investigation program (such as changes in soil locations or wells to be sampled, sampling frequency, and/or chemical analyses) will be described in addenda to this SAP/QAPP and the Remedial Investigation/Feasibility Study Work Plan (RIFS Work Plan). All such changes must be approved by the Washington State Department of Ecology (WSDOE). Prior approval is desirable, however, changes may be made in the field if necessary and submitted for subsequent WSDOE approval.

Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described in this SAP/QAPP. This Plan was developed in accordance with WSDOE's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (WSDOE 2004) and Washington State Model Toxics Control Act (MTCA) WAC 173-340-820 (WSDOE 2007).

Appendix D of the RI/FS Work Plan presents the project-specific Health and Safety Plan (HASP). A copy of the SAP/QAPP and the HASP should be carried in the field when completing the Remedial Investigation Supplemental Site Investigation activities.

1.1 INTRODUCTION

This SAP/QAPP has been prepared by Floyd|Snider on behalf of the Port of Seattle (Port). The proposed Remedial Investigation Supplemental Site Investigation activities include the following:

- Shallow and subsurface soil sampling
- Monitoring well installation
- Monitoring well groundwater sampling
- Monitoring well slug testing (hydraulic conductivity evaluation)
- Surface sediment sampling
- Laboratory chemical analyses of soil and groundwater samples

- Laboratory bioassay testing of surface sediment samples from Lora Lake

The rationale for the Remedial Investigation Supplemental Site Investigation activities is presented in the associated RI/FS Work Plan.

2.0 Project Organization and Responsibility

Under the authorization of the Port of Seattle, Floyd|Snider will perform field activities as part of the Remedial Investigation Supplemental Site Investigation for the site RI/FS. Analytical Resources, Inc. (ARI) in Tukwila, Washington, will be the primary analytical laboratory, performing all chemical analyses on samples that are collected and submitted during the investigation, with the exception of dioxin/furan congener analyses. Subcontracted through ARI, Frontier Analytical Laboratory (Frontier) in El Dorado Hills, California, will receive samples directly from ARI to perform all the dioxin/furan congener analyses. Nautilus Environmental, in Tacoma, Washington, will perform biological testing on sediment grab samples collected from Lora Lake and EcoChem, Inc. in Seattle, Washington, will perform third-party data validation on all chemical data generated by field activities.

The various quality assurance field, laboratory, and management responsibilities of key project personnel are defined below.

2.1 MANAGEMENT RESPONSIBILITIES

2.1.1 Don Robbins—Port of Seattle Project Manager

Don Robbins is the Port's point of contact and control for matters concerning the project. He will perform the following:

- Define project objectives.
- Familiarize Floyd|Snider with any of the project's special considerations.
- Communicate with WSDOE and project stakeholders.
- Review and approve all reports (deliverables) before submission to stakeholders.
- Represent the project team at meetings and public hearings.

2.1.2 Matt Woltman—Floyd|Snider Project Manger

Matt Woltman will have overall responsibility for project implementation. As Project Manager, he will be responsible for the overall quality assurance on this project to ensure that it meets technical and contractual requirements. The Floyd|Snider Project Manager will report directly to the Port's Project Manager and is responsible for technical QC and project oversight.

The Floyd|Snider Project Manager will perform the following:

- Monitor project activity and quality.

- Provide overview of field activities to the Port and WSDOE.
- Review RI/FS reports.
- Provide technical representation of project activities.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

2.2.1 Jessi Massingale—Floyd|Snider QA Manager

The Floyd|Snider QA Manager reports directly to the Floyd|Snider Project Manager and will be responsible for ensuring that all QA/QC procedures for this project are being followed. The Floyd|Snider QA Manager will be responsible for laboratory coordination and managing data validation of all sample results from the analytical laboratories. Additional responsibilities include the following:

- Overview and review of field QA/QC.
- Coordinate supply of performance evaluation samples and review results from performance audits.
- Review laboratory QA/QC.
- Advise on data corrective action procedures.
- Prepare and review RI/FS reports.
- QA/QC representation of project activities.

2.3 LABORATORY RESPONSIBILITIES

ARI will perform all chemical analytical services in support of the Remedial Investigation Supplemental Site Investigation activities.

2.3.1 Sue Dunnihoo—ARI Project Manager

The ARI Project Manager will report directly to the Floyd|Snider QA Manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available.
- Coordinating dioxin analyses with Frontier.
- Advising Floyd|Snider's QA Manager of laboratory status.
- Review and approval of final analytical reports.
- Coordinating internal laboratory analyses.
- Supervising in-house chain-of-custody procedures.

- Scheduling sample analyses.
- Overseeing data review.

Nautilus Environmental (Nautilus) will perform the bioassay testing on surface sediment samples collected from Lora Lake in support of the Remedial Investigation Supplemental Site Investigation activities.

2.3.2 Cat Curren—Nautilus Project Manager

The Nautilus Project Manager will report directly to the Floyd|Snider QA Manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available.
- Advising Floyd|Snider's QA Manager of laboratory status.
- Review and approval of final analytical reports.
- Coordinating internal laboratory analyses.
- Supervising in-house chain-of-custody procedures.
- Scheduling sample analyses.
- Final review of toxicology results.

2.4 FIELD RESPONSIBILITIES

2.4.1 Megan McCullough—Floyd|Snider Field QA Officer

The Floyd|Snider Field QA Officer will be responsible for leading and coordinating the day-to-day activities in the field. The Field QA Officer will report directly to the Floyd|Snider Project Manager.

Specific responsibilities include:

- Day-to-day coordination with the Floyd|Snider Project Manager.
- Developing and implementing work plans, and setting the field schedule.
- Coordinating and managing field staff including sampling and drilling.
- Reviewing technical data provided by the field staff, including field measurement data.
- Adhering to work schedule.
- Coordinating and overseeing subcontractors.

- Identifying problems, resolving difficulties in consultation with the Floyd|Snider Project Manager, implementing and documenting corrective action procedures, and communicating between team and upper management.
- Prepare data report.

3.0 Laboratory Quality Assurance Objectives

This SAP/QAPP establishes QC procedures and QA criteria to meet the data quality objectives (DQOs) set forth for the field activities to be conducted at the Site. The overall QA objective is to specify laboratory procedures for ensuring that data quality is maintained for field sampling, chain-of-custody, laboratory analyses, and reporting.

Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field/laboratory equipment, and corrective action are described in other sections of this SAP/QAPP.

3.1 LABORATORY DATA QUALITY OBJECTIVES

The DQOs for the Remedial Investigation Supplemental Site Investigation described in this SAP/QAPP are to obtain the type and quantity of data in a manner such that the data are of known, appropriate, and sufficient quality to support the intended use. Analytical DQOs include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principle data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in WSDOE and U.S. Environmental Protection Agency (USEPA) guidance (WSDOE 2004 and USEPA 1998). Data quality assurance criteria are presented in Table B.1.

The quality of analytical data generated is assessed by the frequency and type of internal QC checks developed for analysis type. Laboratory results will be evaluated by reviewing results for analyses of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

3.2 PRECISION

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of 1 per laboratory analysis group or 1 in 20 samples, whichever is more frequent per matrix analyzed, as practical. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria. The acceptable ranges of RPD applied to this project vary by analyte according to the USEPA Contract Laboratory Program National Functional Guidelines. Analytes with

RPDs outside the acceptable range will be qualified, using professional judgment, with a “J” as an estimated concentration (J-flagged).

Field precision will be evaluated by the collection of blind field duplicates at a minimum frequency of 1 per laboratory analysis group or 1 in 20 samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit, where the percent error (expressed as RPD) increases. The equations used to express precision are as follows:

$$\text{RPD}=\frac{(C_1-C_2)\times 100\%}{\frac{(C_1+C_2)}{2}}$$

Where:
RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

3.3 ACCURACY

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing “spiked” samples with known standards (surrogates, laboratory control samples, and/or matrix spike) and measuring the percent recovery. Accuracy measurements on matrix spike samples will be carried out at a minimum frequency of 1 in 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics. The acceptable accuracy ranges for the analytes included in this investigation are presented in Table B.1. Should the percent recoveries be outside the acceptable range, using professional judgment, data may be J-flagged as estimated concentrations.

Laboratory accuracy will be evaluated against quantitative laboratory control sample, matrix spike, and surrogate spike recoveries using limits for each applicable analyte. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R=100\%\times\frac{(S\text{-}U)}{C_{sa}}\%R = 100\% \text{ x } (S\text{-}U)/C$$

Where:
%R = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

3.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care will be taken in the design of the sampling program to ensure that sample locations are selected properly, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

Selected analytes were identified as contaminants of concern (COCs) based on previous sampling investigations.

3.5 COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. In order to ensure that results are comparable, samples will be analyzed using standard USEPA methods and protocols. Calibration and reference standards will be traceable to certified standards and standard data reporting formats will be employed. Data will also be reviewed to verify that precision and accuracy criteria were achieved and, if not, that data were appropriately qualified.

3.6 COMPLETENESS

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{(Number\ of\ acceptable\ data\ points) \times 100}{(Total\ number\ of\ data\ points)}$$

The DQO for completeness for each component of this project is 95 percent. Data that were qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that were qualified as rejected will not be considered valid for the purpose of assessing completeness.

3.7 QUALITY CONTROL PROCEDURES

Sampling procedures for this investigation are described in detail in Section 4.0. The following sections discuss the field and laboratory quality control procedures that will be followed for this investigation.

3.7.1 Field Quality Control Procedures

Trip blanks will be included in each cooler with samples being analyzed for volatile organic compounds (VOCs) to ensure that the sample containers do not contribute to any detected analyte concentrations and to identify any artifacts of improper sample handling, storage, or shipping. A rinsate blank QC sample will also be collected for each sampling event on the non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure that field decontamination procedures are effective. All field QC samples will be documented in the field logbook and verified by the QA Manager or designee. A blind field duplicate will be collected at a frequency of 1 in 20 samples to evaluate the efficiency of field decontamination procedures, variability from sample handling, and site heterogeneity.

3.7.2 Laboratory Quality Control Procedures

Laboratory Quality Control Criteria. Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits were exceeded. If control limits are exceeded in the sample group, corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented and reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities identified in the standard will be documented.

The following paragraphs summarize the procedures that will be used to assess data quality throughout sample analysis.

Laboratory Duplicates. Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of 1 duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent.

Matrix Spikes and Matrix Spike Duplicates. Analysis of matrix spike (MS) samples provides information on the extraction efficiency of the method on the sample matrix. By performing matrix spike duplicate (MSD) analyses, information on the precision of the method is also provided for organic analyses. A minimum of 1 MS/MSD will be analyzed for every sample group or for every 20 samples, whichever is more frequent.

Laboratory Control Samples. A laboratory control sample (LCS) is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The blank spike compound recovery assesses analytical accuracy in the absence of any sample heterogeneity or matrix effects.

Surrogate Spikes. All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample result will be corrected for recovery using these values.

Method Blanks. Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed for every extraction batch or for every 20 samples, whichever is more frequent.

3.8 BIOASSAY QUALITY CONTROL PROCEDURES

For each sediment sample collected for bioassays, two freshwater benthic invertebrate test species will be used: *Hyalella azteca* (10-day acute) and *Chironomus dilutus* (20-day chronic). The endpoints measured will be growth and survival. The bioassay tests, as described in Section 6.0, will incorporate standard QA/QC procedures to ensure valid test results, including a negative control, positive control, and reference sediment samples, as well as measurement of water quality during testing. Test quality control checklists will be used to ensure the appropriate test elements are followed (Attachment B.1).

3.8.1 Replication

For freshwater bioassays, eight laboratory replicates of test sediments and negative controls will be run per test to account for laboratory variability in the test method in accordance with ASTM and USEPA guidance (ASTM 2000 and USEPA 2000).

3.8.2 Negative Controls

A negative control for a sediment toxicity test is considered a clean control that consists of a clean, field-collected, native culture material, such as beach sand or similar material that are expected to produce low mortality. The overlying freshwater used in the toxicity test is the same as the test samples. One negative control (five replicates) will be run with the batch of samples collected from Lora Lake.

3.8.3 Positive Controls

A positive control is considered a toxic control in which a reference toxicant is used to establish the relative sensitivity of the test organisms. Positive controls are performed on spiked fresh water and compared with historical laboratory reference toxicity test results to confirm that organism responses are within control limits established by the testing laboratory. One positive control series will be run with the batch of samples collected from Lora Lake.

3.8.4 Water Quality Monitoring

During the bioassay tests daily measurements of temperature, pH, and dissolved oxygen will be conducted to ensure that undue stress is not exerted on the organisms unrelated to the test sediments. Conductivity, hardness, and alkalinity will also be measured at the test initiation and termination (ASTM 2000). Ammonia and total sulfides will be measured in the test sediment at the beginning and end of the test duration for the *Hyalella azteca* and *Chironomus dilutus* sediment toxicity tests (WSDOE 2008). Bioassay laboratory performance standards are presented in Table B.2.

4.0 Sample Handling and Custody Documentation

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are reported. A sample log form and field logbook entries will be completed for each location and each sample collected.

4.1 SAMPLE HANDLING

To control the integrity of the samples during transit to the laboratory and prior to analysis, established preservation and storage measures will be taken. Sample containers will be labeled with the client name, survey number, sample number, sampling date and time, required analyses, and initials of the individual that collected the sample. The Field QA Officer will check all container labels, custody form entries, and logbook entries for completeness and accuracy at the end of each sampling day.

4.2 SAMPLE NONMENCLATURE

4.2.1 On-site Soil Sample Nomenclature

The sample naming format that will be used for on-site soil samples includes the "boring location number—depth of sample—month/day/year of collection." For example, a sample collected from Primary On-Site Boring PSB-01 from the 2–4-foot depth interval on June 15, 2010, would be labeled PSB01-2–4-061510. Quality control samples, such as field duplicates, and equipment rinse samples collected from non-dedicated sampling equipment will be named according to the boring location where they were collected, as described below in Section 4.2.5.

4.2.2 Off-site Soil Sample Nomenclature

The off-site soil sample number format will be "sample location number—depth interval—month/day/year of collection." For example, a sample collected from Secondary Off-Site Boring SSB-5 from 0–0.5 feet on June 15, 2010, would be labeled SSB01-0–0.5-061510. Other information that will be included on the bottle label is the date, time, analyses, and initials of sampler.

4.2.3 Groundwater Sample Nomenclature

The sample number format for all groundwater samples will be "well number—month/day/year of collection." For example, a sample collected from Well MW-01 on June 15, 2010, would be labeled MW-01-061510. Other information that will be included on the bottle label is the date, time, analyses, and initials of sampler.

4.2.4 Surface Sediment Bioassay Sample Nomenclature

The Lora Lake surface sediment samples collected for bioassay testing and conventional analyses number format will be "Lora Lake (LL)—sample location number—month/day/year of collection." For example, a sample collected from Lora Lake location SED1 on October 15, 2010, would be labeled LL-SED1-101510. Other information that will be included on the bottle label is the date, time, analyses, and initials of sampler.

4.2.5 Quality Control Sample Nomenclature

A duplicate sample collected from the example PSB-01 location discussed above would be labeled PSB01-2–4-061510-D. The "-D" at the end of the sample name identifies this sample as a field duplicate. An equipment rinse sample collected immediately following the example sample collection above would be named "PSB01-2–4-061510-ER. The "-ER" at the end of the sample name signifies this sample is an equipment rinse sample. In this way, every soil sample, groundwater sample, sediment bioassay sample, and quality control sample has a unique identifier, and the collection date is known from the sample number.

4.3 SAMPLE CHAIN-OF-CUSTODY

Chain-of-custody procedures will be strictly followed to provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the chain-of-custody record, which is initially completed by the sampler and is thereafter signed by those individuals who accept custody of the sample. A sample will be considered to be in custody if it is:

- in someone's physical possession,
- in someone's view,
- locked up or secured in a locked container or vehicle or otherwise sealed so that any tampering would be evident, or
- kept in a secured area, restricted to authorized personnel only.

The laboratory will provide sufficient copies of blank Chain-of-Custody Forms. All sample information (i.e., sample date/time, sample matrix, number of containers, etc.), including all required analyses, will be logged onto a Chain-of-Custody Form prior to formal transfer of sample containers to the analytical laboratory. Any time possession of the samples is transferred, the individuals relinquishing and receiving the samples will respectively sign, date, and note the time of transfer on the Chain-of-Custody Form.

This form documents the transfer of custody of samples from the sampler to the laboratory.

The person responsible for transfer/transport of the samples to the laboratory will complete and sign the Chain-of-Custody Form, keeping a copy for future reference. The sampler will place the original form in a clear zip-lock bag inside the sample cooler with the samples. One Chain-of-Custody Form will be completed and placed inside each individual cooler.

4.4 SAMPLE PRESERVATION

Samples requiring field preservation will be placed into pre-preserved sample jars supplied by the laboratory (i.e., VOCs and metals depending on media; refer to Table B.3). Immediately after the sample jars are filled with each media, they will be placed in the appropriate cooler with a sufficient number of ice packs (or crushed ice) to keep them cool through transport to the laboratory.

4.5 SAMPLE TRANSPORT

Table B.3 summarizes sample size requirements, container type, preservation method and holding times for soil and groundwater analytes. Technical field staff will be responsible for all sample tracking and custody procedures in the field. The Floyd|Snider Field QA Officer will be responsible for final sample inventory and will maintain sample custody documentation. At the end of each day, and prior to transfer, custody form entries will be made for all samples. Each sample cooler will be accompanied by custody forms. Copies of all forms will be retained and included as appendices to QA/QC reports to management.

Prior to transport, sample containers will be wrapped and securely packed inside the cooler with ice packs or crushed ice by the field technician or designee. The original, signed custody forms will be transferred with the cooler. Soil and groundwater samples will be delivered to the laboratory under custody following completion of sampling activities on a daily basis, or at maximum every other day.

Sediment bioassay samples collected from Lora Lake will be shipped to Nautilus laboratory in Tacoma, Washington. Samples that will be shipped to the laboratory by a national courier such as Federal Express will be packaged in a cooler, with all openings sealed with tape. Chain-of-custody documentation will be sealed inside the cooler, with custody seals placed across the lid opening. If the shipping container is opened during transport, the custody seals will be broken, notifying the laboratory upon receipt of the breach in sample custody.

4.6 SAMPLE RECEIPT

The designated sample custodian at the laboratory will accept custody of the samples and verify that the COC matches the samples received. The ARI or Nautilus Project Manager will ensure that the custody forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the custody forms. The laboratory will contact the Floyd|Snider QA Manager immediately if discrepancies are discovered between the custody forms and the sample shipment upon receipt. The ARI or Nautilus Project Manager, or designee, will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

5.0 Laboratory Analytical Program

5.1 ANALYSIS PROGRAM

Soil, groundwater, and surface sediment samples collected for each type of Remedial Investigation Supplemental Site Investigation field activity will be analyzed for the following constituent groups using the methods presented below. The Lora Lake Apartments soil and groundwater analytical program and number of samples collected for each field activity are also summarized in Table B.4. The table provides detail on the sample intervals, analytes, and sample frequency for each sampling event, and boring location. For soil and groundwater samples, the chemical analyses will be performed by ARI with Frontier performing the dioxin analyses.

5.1.1 Shallow Soil Dioxin Investigation (Soils)

The samples collected for the Shallow Soil Dioxin Investigation will be analyzed for the following constituents by the method indicated below:

- Dioxin/furans by USEPA Method 1613

This investigation will collect samples from primary on-site shallow soil borings (PSB-1 through PSB-8), secondary on-site soil borings (SSB-13 through SSB-16) and secondary off-site soil borings (SSB-1 through SSB-12; refer to Figure B.2). Primary on-site shallow soil boring samples collected for dioxin analyses will be collected from 4 intervals: 0–0.5 foot below ground surface (bgs), 1.5–2 feet bgs, 2–4 feet bgs, and 4–6 feet bgs. The bottom two intervals will be archived for potential future dioxin analyses, pending evaluation of results of the upper internal analyses, as described in Section 8.2 of the RI/FS Work Plan. Secondary on-site and off-site soil samples, collected for dioxin analyses, will be collected from 2 intervals: 0–0.5 foot bgs and 1.5–2 feet bgs, and all samples will be archived and potentially analyzed for dioxins, pending evaluation of results of the on-site dioxin analyses, as described in Section 8.2 of the RI/FS Work Plan. The total number of dioxin shallow soil samples for initial analyses and archival is presented in Table B.4.

5.1.2 Central and Eastern Source Area Investigation (Soils)

The soil samples collected for the Central and Eastern Source Area Investigation will be analyzed for the following constituents by the methods indicated below:

- Carcinogenic polycyclic aromatic hydrocarbons (cPAH) by USEPA Method 8270
- Pentachlorophenol (PCP) by USEPA Method 8041
- Total petroleum hydrocarbons (TPH; diesel and oil range) by NWTPH-Dx

- TPH (gasoline range) by NWTPH-G
- Benzene, toluene, ethlybenzene, xylene (BTEX) by USEPA Method 8021
- Arsenic and lead by USEPA Method 6010
- Dioxin/furans by USEPA Method 1613
- Tetrachloroethene (PCE), trichloroethene (TCE), and 1,2-dichloroethane (1,2-DCA) by USEPA Method 8260C
- Total organic carbon (TOC) by Plumb 1981

This investigation will collect samples from primary on-site soil borings (PSB-9 through PSB-18; refer to Figure B.2). For this investigation, 10 subsurface Geoprobe borings will be installed to determine the nature and extent of soil contamination in the central and eastern source areas of the Site. Soil samples will be collected from up to a total of six intervals for analytical testing at each boring location. Sample collection intervals include the following: 0–0.5 foot bgs, 1.5–2 feet bgs, 2–4 feet bgs, 4–6 feet bgs, the fill/native soil contact where distinguishable, and the groundwater table. The bottom three sample intervals of all boring locations, except PSB-15, PSB-16, and PSB-17, will be archived for potential future dioxin analyses, pending evaluation of results of the upper interval analyses, as described in Section 8.3 in the RI/FS Work Plan. Soil samples from all six sample intervals at PSB-15, PSB-16, and PSB-17, located closest to MW-4 and MW-5, will be immediately analyzed for dioxins following sample collection because of the known deeper vertical extent of dioxin concentrations in these locations. The total number of soil samples for initial analyses and archival is presented in Table B.4.

5.1.3 Northeast Corner Petroleum Hydrocarbon Investigation (Direct-push Probe Soils)

The direct-push probe soil samples collected for the Northeast Corner Petroleum Hydrocarbon Investigation will be analyzed for the following constituents by the methods indicated below:

- cPAH by USEPA Method 8270
- PCP by USEPA Method 8041
- TPH (diesel and oil range) by NWTPH-Dx
- TPH (gasoline range) by NWTPH-G
- BTEX by USEPA Method 8021
- Arsenic and lead by USEPA Method 6010
- Dioxin/furans by USEPA Method 1613

- PCE, TCE, and 1,2-DCA by USEPA Method 8260C
- TOC by Plumb 1981

This investigation will collect samples from primary on-site soil borings (PSB-19, PSB-20, and PSB-21; refer to Figure B.2). For this investigation, three borings will be installed surrounding, and upgradient of Monitoring Well MW-6 to identify a potential soil source of diesel contamination in groundwater encountered in MW-6. These borings will be installed to an approximate depth of 20 feet bgs and will extend past contact with the groundwater table. The fill unit that exists across the majority of the Site is not present in the northeast corner; therefore, soil samples will not be collected at the geologic contact between fill and native soils, as is proposed for the other primary on-site borings. For site COCs, excluding dioxins and petroleum hydrocarbons, soil samples will be collected for analytical testing from up to six intervals at each boring location. Sample collection intervals include the following: 0–0.5 foot bgs, 1.5–2 feet bgs, 2–4 feet bgs, 4–6 feet bgs, the water table, and just below the water table (Table B.4). Soil samples collected for dioxin analyses will be collected from the first four sample intervals, as listed above for all site COCs. Samples from the 2–4 feet bgs and 4–6 feet bgs intervals will be archived for potential future dioxins analyses, pending evaluation of results of the shallower samples.

Petroleum hydrocarbon samples (diesel range, heavy oil range, and gasoline range) will be collected from two to four sample intervals, based on field screening indications of soil contamination. Sample collection will consist of a minimum of one sample at the groundwater table, and one sample immediately above the groundwater table in the vadose zone for borings with no indication of petroleum hydrocarbons. Field screening will be conducted to identify contamination and to assist with determining sample intervals to be collected for laboratory analysis. Soil samples for TOC analyses will be collected from two sample intervals, at the groundwater table and directly below the groundwater table to assist with future site-specific groundwater and transport pathway modeling, if determined to be necessary in the RI/FS or design phases of the project. The total number of soil samples for initial analyses and archival is presented in Table B.4.

5.1.4 Northeast Corner Petroleum Hydrocarbon Investigation (Well Installation Soils)

The well installation soil samples collected for the Northeast Corner Petroleum Hydrocarbon Investigation will be analyzed for the following constituents by the methods indicated below:

- cPAH by USEPA Method 8270
- PCP by USEPA Method 8041
- TPH (diesel and oil range) by NWTPH-Dx

- TPH (gasoline range) by NWTPH-G
- BTEX by USEPA Method 8021
- Arsenic and lead by USEPA Method 6010
- Dioxin/furans by USEPA Method 1613
- PCE, TCE, and 1,2-DCA by USEPA Method 8260C
- TOC by Plumb 1981

Three monitoring wells (MW-12, MW-13, and MW-14) will be installed in the northeast corner to further delineate groundwater impacts in the area, provide increased data coverage along the eastern property boundary, and investigate potential contaminant sources to groundwater surrounding and upgradient of MW-6 (Figure B.2). During well installation, soil samples will be collected with the hollow-stem auger (HSA) rig using a split-spoon sampler from the shallow intervals listed below, and approximately every 2.5 feet through the total boring depth. Similar to the other on-site boring locations, soil samples will be collected from the four shallow subsurface intervals for dioxins analyses at 0–0.5 foot bgs, 1.5–2 feet bgs, 2–4 feet bgs, 4–6 feet bgs. The lower two soil sample intervals will be archived and for potential future analyses, pending evaluation of results of the upper interval results. All other site COCs will be analyzed in soil samples collected from the following four sample intervals: directly above the groundwater table, at the groundwater table, directly below the groundwater table, and any interval where field screening identifies soil contamination. TOC will be analyzed from three intervals, including at the groundwater table, below the groundwater table, and immediately above groundwater in the vadose zone. The total number of soil samples for initial analyses and archival is presented in Table B.4.

5.1.5 Site-wide Groundwater Quality Investigation (Groundwater)

The groundwater samples collected for the Site-wide Groundwater Quality Investigation will be analyzed for the following constituents by the methods indicated below:

- cPAH by USEPA Method 8270D SIM- Low Level
- PCP by USEPA Method 8041
- TPH (diesel and oil range) by NWTPH-Dx
- TPH (gasoline range) by NWTPH-G
- BTEX by USEPA Method 8021-Low Level
- Arsenic and lead (dissolved) by USEPA Method 200.8
- Dioxin/furans by USEPA Method 1613
- PCE, TCE, and 1,2-DCA by USEPA Method 8260C-SIM

- Total suspended solids by SM 2540D
- pH by USEPA Method 150.1

This investigation will sample groundwater for 3 quarters from on-site wells (MW-01 through MW-06 and MW-12 through MW-14) and off-site wells (MW-07 through MW-10; refer to Figure B.2). The wells to be sampled comprise all existing wells (including off-site downgradient wells) and new wells installed as part of the Remedial Investigation Supplemental Site Investigation (Section 8.5 in the RI/FS Work Plan). The total number of groundwater samples that will be collected for analysis is presented in Table B.4.

5.1.6 Lora Lake Conventional Sediment Analyses—Bioassay Testing

The collection of surface sediment samples from Lora Lake for bioassay testing includes analysis of conventional sediment parameters to better understand the biological environmental and sediment quality of the lake (Figure B.3). The following conventional analyses will be performed by ARI:

- Total solids by USEPA Method 160.3
- TOC by Puget Sound Estuary Program (PSEP) protocol
- Grain size by PSEP protocol
- Ammonia by USEPA Method 350.1
- Total sulfides by PSEP protocol

Standard WSDOE and USEPA sample preparation, cleanup, and analytical methods will be used for all chemical analyses. The laboratory internal standard operating procedures will provide data quality procedures at a level sufficient to meet the analytical DQOs.

5.2 SAMPLE ARCHIVAL

Dioxin analysis will be conducted by Frontier Laboratories using USEPA Method 1613 with a holding time of 1 year. On-site and off-site soil samples archived for possible dioxin analyses, as necessary, will be stored at ARI. Archived soil samples will be stored in a laboratory freezer maintained at a temperature range of -10 to -20 degrees Fahrenheit.

5.3 REPORTING LIMITS

The analytical methods identified in this SAP/QAPP result in the lowest analytically achievable method detection limits and reporting limits or Practical Quantitation Limits (PQLs). Table B.5 presents the target reporting limits and the project data quality assurance criteria for each analytical method as performed by ARI and Frontier. These reporting limits are goals only, insofar as instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired reporting limit and associated QC criteria. In such instances, the laboratory will report the reason for any deviation from these reporting limits.

5.4 SPECIFIC DIOXIN/FURAN DATA ANALYSES

Dioxins/furans are generally present in the environment as a complex mixture of chemical congeners that differ in terms of the number and location of chlorine atoms. The most toxic and best-studied of the dioxin/furan congeners is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Because of the need to evaluate the risks associated with the mixture of congeners, the toxicity equivalency factor (TEF) methodology is used. A TEF value is assigned to each congener relative to the toxicity of TCDD. The total toxic equivalent concentration (TEQ) of a mixture is the sum of the products of the concentration of each congener in a sample and the congener's corresponding TEF value. The TEF values used to calculate the TEQs are those resulting from the World Health Organization re-evaluation of TEFs for dioxins performed in 2005 (Van den Berg et al. 2006), as presented in MTCA Table 708-1 (WSDOE 2007). Table B.6 presents the dioxin/furan congeners that will be analyzed for and evaluated using the methodology described above.

6.0 Lora Lake Sediment Bioassay Testing Program

Freshwater biological toxicity testing (bioassay testing) is being performed on Lora Lake sediments to determine if there are adverse biological effects in the biologically active zone of surface sediments (0 to 10 cm). This section provides consistent bioassay testing procedures for the collection of sediment samples from Lora Lake and during the bioassay test durations.

Four surface sediment (0 to 10 cm) samples will be collected from Lora Lake for freshwater bioassay testing. The proposed surface sediment sample locations are intended to meet the project objectives and provide adequate spatial coverage of Lora Lake. The sediment sampling locations were selected with the rationale as described in Section 8.7.2 of the RI/FS Work Plan and are shown in Figure B.3. Samples collected at locations LL-SED-01 and LL-SED-04 will be collected as close to the respective stormwater outfall and lake discharge areas as possible.

Project-specific reference sediment samples for bioassay testing will not be collected as part of this investigation. Lora Lake sediment bioassay results will be compared to control tests conducted concurrently with the Lora Lake sediment biological tests, as described below in Section 6.2.

6.1 BIOASSAY TESTING METHODS

The species selected for the freshwater bioassay tests are presented below:

- 10-day acute amphipod (*Hyalella azteca*) for mortality
- 20-day chronic midge (*Chironomus dilutus*, formerly known as *tentans*) for mortality and growth

Bioassay testing will be performed by Nautilus, a bioassay laboratory in Tacoma, Washington, according to guidelines for the *Hyalella azteca* and *Chironomus dilutus* tests (USEPA 2000, ASTM 2000). Nautilus is accredited by WSDOE to perform each of the above testing procedures according to the accepted protocols. If species substitutions are required due to acceptability, availability, or other factors, such substitutions will be confirmed with WSDOE prior to test initiation.

Bioassay testing will be initiated within 1 week of sample collection, allowing a few days for animal equilibration before test initiation. It a test fails to meet WSDOE's acceptance criteria or other QA issues arise that invalidate the data, WSDOE will be consulted before another test is initiated. If the sediment holding time extends beyond an 8-week time period without acceptable test results, the sediment will be re-sampled and re-tested. All tests must meet positive and negative control criteria. Bioassay laboratory performance standards are presented in Table B.2.

6.2 BIOASSAY DECISION CRITERIA

Bioassay test results will be evaluated by comparing test data to the criteria presented in the *Sediment Evaluation Framework for the Pacific Northwest* (RSET 2009), with one modification. Currently, freshwater reference areas for collection of reference sediments for biological testing have not been identified. Therefore, the results of the Lora Lake bioassay tests will be compared to the negative control tests conducted concurrently with the Lora Lake tests. The RSET decision criteria approach will be used to evaluate the bioassay test results, but comparison to reference results will be replaced with comparison to the negative control results. RSET's decision criteria consist of two levels of observed response in the test organisms. These are known as "one-hit" or "two-hit" failures. The bioassay-specific guidelines for each of these response categories are listed below. In general, a one-hit failure is a marked response in any one biological test. A two-hit failure is a lower intensity of response. The marked response must be found in two or more biological tests for the test sediment to potentially cause adverse impacts to ecological receptors.

The one-hit and two-hit nomenclature was developed for the Puget Sound Dredged Disposal Analysis program and is used for interpreting marine/estuarine toxicity tests. For freshwater toxicity tests, criteria presented in Table B.7 correspond to one-hit and two-hit failures.

6.2.1 Freshwater Bioassays One-Hit Failure

Amphipod 10-day Survival Bioassay. For the amphipod bioassay, mean test mortality greater than 25 percent over the mean control response, and statistically different from the control (alpha = 0.05), is considered a one-hit failure.

Midge 20-day Survival/Growth Bioassay. For the midge 20-day mortality test, a mean mortality in test sediment of 25 percent over the mean control response, and statistically different from the control (alpha = 0.05), is considered a one-hit failure. For the growth test, a mean reduction in biomass greater than 40 percent and statistically different from control (alpha = 0.05) is considered a one-hit failure.

6.2.2 Freshwater Bioassays Two-Hit Failure

Amphipod 10-day Survival Bioassay*.* For the amphipod bioassay, mean test mortality greater than 10 percent over the mean control response, and statistically different from the control (alpha = 0.05), is considered a two-hit failure.

Midge 20-day Survival/Growth Bioassay*.* For the midge 20-day mortality test, a mean mortality in test sediment of 15 percent over the mean control response, and statistically different from the control (alpha = 0.05), is considered a two-hit failure. For the growth test, a mean reduction in biomass greater than 40 percent and statistically different from control (alpha = 0.05) is considered a two-hit failure.

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7.0 Data Reduction, Validation, and Management

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. QC data resulting from methods and procedures described in this document will also be reported.

7.1 DATA REDUCTION AND LABORATORY REPORTING

The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratories to resolve any QC problems in a timely manner. The analytical laboratories will be required, where applicable, to report the following:

- **Project/Case Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, QC, sample transport/shipment, sample storage, and analytical difficulties. Any problems encountered (actual or perceived) and their resolutions will be documented in as much detail as necessary.
- **Sample IDs.** Records will be produced that clearly match all blind duplicate QA samples with laboratory sample IDs.
- **Chain-of-Custody Records.** Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.
- **Sample Results**. The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identification code and the corresponding laboratory identification code:
    - Sample matrix.
    - Date of sample extraction.
    - Date and time of analysis.
    - Weight and/or volume used for analysis.
    - Final dilution volumes or concentration factor for the sample.
    - Percent moisture in solid samples.
    - Identification of the instrument used for analysis.
    - Method reporting and quantitation limits.

  - Analytical results reported with reporting units identified.
  - All data qualifiers and their definitions.
  - Electronic data deliverables (EDDs).

- **Quality Assurance/Quality Control Summaries.** This section will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (refer to above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.
- **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate Spike Recovery.** All surrogate spike recovery data for organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.
- **Matrix Spike Recovery.** All matrix spike recovery data for metals and organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The RPD for all duplicate analyses will be reported.
- **Matrix Duplicate.** The RPD for all matrix duplicate analyses will be reported.
- **Blind Duplicates.** Blind duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

7.2 DATA VALIDATION

Floyd|Snider will review the laboratory reports for internal consistency, transmittal errors, laboratory protocols, and for adherence to the DQOs as specified in this SAP/QAPP. Data validation of all analytical data will be performed by EcoChem, Inc. A Level III Data Quality Review (Summary Validation) will be performed on all the analytical data, except dioxins, which will have a Level IV, Tier III Data Quality Review (Full Validation).

A Level III Data Quality Review (Summary Validation) includes the following:

- Evaluation of package completeness.
- Verification that sample numbers and analyses match those requested on the Chain-of-Custody Form.
- Review of method-specified preservation and sample holding times.

- Verification that the required detection limits and reporting limits have been achieved.
- Verification that the field duplicates, MS/MSDs, and laboratory control samples were analyzed at the proper frequency.
- Verification of analytical precision and accuracy via replicate analysis and analyte recoveries.
- Verification that the surrogate compound analyses have been performed and meet QC criteria.
- Verification that the laboratory method blanks are free of contaminants.
- Review of instrument performance—initial calibration, continuing calibration, tuning, sensitivity, and degradation.

A Level IV, Tier III Data Quality Review (Full Validation) will be performed for dioxin/furan high-resolution data to ensure appropriate QC requirements and avoidance of false positives. In addition to the above Level III review elements, this review includes the following:

- Evaluation of all QC elements such as sample preservation, analytical holding times, blank contamination, precision, accuracy, and detection limits, consistent with the Compliance Screening Level 1 validation.
- Evaluation of instrument performance and calibration.
- Evaluation of compound identification and quantitation (transcription and calculation).

Data validation will be based on the QC criteria as recommended in the methods identified in this SAP/QAPP and in the National Functional Guidelines for Organic and/or Inorganic Data Review (USEPA 2008 and 2004). The dioxin/furan data will also be evaluated using the *USEPA Region 10 SOP for Validation of Dioxins and Furans* (USEPA 1996).

Data usability, conformance with the DQOs, and any deviations that may have affected the quality of the data, as well as the basis of application of qualifiers, will be included in the final reporting of the data. Any required corrective actions based on the evaluation of the analytical data will be determined by the ARI Project Manager and Data Validator in consultation with the Floyd|Snider QA Manager and may include qualification or rejection of the data.

7.3 BIOASSAY DATA QUALITY REVIEW

A review of the bioassay tests conducted on surface sediment samples collected from Lora Lake is necessary to confirm that appropriate and thorough laboratory testing and documentation procedures were followed. Bioassay test data will be compiled and reviewed for validity using the appropriate guidelines set forth in this SAP/QAPP. Data will be reported according to the established QA/QC procedures described in WSDOE's *Sediment Sampling and Analysis Plan Appendix* (WSDOE 2008). The bioassay laboratory will document and provide an explanation of any exceptions to the established procedures.

The data quality review will compare bioassay testing holding conditions, test setup, test implementation, and test termination to pertinent bioassay protocols. The following test setup procedures will be reviewed: organism procurement, number of organisms, number of replicates, volume of sediment, and general test initiation conditions. The review of test implementation will evaluate daily monitoring variables and summaries of information pertinent to the negative and positive control samples.

7.4 DATA MANAGEMENT

Floyd|Snider owns and maintains a custom database used to store and query environmental chemistry results. This database will be used during the RI/FS Work Plan activities and data will be queried and provided to the Port and uploaded to WSDOE's Environmental Information Management system. All collected field data—soil, groundwater, and bioassay testing results—will be entered into the database. Analytical laboratory data will be received in an EDD format suitable for importation into the database. Both laboratory data qualifiers and external data validation qualifiers are stored in the database. The database is managed and stored in a Structured Query Language Server and subject to electronic backup every 2 hours.

Data will be mapped in ArcGIS v9.3. Furthermore, specialized queries may be written to aid in data analyses. Queried data will be tabulated in Excel spreadsheet format. Excel spreadsheets will be formatted to be compatible with export of data to comma separated values format. All numerical data such as coordinates, concentration values, distances, depths will be entered into the Excel spreadsheet as numbers.

8.0 Corrective Actions

Corrective action procedures are described in this section.

8.1 CORRECTIVE ACTION FOR FIELD SAMPLING

The Floyd|Snider Field QA Officer will be responsible for correcting field errors in sampling or documenting equipment malfunctions during the field sampling effort. The Floyd|Snider QA Manager will be responsible for resolving situations in the field that may result in non-compliance with this SAP/QAPP. All corrective measures will be immediately documented in the field logbook.

8.2 CORRECTIVE ACTION FOR LABORATORY ANALYSES

The laboratory is required to comply with their Standard Operating Procedures and the requirements of the USEPA analytical methods as specified in this SAP/QAPP. The ARI or Nautilus Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SAP/QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If any QC sample exceeds the project-specified control limits, the analyst will identify and correct the anomaly before continuing with the sample analysis. The analyst will document the corrective action taken in a memorandum submitted to the Floyd|Snider QA Manager. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and/or re-extraction) will be submitted with the data package.

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9.0 Soil and Groundwater Sampling Procedures

9.1 SOIL BORING SAMPLING

Soil samples will be collected from soil borings advanced using direct-push technology (e.g., Geoprobe^{TM}). Soil samples will be collected from the proposed boring locations as shown in Figure B.2 of the RI/FS Work Plan. All borings will be monitored and recorded by a field technician. Soil samples will be described and classified according to the United Soil Classification System (USCS) and photographed. When using direct-push technology, soil intervals will be collected continuously using a 4-foot long sampler and continuously logged. Sample interval collection will start at the ground surface and continue until saturated soils are encountered below the water table, at a depth of approximately 20 feet bgs.

Soil samples will be screened to identify intervals potentially contaminated with volatile constituents using a photoionization detector (PID), as described below in Section 9.1.1. Soil will be removed from the 4-foot long sampling tube within the sample interval of interest (e.g., 2–4 feet bgs) and placed into a decontaminated stainless steel bowl for homogenization. Following homogenization, the sample material will be placed into laboratory-supplied sample containers, with the lid tightly sealed, labeled, and placed in a cooler on ice. However, prior to sample homogenization, soil samples will be collected directly from the sampling tube using USEPA Method 5035A for VOC compounds. This preservation method uses a Teflon corer to collect an undisturbed, sealed sample that minimizes loss of volatiles during sampling and transport. Samples will be placed in a cooler and packed with ice. Standard chain-of-custody procedures will be implemented for all sampling events.

As part of sample collection, the following information will be recorded on the soil sample collection form, or boring log:

- Date, time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Soil sample depth and soil description
- Sample recovery
- Presence of debris
- Presence of sheen or any other indications of contamination such as odor

Soil samples will also be collected from the well installation borings advanced with standard HSA techniques using the same soil sampling procedures as those used in the Geoprobe soil borings.

9.1.1 Soil Field Screening Procedures

Soil samples will be field screened to identify potentially contaminated intervals using a PID. The PID will detect parts per million concentrations of total volatile organic contaminants, including VOCs, petroleum hydrocarbons, and the BTEX compounds. The PID reports a total volatile concentration and cannot differentiate between contaminant types. The PID cannot detect non-volatile contaminants, such as dioxin, metals, PCP, or cPAHs. The PID will be calibrated using a two-point calibration of ambient air as a zero point, and isobutylene gas at a concentration of 100 ppm. The instrument will be checked daily, at a minimum, to monitor calibration and will be recalibrated when necessary using the two-point calibration method. PID calibration can be affected by temperature, moisture, and extended exposure to volatile contaminants.

Sample material will be collected from approximately 1-foot intervals using a stainless steel spoon or similar, and placed into a sealed plastic baggie. The soil material will be agitated and then the tip of the PID placed inside the baggie to read VOC concentrations released during agitation. The maximum PID response will be noted on the boring log.

Soil will also be screened for the presence of staining, sheens, odors, or anthropogenic materials such as slag, metal fragments, woody debris, etc. Sheen will be noted by placing a small quantity of sample material in a decontaminated pan or bowl and pouring water onto the sample to see if a sheen forms on the water surface. Photographs of the soil will also be taken. The vertical extent of contamination based on field screening observations will be established by continuously field screening potentially contaminated soil until apparently clean soil is encountered.

9.1.2 Soil Sampling Equipment Decontamination Procedures

Field sampling equipment used in the collection of soil samples from soil borings (i.e., stainless steel bowl and spoons, etc.) will be decontaminated by washing with an Alconox and tap water wash, and rinsing with deionized water. All field sampling equipment will be decontaminated prior to initiating sampling activities, between sampling locations, and following completion of sampling activities. Drilling equipment that directly contacts soil samples will be decontaminated after each exploration with an Alconox wash and deionized water rinse. Auger flights used during well installation and soil sample collection will be cleaned between each boring location by removing any attached soil with brushes, and any remaining visible soil will be removed with high-pressure water or steam. Decontamination equipment needed for drilling equipment will be provided by the drilling subcontractor and will be determined prior to mobilization to the field.

9.2 HAND AUGER SOIL SAMPLING

Secondary off-site shallow surface soil samples for dioxin analyses located along the site property boundary and the four secondary on-site shallow surface soil borings (SSB-13 through SSB-16) will be collected by hand using a hand-held auger where sampling locations are accessible by foot. A hand auger has a cutting end (bit) that advances the device through the subsurface as it is manually turned. A disturbed soil sample is collected and lifted within the auger to the surface for description, field screening, and archival for possible dioxin analysis.

The secondary soil sampling locations are shown in Figure B.2. Secondary dioxin samples will be collected using an auger and/or trowel to scoop the surface intervals of soil (0–0.5 foot and 1.5–2 feet), as measured with a ruler. The soil sample will be visually classified in accordance with USCS, consistent with the procedures used for collecting all other soil samples. The soil descriptions will be recorded on a Soil Boring Log (Attachment B.2) and photographed. The soil will be placed in a decontaminated stainless steel bowl and homogenized until the soil is uniform in color and texture. Appropriate soil sampling containers will be filled with the homogenized soil, the sample labels completely filled out, and the containers stored on ice.

If the required penetration depth or sufficient sample volume cannot be achieved at any of the selected sampling locations, the hole will be relocated within 10 feet of the target location. The new sampling location will be recorded in the field logbook. Field judgment will be used to determine if samples collected from the original boring location will be discarded and replaced with samples from the new location, or if samples collected from both locations will be submitted for laboratory analysis. This determination will be dependent on the soil conditions encountered and sample volume requirements.

As part of sample collection, the following information will be recorded on the soil sample collection form:

- Date, time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Soil sample depth and soil description
- Sample recovery
- Presence of debris
- Presence of sheen or any other indications of contamination such as odor

Decontamination procedures will be conducted for field sampling equipment as described above in Section 9.1.2.

9.3 WELL INSTALLATION AND DEVELOPMENT

9.3.1 Hollow-stem Auger Soil Sampling

During monitoring well installation using a HSA drill rig, split-spoon soil samples will be collected every 2.5 feet from the ground surface to the total boring depth. Each split spoon sample is 1.5 feet in length, and will be geologically logged and field screened according to the methods described above in Sections 9.1 and 9.1.1.

Additional soil intervals may be sampled using the split-spoon sampler if field screening indicates a zone of contamination is present at the bottom of a sampled interval, or if direct-push borings installed in the area indicate contamination may be present at a specific depth interval. Soil samples will be documented on the Well Installation Log Form (Attachment B.3). Soil samples will be described and classified according to the USCS.

9.3.2 Well Installation

Monitoring wells will be installed following the “Minimum Standards for Construction and Maintenance of Wells” from WAC 173-160. Monitoring wells will be completed by Cascade Drilling of Woodinville, Washington. Well locations are shown in Figure B.2. The boreholes for the wells will be drilled using standard HSA techniques. Auger boreholes will be advanced using a 4-inch auger. As discussed in Section 9.3.1 above, split-spoon soil samples will be collected approximately every 2.5 feet during boring installation. The well screen placement will be determined and adjusted in the field as work progresses based on soil samples collected, and inferred groundwater elevations at each well location. The objective is to center the well screen at the groundwater table, within the permeable soils and, if possible, avoid lenses of silt or confining layers.

The monitoring wells will be constructed with screen intervals ranging from approximately 5 to 10 feet and set approximately 10 to 15 feet bgs, depending on field conditions, and previous groundwater elevation data for the surrounding area. Screens will be set to cover the groundwater table seasonal fluctuation, and will be set a few feet above the highest expected groundwater table elevation. Screen lengths will be determined to allow for a minimum of 5 feet of screen to be submerged at the lowest expected groundwater elevation. Screen location will be determined based on previous groundwater table elevation information, seasonal fluctuation data, and groundwater depth at time of drilling. All wells will be constructed of 2-inch diameter, flush-threaded, Schedule 40 PVC well casing and screen. Well screen assemblies will consist of a 5-foot to 10-foot length of 0.020-inch (20-slot), flush-threaded, machine-slotted, Schedule 40 PVC set in a 10/20 sand or equivalent silica sand filter pack. The well design includes a 0.5-foot long flush-threaded, Schedule 40 PVC sump with a flush-threaded end cap. The sand filter pack will be installed by pouring sand into the space between the well casing and auger as the auger is withdrawn. A weighted tape will be used to monitor filter pack placement and depth during installation. The sand filter pack will extend 3 feet above the top of the screened interval. A minimum 2-foot thick seal of hydrated bentonite chips will be installed in the annular space immediately above the sand filter pack and hydrated with potable water if installed above the water table. The remainder of the annular space will be sealed with bentonite grout or hydrated bentonite chips to within 1 foot of the ground surface.

The monitoring wells will be secured with flush-to-ground locking steel protective monuments with expansion seals on the well casing to minimize the potential for rain/surface water entering the monument. Installed wells will be labeled with a permanent marker on the well casing on the well cover of flush mounts. All newly installed monitoring wells will be surveyed by a licensed surveyor.

9.3.3 Well Development

Development activities, including purging and surging, will be performed on each newly installed monitoring well to remove water and fines from the well casing, filter pack, and surrounding formation. This will be done to remove water and fines in the formation disrupted by well installation, and to establish a hydraulic connection between each well and the surrounding water table. The goal of well development is to allow groundwater representative of the formation to flow into the well. Well development will be completed by continuous pumping at a steady rate using a whale pump. Wells will be developed using the described methodologies or equivalents at least 48 hours following well installation. Well development equipment will be decontaminated by pumping clean water through the pump and washing to the satisfaction of the field technical staff.

Low turbidity conditions are desirable during well development and groundwater sampling activities due to the analytical sensitivity and low detection limits associated with dioxin testing. Well development will be completed according to the procedures described below with the goal of achieving the lowest possible turbidity levels that site conditions will allow. Well development will be considered complete when the variation in turbidity (NTU) readings is less than 10 percent, and a minimum of 10 well volumes have been removed. The final turbidity reading and duration of stability will be recorded on the well development log.

The procedures to be used during well development include the following:

1. Upon arriving at each well location, measure the depth to static water level and the depth to the bottom of the well or sediment present at the bottom of the well using a water level indicator with 0.01-inch increments. Record the depth to the water level and total well depth on the Groundwater Sample Collection Form (Attachment B.4).
2. Calculate the volume of water within the well casing for the well by multiplying the height of the observed water column by the volume of water contained

within one linear foot of the well casing (i.e., there are 0.016 gallons of water per foot for a 2-inch inside diameter PVC well casing). Record the volume of water within the well casing on the Groundwater Sample Collection Form.

3. Attach 0.5 inch disposable PVC tubing to a submersible 12-Volt electric pump and lower the pump to the bottom of the well. Engage the pump, and pump purge water into a 5-gallon bucket to determine and adjust the purge rate. Visually examine the water and observe the fines (i.e., silt and sand) content in the water, evaluate for the presence of an odor, and collect field measurements of turbidity. Agitate the pump at the bottom of the well during purging to entrain and facilitate the removal of sand and sediment that has accumulated in the end cap during well installation. Record all visual observations and turbidity readings (including time) on the Groundwater Sample Collection Form.
4. Remove the submersible pump when the turbidity in well purge water begins to improve and lower a solid PVC surge rod into the well using disposable poly rope. Surge the well again by repeatedly raising and lowering the surge rod along the length of the screened interval to push water through the screen and into the filter pack.
5. Following surging, place the pump back into the well and position it at varying depths in the water column to promote lateral groundwater inflow at various elevations throughout the length of the screened interval. Perform this procedure to flush the sand pack.
6. Well development will be considered complete when the variation in successive turbidity readings drops below 10 percent, turbidity readings are at their lowest levels, and a minimum volume of water equal to 10 times the volume of water within the well casing has been purged. In cases where turbidity readings do not stabilize or satisfy the 10 percent criterion following removal of 10 times the volume of water in the well casing, development will be considered complete when the well discharge appears to reach a relatively steady-state turbidity.
7. Upon completion of well development, record a final depth to static water level, final turbidity measurement, and depth to the bottom of the well on the Groundwater Sample Collection Form.
8. Between development of monitoring wells, decontaminate the non-disposable equipment including the submersible pump, surge block, and water level indicator using a three-step decontamination process consisting of an Alconox solution wash, potable water rinse, and final de-ionized water rinse. Use new lengths of disposable poly rope and PVC tubing at each well location and discard after use.

All purge water and decontamination water generated during well development activities will be collected into 55-gallon drums that will be labeled to indicate date of generation, monitoring well source, and volume of contents. The drums containing purge water will be stored on-site pending disposal as described below in Section 11.0.

9.4 EXISTING WELL CONDITIONS CHECK

Prior to the first quarterly monitoring event, all previously installed monitoring wells will be measured for accumulation of solids in the well and groundwater turbidity. Wells identified to contain a measurable volume of solids and/or elevated turbidity readings will be redeveloped to remove solids from the well casing and surrounding sand pack prior to sampling. The existing well conditions check will be consistent with the following activities to be conducted by field staff:

1. Upon arriving at each well location, measure the depth to static water level and the depth to the bottom of the well or sediment present at the bottom of the well using a water level indicator with 0.01-inch increments. Record the depth to the water level and total well depth in the field notebook.
2 Compare the total well depth measured to the total well depth recorded on the monitoring well installation log.
3. If the measured depth varies from the total well depth recorded on the monitoring well installation log by more than 0.2-feet, or if the bottom of the well feels soft when the water level indicator is dropped to the bottom of the well, redevelop the well according to the methods described in Section 9.3 above.
4. Complete a Groundwater Sample Collection Form as described above (Attachment B.4).

9.5 GROUNDWATER SAMPLING

Groundwater samples will be collected from all monitoring wells during the three quarterly monitoring events. After the additional monitoring wells are installed and developed in the northeast corner and the existing wells redeveloped, if necessary, all monitoring wells will be sampled to confirm the absence or presence of contaminants previously detected in on-site and off-site downgradient monitoring wells. Monitoring wells will be purged and sampled using low-flow procedures with a peristaltic pump and disposable polyethylene tubing.

The following field sampling procedures will be completed during collection of groundwater samples.

9.5.1 Measuring Depth to Water

1. Open protective casing. Observe and note on the field log the condition of monument/well.

2. Decontaminate well sounder by rinsing with deionized water.
3. Drop water level indicator into well and determine water level by means of LED or beeper. Measure mark on the probe to the nearest 0.01 foot using a tape measure. Record this value, with date and time, on the Groundwater Sample Collection Form as the static depth to water.

9.5.2 Purging Monitoring Wells

1. Lower a low-flow peristaltic pump into the well, centered on the well's submerged screen interval.
2. Begin purging the well. All purge water will be containerized and property disposed of according to state and federal regulations (refer to Section 11.0).
3. Purge the well at low-flow rates not to exceed 0.5 liter per minute.
4. Adjust the pump controller to achieve an acceptable purge rate.
5. During purging, record field parameters (temperature, pH, dissolved oxygen, conductivity, salinity, and turbidity) in the purge water at 3- to 5-minute intervals with a multi-parameter groundwater meter. Record the time and parameter values and purge rate on the Groundwater Sample Collection Form for each set of readings. If the field measurements for turbidity, dissolved oxygen, and conductivity are approximately stable (within 10 percent) for three consecutive readings, the groundwater sample will be collected. If dissolved oxygen is less than 5 mg/L, three consecutive readings within 1 mg/L will be considered stable. Should the turbidity readings be negative values, the measurement will be recorded as less than 1 (<1). Depth to water will be measured and recorded during the first 5 minutes of purging to calculate drawdown, as discussed above. Because these field parameters (particularly turbidity) may not reach these stringent stabilization criteria at a particular well, collection of each groundwater sample will be based on the field personnel's best professional judgment at the time of sampling. The last set of field parameters measured during purging will represent field parameters for the groundwater sample.
6. Record all field measurements and observations legibly on the Groundwater Sample Collection Form (Attachment B.4).

9.5.3 Sample Collection

1. After purging the well and labeling the bottles, collect the groundwater sample by directly filling the lab-provided bottles from the pump discharge line (maintain same flow rate as purging). In this way, only dedicated (disposal) tubing will be used in sampling and there will be no need for equipment decontamination (other than the water level indicator). The specific bottles to

be filled for each chemical analysis will be communicated by the laboratory, and is listed in Table B.3.

2. Immediately place all labeled, filled bottles in coolers packed with ice.
3. Samples collected for dissolved metals analysis will be filtered at the laboratory.

9.5.4 Sampling Equipment Decontamination Procedures

All non-disposable equipment, including the water level indicator used for sample collection, will be decontaminated between well locations using a three-step decontamination process consisting of an Alconox solution wash, potable water rinse, and final deionized water rinse. Field technician nitrile gloves will be disposed of after completion of groundwater sampling at each monitoring well and prior to moving to the next well location.

9.6 MONITORING WELL SLUG TEST

After completing the installation and development of the new monitoring wells and redevelopment of the existing wells in the monitoring well network, slug tests will be conducted at each well location to estimate the aquifer hydraulic conductivity in the vicinity of the well. Hydraulic conductivity data are being collected to assist with future evaluation of groundwater contaminant migration and potential transport modeling, if determined to be necessary.

Hydraulic conductivity information for the groundwater table will be collected through completion of slug tests in each on-site and off-site (downgradient) monitoring well. Water levels in monitoring wells will be recorded using a combination of pressure transducers with internal data loggers and a manual electronic water level indicator. The data collection will include continuous (every half a second) transducer-based water level measurements in wells located on-site (MW-01 through MW-06 and MW-12 through MW-14), and in off-site wells (MW-07 through MW-11). The data logger will be programmed to automatically convert pressure changes to water levels. If possible, a vented transducer will be used that internally corrects for fluctuations in atmospheric pressure.

Slug tests will be performed using a PVC slug rod, a down-hole pressure transducer as described above, and a water level indicator in general accordance with ASTM D 4044-96 (2000). The general procedure for conducting the slug tests in monitoring wells is summarized below:

1. Measure the static depth of groundwater at each monitoring well, as described in Section 9.5.1, before the pressure transducer is placed near the bottom of the well.

2. After stabilization of the groundwater level (from the displacement of the transducer), lower the slug rod into the well until it is submerged in the water column.
3. Monitor the recovery of the perturbed water level until it has returned to within 95 percent of the initial head indicated by the transducer prior to the introduction of the slug rod.
4. Once the water level has re-equilibrated, quickly remove the slug from the water column and monitor the groundwater level for recovery.
5. After the water level has recovered to within tolerance (95 percent), manually measure again the depth to groundwater, remove the transducer, and secure the well.

The slug test response data will be analyzed using the Bouwer and Rice method (Bouwer and Rice 1976, Bouwer 1989).

9.7 SURVEYING

All primary on-site soil boring locations, and newly constructed monitoring well locations will be surveyed for reference and mapping purposes after soil boring installation and monitoring well construction. Secondary on-site and off-site shallow dioxin soil boring locations may also be surveyed, or will be located during installation using a sub-meter global positioning system (GPS) unit. Soil borings and monitoring wells will be surveyed according to the requirements specified in the Agreed Order:

- Survey boring locations to a horizontal and vertical closure of 1:5,000.
- Survey monitoring well locations to a vertical closure of 1:10,000.
- Survey monitoring well casing elevations to an accuracy of within 0.01 foot.

Site mapping will be conducted using the Washington State Plane North Coordinate System. Survey data will be included in the data report.

10.0 Sediment Sampling Procedures

This section describes the sample collection and processing procedures for surface sediment (0 to 10 cm) sampling. The sediment sampling procedures and analyses will be performed in accordance with the following:

- WSDOE's *Sediment Sampling and Analysis Plan Appendix* (WSDOE 2008).
- PSEP guidelines (PSEP 1997).

Proposed surface sediment sampling locations are identified in Figure B.3. All sampling and handling procedures presented in this SAP/QAPP may be subject to modification in the field to meet the objectives of this investigation and will be documented in field logs and in the RI/FS Data Report. All modifications must be approved by WSDOE. Prior approval is desirable, but changes may be made in the field if necessary and submitted for subsequent WSDOE approval.

10.1 POSITIONING AND LOCATION CONTROL

Positioning and navigation for sediment sample locations will be accomplished with a Real Time Kinematic differential GPS that will be used on board the sampling vessel. Positioning data will be collected using a Trimble Pro-XRS DGPS unit with sub-meter accuracy (uncorrected). Water depths will be measured directly by lead-line for sediment samples collected from the vessel. The positioning system will be calibrated over a known coordinate prior to the initiation of field activities. Horizontal data will be analyzed using the North American Datum 1983 High Accuracy Reference Network, Washington State Plane Coordinates North Zone in feet.

Lora Lake is a small, shallow, urban freshwater lake, which requires use of a small inflatable boat for sample collection. Therefore, vertical sounding measurements cannot be collected to determine lake depth and instead lead line measurements will be made at each sampling location and along transects throughout the lake to gain a better understanding of the bathymetry of Lora Lake, as described below in Section 10.3.

10.2 DIVER-ASSISTED HAND CORING AND SAMPLE PROCESSING PROCEDURES

Diver-assisted sediment sampling will be performed due to the shallow depth of Lora Lake and restricted vessel access. An inflatable boat will be walked to the lake entry and will contain all diver equipment and sediment sampling equipment. The inflatable sampling vessel will be positioned at the proposed sampling location using the positioning and location control procedures as described above. Sediment grab sample processing will occur on a second inflatable boat.

Sediment samples will be collected using either a 7-inch or a 14-inch diver-assisted hand corer. The diver-assisted hand corer, commonly referred to as a “cookie cutter” will be inserted into the upper 10 cm of the sediment column and brought to the surface for sample processing. If the required penetration depth or sufficient sample volume cannot be achieved at any of the selected sampling locations, a new sampling location will be selected. The new sampling location will be as close to the proposed sampling location as possible and recorded on the Surface Sediment Sample Collection Form (Attachment B.5). The sediment sample will be visually classified in accordance with ASTM D 2488. The sediment descriptions, along with the sampling time, sampling coordinates, and diver notes will be recorded on a Surface Sediment Sample Collection Form (Attachment B.5). Sediment samples will also be photographed.

Based on the volume of sediment required for the bioassay tests and conventional analyses, multiple surface sediment grabs will be required at each sampling location. The sediment grab samples from each target location will be combined in a decontaminated stainless steel bowl and homogenized to a uniform appearance after removal of unrepresentative materials (e.g., woody debris, rocks). This composite sediment sample from each location will be used for the bioassay tests and conventional analyses.

Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completely filled out, and the containers stored on ice. The chain-of–custody, sample handling, and transport procedures for these sediment samples are described in Sections 4.3 and 4.5, above.

10.2.1 Sediment Equipment Decontamination Procedures

Field sampling equipment, such as the stainless steel hand core sampler, stainless steel bowl and spoon, will be cleaned before loading on the vessel and between each sampling location. Equipment for reuse will be decontaminated aboard the second inflatable boat in decontamination bins according to the procedure below.

1. Spray clean tap water over equipment to dislodge and remove any remaining sediments.
2. Scrub surfaces of equipment contacting sample material with brushes using an Alconox solution in a bin.
3. Rinse scrubbed equipment with clean tap water.
4. Spray equipment with a final rinse of deionized water to remove tap water impurities.

Acid or solvents will not be used in the field during the Remedial Investigation Supplemental Site Investigation for the following reasons:

- The potential safety hazards associated with handling these materials.

- Environmental concerns posed by disposal or spillage of acids and solvents during field activities aboard the vessel.
- The residue of solvents or acids on sampling equipment may affect sample integrity for laboratory analysis.

10.3 LORA LAKE BATHYMETRY SURVEY METHODS

Little is known about the existing bathymetry of Lora Lake. To gain a better understanding of the bathymetry of Lora Lake, as part of the surface sediment sample collection field event, multiple transects will be conducted throughout the lake to measure water depths. Two inflatable sampling vessels will be used to run depth measurement transects along both north-south and east-west alignments within Lora Lake. It is anticipated that seven transects will be run in the north-south direction, and five transects will be run in the east-west direction. Water depths will be measured directly from the sampling vessels by lead line. The lead-line-measured water depths and GPS coordinates collected along each transect will be recorded in a field notebook. The tabulated water depth measurements and GPS coordinates will then be used to prepare an interpolated Lora Lake bathymetry map using ArcGIS with the 3-D Analyst Extension. In addition to bathymetry, to the degree possible, details regarding the location, pipe length, pipe diameter, invert elevation, and slope of the discharge pipe to Miller Creek, and the stormwater inlet pipe to Lora Lake will be documented, and included in future mapping. This information will be collected during diver surface sediment sample collection.

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11.0 Waste Management

With the exception of waste PPE, all investigation-derived waste (IDW) generated during this investigation will be containerized, sealed, labeled, and retained on-site in WSDOT-approved 55-gallon drums. The drums will be labeled as non-hazardous waste until waste characterization is conducted, confirming the waste material classification. All waste derived during the Remedial Investigation Supplemental Site Investigation will be disposed of by the Port in accordance with appropriate state and federal regulations. Soils will be transported in 55-gallon drums to a USEPA-approved disposal facility for treatment or direct land disposal, depending on laboratory analytical results and waste characterization by a licensed waste hauler.

As drums containing soil drill cuttings and decontamination water are generated, they will be placed in a paved and secured area of the Site within the fenced site perimeter. The drums will be stored temporarily on-site until the waste is properly characterized for disposal, profiled, and manifested using the Remedial Investigation Supplemental Site Investigation analytical data in combination with existing data.

All drums containing soil drilling cuttings and decontamination water generated during the Remedial Investigation Supplemental Site Investigation will be transferred from the Site by a licensed disposal facility for treatment and/or disposal.

IDW drum labels will include the following information:

- Drum contents and source (i.e., drill cuttings PSB-1, decontamination water).
- Date generated.
- Generator contact information and phone number.
- Waste classification (i.e., non-hazardous).

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12.0 Data Reporting

The Lora Lake Apartments Draft RI/FS will document activities associated with the collection, transportation, and laboratory analysis of soil, bioassay, sediment, and groundwater samples. The report will include the following:

- A description of the purpose and goals of the investigation.
- A summary of the field sampling and laboratory analytical procedures, referencing this SAP/QAPP and identifying any deviations resulting from field conditions.
- A general vicinity map showing the location of the Site and Lora Lake, and a sampling location map. Coordinates (i.e., latitude and longitude and state plan coordinates) for the sampling locations will be reported in an accompanying table.
- Data tables for all media summarizing the chemical and conventional analytical results, bioassay test results, as well as pertinent QA/QC data. The data tables will include sample location numbers, sample IDs, dates of sample collection, depth of sample collection, and whether the sample was a duplicate or other QC sample.
- QA reports and laboratory data reports as appendices or attachments.
- Copies of field logs and Chain-of-Custody Forms as appendices or attachments.
- The RI field sampling results will be used to update or revise the conceptual site model as needed. The results will also be evaluated relative to potential contamination sources.
- All analytical results will be compared to Site cleanup levels proposed in the Draft RI/FS in coordination with WSDOE.

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13.0 References

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Port of Seattle
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Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Tables

PUBLIC REVIEW DRAFT

Table B.1
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit/PQL	Precision	Accuracy	Completeness	Reference
Groundwater Samples							
Carcinogenic Polycyclic Aromatic Hydrocarbons	Water	µg/L	0.01	± 50%	± 60%	95%	USEPA Method 8270D-SIM–Low Level
Pentachlorophenol	Water	µg/L	0.25	± 50%	± 60%	95%	USEPA Method 8041
Total Petroleum Hydrocarbons Diesel Range Heavy Oil Range Gasoline Range	Water	mg/L	Diesel: 0.25 Oil: 0.50 Gas: 0.25	± 50%	± 60%	95%	NWTPH-Dx NWTPH-Dx NWTPH-G
Benzene, Toluene, Ethylbenzene, Xylene	Water	µg/L	0.25	± 50%	± 50%	95%	USEPA Method 8021–Low Level
Arsenic (As) and Lead (Pb), Dissolved	Water	µg/L	As: 0.2 Pb: 1.0	± 50%	± 50%	95%	USEPA Method 200.8
Dioxin/Furans	Water	pg/L	5–50	± 30%	± 30%	95%	USEPA Method 1613
Volatile Organic Compounds Tetrachloroethene Trichloroethene 1,2-Dichloroethane	Water	µg/L	0.02	± 50%	± 50%	95%	USEPA Method 8260C-SIM
Total Suspended Solids	Water	mg/L	1.0	± 20%	± 25%	95%	SM 2540D
pH	Water	pH units	0.01	± 25%	± 20%	95%	USEPA Method 150.1
Soil Samples							
Carcinogenic Polycyclic Aromatic Hydrocarbons	Soil	µg/kg	20	± 50%	± 60%	95%	USEPA Method 8270D
Pentachlorophenol	Soil	µg/kg	6.25	± 50%	± 60%	95%	USEPA Method 8041

Table B.1
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit/PQL	Precision	Accuracy	Completeness	Reference
Soil Samples (continued)							
Total Petroleum Hydrocarbons Diesel Range Heavy Oil Range Gasoline Range	Soil	mg/kg	Diesel: 5 Oil: 10 Gas: 5	± 50%	± 50%	95%	NWTPH-Dx NWTPH-Dx NWTPH-G
Benzene, Toluene, Ethylbenzene, and Xylene	Soil	µg/kg	25	± 50%	± 50%	95%	USEPA Method 8021
Arsenic (As) and Lead (Pb)	Soil	mg/kg	As: 5.0 Pb: 2.0	± 20%	± 25%	95%	USEPA Method 6010
Dioxin/Furans	Soil	ng/kg	0.5–5	± 30%	± 30%	95%	USEPA Method 1613
Volatile Organic Compounds Tetrachloroethene Trichloroethene 1,2-Dichloroethane	Soil	µg/kg	1.0	± 50%	± 50%	95%	USEPA Method 8260C
Total Organic Carbon	Soil	mg/kg or %	200 or 0.02	± 20%	± 20%	95%	Plumb 1981

Notes:

1 All reporting limits shown are method PQLs from Analytical Resources, Inc. laboratory in Tukwila, Washington.

Abbreviations:

As	Arsenic
Pb	Lead
PQL	Practical Quantitation Limit
SIM	Select ion monitoring
USEPA	U.S. Environmental Protection Agency

Table B.2
Laboratory Performance Standards for Bioassay Tests

Toxicity Test & Species (Measurement Endpoint)	**Number of Laboratory Replicate Jars**	**Number of Organisms Per Jar**	**Frequency of Water Quality Monitoring**		**Recommended Control Limits**				**Performance Standards**	
			Overlying Water Temperature, Conductivity, Dissolved Oxygen, pH	**Sulfides, Ammonia, Hardness, Alkalinity**	**Temp (ºC)**	**Conductivity/ Salinity**	**Dissolved Oxygen (Percent Saturation)**	**Water Renewal**	**Negative Control**	**Ongoing Positive Control Charts**
Amphipod *Haylelia azteca* 10-day acute (Mortality)	8	10	Daily	Beginning/ Day 5/ End	20 ± 1	< 15 ppt	> 2.5 mg/L	2 times daily	< 20% mortality	± 2 SD
Larval Midge *Chironomus dilutus* 20-day chronic (Mortality & Growth)	8	12	Daily	Beginning/ Days 5, 10, & 15/ End	20 ± 1[1]	NA	> 2.5 mg/L	2 times daily	< 30% mortality; and mean dry weight per organism > 0.6 mg/ surviving organism or recommended equivalent 0.48 mg AFDW/surviving organism (ASTM 2000)	± 2 SD

Notes:
1 Lower temperature recommended by laboratory to prevent early emergence of pupae. USEPA method-specified 23ºC is often too high for chronic tests (USEPA 2000).
2 Initial light reading is taken after completion of the 5-minute incubation period (after combination of bacterial solution). Time 5 and Time 15 minute readings are taken after Time 0 reading.

Abbreviations:

AFDW	Ash free dry weight
ASTM	American Society of Testing and Materials
SD	Standard deviation
USEPA	U. S. Environmental Protection Agency

Table B.3
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Groundwater Samples				
Carcinogenic Polycyclic Aromatic Hydrocarbons Pentachlorophenol	USEPA 8270D-SIM-Low Level USEPA 8041	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 to analyze
Total Petroleum Hydrocarbons—Heavy Oil Range and Diesel Range	NWTPH-Dx	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 to analyze
Total Petroleum Hydrocarbons—Gasoline Range	NWTPH-G	(2) 40-mL amber glass vials[1]	HCL to pH <2.0, cool to 4°C	14 days to analyze
Benzene, Toluene, Ethylbenzene, and Xylene	USEPA 8021	(2) 40-mL amber glass vials[1]	HCL to pH <2.0, cool to 4°C	14 days to analyze
Arsenic, Lead, Dissolved	USEPA 200.8	(1) 500-mL HDPE	Laboratory filtered and preserved, cool to 4°C	6 months
Dioxin/Furans	USEPA 1613	(2) 1-L amber glass	None, cool to 4°C	1 year
Volatile Organic Compounds[2]	USEPA 8260C-SIM and 8260C	(4) 40-mL VOA vials[1]	HCl to pH <2, cool to 4°C	14 days to analyze
Total Suspended Solids	SM2540D	(1) 1-L HDPE	None, cool to 4°C	7 days
pH	USEPA 150.1	(1) 500-mL HDPE	None, cool to 4°C	Analyze Immediately
Soil Samples				
Carcinogenic Polycyclic Aromatic Hydrocarbons Pentachlorophenol	USEPA 8270D USEPA 8041	(2) 8 oz WMG (1) 4 oz WMG	None, cool to 4°C	14 days to extract, then 40 days to analyze (or freeze for 1 year)

Table B.3
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Soil Samples (continued)				
Total Petroleum Hydrocarbons—Heavy Oil Range and Diesel Range	NWTPH-Dx		None, cool to 4˚C	
Arsenic and Lead	USEPA 6010		None, cool to 4˚C	6 months
Total Petroleum Hydrocarbons—Gasoline Range	NWTPH-G	(2) 40ml VOA vials[3]	MeOH, cool to 4˚C	14 days to analyze
Benzene, Toluene, Ethylbenzene, Xylene	USEPA 8021			
Dioxin/Furans	USEPA 1613	(1) 8-oz WMG	None, cool to 4˚C	1 year
Volatile Organic Compounds[2]	USEPA 8260C	(3) 40ml VOA vials[3]	(2) vials with sodium bisulfate, (1) vial with MeOH, cool to 4˚C	14 days to analyze
Total Organic Carbon	Plumb 1981	(1) 4-oz WMG	None, cool to 4˚C	14 days to prep, then 6 months to analyze (or freeze for 1 year)
Sediment Bioassay Toxicity Tests				
10-day acute amphipod (*Hyalella azteca)* for mortality 20-day chronic midge (*Chironomus dilutus*) for mortality and growth	USEPA, ASTM	(4) 1-liter glass	Cool ≤ 4ºC, not frozen	8 weeks

Table B.3
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Sediment Samples for Conventionals Analyses				
Ammonia	350.1	4-oz. WMG	Cool ≤ 6ºC, pH <2 with 2 ml 9N H_2SO_4	7 days
Total Solids	PSEP	4-oz. WMG	Cool ≤ 4ºC Freeze	14 days, 6 months
Total Sulfides	PSEP/SM4500-S2	2-oz. WMGS	Cool ≤ 4ºC, 1N Zinc Acetate[1]	7 days
Grain Size	PSEP	16-oz HDPE	Cool ≤ 4ºC	6 months
Total Organic Carbon	USEPA 9060	4-oz WMG	Cool ≤ 4ºC, Freeze	14 days to prep, then 6 months (or freeze for 1 year)

Notes:
1 No head space in sample container.
2 Tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene 1,2-dichloroethane.
3 Soil samples for volatile organic compound analyses collected using USEPA Method 5035A with a soil Teflon corer.

Abbreviations:

ASTM	American Society of Testing and Materials
PSEP	Puget Sound Estuary Program
SIM	Select ion monitoring
USEPA	U. S. Environmental Protection Agency
WMG	Wide-mouth glass jar
WMGS	Wide-mouth glass jar with septa
HDPE	High-density polyethylene

Table B.4
Remedial Investigation Supplemental Site Investigation Analytical Program and Sample Numbers[1]

Supplemental Investigation and Sampling Depths	Site Contaminant of Concern Analyses												
			TPH										
	cPAH	PCP	Diesel Range	Heavy Oil Range	Gasoline Range	BTEX	Arsenic	Lead	Dioxins	VOCs[2]	TOC	TSS	pH
Shallow Soil Dioxin Investigation—Primary On-site Borings PSB-1 to PSB-8 (Work Plan Section 8.2.1.1)													
0–0.5 feet bgs									8				
1.5–2 feet bgs									8X				
2–4 feet bgs									8—archived[3]				
4–6 feet bgs									8—archived[3]				
Shallow Soil Dioxin Investigation—Secondary Off-site and Secondary On-site Borings SSB-1 to SSB-16 (Work Plan Sections 8.2.1.2 and 8.2.2)													
0–0.5 feet bgs									16—archived[4]				
1.5–2 feet bgs									16—archived[4]				
Central and Eastern Source Area Investigation—Primary Borings PSB-9 to PSB-18 (Work Plan Section 8.3)													
0–0.5 feet bgs	10	10	10	10	10	10	10	10	10	10			
1.5–2 feet bgs	10	10	10	10	10	10	10	10	10	10			
2–4 feet bgs	10	10	10	10	10	10	10	10	10	10			
4–6 feet bgs	10	10	10	10	10	10	10	10	3 7—archived[3,5]	10			
Fill / native soil contact where distinguishable	10	10	10	10	10	10	10	10	3 7—archived[3,5]	10	10		
Groundwater Table	10	10	10	10	10	10	10	10	3 7—archived[3,5]	10	10		
Northeast Corner Petroleum Investigation—Primary Borings PSB-19 to PSB-21 (Work Plan Section 8.4.1)													
0–0.5 feet bgs	3	3					3	3	3	3			
1.5–2 feet bgs	3	3					3	3	3	3			
2–4 feet bgs	3	3					3	3	3—archived[3]	3			
4–6 feet bgs	3	3					3	3	3—archived[3]	3			
Above Groundwater Table			3	3	3	3							
Groundwater Table	3	3	3	3	3	3	3	3		3	3		
Below Groundwater Table	3	3	3—Field Screening			3	3	3		3	3		
Highest Field Indication of Contamination[6]			3—Field Screening										
Northeast Corner Petroleum Investigation—Well Installation Borings MW-12 to MW-14 (Work Plan Section 8.4.2)													
0–0.5 feet bgs									3				
1.5–2 feet bgs									3X				
2–4 feet bgs									3—archived[3]				
4–6 feet bgs									3—archived[3]				
Above Groundwater Table	3	3	3	3	3	3	3	3		3	3		
Groundwater Table	3	3	3	3	3	3	3	3		3	3		
Below Groundwater Table	3	3	3	3	3	3	3	3		3	3		
Highest Field Indication of Contamination[6]	3	3	3	3	3	3	3	3		3			
Site-wide Groundwater Quality Investigation—Groundwater Monitoring Events (Section 8.5) MW-1 to MW-14													
All Three Monitoring Events	42	42	42	42	42	42	42		42	42		42	42

Notes:
1. The sample numbers presented above do not include QC samples such as field duplicates or MS/MSD sample volumes. Refer to Table B.3 for actual sample volume and container requirements and Section 3.7 of the SAP/QAPP for QC sample requirements. Coordinate with the analytical laboratory for appropriate MS/MSD sample volume requirements.
2. Tetrachloroethene, trichloroethene, 1,2-dichloroethane
3. The lower two soil sample intervals will be archived immediately following collection. Completion of dioxin analyses on these samples is contingent on sample results of top intervals.
4. Soil samples will be archived immediately following collection. Dioxin analyses will be contingent on adjacent sample results for on-site borings.
5. Dioxins will be analyzed and not archived in all sample intervals for Primary Borings PSB-15, PSB-16, and PSB-17, located adjacent to MW-4 and MW-5.
6. The highest field indication of contamination interval may be one of the upper four identified sample intervals, and will be determined in the field based on field screening indications.

Abbreviations:

bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylene
cPAH	Carcinogenic polycyclic aromatic hydrocarbons
PCP	Pentachlorophenol
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
VOC	Volatile organic compounds

Table B.5
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Analysis Method	Detection Limit	Reporting Limit (PQL)[1]
Groundwater Samples			
Carcinogenic Polycyclic Aromatic Hydrocarbons	USEPA Method 8270D-SIM–Low Level	0.002–0.006 µg/L	0.01 µg/L
Pentachlorophenol	USEPA Method 8041	0.036 µg/L	0.25 µg/L
Total Petroleum Hydrocarbons			
Diesel Range	NWTPH-Dx	Diesel: 0.03 mg/L	Diesel: 0.25 mg/L
Heavy Oil Range	NWTPH-Dx	Oil: 0.03 mg/L	Oil: 0.50 mg/L
Gasoline Range	NWTPH-G	Gas: 0.033 mg/L	Gas: 0.25 mg/L
Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)	USEPA Method 8021–Low Level	B: 0.013 µg/L E: 0.06 µg/L T: 0.07 µg/L X: 0.19 µg/L	0.25 µg/L
Arsenic (As) and Lead (Pb), Dissolved	USEPA Method 200.8	As: 0.03 µg/L Pb: 0.13 µg/L	As: 0.2 µg/L Pb: 1.0 µg/L
Dioxin/Furans	USEPA Method 1613	0.3–2 pg/L	5–50 pg/L
Volatile Organic Compounds (PCE, TCE, 1,2-DCA)	USEPA Method 8260C -SIM	PCE: 0.0059 µg/L TCE: 0.0022 µg/L 1,2-DCA: 0.05 µg/L	0.02 µg/L
Total Suspended Solids	SM 2540D	NA	1.0 mg/L
pH	USEPA Method 150.1	NA	0.01 pH units
Soil Samples			
cPAHs	USEPA Method 8270	7–14 µg/kg	20 µg/kg
Pentachlorophenol	USEPA Method 8041	2.49 µg/kg	6.25 µg/kg

Table B.5
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	**Analysis Method**	**Detection Limit**	**Reporting Limit (PQL)[1]**
Soil Samples (continued)			
Total Petroleum Hydrocarbons			
Diesel Range	NWTPH-Dx	Diesel: 0.3 mg/kg	Diesel: 5 mg/kg
Heavy Oil Range	NWTPH-Dx	Oil: 0.7 mg/kg	Oil: 10 mg/kg
Gasoline Range	NWTPH-G	Gas: 2.25 mg/kg	Gas: 5 mg/kg
Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)	USEPA Method 8021	B: 7.6 µg/kg, E: 8.0 µg/kg T: 3.4 µg/kg, X: 6.8–7.4 µg/kg	25 µg/kg
Arsenic (As) and Lead (Pb)	USEPA Method 6010	As: 0.052 mg/kg Pb: 0.20 mg/kg	As: 5.0 mg/kg Pb: 2.0 mg/kg
Dioxin/Furans	USEPA Method 1613	0.02–0.17 ng/kg	0.5–5 ng/kg
Volatile Organic Compounds (PCE, TCE, 1,2-DCA)	USEPA Method 8260C	PCE: 0.40 µg/kg TCE: 0.51 µg/kg 1,2-DCA: 0.35 µg/kg	1.0 µg/kg
Total Organic Carbon	Plumb 1981	0.0029 % (29 mg/kg)	0.02 % (200 mg/kg)

Notes:

1 All reporting limits shown are method PQLs from Analytical Resources Inc. laboratory in Tukwila, Washington.

Abbreviations:

1,2-DCA	1,2-Dichloroethane
As	Arsenic
BTEX	Benzene, toluene, ethylbenzene, xylene
Pb	Lead
PCE	Tetrachloroethene
PQL	Practical Quantitation Limit
TCE	Trichloroethene
USEPA	U. S. Environmental Protection Agency

Table B.6
Toxic Equivalency Factors for Chlorinated Dibenzo-p-dioxin and Chlorinated Dibenzofuran Congeners[1]

CAS Number	Congener	TEF (unitless)
Dioxin Congeners (CDDs)		
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)	1
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-HxCDD)	0.1
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-HxCDD)	0.1
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-HxCDD)	0.1
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD)	0.01
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (1,2,3,4,6,7,8,9-OCDD)	0.0003
Furan Congeners (CDFs)		
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	0.1
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF)	0.03
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8- PeCDF)	0.3
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	0.1
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8- HxCDF)	0.1
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9- HxCDF)	0.1
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF)	0.1
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF)	0.01
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF)	0.01
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (1,2,3,4,6,7,8,9-OCDF)	0.0003

Note:

1 2005 World Health Organization Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds (Van den Berg et al. 2006).

Abbreviations:

CDD	Chlorinated dibenzo-p-dioxin
CDF	Chlorinated dibenzofuran
TEF	Toxic equivalency factor

Table B.7
Interpretive Criteria and Performance Standards for Freshwater Bioassay Tests[1]

Toxicity Test	Negative Control Performance Standard	1-Hit Criteria	2-Hit Criteria
Hyalella azteca 10-day mortality	C ≤ 20%	T – C > 25% and T vs. C SS (p = .05)	T – C > 10% and T vs. C SS (p = .05)
Chironomus dilutus 20-day mortality	C ≤ 32%	T – C > 25% and T vs. C SS (p = .05)	T – C > 15% and T vs. C SS (p = .05)
Chironomus dilutus 20-day growth	CF ≥ 0.48 mg/ind	T/C < 0.6 and T vs. C SS (p = .05)	T/C < 0.75 and T vs. C SS (p = .05)

Note:

1 Interpretive criteria and performance standards are based on the Sediment Evaluation Framework for the Pacific Northwest (RSET 2009) criteria with the modification of comparison of test results to the negative control rather than reference results due to lack of freshwater reference areas.

Abbreviations:

C	Control
CF	Control final
ind	Individual
p	Significance level
R	Reference
RF	Reference final
T	Test sample
SS	Statistically significant
Ind	Individual organism

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Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Figures

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Notes:
- Map created using ArcGIS Online World Street Map.

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Remedial Investigation/
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Figure B.1
Lora Lake Apartments Site

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Date: 3/24/2010

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Legend

Proposed RI Supplemental Boring Locations

PSB-4	Primary Shallow Soil Dioxin Investigation Borings – Samples Analyzed for Dioxins Only (8).
PSB-10	Primary Central and Eastern Source Area Investigation Boring – Samples Analyzed for All Site COCs (10).
PSB-19	Primary NE Corner Petroleum Investigation Boring – Samples Analyzed for All Site COCs (3)[1]
SSB-6	Secondary Shallow Soil Dioxin Investigation Boring – Samples Archived for Potential Dioxins Analysis (13).
SSB-10	Secondary Shallow Soil Investigation Boring – Samples Archived for Potential Dioxins Analysis Pending Results of SSB-7 through SSB-9 (3).
MW-14	Subsurface Soil Boring and Monitoring Well Completion Analyzed for All Site COCs (3)

Existing Sampling Locations

MW-2	Monitoring Well Location (2007, 2008)
LL-12	Geoprobe Location (2008)
LLP-8	Geoprobe Location (2007)

Plume Locations (AECOM 2009)

?	Dioxin in Soil
?	Lead and cPAH in Soil
?	Lead in Soil
?	PCP in Soil
?	TPH-Dx in Soil
☐	Former Locations of Buildings and Structures[2]
- - -	Lora Lake Apartments Site Property Boundary[3]

Notes:

1. Borings installed for delineation of TPH source area.
   - Existing locations of monitoring wells, soil borings, and plumes based on AECOM Summary Report (AECOM 2009b).
2. All buildings and structures were demolished as part of the 2009 interim action and to comply with FAA flight path requirements. These demoition activities were completed by fall 2009.
3. Lora Lake Apartments Site Property Boundary provided by AECOM.
   - All proposed locations by Floyd|Snider are approximate and are subject to change.
   - Aerial image provided by Bing Maps © 2009. (Aerial image has been modified to show demolished buildings with foundations left intact.) Image date ~2004-2006.

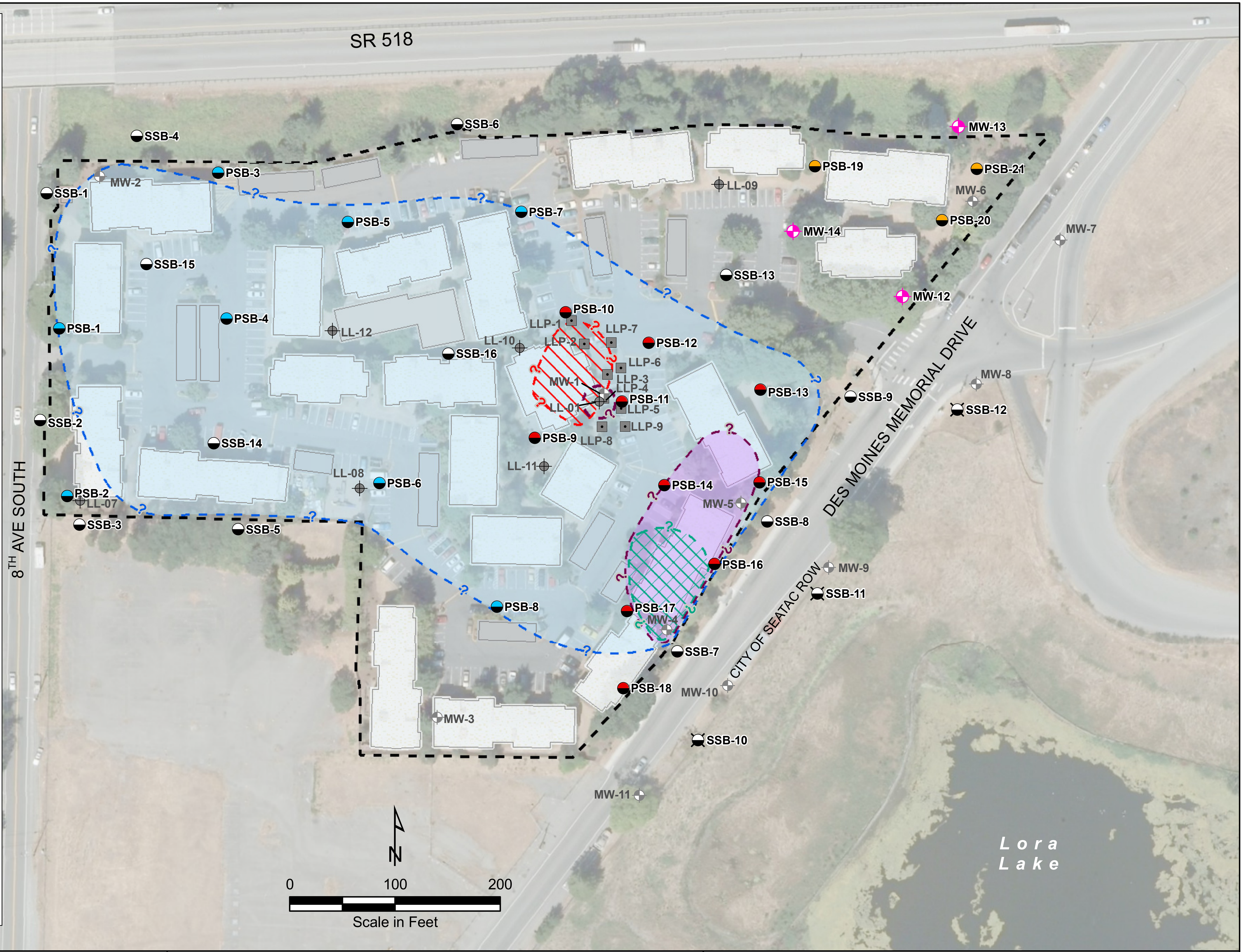

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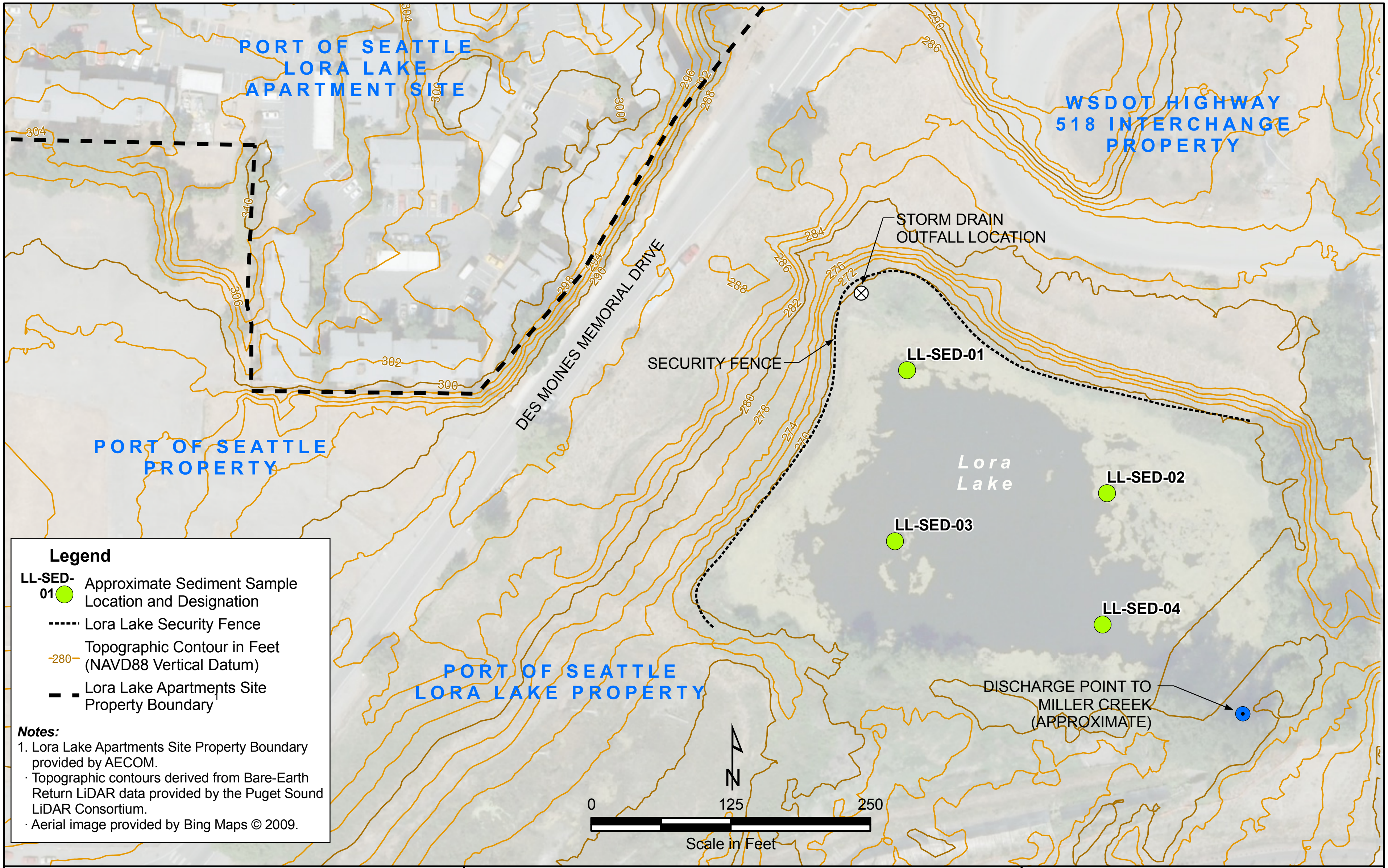
Figure B.2
Proposed Soil Boring Locations and
Approximate Extents of Soil Contamination

File: F:\projects\POS-LLA\GIS\MXD\Appendix B - SAP QAPP\Figure B.2 (Proposed SB Locations and Approx Extents of Soil Contamination).mxd
Date: 3/24/2010

PUBLIC REVIEW DRAFT



Notes:

1. Lora Lake Apartments Site Property Boundary provided by AECOM.

· Topographic contours derived from Bare-Earth Return LiDAR data provided by the Puget Sound LiDAR Consortium.

· Aerial image provided by Bing Maps © 2009.

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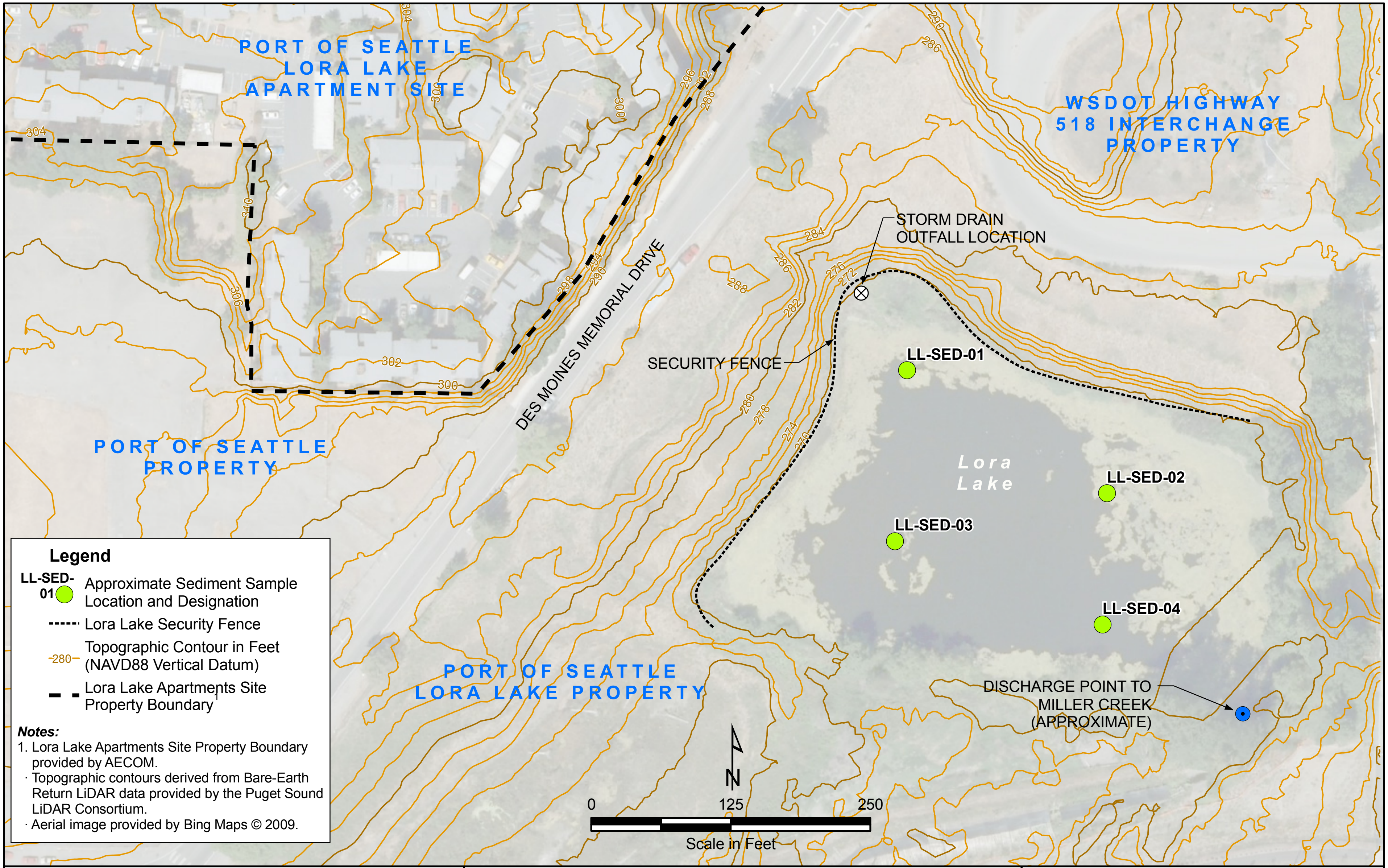
Port of Seattle
Lora Lake Apartments
Burien, Washington

Figure B.3
Proposed Lora Lake Sediment
Bioassay Sampling Locations

File: F:\projects\POS-LLA\GIS\MXD\Appendix B - SAP QAPP\Figure B.3 (Proposed Lora Lake Sediment Bioassay Sampling Locations).mxd
Date: 3/24/2010

PUBLIC REVIEW DRAFT



Legend

LL-SED-01 ●	Approximate Sediment Sample Location and Designation
------	Lora Lake Security Fence
-280-	Topographic Contour in Feet (NAVD88 Vertical Datum)
▬ ▬	Lora Lake Apartments Site Property Boundary[1]

Notes:

1. Lora Lake Apartments Site Property Boundary provided by AECOM.
· Topographic contours derived from Bare-Earth Return LiDAR data provided by the Puget Sound LiDAR Consortium.
· Aerial image provided by Bing Maps © 2009.

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Port of Seattle
Lora Lake Apartments
Burien, Washington

Figure B.3
Proposed Lora Lake Sediment
Bioassay Sampling Locations

File: F:\projects\POS-LLA\GIS\MXD\Appendix B - SAP QAPP\Figure B.3 (Proposed Lora Lake Sediment Bioassay Sampling Locations).mxd
Date: 3/24/2010

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Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Attachments

PUBLIC REVIEW DRAFT

List of Attachments

Attachment B.1	Bioassay Test QA/QC Check lists
Attachment B.2	Soil Boring Log
Attachment B.3	Well Installation log
Attachment B.4	Groundwater Sample Collection Form
Attachment B.5	Surface Sediment Sample Collection Form

ATTACHMENT B.1

QA/QC CHECKLIST FOR 10-DAY AMPHIPOD MORTALITY BIOASSAY (EPA)

Project Name: ____________________ Project No: ____________________
Laboratory: ____________________ Responsible Technician: ____________________
Amphipod Species: ____________________ Date Sampled: ____________________
Test Start Date: __________ Completion Date: __________ Test Method: ____________________
☐ Marine OR ☐ Freshwater Sample Matrix (grain size and salinity): ____________________
Problems Noted: ____

COMPLETENESS AND HOLDING CONDITIONS

Number of samples submitted: ____________________ Number of samples analyzed: ____________________
Holding conditions acceptable? ____________________ PSEP: 4 ºC < 2 weeks: ____________________
PSEP: 4 ºC under nitrogen < 8 weeks: ____________________
If no, which samples: ____

TEST IMPLEMENTATION

Test Initiated Correctly? ____________________ Number of animals per unit (10 per unit)? ____________________
Light 16L:8D? ____________________ Number of replicates per sample: ____________________
Food 1 ml YCT daily? ____________________ Avg. weight per animal: __NA_________________
If no, what food type: ____________________ Any water quality adjustments: ____________________
Age of organism at test initiation: ____________________
Daily Monitoring Correct? ____________________ Water renewal: ____________________

Interstitial conductivity (initiation): __________ Overlying Dissolved Oxygen – daily (>2 mg/L): __________
Overlying Ammonia (initiation & termination): __________ Overlying Temperature – daily (23 ºC): __________
Overlying Sulfide (initiation & termination): __________ Overlying Conductivity – daily: __________
Overlying pH – daily (7 to 9) __________

QA/QC SAMPLES

Negative Control
Collection Site: ____________________
Water Source: ____________________
Mean Control Survival (%): ____________________
Where survival requirements met (> 80%)? ____________________

Positive Control
Reference Toxicant: ____________________
Exposure Concentrations: ____________________
Mean Control Survival (%) ____________________
Length of reference toxicity test: ____________________
Organism response (LC50): ____________________
Laboratory performance standards for reference toxicant: ____________________
Did the test LC50 fall within lab standards? ____________________

Reference Sediment
Collection site: ____________________
Total no. of analyses: ____________________ Mean Survival: ____________________

ATTACHMENT B.1

QA/QC CHECKLIST FOR 20-DAY CHIRONOMID GROWTH AND MORTALITY BIOASSAY (EPA)

Project Name:
Laboratory:
Midge Species:
Date Sampled:
Test Start Date:
Completion Date:
Project No:
Responsible Technician:
Test Method:
Sample Matrix (grain size and salinity):
Problems Noted:

COMPLETENESS AND HOLDING CONDITIONS

Number of samples submitted:
Holding conditions acceptable?
Number of samples analyzed:
PSEP: 4 ºC < 2 weeks:
PSEP: 4 ºC under nitrogen < 8 weeks:
If no, which samples:

TEST IMPLEMENTATION

Test Initiated Correctly?
Light 16L:8D?
Food 1 ml tetrafin daily?
If no, what food type:
Daily Monitoring Correct?

Number of animals per unit (12 per unit)?
Number of replicates per sample:
Avg. weight per animal: __NA__________________
Any water quality adjustments:
Age of organism at test initiation:
Emergence: ☐ Yes ☐ No
Water renewal:

Interstitial conductivity (initiation):
Overlying Ammonia (initiation & termination):
Overlying Sulfide (initiation & termination):
Overlying Dissolved Oxygen – daily (>2 mg/L):
Aeration required? Date started

Overlying Temperature – daily (23 ºC):
Overlying Conductivity– daily:
Overlying pH – daily (7 to 9)

QA/QC SAMPLES

Negative Control
Collection Site:
Water Source:
Mean Control Survival (%):
Average Weight of 0.6 mg dw or 0.48 mg AFDW?

Positive Control
Reference Toxicant:
Exposure Concentrations:
Mean Control Survival (%):
Length of reference toxicity test:
Organism response (LC50):
Laboratory performance standards for reference toxicant:
Did the test LC50 fall within lab standards?

Reference Sediment
Collection site:
Total no. of analyses:
Mean Survival:

ATTACHMENT B.2

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Boring ID: Boring ID

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company

Coordinate System: NAV83
Ground Surface Elevation: NA
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Task: Task No.
Address: Site Address, city
Address - 2nd Line

Remarks:
Remarks Line 2

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

ATTACHMENT B.2

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Boring ID: Boring ID

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company

Coordinate System: NAV83
Ground Surface Elevation: NA
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Task: Task No.
Address: Site Address, city
Address - 2nd Line

Remarks:
Remarks Line 2

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED		DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
					20		
					21		
					22		
					23		
					24		
					25		
					26		
					27		
					28		
					29		
					30		
					31		
					32		
					33		
					34		
					35		
					36		
					37		
					38		
					39		
					40		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

ATTACHMENT B.3

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. & Datum:	**Drill Type:**	**Client:**
Coordinate System:	**Sample Method:**	**Project:**
Latitude/Northing:	**Boring Diameter:**	**Task Number:**
Longitude/Easting:	**Boring Depth (ft bgs):**	**Site Location:**
Casing Elevation:	**Groundwater ATD (ft bgs):**	

Remarks:

SAMPLE ID / INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	**MONITORING WELL DETAIL**
			0			
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. & Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

SAMPLE ID / INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	**MONITORING WELL DETAIL**
			20			
			21			
			22			
			23			
			24			
			25			
			26			
			27			
			28			
			29			
			30			
			31			
			32			
			33			
			34			
			35			
			36			
			37			
			38			
			39			
			40			

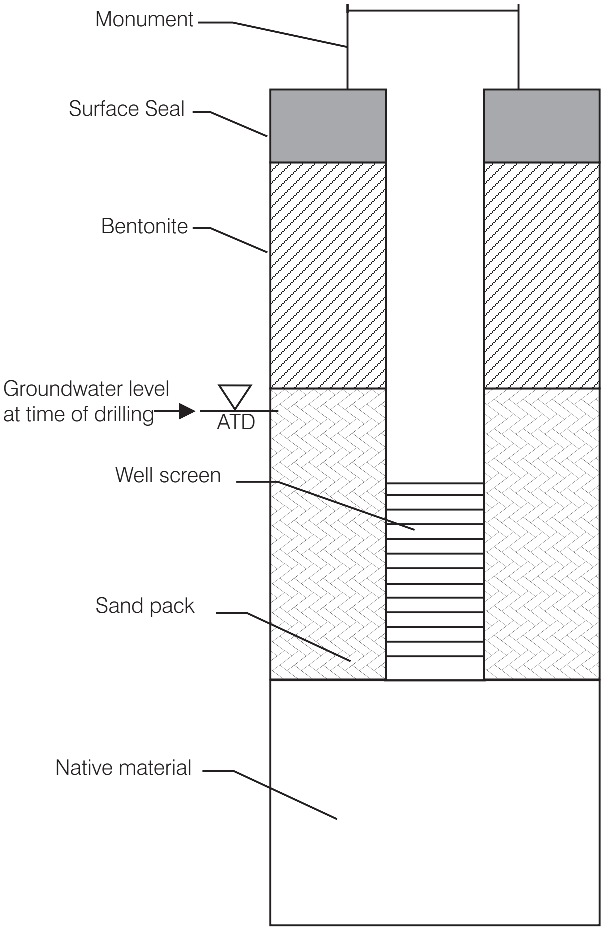
Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

ATTACHMENT B.3

Well Installation Log

Boring________________________Date____________________Sheet_____of_____

Logged By____



Monument type and height______________________________

Depth and thickness of bentonite________________________

Depth and thickness of sand pack_______________________

Screened interval______________________________________

Additional Well Information

Well/Completion Type ☐ Flush mount, ☐ Above ground

If above ground - protective guard posts installed ☐ Yes ☐ No

Well material and diameter ___________________________

Type of sand pack __________________________________

Is screen prepacked _________________________________

Was well developed ☐ Yes ☐ No If yes, final turbidity________ NTU

Casing Depth_____________________

Soil cuttings disposal method__________________________

GROUNDWATER SAMPLE COLLECTION FORM

ATTACHMENT B.4

Lora Lake Apartments RI Supplemental Site Investigation

Well ID: ____________________

Date of Collection: ____________________

Field Personnel: ____________________

Well Purge Data

Well Condition: ______________ Secure: ☐ Yes ☐ No

Purge Rate (L/min): ____________________

Well Damage Description: ____________________

Purge Rate Comments: ____________________

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No

One Casing Volume (gal): ____________________

Depth of water (from top of well casing): __________ Time:__________

Well Casing Type/Diameter: ____________________

After 5 minutes of purging (from top of casing): ____________________

Begin purge (time):____________________

End purge (time): ____________________

Gallons purged: ____________________

Purge water disposal method: Ground ☐ Other ☐

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼”	1.660”	1.380”	0.08	0.64
2”	2.375”	2.067”	0.17	1.45
3”	3.500”	3.068”	0.38	3.2
4”	4.500”	4.026”	0.66	5.51
6”	6.625”	6.065”	1.5	12.5

Time	Vol. Purged	pH	DO (mg/L)	Conductivity (ms/m)	Turbidity (NTU)	Temp (C°/F°) circle one	Comments/Meters

Sampling Data

Sample No:____________________ Location and Depth: ____________________

Date Collected (mo/dy/yr): ______________ Time Collected: __________ ☐ AM ☐ PM Weather: ____________________

Type: ☐ Ground Water ☐ Surface Water Other: ______________ Sample: ☐ Filtered ☐ Unfiltered Other:______________

Sample Collected with: ☐ Bailer ☐ Pump Other: ______________ Made of: ☐ Stainless Steel ☐ PVC ☐ Teflon Other:______________

Sample Decon Procedure:____________________

Initial Sample Description (Color, Turbidity, Odor, Other): ____________________

Sample Description After Purge/During Sample Collection: ____________________

Sample Analyses

Analytes	**Containers**	**Preservatives**	**Any Noted Deviations**

Additional Containers etc: ____________________

Additional Information

Duplicate Samples:

____

____

Comments (Calculations, etc.):

____

____

Signature: ____________________ **Date:** ____________________

ATTACHMENT B.5

SURFACE SEDIMENT SAMPLE COLLECTION FORM

Date/Time Collected: ______________________

Weather: ______________________

Field Personnel: ______________________

Sample Type:

☐ 1. Surface Sample (0-10 cm)
☐ 2. Next Surface Sample (10- 20 cm)

Sample ID/Design. ______________________

Sample Method (Van Veen Surface Grab/Diver Core-Cookie Cutter)

Datum (Horizontal/Vertical) ______________________

Sample Types 1, 2, 3, 4, 5:
*If sample type 4, were reference samples collected? ☐ Yes ☐ No

Leadline Water Dept: ______________ (A)
Predicted Tide Elevation ______________ (B)
Mudline Elevation ______________ (B-A)
Actual Tide Elevation ______________

Run # or Composite Pt	Time	Latitude (Northing)	Longitude (Easting	Sample Criteria (Surface Grab Only)					Accept Sample Y/N	Comments (Include depth of sample)
				1	2	3	4	5		

Acceptance criteria: 1 Overlying water is present, 2 Water has low turbidity, 3 Sampler is not over filled, 4 Sample surface is flat, 5 Desired sample depth is reached

Decon Procedure (Alconox Wash, DI water rinse, other):______________________________

Sediment Sample Description

Sediment Sample Description (density, moisture, color, minor constituents, major constituents, other observations - *see field ref cards):

Sample containers filled (number and type):

Laboratory analysis:

Diver Comments etc:

Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Appendix C
Data Tables from Previous Environmental Site Investigations

PUBLIC REVIEW DRAFT

Table of Contents

Data Tables from GeoScience Management's 2008 Letter Report to the Port of Seattle re: Report of Focused Subsurface Investigation at Lora Lake Apartments in Vicinity of Previous Environmental Cleanup in 1987 by Golder Associates Tax Lot Number 2023049105, Port of Seattle Parcel Number 029R 15001 Des Moines Memorial Way South, WA.

Data Tables from AECOM's 2009 *Summary Report—2008 Investigations and Data Gap Evaluation Lora Lakes Apartments.*

GeoScience Management
Data Tables

Table 1. Summary of Chemical Analyses

Lora Lake Apartments Focussed Environmental Site Assessment

Sample ID	Analytical Laboratory	Lab Report Number	Sample Date	NWTPH-Gx	NWTPH-Dx	VOCs	SVOCs	PCBs	PCDDs / PCDFs	RCRA Metals	Arsenic Only	Pentachloro-phenol
Geoprobe Soil Samples												
LLP-2-6.5	OnSite	07-209-03	7/24/2007	--	X	--	--	--	--	--	X	--
LLP-2-17	OnSite	07-209-05	7/24/2007	--	X	--	--	--	--	--		--
LLP-3-6	OnSite	07-209-06	7/25/2007	--	X	--	--	--	--	--	X	--
LLP-4-6.5	OnSite	07-209-08	7/25/2007	--	X	--	--	--	--	--	--	--
LLP-4-14.5	OnSite	07-209-09	7/25/2007	X	X	X	X	X	--	X	--	--
LLP-5-15.5	OnSite	07-209-10	7/25/2007	X	X	X	X	X	--	X	--	--
LLP-6-6.5	OnSite	07-209-11	7/25/2007	--	X	--	--	--	--	--	--	--
LLP-6-14.5	OnSite	07-209-12	7/25/2007	--	X	--	--	--	--	--	--	--
Geoprobe Groundwater Samples												
LLP-2 Water	OnSite	07-209-18	7/24/2007	--	X	--	--	--	--	--	--	--
LLP-3 Water	OnSite	07-209-19	7/25/2007	--	X	--	--	--	--	--	--	--
LLP-4 Water	OnSite	07-209-21	7/25/2007	X	X	X	X	X	--	X	--	--
LLP-5 Water	OnSite	07-209-22	7/25/2007	X	X	X	X	X	--	X	--	--
LLP-6 Water	OnSite	07-209-23	7/25/2007	--	X	--	--	--	--	--	--	--
LLP-8 Water	OnSite	07-209-25	7/25/2007	X	X	X	X	X	--	X	--	--
LLP-9 Water	OnSite	07-209-26	7/25/2007	X	X	X	X	X	--	X	--	--
Well MW-1 Soil Samples												
MW-1-7	CAS	K0710957-002	10/25/2007	X	X	--	X	--	X	--	--	--
MW-1-14	CAS	K0710957-003	10/25/2007	X	X	--	X	--	X	--	--	--
Well MW-1 Groundwater Samples												
MW-1	CAS	K0710957-001	11/7/2007	X	X	--	X	--	X	--	--	--
MW-1	CAS	K0711491-001	12/5/2007	X	X	X	X	--	--	--	--	X

Comments:

NWTPH-Gx means gasoline-range organics

NWTPH-Dx means diesel- and oil-range organics

VOCs means Volatile Orgnic Compounds by EPA Method 8260B

SVOCs means Semi-volatile Orgnic Compounds by EPA Method 8270D-SIM

PCBs means polychlorinated biphenols by EPA Method 8082

PCDDs / PCDFs means polychlorinated dibenzodioxins and polychlorinated dibenzofurans by HRGC/HRMS

RCRA means total metals in soil EPA Methods 6010B/7471A, and dissolved metals in groundwater, EPA Methods 200.8/7470A.

Arsenic by EPA Method 6010B.

Pentachlorphenol by EPA Method 8151A Modified

-- means not analyed for particular analytes

OnSite means OnSite Environmental, Inc.

CAS means Columbia Analytical Services, Inc.

Table 2. Summary of Hydrocarbon Data

Lora Lake Apartments Focussed Environmental Site Assessment

Sample ID/Depth (ft.)	Lab ID	Sample Date	Benzene	Toluene	Ethylbenzene	Xylenes	Gasoline	Diesel	Oil
Geoprobe Soil Samples			**Reported Concentrations in (mg/Kg)**						
LLP-2-6.5	07-209-03	7/24/2007	--	--	--	--	--	**1,300**	**9,800**
LLP-2-17	07-209-05	7/24/2007	--	--	--	--	--	ND(<27)	180
LLP-3-6	07-209-06	7/25/2007	--	--	--	--	--	160	1,100
LLP-4-6.5	07-209-08	7/25/2007	--	--	--	--	--	100	930
LLP-4-14.5	07-209-09	7/25/2007	ND(<0.11)	0.620	1.4	**12.5**	**1,900**	**6,000**	**17,000**
LLP-5-15.5	07-209-10	7/25/2007	ND(<0.0011)	ND(<0.0011)	ND(<0.0011)	ND(<0.0022)	ND(<11)	39	160
LLP-6-6.5	07-209-11	7/25/2007	--	--	--	--	--	75	240
LLP-6-14.5	07-209-12	7/25/2007	--	--	--	--	--	ND(<28)	ND(<56)
Well MW-1 Soil Samples			**Reported Concentrations in (mg/Kg)**						
MW-1-7	K0710957-002	10/25/2007	Awaiting transmittal of lab data				2.7 J	30 H	170 O
MW-1-14	K0710957-003	10/25/2007					**1,000 Y**	**8,900 DY**	**12,000 DL**
MTCA Method A Cleanup Levels - Soil			0.03	7	6	9	30/100 *	2,000	
Sample ID/Depth (ft.)	**Lab ID**	**Sample Date**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**Gasoline**	**Diesel**	**Oil**
Geoprobe Groundwater Samples			**Reported Concentrations in (ug/L)**						
LLP-2 Water	07-209-18	7/24/2007	--	--	--	--	**--**	**6,700**	**7,800**
LLP-3 Water	07-209-19	7/25/2007	--	--	--	--	**--**	280	**710**
LLP-4 Water	07-209-21	7/25/2007	0.72	8.1	4.8	50	**2,000**	**1,100**	**1,300**
LLP-5 Water	07-209-22	7/25/2007	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.40)	220	440	**690**
LLP-6 Water	07-209-23	7/25/2007	--	--	--	--	--	**1,500**	**1,300**
LLP-8 Water	07-209-25	7/25/2007	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.40)	ND<(100)	ND(<250)	ND(<400)
LLP-9 Water	07-209-26	7/25/2007	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.40)	ND<(500)	ND(<250)	ND(<410)
Sample ID/Depth (ft.)	**Lab ID**	**Sample Date**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**Gasoline**	**Diesel**	**Oil**
Well MW-1 Groundwater Samples			**Reported Concentrations in (ug/L)**						
MW-1	K0710957-001	11/7/2007	--	--	--	--	**2,100 Y**	**11,000 Z**	**4,800 Z**
MW-1	K0711491-001	12/5/2007	ND(<0.14)	0.12 J	0.13 J	3.9	210 J	**2,300 Y**	**2,500 L**
MTCA Method A Cleanup Levels - Groundwater			5	1,000	700	1,000	800/1,000 *	500	

Comments:

BTEX by EPA Method 8260B

Gasoline-range organics by Method NWTPH-Dx

Diesel-, and Oil-range organics by Method NWTPH-Dx.

-- means not analyed for particular analytes

ND means target analyte not detected at or above the detection limit in parenthesis

BOLD means result exceeds cleanup level

J means analyte concentration is an estimate

D means reported result is from a dilution

O means chromatographic fingerprint resembles oil, but does not match standard

Soil data reported in mg/kg units which approximate parts per million (ppm) concentrations

Groundwater data reported in ug/L units which approximate parts per billion (ppb) concentrations

Model Toxics

* Cleanup level for gasoline if benzene present / benzene not present

Y means chromatographic fingerprint does not match standard

Z means means chromatographhic standard does not resemble petroleum product

H means chromatographic fingerprint resembles petroleum product, but doesn't match standard

L means chromatographic fingerprint resembles petroleum product, but doesn't match standard

Table 3. Summary of Volatile Organics Analysis Data

Lora Lake Apartments Focussed Environmental Site Assessment

Geoprobe Boring Samples	Soil Samples			Groundwater Samples					
Sample Designation	**LLP-4-14.5**	**LLP-5-15.5**	**MTCA Method A/B Cleanup Levels**	**LLP-4 Water**	**LLP-5 Water**	**LLP-8 Water**	**LLP-9 Water**	**MW-1**	**MTCA Method A/B Cleanup Levels**
Sample Date	7/25/2007	7/25/2007		7/25/2007	7/25/2007	7/25/2007	7/25/2007	12/5/2007	
Laboratory Designation	07-209-09	07-209-10		07-209-21	07-209-22	07-209-25	07-209-26	K0711491-001	
Analyte	**Reported Concentrations (mg/kg)**			**Reported Concentrations (ug/L)**					
Chloromethane	ND(<0.11)	ND(<0.0011)	77	ND(<0.40)	ND(<0.20)	ND(<0.20)	ND(<0.20)	0.15 J	3.4
Acetone	ND(<0.56)	0.068	8,000	17	ND(<5)	ND(<5)	ND(<5)	ND(<4.1)	800
Benzene	ND(<0.11)	ND(<0.0011)	0.03	0.72	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.14)	5
Toluene	0.62	ND(<0.0011)	7	8.1	ND(<0.20)	ND(<0.20)	ND(<0.20)	0.12 J	1,000
Ethylbenzene	1.4	ND(<0.0011)	6	4.8	ND(<0.20)	ND(<0.20)	ND(<0.20)	0.13 J	700
Xylenes	**12.5**	ND(<0.0022)	9	50	ND(<0.40)	ND(<0.40)	ND(<0.40)	3.9	1,000
2-Butanone	0.56	0.0072	48,000	ND(<10)	ND(<5.0)	ND(<5.0)	ND(<5.0)	ND(<2.3)	4,800
(trans) 1,2-Dichloroethene	ND(<0.11)	ND(<0.0011)	110	0.89	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.15)	5
(cis) 1,2-Dichloroethene	ND(<0.11)	ND(<0.0011)	110	0.97	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.12)	5
Chloroform	ND(<0.11)	ND(<0.0011)	160	ND(<0.40)	ND(<0.20)	0.63	ND(<0.20)	ND(<0.14)	7.2
1,2-Dichloroethane	ND(<0.11)	ND(<0.0011)	11	0.62	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.12)	5
Trichloroethene	ND(<0.11)	ND(<0.0011)	0.03	1.8	ND(<0.20)	ND(<0.20)	ND(<0.20)	ND(<0.14)	5
Tetrachloroethene	ND(<0.11)	ND(<0.0011)	0.05	0.47	ND(<0.20)	ND(<0.20)	ND(<0.20)	0.18 J	5
Bromoform	ND(<0.11)	ND(<0.0011)	130	ND(<2.0)	ND(<1.0)	1.6	ND(<1.0)	ND(<0.28)	5.5
Isopropylbenzene	1.5	ND(<0.0011)	8,000	3.0	2.0	ND(<0.20)	0.21	0.17 J	800
1,3,5-trimethylbenzene	7.4	ND(<0.0011)	4,000	13	0.55	ND(<0.20)	ND(<0.20)	2.5	400
tert-butylbenzene	0.12	ND(<0.0011)	--	ND(<0.40)	0.35	ND(<0.20)	ND(<0.20)	ND(<0.13)	--
1,2,4-trimethylbenzene	18	0.0013	4,000	50	2.0	ND(<0.20)	ND(<0.20)	5.8	400
n-Propylbenzene	2.8	ND(<0.0011)	--	2.9	0.63	ND(<0.20)	ND(<0.20)	0.24 J	--
sec-Butylbenzene	1.6	0.0096	--	0.90	3.3	ND(<0.20)	0.52	0.63 J	--
p-Isopropyltoluene	5.5	0.0021	--	2.8	0.43	ND(<0.20)	ND(<0.20)	0.79	--
n-Butylbenzene	2.7	0.0057	--	ND(<0.40)	ND(<0.20)	ND(<0.20)	ND(<0.20)	0.63 J	--
Naphthalene	**7.9**	ND(<0.0011)	5	33	ND(<1.0)	ND(<1.0)	ND(<1.0)	1.6 J	160

Comments:

MTCA means Model Toxics Control Act Regulation, 173-340 WAC, Amended 10/1

Method B values from CLARC database

Results for soil are reported in mg/kg units which approximate parts per million (pp

Results for water are reported in ug/L units which approximate parts per billion (ppl

J means result is estimated

Bold indicates detected value exceeds cleanup level

-- indicates value not available

ND means target analyte not detected at or above concentration indicated in parenthesis

VOC analysis by GC/MS, EPA Method 8260B

Table 4.

Summary of SemiVolatile Organic Compounds Analysis Data

Lora Lake Apartments Focused Environmental Site Assessment

Investigation Samples	Soil Samples					Groundwater Samples						
Sample Designation	**LLP-4-14.5**	**LLP-5-15.5**	**MW-1-7**	**MW-1-14**	**MTCA Method A/B Cleanup Levels**	**LLP-4 Water**	**LLP-5 Water**	**LLP-8 Water**	**LLP-9 Water**	**MW-1**	**MW-1**	**MTCA Method A/B Cleanup Levels**
Sample Date	7/25/2007	7/25/2007	10/25/2007	10/25/2007		7/25/2007	7/25/2007	7/25/2007	7/25/2007	11/7/2007	12/5/2007	
Laboratory ID Number	07-209-09	07-209-10	K0800540-001	K0710957-003		07-209-21	07-209-22	07-209-25	07-209-26	K0710957-001	K0711491-001	
Analyte	**Reported Concentrations (mg/kg)**					**Reported Concentrations (ug/L)**						
Phenol	ND(<0.74)	ND(<0.19)	0.0051 J	ND(<0.10)	48,000	3.1	ND(<1.9)	ND(<1.9)	ND(<1.8)	2.2	ND(<0.33)	4,800
Benzyl Alchohol	ND(<0.74)	ND(<0.19)	0.0021 J	ND(<0.11)	24,000	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	1.3 J	ND(<0.38)	2,400
2-Methylphenol (o-Cresol)	ND(<0.74)	ND(<0.19)	ND(<0.0015)	ND(<0.075)	--	4.4	ND(<1.9)	ND(<1.9)	ND(<1.8)	4.7	ND(<0.33)	--
(3+4)-Methylphenol (m,p-Cresol)	ND(<0.74)	ND(<0.19)	ND(<0.0015)	ND(<0.075)	--	5.4	ND(<1.9)	ND(<1.9)	ND(<1.8)	4.4	ND(0.48)	--
2,4-Dimethylphenol	ND(<0.74)	ND(<0.19)	ND(<0.0055)	ND(<0.28)	1600	26	ND(<1.9)	ND(<1.9)	ND(<1.8)	6.5 J	1.7 J	160
2,4-Dichlorophenol	ND(<0.74)	ND(<0.19)	ND(<0.001)	ND(<0.05)	240	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	1.9	ND(<0.30)	24
Benzoic Acid	--	--	ND(<0.096)	ND(<4.8)	320,000	--	--	--	--	15	ND(<5.9)	64,000
Naphthalene	2.7	ND(<0.015)	ND(<0.0023)	3.5 D	5.0	19	0.46	ND(<0.19)	ND(<0.18)	0.52	9.0 J	160
2-Methylnaphthalene	7.0	ND(<0.015)	ND(<0.0022)	12.0 D	320	1.6	ND(<1.9)	ND(<1.9)	ND(<1.8)	0.35	1.6 J	32
1-Methylnaphthalene	4.3	ND(<0.015)	--	--	24	1.3	ND(<1.9)	ND(<1.9)	ND(<1.8)	--	--	2.4
2,4,6-Trichlorophenol	ND(<0.74)	ND(<0.19)	ND(<0.0014)	ND(<0.07)	91	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	0.31 J	ND(<0.21)	4
2,4,5-Trichlorophenol	ND(<0.74)	ND(<0.19)	ND(<0.0015)	ND(<0.075)	8,000	7.6	ND(<1.9)	ND(<1.9)	ND(<1.8)	19	ND(<0.39)	800
Acenaphthylene	0.15	ND(<0.015)	ND(<0.0012)	0.45 D	--	9.3	ND(<1.9)	ND(<1.9)	ND(<1.8)	ND(<0.035)	ND(<0.24)	--
Acenaphthene	1.1	ND(<0.015)	ND(<0.0014)	1.2 D	4,800	1.1	0.23	ND(<0.19)	ND(<0.18)	ND(<0.060)	ND(<0.29)	960
2,3,5,6-Tetrachlorophenol	ND(<0.74)	ND(<0.19)	--	--	2,400	68	ND(<1.9)	ND(<1.9)	ND(<1.8)	--	--	480
Dibenzofuran	ND(<0.74)	ND(<0.19)	ND(<0.0012)	1.0 D	160	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	ND(<0.041)	ND(<0.33)	32
Fluorene	1.4	ND(<0.015)	ND(<0.0011)	2.7 D	3,200	0.25	0.91	ND(<0.19)	ND(<0.18)	0.32 J	ND(<0.33)	640
N-Nitrosodiphenylamine	ND(<0.74)	ND(<0.19)	ND(<0.0016)	ND(<0.08)	200	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	ND(<0.11)	ND(<0.48)	--
Pentachlorophenol	ND(<3.7)	ND(<0.93)	0.11	ND(<1.0)	8.3	**120**	ND(<9.7)	ND(<9.7)	ND(<9.2)	**150 D**	**5.7 J**	0.73
Phenanthrene	4.0	0.020	0.0019 J	8.8 D	--	0.41	ND(<1.9)	ND(<1.9)	ND(<1.8)	0.64	2.4 J	--
Anthracene	1.2	ND(<0.015)	ND(<0.0016)	2.3 D	24,000	ND(<0.20)	ND(<1.9)	ND(<1.9)	ND(<1.8)	0.23 J	ND(<0.62)	4,800
Di-n-butyl Phthalate	ND(<0.74)	ND(<0.19)	ND(<0.0079)	ND(<0.40)	--	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	7.7	ND(<0.37)	--
Fluoranthene	1.5	ND(<0.015)	0.0027 J	3.0 D	3,200	ND(<0.20)	ND(<0.19)	ND(<0.19)	ND(<0.18)	0.27 J	ND(<0.66)	640
Pyrene	1.3	0.017	0.0029 J	2.7 D	2,400	ND(<0.20)	0.21	ND(<0.19)	ND(<0.18)	0.25 J	ND(<0.74)	480
Butyl Benzyl Phthalate	ND(<0.74)	ND(<0.19)	ND(<0.0032)	ND(<0.16)	16,000	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	2.0	ND(<0.47)	3,200
Bis(2-ethylhexyl) Phthalate	ND(<0.74)	ND(<0.19)	0.016 J	ND(<0.35)	71	ND(<2.0)	ND(<1.9)	ND(<1.9)	ND(<1.8)	**14**	3.1 J	6.3
benzo(g,h,i)perylene	0.19	ND(<0.015)	0.0026 J	0.32 D	--	ND(<0.020)	ND(<0.019)	ND(<0.019)	ND(<0.018)	ND(<0.044)	--	--
PCBs	ND(<0.056)	ND(<0.056)	--	--	1.0	ND(<0.92)	ND(<0.19)	ND(<0.093)	ND(<0.20)	--	--	0.1

SVOC analysis by GC/MS, EPA Method 8270 SIM

ND means analyte was not present at or above the detection limit shown in parathensis

BOLD means analyte exceeds cleanup level

Flags - J means analyte concentration is estimated. D means reported result is from a dilution.

MTCA means Model Toxics Control Act regulations, Method A Tables or Values from Method B CLARC tables. Dibenzofuran cleanup levels in CLARC tables listed here do not match those in Ecology PUB 07-09-045.

Table 5. Summary of Carcinogenic Polyaromatic Hydrocarbons (cPAHs) Analysis Data

Lora Lake Apartments Focused Environmental Site Assessment

Sample ID	Laboratory ID Number	Sample Date	Benzo(a) pyrene	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Indeno(1,2,3-cd) pyrene	Toxicity Equivalency (TEQ)	MTCA Method A Cleanup Level for cPAHs (benzo(a)pyrene equivalent)
Soil Samples			**Reported Concentrations (mg/kg)**								
LLP-4-14.5	07-209-09	7/25/2007	0.54	0.88	0.88	0.15	0.76	0.088	0.14	**0.76**	0.1
LLP-5-15.5	07-209-10	7/25/2007	ND(<0.015)	ND(<0.015)	ND(<0.015)	ND(<0.015)	ND(<0.015)	ND(<0.015)	ND(<0.015)	0	0.1
MW-1-7	K0800540-001	10/25/2007	ND(<0.0017)	ND(<0.0017)	0.0024 J	ND(<0.0014)	0.0016 J	ND(<0.0015)	0.0023 J	0.0005	0.1
MW-1-14	K0710957-003	10/25/2007	0.63 D	0.89 D	0.68 D	0.26 D	1.5 D	ND(<0.29)	0.37 D	0.865	0.1
Groundwater Samples			**Reported Concentrations (ug/L)**								
LLP-4 Water	07-209-21	7/25/2007	0.13	ND(<0.20)	0.045	ND(<0.020)	ND(<0.20)	ND(<0.20)	ND(<0.20)	**0.136**	0.1
LLP-5 Water	07-209-22	7/25/2007	0.030	0.067	0.045	ND(<0.019)	0.077	ND(<0.019)	ND(<0.019)	0.042	0.1
LLP-8 Water	07-209-25	7/25/2007	ND(<0.019)	ND(<0.019)	ND(<0.019)	ND(<0.019)	ND(<0.019)	ND(<0.019)	ND(<0.019)	0	0.1
LLP-9 Water	07-209-26	7/25/2007	ND(<0.018)	0.036	ND(<0.018)	ND(<0.018)	0.025	ND(<0.018)	ND(<0.018)	0.004	0.1
MW-1	K0710957-001	11/7/2007	0.39 J	ND(<0.041)	0.17 J	ND(<0.055)	ND(<0.064)	ND(<0.039)	ND(<0.048)	**0.407**	0.1
MW-1	K0711491-001	12/5/2007	ND(<0.66)	ND(<0.60)	ND(<0.59)	ND(<0.83)	ND(<0.79)	ND(<0.76)	ND(<0.69)	0	0.1
Toxicity Equivalency Factor (TEF)			1	0.1	0.1	0.1	0.01	0.1	0.1	--	--

COMMENTS:

SVOC analysis by GC/MS, EPA Method 8270 SIM

ND means analyte was not present at or above the detection limit shown in parathensis

TEF Values from Chapter 173-340 WAC, Amended 10/12/2007, Table 708-2

MTCA means Model Toxics Control At Regulation, Chapter 173-340 WAC, Method A Soil Cleanup Tables, Amended 10/12/2007

FLAGS: - J means analyte concentration is estimated.
- D means reported value from a dilution
BOLD means concentrations exceed cleanup levels

Table 6. Summary of PCDD / PCDF Analysis Data

Investigation Samples	**Soil Samples**						**Groundwater Samples**		
Sample Designation	**MW-1-7**			**MW-1-14**			**MW-1**		
Sample Date	10/25/2007			10/25/2007			11/7/2007		
Laboratory ID Number	K0800540-001			K0710957-003			K0710957-001		
Analyte	**(ng/Kg)**	**Toxicity Equivalency Factor (TEF)**	**Toxic Equivalency (TEQ) (ng/Kg)**	**(ng/Kg)**	**Toxicity Equivalency Factor (TEF)**	**Toxic Equivalency (TEQ) (ng/Kg)**	**(pg/L)**	**Toxicity Equivalency Factor (TEF)**	**Toxic Equivalency (TEQ) (pg/L)**
2,3,7,8-TCDD	11.7	1	11.7	24.3	1	24.3	4.78 J	1	4.78
1,2,3,7,8-PeCDD	78.6	1	78.6	87.5	1	87.5	16.2 J	1	16.2
1,2,3,4,7,8-HxCDD	152	0.1	15.2	20.3	0.1	2.03	13.9 JK	0.1	1.39
1,2,3,6,7,8-HxCDD	1300 E	0.1	130	304	0.1	30.4	132	0.1	13.2
1,2,3,7,8,9-HxCDD	515	0.1	51.5	294	0.1	29.4	52.0	0.1	5.2
1,2,3,4,6,7,8-HpCDD	60,700 BE	0.01	607	5,350 E	0.01	63.3	3,220	0.01	32.2
OCDD	473000 BE	0.0003	142	69,900 BE	0.0003	35.1	29,300 BE	0.0003	8.79
2,3,7,8-TCDF	5.07 C	0.1	0.507	63.1 C	0.1	1.47	7.72 JC	0.1	**--**
1,2,3,7,8-PeCDF	6.46	0.03	0.194	19.9	0.03	0.597	1.67 JK	0.03	0.0501
2,3,4,7,8-PeCDF	27.0	0.3	8.1	15.7	0.3	4.71	13.7 J	0.3	4.11
1,2,3,4,7,8-HxCDF	245	0.1	24.5	30.5	0.1	3.05	57.7	0.1	5.77
1,2,3,6,7,8-HxCDF	119	0.1	11.9	30.2	0.1	3.02	12.4 J	0.1	1.24
1,2,3,7,8,9-HxCDF	2.76 J	0.1	0.276	ND(<1.92)	0.1	--	ND(<7.54)	0.1	--
2,3,4,6,7,8-HxCDF	121	0.1	12.1	42.5	0.1	4.25	31.0	0.1	3.10
1,2,3,4,6,7,8-HpCDF	15300 E	0.01	153	929 E	0.01	9.21	707	0.01	7.07
1,2,3,4,7,8,9-HpCDF	629 E	0.01	6.29	38.6	0.01	0.386	39.0	0.01	0.390
OCDF	137000 E	0.0003	41.1	5,540 E	0.0003	2.89	3,450	0.0003	1.04
Total TEQ	--	--	**1290**	--	--	**302**	**--**	**--**	**105**
Model Toxics Control Act Regulation, 173-340 WAC, Method B Soil - CLARC Tables *			160 mg/kg *			160 mg/kg *			32 ug/L *

Analysis by EPA Method 8290/PCDD PCDF

ng/Kg approximates parts per trillion (PPT) concentrations

pg/L approximates parts per quadrillion (PPQ)concentrations

ND means analyte was not present at or above the detection limit shown in parathensis

Toxicity Equivalency Factors from World Health Organization 2005 (WHO-05)

-- means not applicable

Flags:
- J means analyte concentration is estimated
- B means analyte detected in Method Blank
- C means 2,3,7,8-TCDF was confirmed on the DB-225 column
- E means Analyte exceeded the upper Method Calibration Limit (MCL)
- K means ion abundance ratios outside of QC limits

* MTCA Method B CLARC tables list PCDD and PCDF cleanup values as 160 mg/kg soil, and 32 ug/L groundwater, but it is not clear if these values are TEF-corrected.

Table 7. Summary of Metals Analyses Data

Lora Lake Apartment Focussed Environmental Site Assessment

Sample ID	Lab ID	Sample Date	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Geoprobe Borings Soil Samples			**Reported Concentrations (mg/Kg)**							
LLP-2-6.5	07-209-03	7/24/2007	ND(<11)	--	--	--	--	--	--	--
LLP-3-6	07-209-06	7/25/2007	ND(<12)	--	--	--	--	--	--	--
LLP-4-14.5	07-209-09	7/25/2007	ND(<11)	51	ND(<0.56)	**40**	47	ND(<0.28)	ND(<11)	ND(<0.56)
LLP-5-15.5	07-209-10	7/25/2007	ND(<11)	49	ND(<0.56)	**25**	6	ND(<0.28)	ND(<11)	ND(<0.56)
MTCA Method A/B Cleanup Levels -Soil			20	16,000	2	19/2,000 *	250	2	400	400

Sample ID	Lab ID	Sample Date	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Geoprobe Borings Groundwater Samples			**Reported Concentrations (u/L)**							
LLP-4 Water	07-209-21	7/25/2007	**65**	ND(<25)	ND(<4.0)	ND(<10)	1.2	ND(<0.50)	ND(<5.0)	ND(<10)
LLP-5 Water	07-209-22	7/25/2007	ND(<3.0)	ND(<25)	ND(<4.0)	ND(<10)	ND(<1.0)	ND(<0.50)	ND(<5.0)	ND(<10)
LLP-8 Water	07-209-25	7/25/2007	ND(<3.0)	ND(<25)	ND(<4.0)	ND(<10)	ND(<1.0)	ND(<0.50)	ND(<5.0)	ND(<10)
LLP-9 Water	07-209-26	7/25/2007	**8.1**	ND(<25)	ND(<4.0)	ND(<10)	ND(<1.0)	ND(<0.50)	ND(<5.0)	ND(<10)
MTCA Method A/B Cleanup Levels - Groundwater			5	3,200	5	50	15	2	80	80

Comments:

Soil results are reported in mg/kg units which approximate parts per million (ppm) concentrations

Groundwater reults are reported in ug/L units which approximate parts per billion (ppb) concentrations

ND means not detected at or above the concentration shown in parenthesis

* Cleanup values for Chromium based on Chromium VI (19 mg/kg) and Chromium III (2,000 mg/kg)

-- means Not Analyzed

MTCA means Model Toxics Control Act Regulation, Chapter 173-340 WAC, Amended 10/12/2007

BOLD means value exceeds cleanup level

Total metals in soil EPA Methods 6010B/7471A, and dissolved metals in groundwater, EPA Methods 200.8/7470A.

AECOM
Data Tables

Table F-3-1 Geoprobe Soils Analytical Results: Metals, PCBs, SVOCs, VOCs, and TPH

			Location ID	LL01	LL01	LL01	LL07	LL07	LL08	LL08	LL08	LL08	LL08	LL09	LL09	LL09	LL09
			Sample ID	LL01-0.0.5	LL01-1.5-2	DUP02-040308	LL07-0-0.5	LL07-1.5-2	LL08-0-0.5	LL08-1.5-2	LL08-2-4	DUP01-040308	LL08-13-15	LL09-0-0.5	LL09-1.5-2	LL09-6-8	LL09-13-15
			Sample Date	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08
Chemical Name	Method A	MTCA B - Carcinogen	MTCA B - Non-Carcinogen														
Metals EPA 6020 / 7471A (mg/kg)																	
Antimony			32	0.29 J	0.23 J	0.2 J	0.39 J	0.27 J	0.27 J	0.16 J	0.6 J	3.51 J	0.05 J	0.13 J	0.1 J	0.07 J	0.06 J
Arsenic	20	0.67	24	4.39 J	3.17 J	2.83 J	3.17	7.11	6.02	2.93	5.47 J	5.32 J	1.2	2.67	2.2	1.96	1.47
Beryllium			160	0.216 J	0.252 J	0.189 J	0.203	0.169	0.204	0.277	0.322 J	0.206	0.187	0.231	0.187	0.222	0.18
Cadmium	2		80	0.437 J	0.282 J	0.268 J	0.315	0.236	0.307	0.38	1.32 J	1.26 J	0.031	0.102	0.081	0.054	0.054
Chromium	19/2000			48.6	34.7 J	23.3	20.9	21	18.9	21.5	22.2	19 J	32.2	24.3	22.1	26.6	24.5
Copper			3.0E+03	20.1 J	16.2 J	14 J	16.5 J	16.2 J	23.2 J	17.1 J	33 J	28.8 J	6.13 J	15.5 J	12.7 J	12.5 J	14.8 J
Lead	250			41.6	265 J	91.6	33.6 J	30 J	42.3 J	18.4 J	106 J	108 J	2.06 J	6.29 J	4.65 J	2.34 J	2.05 J
Nickel			1.6E+03	26.2	28.2	23.7 J	29.8	25.2	23.7	27.8	40.5 J	29.2	21.7	31.5	31.2	34	37.5
Selenium			400	0.5 J	0.3 J	< 1.1	0.4 J	< 1.2	< 1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.2
Silver			400	0.065	0.048 J	0.044 J	0.065	0.057	0.068	0.052	0.094 J	0.088 J	0.015 J	0.07	0.04	0.039	0.027
Thallium			5.6	0.081	0.054	0.048	0.044 J	0.05 J	0.051 J	0.056 J	0.056 J	0.047 J	0.031 J	0.08 J	0.051 J	0.093 J	0.047 J
Zinc			2.4E+04	62.6 J	75.7 J	66.2 J	47.3 J	33.2 J	60.7 J	47.9 J	119 J	119 J	22.3 J	29.4 J	25.9 J	21.8 J	25.9 J
Mercury	2		24	0.053	0.04 J	0.034 J	0.041	0.068	0.065	0.032	0.065 J	0.088 J	< 0.02	0.024	0.02	0.02	0.019 J
PCBs EPA 8082 (µg/kg)																	
Aroclor 1242				NA	NA	NA	NA	NA	< 7.1	< 5.5	14	NA	< 5.5	NA	NA	NA	NA
Aroclor 1254			1.6E+03	NA	NA	NA	NA	NA	< 80	< 5.5	39 J	NA	< 5.5	NA	NA	NA	NA
Aroclor 1260				NA	NA	NA	NA	NA	< 7.1	8.9	51	NA	< 5.5	NA	NA	NA	NA
Total PCBs	1.00E+04	500		NA	NA	NA	NA	NA	47	14.4	104	NA	8.25	NA	NA	NA	NA
Volatile Organic Compounds EPA 8260 (µg/kg)																	
1,1,1-Trichloroethane			7.2E+07	< 6.4	< 5.2	< 5.6	< 5.4	< 6	< 4.8	< 4.8	< 4.7	< 5.1	< 5	< 4.6	< 4.9	< 5	< 5.1
1,2,4-Trimethylbenzene			4.0E+06	< 26	< 21	< 23	0.097 J	< 24	< 19	< 19	< 19	< 21	< 20	< 19	< 20	< 20	< 21
2-Butanone			4.8E+07	16 J	< 21	< 23	< 22	< 24	2.8 J	< 19	8.1 J	4.9 J	< 20	< 19	< 20	< 20	< 21
Acetone			8.0E+06	230	42	67	41	33	22	24	67	46	16 J	12 J	11 J	3.3 J	3 J
Carbon Disulfide			8.0E+06	0.43 J	< 5.2	< 5.6	< 5.4	< 6	< 4.8	0.095 J	0.21 J	< 5.1	< 5	< 4.6	< 4.9	< 5	< 5.1
Dichlorodifluoromethane			1.6E+07	< 6.4	< 5.2	0.29 J	< 5.4	< 6	< 4.8	< 4.8	< 4.7	< 5.1	< 5	< 4.6	< 4.9	< 5	0.4 J
Ethylbenzene	6		8.0E+06	< 6.4	< 5.2	< 5.6	< 5.4	0.34 J	0.23 J	< 4.8	< 4.7	0.31 J	< 5	< 4.6	< 4.9	< 5	< 5.1
m,p-Xylene	9			0.54 J	0.19 J	0.23 J	0.43 J	1.1 J	0.72 J	< 4.8	< 4.7	0.88 J	0.51 J	< 4.6	< 4.9	< 5	< 5.1
o-Xylene	9		1.6E+08	< 6.4	< 5.2	< 5.6	< 5.4	0.26 J	0.17 J	< 4.8	< 4.7	0.17 J	< 5	< 4.6	< 4.9	< 5	< 5.1
Toluene	7		6.4E+06	1.8 J	0.46 J	0.65 J	0.87 J	2.6 J	1.8 J	< 4.8	0.38 J	2.3 J	1.6 J	0.24 J	0.53 J	0.26 J	0.38 J
Semi-volatile Organic Compounds EPA 8270 (µg/kg)																	
2-Methylnaphthalene			3.2E+05	< 5.8	< 5.5 UJ	< 5.5 UJ	< 7.3	< 5.8	< 7.1	< 5.5	90 J	190 J	< 5.5	2.4 J	< 5.6	< 5.6	< 6.1
4-Methylphenol			4.0E+05	< 5.8	5.9 J	< 5.5	< 7.3	< 5.8	< 7.1	< 5.5	24 J	39 J	< 5.5	1.6 J	< 5.6	< 5.6	< 6.1
Acenaphthene			4.8E+06	< 5.8	< 5.5 UJ	< 5.5 UJ	< 7.3	< 5.8	2.2 J	< 5.5	110 J	220 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Acenaphthylene				1.6 J	< 5.5	1.6 J	< 7.3	< 5.8	< 7.1	< 5.5	14 J	16 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Anthracene			2.4E+07	3.1 J	< 5.5 UJ	1.9 J	1.6 J	< 5.8	5.7 J	< 5.5	59 J	87 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Benzo(a)anthracene				7.8	2.9 J	3.9 J	2.3 J	2 J	17	15	78 J	120 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Benzo(a)pyrene		140		9.2	< 5.5 UJ	< 5.5 UJ	< 7.3	< 5.8	18	24	77 J	97 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Benzo(b)fluoranthene				15	4.6 J	5.1 J	5 J	4.5 J	23	29	180 J	250 J	< 5.5	3.5 J	< 5.6	< 5.6	< 6.1
Benzo(g,h,i)perylene				9.3	3.2 J	4.3 J	< 7.3	3.6 J	12	16	56 J	68 J	< 5.5	2.3 J	< 5.6	< 5.6	< 6.1
Benzo(k)fluoranthene				4.2 J	< 5.5 UJ	1.9 J	< 7.3	1.5 J	8.1	11	62 J	80 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Benzoic Acid			3.2E+08	270	< 110	< 110 UJ	< 150 UJ	< 120	< 150 UJ	< 110 UJ	< 580 UJ	< 580 UJ	< 110 UJ	< 110 UJ	< 120 UJ	< 120 UJ	< 130 UJ
Benzyl Alcohol			2.4E+07	8.9 J	< 11	< 11	51	< 12	2.7 J	< 11	< 58	< 58	< 11	< 11	< 12	< 12	< 13
bis(2-Ethylhexyl)phthalate		7.1E+04	1.6E+06	60	19 J	8.4 J	24 J	< 58	130	< 55	69 J	84 J	< 55	35 J	< 56	< 56	7.1 J
Butylbenzylphthalate			1.6E+07	17	< 5.5	< 5.5 UJ	7 J	< 5.8	< 7.1	< 5.5	49 J	< 29	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Chrysene				13	4.3 J	5.5 J	4.5 J	4 J	20	18	210 J	460 J	< 5.5	4.3 J	< 5.6	< 5.6	< 6.1
Dibenz(a,h)anthracene				< 5.8	< 5.5	< 5.5	< 7.3	< 5.8	2.7 J	3.6 J	12 J	15 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Dibenzofuran			1.6E+05	< 5.8	< 5.5	< 5.5 UJ	< 7.3	< 5.8	< 7.1	< 5.5	85 J	170	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Diethylphthalate			6.4E+07	< 5.8	< 5.5	< 5.5	1.4	< 5.8	< 7.1	< 5.5	< 29	< 29	1.4	< 5.5	< 5.6	< 5.6	< 6.1
Di-n-Butylphthalate			8.0E+06	19	< 11	< 11	8.2 J	< 12	11 J	< 11	< 58	< 58	< 11	< 11	< 12	< 12	< 13
Fluoranthene			3.2E+06	20	< 6.8 U	8.7 J	7.8	< 4.2 U	34	20	510 J	740 J	< 5.5	6.1	< 5.6	< 5.6	< 6.1
Fluorene			3.2E+06	< 5.8	< 5.5 UJ	1.5 J	1.3 J	< 5.8	1.7 J	< 5.5	100 J	210 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Hexachlorobenzene		630	6.4E+04	< 5.8	< 5.5	1.7 J	< 7.3	< 5.8	< 7.1	< 5.5	< 29	< 29	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Indeno(1,2,3-cd)pyrene				8.9	2.8 J	3.6 J	< 7.3	2.7 J	12	18	67 J	74 J	< 5.5	< 5.5	< 5.6	< 5.6	< 6.1
Naphthalene	5		1.6E+06	< 5.8	< 5.5 UJ	< 5.5 UJ	< 7.3	< 5.8	< 7.1	< 5.5	250 J	540 J	< 5.5	2.3 J	< 5.6	< 5.6	< 6.1
Pentachlorophenol		8.3E+03	2.4E+06	110	370	720 J	38 J	< 58	39 J	53 J	340 J	250 J	< 55	< 55	< 56	< 56	< 61
Phenanthrene				< 16 U	< 5.9 U	10 J	9.2	< 4.2 U	26	4.7	430 J	670 J	< 5.5	4	< 5.6	< 5.6	< 6.1
Pyrene			2.4E+06	20	8.1 J	10 J	6.5 J	4.1 J	36	20	400 J	590 J	< 5.5	5 J	< 5.6	< 5.6	< 6.1
NWTPH-Dx (mg/kg)																	
Diesel Range Hydrocarbons	2.0E+03			22 J	22 J	13 J	9.4 J	16 J	13 J	NA	160 NJ	100 NJ	1.4 J	5 J	2.6 J	< 28	< 31
Residual Range Organics (RRO)	2.0E+03			170 NJ	97 J	69 J	75 J	120 J	52 J	NA	610 J	400 J	< 6.9 U	27 J	< 5 U	< 120	< 130
NWTPH-Gx (mg/kg)																	
Gasoline Range Organics-NWTPH	100/30			2.4 J	< 5.7	< 5.7	< 5.5	< 6.1	< 5.3	< 5.6	5.4 J	2.6 J	< 5.6	< 5.8	< 5.8	< 5.8	< 6.5

Shaded and Bold - Value exceed Method B CUL
(or Method A if no Method B value available)
Qualifiers:
J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Table F-3-1 Geoprobe Soils Analytical Results: Metals, PCBs, SVOCs, VOCs, and TPH

			Location ID	LL10	LL10	LL11	LL11	LL12	LL12	LL12	LL12
			Sample ID	LL10-0-0.5	LL10-1.5-2	LL11-0-0.5	LL11-1.5-2	LL12-0-0.5	LL12-1.5-2	LL12-6-8	LL12-13-15
			Sample Date	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08	04/03/08
Chemical Name	**Method A**	**MTCA B - Carcinogen**	**MTCA B - Non-Carcinogen**								
Metals EPA 6020 / 7471A (mg/kg)											
Antimony			32	**0.69** J	**0.22** J	**0.19** J	**0.05** J	**0.49** J	**0.13** J	**0.06** J	**0.07** J
Arsenic	20	0.67	24	**11.1**	**3.28** J	**3.76** J	**1.62** J	**6.3**	**2.62**	**1.97**	**0.89**
Beryllium			160	**0.242**	**0.201** J	**0.207** J	**0.174** J	**0.255**	**0.214**	**0.14**	**0.244**
Cadmium	2		80	**0.377**	**0.487** J	**0.319** J	**0.056** J	**0.727**	**0.442**	**0.059**	**0.066**
Chromium	19/2000			**24.4**	**26.1**	**29.6**	**21.4**	**27.3**	**22.8**	**23.9**	**37**
Copper			3.0E+03	**17.6** J	**17.2** J	**24.3** J	**11** J	**50.8** J	**13.4** J	**11** J	**19.8** J
Lead	250			**67.6** J	**57**	**21.3**	< 2.14 U	**74.9** J	**6.7** J	**2.18** J	**2.76** J
Nickel			1.6E+03	**26.6**	**26.3**	**23.7**	**28.7**	**27.8**	**33**	**30.2**	**40.6**
Selenium			400	< 1.2	< 1.1	< 1.1	< 1.1	**0.5** J	< 1.1	< 1	< 1.3
Silver			400	**0.092**	**0.082**	**0.064**	**0.034**	**0.084**	**0.037**	**0.037**	**0.037**
Thallium			5.6	**0.074** J	**0.057**	**0.069**	**0.044**	**0.056** J	**0.049** J	**0.031** J	**0.058** J
Zinc			2.4E+04	**52.8** J	**95.8** J	**47** J	**21.6** J	**140** J	**38.4** J	**24.1** J	**32.2** J
Mercury	2		24	**0.072**	**0.05**	**0.04**	**0.017** J	**0.063**	**0.032**	**0.013** J	**0.018** J
PCBs EPA 8082 (µg/kg)											
Aroclor 1242				NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254			1.6E+03	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260				NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	1.00E+04	500		NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds EPA 8260 (µg/kg)											
1,1,1-Trichloroethane			7.2E+07	< 6.6	< 6	< 6.9	< 5.5	**0.28** J	< 6.1	< 4.8	< 5
1,2,4-Trimethylbenzene			4.0E+06	< 27	< 24	< 28	< 22	< 24	< 25	< 19	< 20
2-Butanone			4.8E+07	< 27	< 24	**4.7** J	< 22	**5.9** J	**4.8** J	< 19	< 20
Acetone			8.0E+06	**62**	**41**	**70**	**18** J	**95**	**79**	**9.1** J	< 20
Carbon Disulfide			8.0E+06	< 6.6	< 6	< 6.9	**0.099** J	**0.12** J	< 6.1	**0.18** J	< 5
Dichlorodifluoromethane			1.6E+07	< 6.6	< 6	< 6.9	**0.42** J	**0.72** J	< 6.1	< 4.8	< 5
Ethylbenzene	6		8.0E+06	< 6.6	< 6	< 6.9	< 5.5	**0.46** J	**0.28** J	< 4.8	< 5
m,p-Xylene	9			**0.35** J	**0.51** J	< 6.9	**0.35** J	**1.6** J	**0.63** J	**0.48** J	**0.18** J
o-Xylene	9		1.6E+08	< 6.6	< 6	< 6.9	< 5.5	**0.54** J	< 6.1	< 4.8	< 5
Toluene	7		6.4E+06	**0.98** J	**1.1** J	**0.86** J	**0.73** J	**3.1** J	**1.5** J	**1.3** J	**0.93** J
Semi-volatile Organic Compounds EPA 8270 (µg/kg)											
2-Methylnaphthalene			3.2E+05	**2.4** J	< 55	< 5.8	< 5.5	**6.4**	< 5.5	< 5.3	< 6.4
4-Methylphenol			4.0E+05	< 5.9	< 55	< 5.8	< 5.5	< 5.9	< 5.5	< 5.3	< 6.4
Acenaphthene			4.8E+06	**2.2** J	< 55	< 5.8	< 5.5	< 5.9	< 5.5	< 5.3	< 6.4
Acenaphthylene				**1.7** J	**17** J	< 5.8	< 5.5	**2.5** J	< 5.5	< 5.3	< 6.4
Anthracene			2.4E+07	**10**	< 55	< 5.8	< 5.5	**3.1** J	< 5.5	< 5.3	< 6.4
Benzo(a)anthracene				**55**	< 55	**2.2** J	< 5.5	**9**	< 5.5	< 5.3	< 6.4
Benzo(a)pyrene		140		**59**	< 55	< 5.8	< 5.5	**13**	< 5.5	< 5.3	< 6.4
Benzo(b)fluoranthene				**60**	< 55	**3.5** J	< 5.5	**20**	**2.5** J	< 5.3	< 6.4
Benzo(g,h,i)perylene				**38**	< 55	**2.6** J	< 5.5	**11**	< 5.5	< 5.3	< 6.4
Benzo(k)fluoranthene				**20**	< 55	< 5.8	< 5.5	**6.2**	< 5.5	< 5.3	< 6.4
Benzoic Acid			3.2E+08	**240** J	< 1,100 UJ	< 120 UJ	< 110 UJ	< 120 UJ	< 110 UJ	< 110 UJ	< 130 UJ
Benzyl Alcohol			2.4E+07	< 12	< 110	< 12	< 11	< 12	< 11	< 11	< 13
bis(2-Ethylhexyl)phthalate		7.1E+04	1.6E+06	**25** J	< 550	**14** J	< 55	**110**	**15** J	< 53	< 64
Butylbenzylphthalate			1.6E+07	< 5.9	< 55	< 5.8	< 5.5	< 5.9	**15**	< 5.3	< 6.4
Chrysene				**62**	< 55	**2.8** J	< 5.5	**16**	**1.8** J	< 5.3	< 6.4
Dibenz(a,h)anthracene				**5.1** J	< 55	< 5.8	< 5.5	**1.8** J	< 5.5	< 5.3	< 6.4
Dibenzofuran			1.6E+05	**1.5** J	< 55	< 5.8	< 5.5	**1.7** J	< 5.5	< 5.3	< 6.4
Diethylphthalate			6.4E+07	< 5.9	< 55	< 5.8	**1.5**	< 5.9	**1.8**	< 5.3	< 6.4
Di-n-Butylphthalate			8.0E+06	< 12	< 110	< 12	< 11	**11** J	< 11	< 11	< 13
Fluoranthene			3.2E+06	**97**	< 55	**5.1**	< 5.5	**22**	**2.9**	< 5.3	**2.3**
Fluorene			3.2E+06	**2.6** J	< 55	< 5.8	< 5.5	< 5.9	< 5.5	< 5.3	< 6.4
Hexachlorobenzene		630	6.4E+04	< 5.9	< 55	< 5.8	< 5.5	< 5.9	< 5.5	< 5.3	< 6.4
Indeno(1,2,3-cd)pyrene				**37**	< 55	**1.6** J	< 5.5	**11**	< 5.5	< 5.3	< 6.4
Naphthalene	5		1.6E+06	**3.2** J	< 55	< 5.8	< 5.5	**6**	< 5.5	< 5.3	< 6.4
Pentachlorophenol		8.3E+03	2.4E+06	**42** J	**1,900**	**310**	**29** J	**150**	< 55	< 53	< 64
Phenanthrene				**51**	< 55	**4.6**	**1.8**	**12**	**1.6**	< 5.3	**4.2**
Pyrene			2.4E+06	**120**	**27** J	**5.1** J	< 5.5	**24**	**2.4** J	< 5.3	**1.5** J
NWTPH-Dx (mg/kg)											
Diesel Range Hydrocarbons	2.0E+03			**12** J	**37** NJ	**4.3** J	**1.6** J	**23** J	**43** J	**1.6** J	**1.7** J
Residual Range Organics (RRO)	2.0E+03			**94** J	**230** J	**53** J	< 11 U	**110** J	**43** J	< 9.7 U	< 9.9 U
NWTPH-Gx (mg/kg)											
Gasoline Range Organics-NWTPH	100/30			< 6.3	**17** NJ	< 6.1	< 5.7	< 6.2	< 5.7	< 5.4	< 7.1

Shaded and Bold - Value exceed Method B CUL
(or Method A if no Method B value available)
Qualifiers:
J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Table F-3-2 Geoprobe Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ)

		Location ID	LL01			LL01			LL01			LL07			LL07			LL08		
		Sample ID	LL01-0-0.5			LL01-1.5-2			DUP02-040308			LL07-0-0.5			LL07-1.5-2			LL08-0-0.5		
		Sample Date	04/03/08			04/03/08			04/03/08			04/03/08			04/03/08			04/03/08		
Chemical Name	TEFs	Unit																		
Dioxins/Furans			Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	322,000	96.6	J	1,440,000	432.0	J	1,280,000	384.0000	J	719	0.216		12,200	3.66	J	3,450	1.04	J
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	44,100	13.23		236,000	70.80	J	228,000	68.4	J	87.2	0.0262		1,050	0.315		446	0.134	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	21,500	215		67,000	670		83,200	832.000		91.9	0.919		1,130	11.3	J	337	3.37	J
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	4,270	42.7		14,600	146.0		20,000	200.0000		21	0.210		319	3.19		83.2	0.832	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	143	1.43		416	4.16		454	4.54	J	2.17	0.0217	NJ+	14.4	0.144		3.3	0.0330	
1,2,3,4,7,8-HxCDD	0.1	ng/kg	92	9.2		117	11.7		135	13.5000		1.08	0.108	J	6.53	0.653		2.61	0.261	
1,2,3,4,7,8-HxCDF	0.1	ng/kg	59.3	5.93		253	25.30		307	30.7000		1.01	0.101	J	12.9	1.29		2.26	0.226	J
1,2,3,6,7,8-HxCDD	0.1	ng/kg	333	33.3		846	84.6		1,070	107.0000		3.27	0.327		27.4	2.74		10	1.00	
1,2,3,6,7,8-HxCDF	0.1	ng/kg	28.2	2.82		109	10.90		134	13.4000		0.881	0.0881	J	11.1	1.11		1.49	0.149	J
1,2,3,7,8,9-HxCDD	0.1	ng/kg	209	20.9		352	35.2		382	38.2000		2.98	0.298		21.8	2.18		8.73	0.873	
1,2,3,7,8,9-HxCDF	0.1	ng/kg	0.75	0.075	J	1.56	0.156	J	2.25	0.225	J	< 0.232	0.012		0.34	0.0340	J	< 0.0826	0.004	
1,2,3,7,8-PeCDD	1	ng/kg	39.5	39.5		68.4	68.4		80.7	80.700		0.725	0.725	J	3.42	3.42		1.37	1.37	NJ+
1,2,3,7,8-PeCDF	0.03	ng/kg	2.66	0.080	J	5.67	0.170		6.86	0.2058		0.11	0.0033	NJ+	0.89	0.0267	J	< 0.434	0.0065	
2,3,4,6,7,8-HxCDF	0.1	ng/kg	29.1	2.91		96.4	9.64		122	12.2000		1.01	0.101	J	15	1.50		1.8	0.180	J
2,3,4,7,8-PeCDF	0.3	ng/kg	8.5	2.55		35.7	10.71		43.6	13.080		0.341	0.102	J	5.39	1.62		0.833	0.250	J
2,3,7,8-TCDD	1	ng/kg	6.53	6.5		7.59	7.6		9.05	9.050		< 0.0919	0.046		0.517	0.517	NJ+	0.425	0.425	NJ+
2,3,7,8-TCDF	0.1	ng/kg	1.41	0.141		1.95	0.195		2.04	0.2040		< 0.123	0.0062		1.06	0.106		0.524	0.0524	NJ+
Total TCDD TEQ (1)				493			1588			1807			3.31			33.8			10.2	

Notes

Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.

(1) One-half the detection limit used in TEQ calculation for non-detect results

Qualifiers:

J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Method B CUL - 11 ng/kg

▨ - Shaded value exceeds Method B screening level

Table F-3-2 Geoprobe Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ)

		Location ID		LL08				LL08				LL08				LL08				LL09				LL09		
		Sample ID		LL08-1.5-2				LL08-2-4				DUP01-040308				LL08-13-15				LL09-0-0.5				LL09-1.5-2		
		Sample Date		04/03/08				04/03/08				04/03/08				04/03/08				04/03/08				04/03/08		
Chemical Name	TEFs	Unit																								
Dioxins/Furans				Reported Value	TEQ			Reported Value	TEQ			Reported Value	TEQ			Reported Value	TEQ			Reported Value	TEQ			Reported Value	TEQ	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg		13,800	4.14	J		351,000	105.3	J		156,000	46.8	J		116	0.0348	J		149	0.0447	J		177	0.0531	J
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg		1,960	0.588	J		36,700	11.0			17,300	5.19			13.7	0.00411			16.8	0.00504			20	0.006	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg		1,320	13.2	J		26,800	268	J		17,200	172	J		16.4	0.164	J		15.1	0.151	J		18.3	0.183	J
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg		397	3.97			4,280	42.8			2,300	23.0			2.78	0.0278			4.05	0.0405			5.23	0.0523	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg		14.4	0.144			155	1.55			109	1.09			0.253	0.00253	J		0.226	0.00226	NJ+		0.185	0.00185	NJ+
1,2,3,4,7,8-HxCDD	0.1	ng/kg		7.38	0.738			105	10.5			127	12.7			0.243	0.0243	NJ+		0.17	0.0170	J		0.15	0.0150	J
1,2,3,4,7,8-HxCDF	0.1	ng/kg		9	0.900			73.3	7.33			65.2	6.52			0.14	0.0140	J		0.329	0.0329	J		0.398	0.0398	J
1,2,3,6,7,8-HxCDD	0.1	ng/kg		34.7	3.47			438	43.8			461	46.1			0.606	0.0606	J		0.462	0.0462	NJ+		0.609	0.0609	J
1,2,3,6,7,8-HxCDF	0.1	ng/kg		5.31	0.531			48.6	4.86			41.8	4.18			0.119	0.0119	J		0.231	0.0231	J		0.206	0.0206	J
1,2,3,7,8,9-HxCDD	0.1	ng/kg		31.5	3.15			468	46.8			592	59.2			0.977	0.0977	J		0.533	0.0533	J		0.464	0.0464	J
1,2,3,7,8,9-HxCDF	0.1	ng/kg	<	0.293	0.015			1.91	0.191	J		2.03	0.203	J	<	0.0426	0.002		<	0.0391	0.002		<	0.0227	0.001	
1,2,3,7,8-PeCDD	1	ng/kg		9.28	9.28			82.8	82.8			102	102			0.303	0.303	J		0.108	0.108	NJ+		0.131	0.131	NJ+
1,2,3,7,8-PeCDF	0.03	ng/kg	<	0.811	0.0122			5.93	0.178			6.31	0.189		<	0.0234	0.0004		<	0.092	0.00138		<	0.133	0.001995	
2,3,4,6,7,8-HxCDF	0.1	ng/kg		4.71	0.471			40.3	4.03			37.1	3.71			0.109	0.0109	J		0.156	0.0156	NJ+		0.167	0.0167	NJ+
2,3,4,7,8-PeCDF	0.3	ng/kg		1.74	0.522	J		12.3	3.69			12	3.60		<	0.0225	0.003			0.144	0.0432	J		0.127	0.0381	NJ+
2,3,7,8-TCDD	1	ng/kg		2.57	2.57			16.5	16.5			17.1	17.1		<	0.0313	0.016		<	0.0274	0.014		<	0.0384	0.019	
2,3,7,8-TCDF	0.1	ng/kg		0.361	0.0361	J		2.62	0.262			1.68	0.168		<	0.0216	0.0011		<	0.106	0.0053		<	0.0928	0.0046	
Total TCDD TEQ (1)					43.7				650				504				0.8				0.61				0.69	

Notes

Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.

(1) One-half the detection limit used in TEQ calculation for non-detect results

Qualifiers:

J = estimated concentration (value less than calculated reporting limit)

N = analyte is tentatively identified (validator qualifier)

\+ = biased high

Method B CUL - 11 ng/kg

▨ - Shaded value exceeds Method B screening level

Table F-3-2 Geoprobe Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ)

		Location ID	LL09			LL09			LL10			LL10			LL11			LL11		
		Sample ID	LL09-6-8			LL09-13-15			LL10-0-0.5			LL10-1.5-2			LL11-0-0.5			LL11-1.5-2		
		Sample Date	04/03/08			04/03/08			04/03/08			04/03/08			04/03/08			04/03/08		
Chemical Name	**TEFs**	**Unit**																		
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	13.9	0.00417	J	< 4.58	0.00069		76,800	23.0	J	2,350,000	705	J	24,100	7.2	J	622	0.2	
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	< 0.394	5.9E-05		< 0.186	2.8E-05		11,000	3.30		371,000	111.3	J	6,300	1.89		214	0.06	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	< 1.05	0.0053		< 0.546	0.00273		6,480	64.8		113,000	1130	J	2,590	25.9		107	1.1	
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	< 0.0888	0.00044		< 0.0321	0.00016		1,640	16.4		22,800	228		965	9.7		57.3	0.6	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	< 0.0233	0.0001		< 0.023	0.0001		70.9	0.709		586	5.86		26.6	0.266		1.87	0.019	J
1,2,3,4,7,8-HxCDD	0.1	ng/kg	< 0.0146	0.001		< 0.0149	0.001		17.4	1.74		137	13.7		1.92	0.19	J	0.353	0.04	J
1,2,3,4,7,8-HxCDF	0.1	ng/kg	< 0.0105	0.001		< 0.00876	0.000		40.5	4.05		441	44.1		13	1.30		0.602	0.06	J
1,2,3,6,7,8-HxCDD	0.1	ng/kg	< 0.0142	0.001		< 0.0145	0.001		149	14.9		1,490	149		54.8	5.5		3.95	0.4	
1,2,3,6,7,8-HxCDF	0.1	ng/kg	< 0.0107	0.001		< 0.00899	0.000		16.4	1.64		156	15.6		3.98	0.40		< 0.218	0.01	
1,2,3,7,8,9-HxCDD	0.1	ng/kg	< 0.0154	0.001		< 0.0156	0.001		68.8	6.88		583	58.3		11.7	1.2		1.4	0.1	J
1,2,3,7,8,9-HxCDF	0.1	ng/kg	< 0.0142	0.001		< 0.0119	0.001		< 0.772	0.039		4.94	0.494		< 0.655	0.0328		< 0.278	0.0139	
1,2,3,7,8-PeCDD	1	ng/kg	< 0.0184	0.01		< 0.0161	0.01		11.3	11.3		93.2	93.2		1.89	1.9	J	0.415	0.4	J
1,2,3,7,8-PeCDF	0.03	ng/kg	< 0.013	0.0002		< 0.0148	0.0002		1.42	0.0426	J	8.69	0.261		0.274	0.0082	J	< 0.0496	0.0007	
2,3,4,6,7,8-HxCDF	0.1	ng/kg	< 0.0118	0.001		< 0.00993	0.000		16	1.60		137	13.7		4.25	0.43		1.2	0.12	J
2,3,4,7,8-PeCDF	0.3	ng/kg	< 0.0125	0.002		< 0.0142	0.002		6.34	1.90		65.1	19.5		1.95	0.59	J	< 0.0488	0.01	
2,3,7,8-TCDD	1	ng/kg	< 0.0259	0.01295		< 0.0295	0.015		2.63	2.63		14.5	14.5		0.544	0.54	J	< 0.075	0.04	
2,3,7,8-TCDF	0.1	ng/kg	< 0.0266	0.0013		< 0.0183	0.0009		0.941	0.0941	J	2.37	0.237		< 0.153	0.008		< 0.0455	0.002	
Total TCDD TEQ (1)				**0.04**			**0.034**			**155**			**2603**			**57.0**		**3.2**	**3.2**	

Notes

Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.

(1) One-half the detection limit used in TEQ calculation for non-detect results

Qualifiers:

J = estimated concentration (value less than calculated reporting limit)

N = analyte is tentatively identified (validator qualifier)

+ = biased high

Method B CUL - 11 ng/kg

▨ - Shaded value exceeds Method B screening level

Table F-3-2 Geoprobe Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ)

		Location ID	LL12				LL12				LL12				LL12		
		Sample ID	LL12-0-0.5				LL12-1.5-2				LL12-6-8				LL12-13-15		
		Sample Date	04/03/08				04/03/08				04/03/08				04/03/08		
Chemical Name	**TEFs**	**Unit**															
Dioxins/Furans			**Reported Value**	**TEQ**			**Reported Value**	**TEQ**			**Reported Value**	**TEQ**			**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	90,500	**27.2**	**J**		1,970	**0.591**	**J**		84.9	**0.0255**			439	**0.132**	
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	10,000	**3.00**			279	**0.0837**			22.6	**0.00678**			42.9	**0.0129**	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	7,910	**79.1**	**J**		203	**2.03**			19.4	**0.194**			56.7	**0.567**	
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	1,320	**13.2**			72.9	**0.729**			5.1	**0.0510**			5.3	**0.0530**	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	73.5	**0.735**			2.63	**0.0263**	**J**		0.499	**0.00499**	**NJ+**		1.6	**0.0160**	**J**
1,2,3,4,7,8-HxCDD	0.1	ng/kg	52.4	**5.24**			0.916	**0.0916**	**J**		0.26	**0.0260**	**NJ+**		0.959	**0.0959**	**J**
1,2,3,4,7,8-HxCDF	0.1	ng/kg	39.7	**3.97**			1.38	**0.138**	**J**	<	0.313	0.016		<	0.396	0.020	
1,2,3,6,7,8-HxCDD	0.1	ng/kg	235	**23.5**			4.7	**0.470**			0.986	**0.0986**	**J**		1.61	**0.161**	**J**
1,2,3,6,7,8-HxCDF	0.1	ng/kg	25.1	**2.51**			0.66	**0.0660**	**J**	<	0.31	0.016		<	0.404	0.020	
1,2,3,7,8,9-HxCDD	0.1	ng/kg	228	**22.8**			2.8	**0.280**			0.915	**0.0915**	**NJ+**		3.11	**0.311**	
1,2,3,7,8,9-HxCDF	0.1	ng/kg	0.78	**0.0780**	**NJ+**	<	0.516	0.026		<	0.396	0.020		<	0.536	0.027	
1,2,3,7,8-PeCDD	1	ng/kg	39.9	**39.9**			0.67	**0.670**	**J**		0.331	**0.331**	**J**	<	0.0977	0.05	
1,2,3,7,8-PeCDF	0.03	ng/kg	2.92	**0.0876**		<	0.0725	0.0011		<	0.05	0.0008		<	0.108	0.0016	
2,3,4,6,7,8-HxCDF	0.1	ng/kg	23.9	**2.39**		<	0.431	0.022		<	0.336	0.017		<	0.448	0.022	
2,3,4,7,8-PeCDF	0.3	ng/kg	6.85	**2.06**		<	0.0699	0.010		<	0.0492	0.007		<	0.104	0.016	
2,3,7,8-TCDD	1	ng/kg	7.91	**7.91**		<	0.0814	0.041		<	0.0619	0.031		<	0.088	0.044	
2,3,7,8-TCDF	0.1	ng/kg	1.15	**0.115**		<	0.06	0.0030		<	0.0534	0.0027		<	0.112	0.0056	
Total TCDD TEQ (1)				234				**5.3**				**0.9**				**1.55**	

Notes
Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.
(1) One-half the detection limit used in TEQ calculation for non-detect results
Qualifiers:
J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Method B CUL - 11 ng/kg

▨ - Shaded value exceeds Method B screening level

Table F-3-3 Geoprobes Soils Analytical Results: cPAH Total Toxic Equivalency Quotient (TEQ)

Location ID			LL01		LL01		LL01		LL07		LL07		LL08		LL08		LL08		LL08	
Sample ID			LL01-0-0.5		LL01-1.5-2		DUP02-040308		LL07-0-0.5		LL07-1.5-2		LL08-0-0.5		LL08-1.5-2		LL08-2-4		DUP01-040308	
Sample Date			04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08	
Chemical Name (µg/kg)	TEFs	Unit																		
Carcinogenic PAH			Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ
Benzo(a)anthracene	0.1	µg/kg	7.8	**0.8**	2.9	**0.3** J	3.9	**0.39** J	2.3	**0.2** J	2	**0.2** J	17	**1.7**	15	**1.5**	78	**7.8** J	120	**12** J
Benzo(a)pyrene	1	µg/kg	9.2	**9.2**	< 5.5	2.8 UJ	< 5.5	2.75 UJ	< 7.3	3.7	< 5.8	2.9	18	**18**	24	**24**	77	**77** J	97	**97** J
Benzo(b)fluoranthene	0.1	µg/kg	15	**1.5**	4.6	**0.5** J	5.1	**0.51** J	5	**0.5** J	4.5	**0.5** J	23	**2.3**	29	**2.9**	180	**18** J	250	**25** J
Benzo(k)fluoranthene	0.1	µg/kg	4.2	**0.4** J	< 5.5	0.3 UJ	1.9	**0.19** J	< 7.3	0.4	1.5	**0.2** J	8.1	**0.81**	11	**1.1**	62	**6.2** J	80	**8** J
Chrysene	0	µg/kg	13	**0.1**	4.3	**0** J	5.5	**0.06** J	4.5	**0** J	4	**0** J	20	**0.2**	18	**0.18**	210	**2.1** J	460	**4.6** J
Dibenz(a,h)anthracene	0.1	µg/kg	< 5.8	0.3	< 5.5	0.3	< 5.5	0.28	< 7.3	0.4	< 5.8	0.3	2.7	**0.27** J	3.6	**0.36** J	12	**1.2** J	15	**1.5** J
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	8.9	**0.9**	2.8	**0.3** J	3.6	**0.36** J	< 7.3	0.4	2.7	**0.3** J	12	**1.2**	18	**1.8**	67	**6.7** J	74	**7.4** J
Total cPAH TEQ (1)				**13.2**		**4.4**		**4.53**		**5.5**		**4.3**		**24.5**		**31.8**		**119**		**156**

Location ID			LL08		LL09		LL09		LL09		LL09		LL10		LL10	
Sample ID			LL08-13-15		LL09-0-0.5		LL09-1.5-2		LL09-6-8		LL09-13-15		LL10-0-0.5		LL10-1.5-2	
Sample Date			04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08	
Chemical Name	TEFs	Unit														
Carcinogenic PAH			Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ
Benzo(a)anthracene	0.1	µg/kg	< 5.5	0.3	< 5.5	0.3	< 5.6	0.28	< **5.6**	0.3	< 6.1	0.3	55	**5.5**	< 55	2.75
Benzo(a)pyrene	1	µg/kg	< 5.5	2.8	< 5.5	2.8	< 5.6	2.8	< **5.6**	2.8	< 6.1	3.1	59	**59**	< 55	27.5
Benzo(b)fluoranthene	0.1	µg/kg	< 5.5	0.3	3.5	**0.4** J	< 5.6	0.28	< **5.6**	0.3	< 6.1	0.3	60	**6**	< 55	2.75
Benzo(k)fluoranthene	0.1	µg/kg	< 5.5	0.3	< 5.5	0.3	< 5.6	0.28	< **5.6**	0.3	< 6.1	0.3	20	**2**	< 55	2.75
Chrysene	0	µg/kg	< 5.5	0	4.3	**0** J	< 5.6	0.03	< **5.6**	0	< 6.1	0	62	**0.62**	< 55	0.28
Dibenz(a,h)anthracene	0.1	µg/kg	< 5.5	0.3	< 5.5	0.3	< 5.6	0.28	< **5.6**	0.3	< 6.1	0.3	5.1	**0.51** J	< 55	2.75
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	< 5.5	0.3	< 5.5	0.3	< 5.6	0.28	< **5.6**	0.3	< 6.1	0.3	37	**3.7**	< 55	2.75
Total cPAH TEQ (1)				NC		**4.2**		NC		**4.2**		NC		**77.3**		NC

Location ID			LL11		LL11		LL12		LL12		LL12		LL12	
Sample ID			LL11-0-0.5		LL11-1.5-2		LL12-0-0.5		LL12-1.5-2		LL12-6-8		LL12-13-15	
Sample Date			04/03/08		04/03/08		04/03/08		04/03/08		04/03/08		04/03/08	
Chemical Name	TEFs	Unit												
Carcinogenic PAH			Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ	Reported Value	TEQ
Benzo(a)anthracene	0.1	µg/kg	2.2	**0.2** J	< 5.5	0.3	9	**0.9**	< 5.5	0.3	< 5.3	0.3	< 6.4	0.32
Benzo(a)pyrene	1	µg/kg	< 5.8	2.9	< 5.5	2.8	13	**13**	< 5.5	2.8	< 5.3	2.7	< 6.4	3.2
Benzo(b)fluoranthene	0.1	µg/kg	3.5	**0.4** J	< 5.5	0.3	20	**2**	2.5	**0.3** J	< 5.3	0.3	< 6.4	0.32
Benzo(k)fluoranthene	0.1	µg/kg	< 5.8	0.3	< 5.5	0.3	6.2	**0.62**	< 5.5	0.3	< 5.3	0.3	< 6.4	0.32
Chrysene	0	µg/kg	2.8	**0** J	< 5.5	0	16	**0.16**	1.8	**0** J	< 5.3	0	< 6.4	0.03
Dibenz(a,h)anthracene	0.1	µg/kg	< 5.8	0.3	< 5.5	0.3	1.8	**0.18** J	< 5.5	0.3	< 5.3	0.3	< 6.4	0.32
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	1.6	**0.2** J	< 5.5	0.3	11	**1.1**	< 5.5	0.3	< 5.3	0.3	< 6.4	0.32
Total cPAH TEQ (1)				**4.2**		NC		**18**		**4.1**		NC		NC

MTCA Method B CUL - 0.137 mg/kg (137 µg/kg)

Notes

(1) Total cPAH TEQ calculated using Toxicity Equivalency Factors from MTCA Regulations Revised November 2007. One-half the detection limit used for non-detect results.

Qualifiers

U = non-detect

J = estimated concentration (value less than calculated reporting limit)

D = compounds at secondary dilution factor

▨ highlight indicates exceedance of the MTCA Method B cleanup level of 137 µg/kg

NC= Not Calculated where all contituents are not detected

Bold = Deleted values

Table F-3-4 Monitoring Well Soils Analytical Results: Metals, VOCs, SVOCs, TPH

			Location ID Sample ID Sample Date	MW-2 MW-2-0-0.5 3/18/2008	MW-2 MW-2-1.5-2 3/18/2008	MW-2 MW-2-6.5-8 3/18/2008	MW-2 MW-2-14-15.5 3/18/2008	MW-3 MW-3-0-0.5 3/18/2008	MW-3 MW-3-1.5-2 3/18/2008	MW-3 MW-3-6.5-8 3/18/2008	MW-3 MW-3-14-15.5 3/18/2008	MW-4 MW-4-0-0.5 3/17/2008	MW-4 MW-4-1.5-2 3/17/2008
Chemical Name	**MTCA A**	**MTCA B - Carcinogen**	**MTCA B Non-Carcinogen**										
Metals EPA Method 6020 / 7471A (mg/kg)													
Antimony			32	**0.83** J	**0.27** J	**0.06** J	**0.07** J	**0.17** J	**0.19** J	**0.24** J	**0.09** J	**2.27** J	**0.28** J
Arsenic	20	0.67	24	**11.2**	**1.5**	**1.8**	**1.8**	**3.2**	**3.7**	**4.6**	**2.1**	**10.1**	**2.6**
Beryllium			160	**0.269** J	**0.275** J	**0.164** J	**0.177** J	**0.259** J	**0.262** J	**0.323** J	**0.214** J	**0.257** J	**0.212** J
Cadmium			80	**0.437**	**0.072**	**0.043**	**0.057**	**0.226**	**0.21**	**0.352**	**0.064**	**3.56**	**0.176**
Chromium	19/2000			**25.8**	**20.7** J	**27.3** J	**30.2** J	**20.9**	**24.7** J	**27.2** J	**26.4** J	**41** J	**24.8** J
Copper			3000	**30**	**6.44** J	**8.18** J	**12.1** J	**16.5**	**12.9** J	**18.4** J	**13** J	**64.8** J	**13.7** J
Lead	250			**53.7**	**2.46**	**1.82**	**1.91**	**10.4**	**13.2**	**15.1**	**2.07**	**370**	**12.3**
Mercury	2		24	**0.072** J	**0.027**	**0.01** J	**0.02**	**0.039** J	**0.032**	**0.042**	**0.016** J	**0.131**	**0.027**
Nickel			1600	**37.5**	**25** J	**26.9** J	**35.6** J	**33.5**	**29.8** J	**37.5** J	**34.3** J	**32.2** J	**29.6** J
Selenium			400	**0.3** J	**0.4** J	< 1.2	< 1.1	J	< 1.1	**0.4** J	< 1.1	**0.5** J	**0.4** J
Silver			400	**0.086**	**0.107**	**0.033**	**0.038**	**0.045**	**0.072**	**0.087**	**0.034**	**0.188**	**0.111**
Thallium			6	**0.066**	**0.067**	**0.03**	**0.035**	**0.053**	**0.05**	**0.067**	**0.042**	**0.059**	**0.043**
Zinc			24000	**76.9**	**18.8** J	**22.3** J	**26.9** J	**38.9**	**33.4** J	**44.2** J	**27.2** J	**598** J	**34.4** J
Volatile Organic Compounds EPA Method 8260 (µg/kg)													
1,2,4-Trichlorobenzene				< 27	< 24	< 22	< 21	< 21	< 22	< 28	< 31	< 24	< 20
1,2,4-Trimethylbenzene			4.0E+06	< 27	< 24	< 22	< 21	< 21	< 22	< 28	< 31	< 24	< 20
1,3,5-Trimethylbenzene				< 27	< 24	< 22	< 21	< 21	< 22	< 28	< 31	< 24	< 20
1,4-Dichlorobenzene				**0.3** J	**0.15** J	< 5.5	< 5.2	< 5.3	< 5.5	< 6.9	< 7.7	**0.14** J	< 4.9
2-Butanone			4.8E+07	**16** J	**6.1** J	< 22	< 21	**3.8** J	**6.5** J	**6.5** J	< 31	**7.9** J	**3.9** J
4-Isopropyltoluene				**1.9** J	**0.67** J	< 22	< 21	< 21	< 22	**0.11** J	< 31	< 24	< 20
4-Methyl-2-Pentanone (MIBK)				< 27	< 24	< 22	< 21	< 21	< 22	< 28	< 31	< 24	< 20
Acetone			8.0E+06	**320**	**95**	**3.5** J	**3.6** J	**98**	**190**	**99**	**13** J	**150**	**71**
Benzene	0.03	180	3.2E+05	***< 6.6***	***< 5.9***	***< 5.5***	***< 5.2***	***< 5.3***	***< 5.5***	***< 6.9***	***< 7.7***	***< 5.9***	***< 4.9***
Carbon Disulfide			8.0E+06	< 6.6	**2.2** J	< 5.5	< 5.2	< 5.3	**0.097** J	**0.63** J	< 7.7	**0.13** J	**0.059** J
Dichlorodifluoromethane			1.6E+07	**0.29** J	< 5.9	**0.29** J	**0.31** J	**0.19** J	< 5.5	**2.8** J	**3.8** J	**0.26** J	**0.14** J
m,p-Xylene	9.0E+03			**0.25** J	< 5.9	< 5.5	< 5.2	< 5.3	**0.53** J	< 6.9	< 7.7	< 5.9	< 4.9
Methylene Chloride	20	1.3E+05	4.8E+06	**0.59** J	**0.5** J	**0.52** J	**0.61** J	**0.35** J	**0.67** J	**0.49** J	**0.57** J	**0.34** J	**0.36** J
Naphthalene	5.0E+03		1.6E+06	**0.76** J	**0.22** J	**0.21** J	< 21	**0.17** J	**0.28** J	< 28	< 31	**0.46** J	**0.32** J
o-Xylene	9.0E+03		1.6E+08	< 6.6	< 5.9	< 5.5	< 5.2	< 5.3	**0.25** J	< 6.9	< 7.7	< 5.9	< 4.9
Styrene				< 6.6	< 5.9	< 5.5	< 5.2	< 5.3	< 5.5	< 6.9	< 7.7	< 5.9	< 4.9
Toluene	7.0E+03		6.4E+06	**0.6** J	**1** J	< 5.5	**0.26** J	**0.35** J	**0.89** J	**0.51** J	**0.22** J	**0.34** J	**0.33** J
Trichlorofluoromethane				< 6.6	**0.21** J	< 5.5	< 5.2	**1.1** J	< 5.5	< 6.9	**2.7** J	< 5.9	< 4.9

Shaded and Bold - Value exceed Method B CUL (or Method A if no Method B value available)

Italics and Bold **- Detection limit exceeds CUL**

Table F-3-4   Monitoring Well Soils Analytical Results: Metals, VOCs, SVOCs, TPH

			Location ID Sample ID Sample Date	MW-2 MW-2-0-0.5 3/18/2008	MW-2 MW-2-1.5-2 3/18/2008	MW-2 MW-2-6.5-8 3/18/2008	MW-2 MW-2-14-15.5 3/18/2008	MW-3 MW-3-0-0.5 3/18/2008	MW-3 MW-3-1.5-2 3/18/2008	MW-3 MW-3-6.5-8 3/18/2008	MW-3 MW-3-14-15.5 3/18/2008	MW-4 MW-4-0-0.5 3/17/2008	MW-4 MW-4-1.5-2 3/17/2008
Chemical Name	**MTCA A**	**MTCA B - Carcinogen**	**MTCA B Non-Carcinogen**										
Semi-volatile Organic Compounds EPA Method 8270 (µg/kg)													
1,4-Dichlorobenzene				< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	< 99	< 9.9
2-Methylnaphthalene			3.2E+05	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	**36** J	< 9.9
Acenaphthene			4.8E+06	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	< 99	< 9.9
Acenaphthylene				**4** J	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	**67** J	< 9.9
Anthracene			2.4E+07	**3** J	< 9.9	< 9.2	< 8.2	< 9	**1.7** J	**1.9** J	< 7.3	**44** J	< 9.9
Benzo(a)anthracene				**7.9** J	< 9.9	< 9.2	< 8.2	< 9	**4.6** J	**3.4** J	< 7.3	**91** J	< 9.9
Benzo(a)pyrene		140		**13**	< 9.9	< 9.2	< 8.2	< 9	**5.9** J	< 9.7	< 7.3	**99**	**1.9** J
Benzo(b)fluoranthene				**19**	< 9.9	< 9.2	< 8.2	< 9	**6.7** J	**5.2** J	< 7.3	**190**	**2** J
Benzo(g,h,i)perylene				**14**	< 9.9	< 9.2	< 8.2	< 9	**4.3** J	**3.3** J	< 7.3	**110**	**2.3** J
Benzo(k)fluoranthene				**5.9** J	< 9.9	< 9.2	< 8.2	< 9	**2.6** J	**2.3** J	< 7.3	**64** J	< 9.9
Benzoic Acid			3.2E+08	**110** J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol			2.4E+07	< 20	< 20	< 19	< 17	< 18	< 20	< 20	< 15	< 200	< 20
bis(2-Ethylhexyl)phthalate		7.1E+04	1.6E+06	**36** J	< 99	**10** J	**7.9** J	**19** J	**16** J	**99**	**19** J	< 990	**12** J
Butylbenzylphthalate			1.6E+07	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	< 99	< 9.9
Chrysene				**16**	< 9.9	< 9.2	< 8.2	**2.2** J	**5.8** J	**6** J	< 7.3	**200**	**2.5** J
Dibenz(a,h)anthracene				< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	**25** J	< 9.9
Dibenzofuran			1.6E+05	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	**16** J	< 9.9
Di-n-Butylphthalate			8.0E+06	< 20	< 20	< 19	< 17	< 18	< 20	< 20	< 15	< 200	< 20
Fluoranthene			3.2E+06	**24**	< 9.9	< 9.2	< 8.2	**2.6** J	**8.4** J	**12**	< 7.3	**290**	**3.5** J
Fluorene			3.2E+06	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	**2.1** J	< 7.3	< 99	< 9.9
Indeno(1,2,3-cd)pyrene				**14**	< 9.9	< 9.2	< 8.2	< 9	**4.6** J	**2.8** J	< 7.3	**110**	**1.8** J
Naphthalene	5.0E+03		1.6E+06	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3	< 99	< 9.9
Pentachlorophenol		8.3E+03	2.4E+06	**57** J	< 99	< 92	< 82	< 90	< 99	< 97	< 73	**15,000**	**57** J
Phenanthrene				**19**	< 9.9	< 9.2	< 8.2	**1.7** J	**6.8** J	**15**	< 7.3	**220**	**1.9** J
Pyrene			2.4E+06	**25**	< 9.9	< 9.2	< 8.2	**2.2** J	**10**	**9.9**	< 7.3	**320**	**3.4** J
NWTPH (mg/kg)													
Diesel Range Hydrocarbons	2.0E+03			< 21 U	< 14 U	< 3.3 U	< 1.8 U	< 8.9 U	< 5.3 U	< 15 U	< 1.4 U	**96** NJ	**2.1** J
Residual Range Organics (RR	2.0E+03			**190** NJ	< 50 U	< 26 U	< 14 U	< 67 U	< 36 U	< 86 U	< 11 U	**480** J	< 15 U
Gasoline Range Hydrocarbons	30			< 1.3 U	< 5.8	< 6.4	< 7	**0.65** J	< 5.8	< 8.7	< 5.7	< 4.6 U	< 1 U

Shaded and Bold - Value exceed Method B CUL (or Method A if no Method B value available)

Italics and Bold **- Detection limit exceeds CUL**

Table F-3-4 Monitoring Well Soils Analytical Results: Metals, VOCs, SVOCs, TPH

			Location ID Sample ID Sample Date	**MW-4 MW-4-9-10.5 3/17/2008**	**MW-4 MW-4-14-15.5 3/17/2008**	**MW-5 MW-5-0-0.5 3/17/2008**	**MW-5 MW-5-1.5-2 3/17/2008**	**MW-5 MW-5-6.5-8 3/17/2008**	**MW-5 MW-5-11.5-13 3/17/2008**	**MW-6 MW-6-0-0.5 3/18/2008**	**MW-6 MW-6-1.5-2 3/18/2008**	**MW-6 MW-6-11.5-13 3/18/2008**	**MW-6 MW-6-19-21.5 3/18/2008**
Chemical Name	**MTCA A**	**MTCA B - Carcinogen**	**MTCA B Non-Carcinogen**										
Metals EPA Method 6020 / 7471A (mg/kg)													
Antimony			32	**0.19 J**	**0.14 J**	**2.32 J**	**0.26 J**	**1.6 J**	**0.61 J**	**0.56 J**	**0.35 J**	**0.11 J**	**0.08 J**
Arsenic	20	0.67	24	**2.6**	**2.2**	**10.2**	**3.6**	**3.1**	**8.7**	**9.2**	**5.3**	**2.2**	**2.2**
Beryllium			160	**0.185 J**	**0.28 J**	**0.293 J**	**0.279 J**	**0.214 J**	**0.229 J**	**0.28 J**	**0.24 J**	**0.259 J**	**0.167 J**
Cadmium			80	**0.149**	**0.081**	**4.49**	**0.163**	**0.573**	**0.377**	**0.402**	**0.277**	**0.074**	**0.086**
Chromium	19/2000			**27.8**	**31.3 J**	**38.2 J**	**29**	**21.1 J**	**25 J**	**52.9 J**	**44.9 J**	**47.8 J**	**36 J**
Copper			3000	**16**	**24.5 J**	**72.6 J**	**17.8**	**17.9 J**	**17.3 J**	**18 J**	**13.6 J**	**13.4 J**	**12.2 J**
Lead	250			**10.3**	**2.98**	**294**	**18.2**	**78.8**	**121**	**51.1**	**26.6**	**4.17**	**2.13**
Mercury	2		24	**0.023 J**	**0.029**	**0.128**	**0.053 J**	**0.053**	**0.047**	**0.215**	**0.107**	**0.019 J**	**0.02**
Nickel			1600	**39.5**	**44.6 J**	**38.3 J**	**37.1**	**28.3 J**	**29.5 J**	**28.7 J**	**26.7 J**	**36.4 J**	**32.7 J**
Selenium			400	J	< 1.2	**0.5 J**	**0.3 J**	**0.4 J**	< 1.2	**0.4 J**	< 1.1	**0.4 J**	< 1.2
Silver			400	**0.021 J+**	**0.05**	**0.179**	**0.062**	**0.107**	**0.113**	**0.124**	**0.085**	**0.064**	**0.037**
Thallium			6	**0.052**	**0.068**	**0.096**	**0.06**	**0.056**	**0.054**	**0.062**	**0.054**	**0.066**	**0.044**
Zinc			24000	**37.1**	**34.9 J**	**641 J**	**42.4**	**143 J**	**68.1 J**	**64.6 J**	**50.1 J**	**27.6 J**	**26.9 J**
Volatile Organic Compounds EPA Method 8260 (µg/kg)													
1,2,4-Trichlorobenzene				< 11	< 25	**0.35 J**	< 23	< 23	< 21	< 39	< 24	< 15	< 18
1,2,4-Trimethylbenzene			4.0E+06	< 11	< 25	**0.29 J**	< 23	**0.19 J**	**0.16 J**	**0.25 J**	< 24	< 15	< 18
1,3,5-Trimethylbenzene				< 11	< 25	**0.13 J**	< 23	< 23	< 21	< 39	< 24	< 15	< 18
1,4-Dichlorobenzene				< 2.8	**0.22 J**	**0.55 J**	**0.15 J**	< 5.6	< 5.2	**0.39 J**	< 6	< 3.6	< 4.4
2-Butanone			4.8E+07	**1.5 J**	< 25	**21 J**	**6.5 J**	**6.3 J**	**8.3 J**	**26 J**	**9.4 J**	< 15	< 18
4-Isopropyltoluene				< 11	< 25	< 27	**0.34 J**	< 23	**0.34 J**	< 39	< 24	< 15	< 18
4-Methyl-2-Pentanone (MIBK)				< 11	< 25	**0.95 J**	< 23	< 23	< 21	< 39	< 24	< 15	< 18
Acetone			8.0E+06	**18**	**5.3 J**	**410**	**210**	**110**	**81**	**380**	**180**	**8.7 J**	**4.6 J**
Benzene	0.03	180	3.2E+05	**<** ***2.8***	**<** ***6.2***	**1.7 J**	**<** ***5.6***	**<** ***5.6***	**0.96 J**	**<** ***9.8***	**<** ***6***	**<** ***3.6***	**<** ***4.4***
Carbon Disulfide			8.0E+06	**0.06 J**	< 6.2	**0.35 J**	**0.18 J**	**0.3 J**	**1.9 J**	**0.14 J**	< 6	**0.093 J**	< 4.4
Dichlorodifluoromethane			1.6E+07	**2.4 J**	**0.27 J**	**1.1 J**	**0.19 J**	**0.19 J**	**0.17 J**	**12**	< 6	**0.61 J**	**1.9 J**
m,p-Xylene	9.0E+03			< 2.8	< 6.2	**0.73 J**	**0.23 J**	**0.44 J**	**0.27 J**	< 9.8	< 6	< 3.6	< 4.4
Methylene Chloride	20	1.3E+05	4.8E+06	**2.4 J**	**0.42 J**	**0.75 J**	**0.41 J**	**0.46 J**	**0.35 J**	**6.4 J**	**0.37 J**	**0.93 J**	**0.63 J**
Naphthalene	5.0E+03		1.6E+06	< 11	**0.5 J**	**1 J**	**0.61 J**	**0.59 J**	**0.7 J**	**1.7 J**	< 24	**0.41 J**	**0.21 J**
o-Xylene	9.0E+03		1.6E+08	< 2.8	< 6.2	**0.43 J**	< 5.6	**0.22 J**	< 5.2	< 9.8	< 6	< 3.6	< 4.4
Styrene				< 2.8	< 6.2	**0.12 J**	< 5.6	< 5.6	< 5.2	< 9.8	< 6	< 3.6	< 4.4
Toluene	7.0E+03		6.4E+06	< 2.8	< 6.2	**1.5 J**	**0.52 J**	**0.64 J**	**0.99 J**	**0.66 J**	**0.59 J**	**0.22 J**	**0.22 J**
Trichlorofluoromethane				< 2.8	< 6.2	< 6.7	< 5.6	< 5.6	< 5.2	**2.4 J**	< 6	< 3.6	< 4.4

Shaded and Bold - Value exceed Method B CUL (or Method A if no Method B value available)

Italics and Bold **- Detection limit exceeds CUL**

Table F-3-4 Monitoring Well Soils Analytical Results: Metals, VOCs, SVOCs, TPH

			Location ID Sample ID Sample Date	MW-4 MW-4-9-10.5 3/17/2008	MW-4 MW-4-14-15.5 3/17/2008	MW-5 MW-5-0-0.5 3/17/2008	MW-5 MW-5-1.5-2 3/17/2008	MW-5 MW-5-6.5-8 3/17/2008	MW-5 MW-5-11.5-13 3/17/2008	MW-6 MW-6-0-0.5 3/18/2008	MW-6 MW-6-1.5-2 3/18/2008	MW-6 MW-6-11.5-13 3/18/2008	MW-6 MW-6-19-21.5 3/18/2008
Chemical Name	**MTCA A**	**MTCA B - Carcinogen**	**MTCA B Non-Carcinogen**										
Semi-volatile Organic Compounds EPA Method 8270 (µg/kg)													
1,4-Dichlorobenzene				< 9.9	< 9.8	**20 J**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
2-Methylnaphthalene			3.2E+05	< 9.9	< 9.8	**22 J**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
Acenaphthene			4.8E+06	< 9.9	< 9.8	**8.1 J**	< 9.9	< 9.9	**51 J**	< 10	< 9.6	< 9.9	< 9.9
Acenaphthylene				**1.2 J**	< 9.8	**50**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
Anthracene			2.4E+07	< 9.9	< 9.8	**43 J**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
Benzo(a)anthracene				**2.7 J**	< 9.8	**100**	< 9.9	**3 J**	**35 J**	**6.2 J**	**2.2 J**	**2 J**	< 9.9
Benzo(a)pyrene		140		**4 J**	< 9.8	**180**	< 9.9	**4.2 J**	**<** ***200***	**7.8 J**	< 9.6	< 9.9	< 9.9
Benzo(b)fluoranthene				**4.3 J**	< 9.8	**220**	< 9.9	**6.7 J**	< 200	**12**	**3.4 J**	< 9.9	< 9.9
Benzo(g,h,i)perylene				**3 J**	< 9.8	**210**	< 9.9	**5.1 J**	**39 J**	**8 J**	**2.2 J**	< 9.9	< 9.9
Benzo(k)fluoranthene				**1.5 J**	< 9.8	**79**	< 9.9	**2.8 J**	< 200	**4 J**	< 9.6	< 9.9	< 9.9
Benzoic Acid			3.2E+08	NA	NA	NA	NA	NA	NA	**130 J**	**140 J**	NA	NA
Benzyl Alcohol			2.4E+07	< 20	< 20	< 99	< 20	< 20	< 400	< 20	< 20	**2.9 J**	< 20
bis(2-Ethylhexyl)phthalate		7.1E+04	1.6E+06	**170**	**18 J**	**67 J**	**24 J**	**470**	**180 J**	**31 J**	**35 J**	**130**	**10 J**
Butylbenzylphthalate			1.6E+07	< 9.9	< 9.8	< 50	< 9.9	**8.3 J**	< 200	< 10	< 9.6	< 9.9	**4.4 J**
Chrysene				**4.2 J**	< 9.8	**160**	**3.3 J**	**5.3 J**	**58 J**	**10**	**2.9 J**	**1.7 J**	< 9.9
Dibenz(a,h)anthracene				< 9.9	< 9.8	**27 J**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
Dibenzofuran			1.6E+05	< 9.9	< 9.8	**6.2 J**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	< 9.9
Di-n-Butylphthalate			8.0E+06	< 20	< 20	**330**	< 20	< 20	< 400	< 20	< 20	< 20	< 20
Fluoranthene			3.2E+06	**5.9 J**	< 9.8	**280**	**3.4 J**	**7 J**	**56 J**	**13**	**5.9 J**	**5 J**	**4.5 J**
Fluorene			3.2E+06	< 9.9	< 9.8	**14 J**	< 9.9	< 9.9	< 200	< 10	**1.1 J**	< 9.9	**1.3 J**
Indeno(1,2,3-cd)pyrene				**3 J**	< 9.8	**190**	< 9.9	**5 J**	< 200	**7 J**	**2.1 J**	< 9.9	< 9.9
Naphthalene	5.0E+03		1.6E+06	< 9.9	< 9.8	**50**	< 9.9	< 9.9	< 200	< 10	< 9.6	< 9.9	**4 J**
Pentachlorophenol		8.3E+03	2.4E+06	**130**	< 98	**2,700**	**53 J**	**120**	< 2,000	**65 J**	< 96	< 99	< 99
Phenanthrene				**5.6 J**	< 9.8	**190**	**2.3 J**	**4 J**	**210**	**8.3 J**	**8.1 J**	**8.2 J**	**7.7 J**
Pyrene			2.4E+06	**6.6 J**	< 9.8	**290**	**3.1 J**	**6.8 J**	**150 J**	**12**	**4.5 J**	**3.8 J**	**2.8 J**
NWTPH (mg/kg)													
Diesel Range Hydrocarbons	2.0E+03			**1.5 J**	< 31	**90 NJ**	**2.7 J**	**19 J**	**1,100 J**	< 15 U	< 11 U	**56 J**	< 2.3 U
Residual Range Organics (RR	2.0E+03			< 9.5 U	< 9.3 U	**480 J**	< 21 U	< 88 U	**810 J**	**180 NJ**	< 99 U	< 32 U	< 19 U
Gasoline Range Hydrocarbons	30			< 0.83 U	< 2 U	< 2.9 U	< 5.8	< 0.73 U	**14 NJ**	< 6.9	< 6.1	< 5.9	< 6

Shaded and Bold - Value exceed Method B CUL (or Method A if no Method B value available)

Italics and Bold **- Detection limit exceeds CUL**

Table F-3-5 Monitoring Well Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotients (TEQ)

		Location ID	MW-2			MW-2			MW-2			MW-2			MW-3		
		Sample ID	MW-2-0-0.5			MW-2-1.5-2			MW-2-6.5-8			MW-2-14-15.5			MW-3-0-0.5		
		Sample Date	03/18/08			03/18/08			03/18/08			03/18/08			03/18/08		
Chemical Name	**TEFs**	**Unit**															
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	12,300	**3.69**	**J**	12.9	**0.00387**	**J**	21.0	**0.0063**	**J**	910	**0.273**	**J**	608	**0.182**	
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	1,520	**0.456**	**J**	< 1.88	0.000282		< 2.89	0.0004335		98.3	**0.02949**		77.6	**0.0233**	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	998	**9.98**	**J**	< 2.42	0.0121		2.35	**0.0235**		75.9	**0.759**		67	**0.670**	
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	258	**2.58**		< 0.668	0.00334		< 0.625	0.003125		17.7	**0.177**		18.3	**0.183**	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	12.3	**0.123**		< 0.063	0.0003		< 0.0572	0.000286		0.706	**0.00706**	**J**	0.577	**0.00577**	**J**
1,2,3,4,7,8-HxCDD	0.1	ng/kg	4.27	**0.427**		< 0.0331	0.001655		< 0.0243	0.001215		0.224	**0.0224**	**NJ+**	0.381	**0.0381**	**J**
1,2,3,4,7,8-HxCDF	0.1	ng/kg	8.94	**0.894**		0.0614	**0.00614**	**NJ+**	< 0.0235	0.001		0.276	**0.0276**	**J**	0.946	**0.0946**	**J**
1,2,3,6,7,8-HxCDD	0.1	ng/kg	23.2	**2.32**		< 0.0321	0.002		0.0989	**0.00989**	**J**	1.81	**0.181**	**J**	1.73	**0.173**	**J**
1,2,3,6,7,8-HxCDF	0.1	ng/kg	3.33	**0.333**		< 0.0239	0.001		< 0.0241	0.001		0.171	**0.0171**	**J**	0.575	**0.0575**	**J**
1,2,3,7,8,9-HxCDD	0.1	ng/kg	12.3	**1.23**		0.164	**0.0164**	**J**	0.0976	**0.00976**	**J**	1.43	**0.143**	**J**	1.44	**0.144**	**J**
1,2,3,7,8,9-HxCDF	0.1	ng/kg	< 0.198	0.010		< 0.0317	0.002		< 0.0319	0.002		< 0.0349	0.002		< 0.0458	0.002	
1,2,3,7,8-PeCDD	1	ng/kg	2.87	**2.87**		< 0.0362	0.02		< 0.0172	0.01		0.296	**0.296**	**NJ+**	0.301	**0.301**	**NJ+**
1,2,3,7,8-PeCDF	0.03	ng/kg	0.802	**0.0241**	**J**	< 0.0191	0.0003		< 0.0139	0.0002		< 0.021	0.0003		0.0999	**0.002997**	**NJ+**
2,3,4,6,7,8-HxCDF	0.1	ng/kg	2.99	**0.299**	**NJ+**	< 0.0265	0.001		< 0.0266	0.001		0.144	**0.0144**	**NJ+**	0.238	**0.0238**	**J**
2,3,4,7,8-PeCDF	0.3	ng/kg	1.75	**0.525**	**J**	< 0.0185	0.003		< 0.0134	0.002		0.0429	**0.0129**	**NJ+**	0.276	**0.0828**	**J**
2,3,7,8-TCDD	1	ng/kg	4.38	**4.38**		< 0.0538	0.027		< 0.0208	0.010		0.114	**0.114**	**NJ+**	< 0.0345	0.017	
2,3,7,8-TCDF	0.1	ng/kg	0.917	**0.0917**	**J**	< 0.0641	0.0032		< 0.0287	0.0014		< 0.0214	0.0011		< 0.138	0.0069	
Total TCDD TEQ (1)				**30.2**			**0.10**			**0.082**			**2.08**			**2.01**	

		Location ID	MW-3			MW-3			MW-3			MW-4			MW-4		
		Sample ID	MW-3-1.5-2			MW-3-6.5-8			MW-3-14-15.5			MW-4-0-0.5			MW-4-1.5-2		
		Sample Date	03/18/08			03/18/08			03/18/08			03/17/08			03/17/08		
Chemical Name	**TEFs**	**Unit**															
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	880	**0.264**		890	**0.267**		16.1	**0.00483**		295,000	**88.5**		9,340	**2.80**	**J**
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	71.6	**0.0215**		101	**0.0303**		< 1.16	0.000174		75,400	**22.6**		1,260	**0.378**	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	87	**0.870**		98.7	**0.987**		< 1.76	0.0088		81,300	**813**		909	**9.09**	
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	20.6	**0.206**		24.2	**0.242**		< 0.266	0.00133		19,200	**192**		251	**2.51**	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	1.17	**0.0117**	**J**	0.937	**0.00937**	**J**	< 0.0395	0.0002		897	**8.97**		9.86	**0.0986**	
1,2,3,4,7,8-HxCDD	0.1	ng/kg	0.641	**0.0641**	**J**	0.737	**0.0737**	**J**	< 0.0265	0.001		506	**50.6**	**J**	6.33	**0.633**	
1,2,3,4,7,8-HxCDF	0.1	ng/kg	1.74	**0.174**	**J**	0.97	**0.0970**	**J**	< 0.0231	0.001		619	**61.9**	**J**	5.1	**0.510**	
1,2,3,6,7,8-HxCDD	0.1	ng/kg	3.26	**0.326**		2.82	**0.282**	**J**	0.0966	**0.00966**	**J**	3,560	**356**		32.7	**3.27**	
1,2,3,6,7,8-HxCDF	0.1	ng/kg	1.01	**0.101**	**J**	0.885	**0.0885**	**J**	< 0.0235	0.001		354	**35.4**		3.1	**0.310**	
1,2,3,7,8,9-HxCDD	0.1	ng/kg	1.78	**0.178**	**J**	2.45	**0.245**	**J**	0.0946	**0.00946**	**J**	2,550	**255**		28.3	**2.83**	
1,2,3,7,8,9-HxCDF	0.1	ng/kg	< 0.0594	0.003		< 0.19	0.010		< 0.0313	0.002		15.2	**1.52**	**NJ+**	< 0.757	0.038	
1,2,3,7,8-PeCDD	1	ng/kg	0.453	**0.453**	**J**	0.47	**0.470**	**NJ+**	< 0.0162	0.01		511	**511**	**J**	6.48	**6.48**	
1,2,3,7,8-PeCDF	0.03	ng/kg	0.284	**0.00852**	**J**	< 0.0606	0.0009		< 0.0118	0.0002		35.1	**1.05**	**NJ+**	0.449	**0.0135**	**J**
2,3,4,6,7,8-HxCDF	0.1	ng/kg	0.691	**0.0691**	**J**	0.595	**0.0595**	**J**	< 0.026	0.001		273	**27.3**		3.04	**0.304**	
2,3,4,7,8-PeCDF	0.3	ng/kg	0.376	**0.113**	**J**	0.491	**0.147**	**J**	< 0.0114	0.002		89.1	**26.7**		1.01	**0.303**	**J**
2,3,7,8-TCDD	1	ng/kg	< 0.0197	0.010		0.098	**0.0980**	**NJ+**	< 0.02	0.010		121	**121**		1.59	**1.59**	
2,3,7,8-TCDF	0.1	ng/kg	< 0.136	0.0068		< 0.14	0.0070		< 0.0142	0.0007		20.9	**2.09**		< 0.0895	0.0045	
Total TCDD TEQ (1)				**2.88**			**3.11**			**0.062**			**2575**			**31.2**	

Notes

Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.
(1) One-half the detection limit used in TEQ calculation for non-detect results
Qualifiers:
J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Method B CUL - 11 ng/kg
▨ Value Exceeds Method B CUL

Table F-3-5 Monitoring Well Soils Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotients (TEQ)

		Location ID	MW-4			MW-4			MW-5			MW-5			MW-5			MW-5			MW-6			MW-6			MW-6			MW-6		
		Sample ID	MW-4-9-10.5			MW-4-14-15.5			MW-5-0-0.5			MW-5-1.5-2			MW-5-6.5-8			MW-5-11.5-13			MW-6-0-0.5			MW-6-1.5-2			MW-6-11.5-13			MW-6-19-21.5		
		Sample Date	03/17/08			03/17/08			03/17/08			03/17/08			03/17/08			03/17/08			03/18/08			03/18/08			03/18/08			03/18/08		
Chemical Name	TEFs	Unit																														
Dioxins/Furans			Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ		Reported Value	TEQ	
1,2,3,4,6,7,8,9-OCDD	0.0003	ng/kg	35,800	10.7	J	1,390	0.417	J	657,000	197	J	6,450	1.94	J	164,000	49.2	J	27,700	8.31	J	2,950	0.885	J	1,170	0.351	J	37.6	0.0113		14.1	0.00423	
1,2,3,4,6,7,8,9-OCDF	0.0003	ng/kg	4,530	1.36		187	0.0561		110,000	33.0		771	0.231		20,800	6.24		3,490	1.05		401	0.120		121	0.0363		< 4.66	0.000699		< 0.645	0.00009675	
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg	5,700	57.0	J	155	1.55		109,000	1090		767	7.67	J	20,200	202		2,490	24.9		342	3.42		141	1.41		4.16	0.0416		< 1.79	0.0090	
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg	1,080	10.8		34.6	0.346		23,600	236		150	1.50		4,160	41.6		458	4.58		70.1	0.701		22.5	0.225		< 0.887	0.004435		< 0.183	0.000915	
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg	38.6	0.386		1.81	0.0181	J	722	7.22	NJ+	6.35	0.0635		236	2.36		33.5	0.335		3.01	0.0301	J	1.51	0.0151	J	< 0.0541	0.0003		< 0.0513	0.0003	
1,2,3,4,7,8-HxCDD	0.1	ng/kg	19.3	1.93		2.18	0.218	J	539	53.9		3.67	0.367		110	11.0		9.12	0.912		1.62	0.162	J	0.735	0.0735	J	< 0.0308	0.002		< 0.0275	0.001	
1,2,3,4,7,8-HxCDF	0.1	ng/kg	17.1	1.71		0.932	0.0932	J	462	46.2	NJ+	4.27	0.427		99.6	9.96		11.3	1.13		3.33	0.333		1.33	0.133	J	< 0.026	0.001		< 0.0333	0.002	
1,2,3,6,7,8-HxCDD	0.1	ng/kg	95.8	9.58		5.03	0.503		3,750	375		21.8	2.18		570	57.0		71.7	7.17		8.61	0.861		3.44	0.344		0.145	0.0145	NJ+	< 0.0266	0.001	
1,2,3,6,7,8-HxCDF	0.1	ng/kg	9.95	0.995		0.684	0.0684	J	290	29.0		2.59	0.259	J	59.7	5.97		5.86	0.586		1.42	0.142	J	0.567	0.0567	J	< 0.0265	0.001		< 0.0341	0.002	
1,2,3,7,8,9-HxCDD	0.1	ng/kg	81.3	8.13		6.86	0.686		3,350	335		16.9	1.69		464	46.4		30.4	3.04		5.32	0.532		2.26	0.226	J	< 0.0322	0.002		< 0.0287	0.001	
1,2,3,7,8,9-HxCDF	0.1	ng/kg	< 0.463	0.023		< 0.283	0.014		12.9	1.29		< 0.229	0.011		1.94	0.194	NJ+	< 0.398	0.020		< 0.106	0.005		< 0.0698	0.003		< 0.0351	0.002		< 0.0451	0.002	
1,2,3,7,8-PeCDD	1	ng/kg	18.1	18.1		1.88	1.88	J	547	547		5.41	5.41		107	107		5.34	5.34		1.04	1.04	J	0.368	0.368	NJ+	< 0.0341	0.02		< 0.0304	0.0152	
1,2,3,7,8-PeCDF	0.03	ng/kg	1.23	0.0369	NJ+	< 0.0639	0.0010		38	1.14	NJ+	0.473	0.0142	J	8.76	0.263		0.717	0.0215	J	0.394	0.0118	NJ+	0.232	0.00696	J	< 0.0158	0.0002		< 0.0225	0.0003	
2,3,4,6,7,8-HxCDF	0.1	ng/kg	7.81	0.781		0.498	0.0498	J	209	20.9		1.93	0.193	J	46.8	4.68		5.59	0.559		0.823	0.0823	J	0.595	0.0595	J	< 0.0294	0.001		< 0.0377	0.002	
2,3,4,7,8-PeCDF	0.3	ng/kg	2.59	0.777		< 0.0617	0.009		73.9	22.2		1.28	0.384	J	16.8	5.04		1.25	0.375	J	0.791	0.237	J	0.428	0.128	J	< 0.0152	0.002		< 0.0217	0.003	
2,3,7,8-TCDD	1	ng/kg	4.11	4.11		0.521	0.521	NJ+	102	102		1.55	1.55		22.6	22.6		1.3	1.30		1.29	1.29		0.656	0.656	J	< 0.0405	0.020		< 0.0516	0.026	
2,3,7,8-TCDF	0.1	ng/kg	0.333	0.0333	J	< 0.0482	0.0024		9.76	0.976		1	0.100	NJ+	4.14	0.414		< 0.51	0.0255		0.685	0.0685	J	0.396	0.0396	J	< 0.0494	0.0025		< 0.0444	0.0022	
Total TCDD TEQ (1)				126			6.43			3098			24.0			572			59.7			9.92			4.13			0.12			0.073	

Notes

Total TCDD TEQ calculated using Toxicity Equivalency Factors in MTCA Regulations revised November 2007.

(1) One-half the detection limit used in TEQ calculation for non-detect results

Qualifiers:

J = estimated concentration (value less than calculated reporting limit)
N = analyte is tentatively identified (validator qualifier)
+ = biased high

Method B CUL - 11 ng/kg
▨ Value Exceeds Method B CUL

Table F-3-6 Monitoring Well Soils Analytcial Results: cPAH Total Toxic Equivalency Quotient (TEQ)

		Location ID	MW-2	MW-2	MW-2	MW-2	MW-3	MW-3	MW-3	MW-3
		Sample ID	MW-2-0-0.5	MW-2-1.5-2	MW-2-6.5-8	MW-2-14-15.5	MW-3-0-0.5	MW-3-1.5-2	MW-3-6.5-8	MW-3-14-15.5
		Sample Date	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08	03/18/08
Chemical Name (µg/kg)	**TEFs**	**Unit**								
Carcinogenic PAH			**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**
Benzo(a)anthracene	0.1	µg/kg	**7.9 J**	< 9.9	< 9.2	< 8.2	< 9	**4.6 J**	**3.4 J**	< 7.3
Benzo(a)pyrene	1	µg/kg	**13**	< 9.9	< 9.2	< 8.2	< 9	**5.9 J**	< 9.7	< 7.3
Benzo(b)fluoranthene	0.1	µg/kg	**19**	< 9.9	< 9.2	< 8.2	< 9	**6.7 J**	**5.2 J**	< 7.3
Benzo(k)fluoranthene	0.1	µg/kg	**5.9 J**	< 9.9	< 9.2	< 8.2	< 9	**2.6 J**	**2.3 J**	< 7.3
Chrysene	0.01	µg/kg	**16**	< 9.9	< 9.2	< 8.2	**2.2 J**	**5.8 J**	**6 J**	< 7.3
Dibenz(a,h)anthracene	0.1	µg/kg	< 10	< 9.9	< 9.2	< 8.2	< 9	< 9.9	< 9.7	< 7.3
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	**14**	< 9.9	< 9.2	< 8.2	< 9	**4.6 J**	**2.8 J**	< 7.3
Total cPAH TEQ (1)			**18.3**	**NC**	NC	NC	**6.8**	**8.3**	**6.8**	NC

		Location ID	MW-4	MW-4	MW-4	MW-4	MW-5	MW-5	MW-5	MW-5
		Sample ID	MW-4-0-0.5	MW-4-1.5-2	MW-4-9-10.5	MW-4-14-15.5	MW-5-0-0.5	MW-5-1.5-2	MW-5-6.5-8	MW-5-11.5-13
		Sample Date	03/17/08	03/17/08	03/17/08	03/17/08	03/17/08	03/17/08	03/17/08	03/17/08
Chemical Name (µg/kg)	**TEFs**	**Unit**								
Carcinogenic PAH			**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**	**TEQ**
Benzo(a)anthracene	0.1	µg/kg	**91 J**	< 9.9	**2.7 J**	< 9.8	**100**	< 9.9	**3 J**	**35 J**
Benzo(a)pyrene	1	µg/kg	**99**	**1.9 J**	**4 J**	< 9.8	**180**	< 9.9	**4.2 J**	< 200*
Benzo(b)fluoranthene	0.1	µg/kg	**190**	**2 J**	**4.3 J**	< 9.8	**220**	< 9.9	**6.7 J**	< 200*
Benzo(k)fluoranthene	0.1	µg/kg	**64 J**	< 9.9	**1.5 J**	< 9.8	**79**	< 9.9	**2.8 J**	< 200*
Chrysene	0.01	µg/kg	**200**	**2.5 J**	**4.2 J**	< 9.8	**160**	**3.3 J**	**5.3 J**	**58 J**
Dibenz(a,h)anthracene	0.1	µg/kg	**25 J**	< 9.9	< 9.9	< 9.8	**27 J**	< 9.9	< 9.9	< 200*
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	**110**	**1.8 J**	**3 J**	< 9.8	**190**	< 9.9	**5 J**	< 200*
Total cPAH TEQ (1)			**149**	**3.8**	**5.7**	NC	**243**	**7.5**	**6.5**	**144**

		Location ID	MW-6	MW-6	MW-6	MW-6
		Sample ID	MW-6-0-0.5	MW-6-1.5-2	MW-6-11.5-13	MW-6-19-21.5
		Sample Date	03/18/08	03/18/08	03/18/08	03/18/08
Chemical Name (µg/kg)	**TEFs**	**Unit**				
Carcinogenic PAH			**TEQ**	**TEQ**	**TEQ**	**TEQ**
Benzo(a)anthracene	0.1	µg/kg	**6.2 J**	**2.2 J**	**2 J**	< 9.9
Benzo(a)pyrene	1	µg/kg	**7.8 J**	< 9.6	< 9.9	< 9.9
Benzo(b)fluoranthene	0.1	µg/kg	**12**	**3.4 J**	< 9.9	< 9.9
Benzo(k)fluoranthene	0.1	µg/kg	**4 J**	< 9.6	< 9.9	< 9.9
Chrysene	0.01	µg/kg	**10**	**2.9 J**	**1.7 J**	< 9.9
Dibenz(a,h)anthracene	0.1	µg/kg	< 10	< 9.6	< 9.9	< 9.9
Indeno(1,2,3-cd)pyrene	0.1	µg/kg	**7 J**	**2.1 J**	< 9.9	< 9.9
Total cPAH TEQ (1)			**11.3**	**6.6**	**7.2**	NC

MTCA Method B CUL - 0.137 mg/kg (137 µg/kg)

Notes

Concentrations reported in µg/kg
(1) Total cPAH TEQs calculated using Toxicity Equivalency Factors from MTCA Regulations Revised November 2007. One-half the detection limit used for non-detect results.
Qualifiers:
U = non-detect
J = estimated concentration (value less than calculated reporting limit)
D = compounds at secondary dilution factor
▨ highlight indicates exceedance of the MTCA Method B cleanup level of 137 µg/kg
NC= Not Calculated where all constituents are not detected
* = Elevated detection levels due to sample dilution.

Table F-4-1 Groundwater Analytical Results: Metals, VOCs, SVOCs, and TPH (March 2008)

			Location ID Sample ID Sample Date	MW-1 MW-1-0308 3/28/2008	MW-2 MW-2-0308 3/28/2008	MW-3 MW-3-0308 3/27/2008	MW-4 MW-4-0308 3/27/2008	MW-5 MW-5-0308 3/27/2008	MW-5 DUP-1-0308 3/27/2008	MW-6 MW-6-0308 3/28/2008
Chemical Name	**Method A**	**MCTA B Carcinogen**	**MCTA B Non-carcinogen**							
Metals EPA Method 6020/7470A (µg/L)										
Antimony			6.4	**0.237**	**0.056**	**0.258**	**0.341**	**0.063 J**	**0.071 J**	**0.188**
Arsenic	5	0.058	4.8	**10.5**	**< *0.33* U**	**< *1.39* U**	**< *1.38* U**	**3.44**	**3.58**	**1.66**
Beryllium			32	< 0.02	< 0.02	< 0.02	**0.008 J**	< 0.04	< 0.04	**0.035 J**
Cadmium	5		8	**0.01 J**	**0.026**	**0.018 J**	**0.024**	**0.035 J**	**0.051**	**0.117**
Chromium	50			**2.73 J**	< 0.91 U	< 0.35 U	< 0.85 U	< 0.61 U	< 0.69 U	**3.16 J**
Copper			590	**1.03**	**0.61**	< 0.28 U	**0.65**	**0.49**	**0.43**	**12.6**
Lead	15			**0.322**	**0.207**	**0.017 J**	**0.134**	**0.082 J**	**0.087 J**	**0.324**
Zinc			4800	**1.5**	**4.8**	**0.7**	**3.2**	**9.6 J**	**2.3 J**	**4**
Mercury	2		4.8	**0.01 J**	J	**0.01 J**	J	J	**0.01 J**	**0.02 J**
Volatile Organic Compounds EPA Method 8260 (µg/L)										
1,2,4-Trimethylbenzene			400	**3.1**	**0.72 J**	< 2	< 2	< 2	< 2	**0.17 J**
1,3,5-Trimethylbenzene			400	< 2	**0.21 J**	< 2	< 2	< 2	< 2	< 2
4-Isopropyltoluene				**0.58 J**	< 2	< 2	< 2	< 2	< 2	< 2
Ethylbenzene	700		800	**0.33 J**	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	**3.5**
Isopropylbenzene			800	**0.31 J**	< 2	< 2	< 2	< 2	< 2	**1.8 J**
m,p-Xylene	1000			**0.37 J**	**0.55**	< 0.5	< 0.5	< 0.5	< 0.5	**0.33 J**
Naphthalene	160		160	**1.9 J**	**0.36 J**	< 2	< 2	< 2	< 2	**4**
n-Butylbenzene				**0.25 J**	< 2	< 2	< 2	< 2	< 2	< 2
n-Propylbenzene				**0.42 J**	< 2	< 2	< 2	< 2	< 2	**1.2 J**
o-Xylene			16000	**0.54**	**0.28 J**	< 0.5	< 0.5	< 0.5	< 0.5	**0.18 J**
sec-Butylbenzene				**0.47 J**	< 2	< 2	< 2	< 2	< 2	< 2
Tetrachloroethene	5	0.08	80	**0.23 J**	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***
Toluene	1000		640	< 0.5	**0.19 J**	< 0.5	< 0.5	< 0.5	< 0.5	**0.17 J**
Trichloroethene	5	0.11	2.4	**0.17 J**	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***	**< *0.5***
Semivolatile Organic Compounds EPA Method 8270 (µg/L)										
2,4,5-Trichlorophenol			800	**0.4 J**	< 0.48	< 0.5	< 0.49	**0.033 J**	< 0.49	**0.23 J**
2,4,6-Trichlorophenol		4		**1.5 J**	< 0.48	< 0.5	< 0.49	< 0.5	< 0.49	< 2.5
2-Methylnaphthalene			32	< 0.97	**0.16 J**	< 0.2	< 0.2	**0.038 J**	**0.028 J**	< 1
2-Methylphenol			400	< 2.5	< 0.48	< 0.5	< 0.49	**0.14 J**	**0.15 J**	< 2.5
4-Methylphenol			40	< 2.5	< 0.48	< 0.5	< 0.49	**0.12 J**	**0.13 J**	< 2.5
Anthracene			4800	< 0.97	< 0.19	< 0.2	**0.025 J**	< 0.2	**0.025 J**	< 1
Benzo(a)anthracene				**0.6 J**	**0.049 J**	**0.044 J**	**0.065 J**	**0.051 J**	**0.066 J**	< 1
Benzo(a)pyrene		0.01		**0.72 J**	**0.038 J**	**< *0.2***	**0.047 J**	**0.037 J**	**0.039 J**	**< *1***
Benzo(b)fluoranthene				**0.83 J**	**0.05 J**	**0.036 J**	**0.059 J**	**0.061 J**	**0.064 J**	< 1
Benzo(g,h,i)perylene				**0.37 J**	**0.034 J**	**0.022 J**	**0.035 J**	**0.035 J**	**0.044 J**	< 1
Benzo(k)fluoranthene				**0.37 J**	**0.04 J**	**0.027 J**	**0.047 J**	**0.053 J**	**0.053 J**	< 1
Benzoic Acid			64000	**6.9 J**	< 4.8	**1.2 J**	**1.2 J**	**1.2 J**	**1.2 J**	**6.3 J**
Benzyl Alcohol			2400	< 25	**0.21 J**	< 5	< 4.9	**0.22 J**	**0.21 J**	< 25
bis(2-Ethylhexyl)phthalate		6.3	320	**1.2 J**	**0.5 J**	< 0.99	**0.48 J**	**0.13 J**	**0.27 J**	**0.74 J**
Chrysene				**0.75 J**	**0.065 J**	**0.046 J**	**0.079 J**	**0.071 J**	**0.077 J**	< 1
Dibenz(a,h)anthracene				< 0.97	**0.027 J**	**0.024 J**	**0.041 J**	**0.045 J**	**0.041 J**	< 1
Di-n-Octyl phthalate			320	< 0.97	**0.045 J**	**0.024 J**	**0.059 J**	**0.048 J**	**0.055 J**	< 1
Fluoranthene			640	**0.85 J**	**0.079 J**	**0.052 J**	**0.094 J**	**0.081 J**	**0.081 J**	< 1
Indeno(1,2,3-cd)pyrene				**0.4 J**	**0.036 J**	**0.027 J**	**0.042 J**	**0.034 J**	**0.037 J**	< 1
Naphthalene			160	**0.39 J**	**0.15 J**	**0.029 J**	**0.045 J**	**0.042 J**	**0.038 J**	< 1
Pentachlorophenol		0.73	480	**16**	**< *0.95***	**< *0.99***	**< *0.97***	**0.97 J**	**1.1**	**< *5***
Phenanthrene				< 0.97	**0.041 J**	**0.022 J**	**0.04 J**	**0.03 J**	**0.037 J**	< 1
Pyrene			480	**2.6**	**0.072 J**	**0.047 J**	**0.089 J**	**0.077 J**	**0.083 J**	< 1
NWTPH (µg/L)										
Diesel Range Hydrocarbons	500			**6,300 J**	< 39 U	< 18 U	< 19 U	< 57 U	< 130 U	**7,300 J**
Residual Range Organics (RRO)	500			**8,300 J**	< 73 U	< 34 U	< 43 U	< 46 U	< 100 U	**890 NJ**
Gasoline Range Organics-NWTPH	800			**390 NJ**	**34 J**	< 250	< 250	< 250	**17 J**	**150 J**

Shaded and Bold - Value exceed Method B CUL (or Method A if no Method B value available)
Italics and Bold - Detection limit exceeds CUL

Table F-4-2 Groundwater Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ) (March 2008)

Location ID			MW-1			MW-2			MW-3			MW-4			MW-5			MW-5			MW-6		
Sample ID			MW-1-0308			MW-2-0308			MW-3-0308			MW-4-0308			MW-5-0308			DUP-1-0308			MW-6-0308		
Sample Date			03/28/08			03/28/08			03/27/08			03/27/08			03/27/08			03/27/08			03/28/08		
Chemical Name	**TEFs**	**Unit**																					
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	pg/l	109,000	**32.7**	**J**	73	**0.0219**	**J**	< 21.2	0.00318		101	**0.0303**	**J**	< 46.5	0.00698		< 28.2	0.00423		54.7	**0.01641**	**J**
1,2,3,4,6,7,8,9-OCDF	0.0003	pg/l	3,590	**1.08**		3.45	**0.00104**	**J**	1.73	**0.00052**	**NJ+**	9.32	**0.00280**	**J**	4.1	**0.00123**	**J**	2.52	**0.00076**	**J**	1.64	**0.00049**	**NJ+**
1,2,3,4,6,7,8-HpCDD	0.01	pg/l	6,380	**63.8**	**J**	< 7.06	0.0353		< 2.25	0.01125		< 9.72	0.0486		< 5.9	0.0295		< 4.55	0.02275		< 3.68	0.0184	
1,2,3,4,6,7,8-HpCDF	0.01	pg/l	758	**7.58**		< 0.563	0.00282		< 0.365	0.002		< 3.6	0.018		< 0.937	0.00469		< 0.61	0.00305		< 0.274	0.00137	
1,2,3,4,7,8,9-HpCDF	0.01	pg/l	35.3	**0.353**		< 0.494	0.002		< 0.479	0.002		< 0.303	0.002		< 0.657	0.00329		< 0.474	0.00237		< 0.359	0.0018	
1,2,3,4,7,8-HxCDD	0.1	pg/l	10.2	**1.02**	**J**	< 0.421	0.02		< 0.413	0.02		< 0.383	0.02		< 0.405	0.02		< 0.264	0.01		< 0.269	0.01	
1,2,3,4,7,8-HxCDF	0.1	pg/l	27.9	**2.79**		< 0.266	0.01		< 0.254	0.01		< 0.155	0.01		< 0.229	0.01		< 0.185	0.01		< 0.227	0.01	
1,2,3,6,7,8-HxCDD	0.1	pg/l	213	**21.3**		< 0.418	0.02		< 0.409	0.02		< 0.379	0.02		< 0.401	0.02		< 0.262	0.01		< 0.266	0.01	
1,2,3,6,7,8-HxCDF	0.1	pg/l	20.7	**2.07**	**J**	< 0.277	0.01		< 0.264	0.01		< 0.162	0.01		< 0.238	0.01		< 0.194	0.01		< 0.237	0.01	
1,2,3,7,8,9-HxCDD	0.1	pg/l	147	**14.7**		< 0.423	0.02		< 0.414	0.02		< 0.384	0.02		< 0.406	0.02		< 0.265	0.01		< 0.269	0.01	
1,2,3,7,8,9-HxCDF	0.1	pg/l	1.63	**0.163**	**NJ+**	< 0.342	0.02		< 0.327	0.02		< 0.199	0.01		< 0.294	0.01		< 0.239	0.01		< 0.292	0.01	
1,2,3,7,8-PeCDD	1	pg/l	60.6	**60.6**	**J**	< 0.407	0.2		< 0.363	0.2		< 0.224	0.1		< 0.41	0.2		< 0.24	0.1		< 0.317	0.2	
1,2,3,7,8-PeCDF	0.03	pg/l	14.6	**0.438**	**J**	< 0.211	0.003		< 0.166	0.002		< 0.14	0.002		< 0.216	0.00324		< 0.103	0.00155		< 0.232	0.00348	
2,3,4,6,7,8-HxCDF	0.1	pg/l	8.78	**0.878**	**J**	< 0.293	0.01		< 0.28	0.01		< 0.17	0.01		< 0.252	0.01		< 0.205	0.01		< 0.25	0.01	
2,3,4,7,8-PeCDF	0.3	pg/l	12.1	**3.63**	**J**	< 0.207	0.03		< 0.163	0.02		< 0.138	0.02		< 0.212	0.03		< 0.101	0.02		< 0.228	0.03	
2,3,7,8-TCDD	1	pg/l	19.5	**19.5**	**J**	< 0.858	0.43		< 0.702	0.35		< 0.751	0.38		< 0.474	0.24		< 0.673	0.34		< 0.707	0.35	
2,3,7,8-TCDF	0.1	pg/l	9.7	**0.970**	**J**	< 0.395	0.020		< 0.427	0.021		< 0.282	0.014		< 0.384	0.0192		< 0.34	0.017		< 0.363	0.01815	
Total TCDD TEQ (1)				234			**0.87**			**0.72**			**0.72**			**0.65**			**0.60**			**0.70**	
Total TCDD TEQ (2)				234			**0.023**			**0.00052**			**0.033**			**0.0012**			**0.00076**			**0.017**	

Notes

Total TCDD and TCDF equivalents calculated using WHO 2005 Toxicity Equivalency Factors (MTCA, 2007).

(1) One-half the detection limit used for non-detect results

(2) Non-detect results excluded from TEQ calculation

Qualifiers

J = estimated concentration (value less than calculated reporting limit)

N = analyte is tentatively identified (validator qualifier)

J+ = estimated concentration, biased high

Method B CUL - 5.8 pg/L

▨ Value Exceeds Method B CUL

Table F-4-3 Groundwater Analytical Results: cPAH Total Toxic Equivalency Quotient (TEQ) (March 2008)

		Location ID	**MW-1**	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**MW-5**	**MW-6**
		Sample ID	**MW-1-0308**	**MW-2-0308**	**MW-3-0308**	**MW-4-0308**	**MW-5-0308**	**DUP-1-0308**	**MW-6-0308**
		Sample Date	**03/28/08**	**03/28/08**	**03/27/08**	**03/27/08**	**03/27/08**	**03/27/08**	**03/28/08**
Chemical Name	**TEFs**	**Unit**							
		µg/L							
Benzo(a)anthracene	0.1	µg/L	**0.6 J**	**0.05 J**	**0.04 J**	**0.07 J**	**0.05 J**	**0.07 J**	< 1
Benzo(a)pyrene	1	µg/L	**0.72 J**	**0.04 J**	< 0.2	**0.05 J**	**0.04 J**	**0.04 J**	< 1
Benzo(b)fluoranthene	0.1	µg/L	**0.83 J**	**0.05 J**	**0.04 J**	**0.06 J**	**0.06 J**	**0.06 J**	< 1
Benzo(k)fluoranthene	0.1	µg/L	**0.37 J**	**0.04 J**	**0.03 J**	**0.05 J**	**0.05 J**	**0.05 J**	< 1
Chrysene	0.01	µg/L	**0.75 J**	**0.07 J**	**0.05 J**	**0.08 J**	**0.07 J**	**0.08 J**	< 1
Dibenz(a,h)anthracene	0.1	µg/L	< 0.97	**0.03 J**	**0.02 J**	**0.04 J**	**0.05 J**	**0.04 J**	< 1
Indeno(1,2,3-cd)pyrene	0.1	µg/L	**0.4 J**	**0.04 J**	**0.03 J**	**0.04 J**	**0.03 J**	**0.04 J**	< 1
Total cPAH TEQ (1)			**1.00**	**0.06**	**0.17**	**0.07**	**0.06**	**0.07**	NC

MTCA Method B - 0.012 µg/L

Notes

(1) Total cPAH equivalents calculated using Toxicity Equivalency Factors from MTCA Regulations Revised Novermber 2007.

Qualifiers

U = non-detect

J = estimated concentration (value less than calculated reporting limit)

D = compounds at secondary dilution factor

NC= Not calculated where all constituents are not detected

▨ Exceeds Method B

Table F-4-4 Groundwater Analytical Results: Metals, PCP, PAHs, TPH-Dx, Hardness and pH (August 2008)

			Location ID	MW-3	MW-4	MW-5	MW-8	MW-9	MW-9 (DUP)	MW-10	MW-11
			Sample ID	MW-3-081908	MW-4-082008	MW-5-082008	MW-8-081908	MW-9-081908	MW-90-081908	MW-10-081908	MW-11-081908
			Sample Date	8/19/2008	8/20/2008	8/20/2008	8/19/2008	8/19/2008	8/19/2008	8/19/2008	8/19/2008
Chemical Name	**Method A**	**MCTA B Carcinogen**	**MCTA B Non-carcinogen**								
Metals EPA Method 6020/7470A (µg/L)											
Antimony			6.4	**0.11**	**0.16**	**0.03** J	**0.2**	**0.04** J	**0.03** J	**0.05**	**0.03** J
Arsenic	5	0.058	4.8	**0.77**	**0.66**	**2.76**	**0.92**	**0.32** J	**0.22** J	**0.59**	**0.33** J
Beryllium			32	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Cadmium	5		8	< 0.024 J-	< 0.027 J-	< 0.039 J-	< 0.01 J-	< 0.02 J	< 0.02 J	< 0.01 J-	**0.066**
Chromium	50			< 0.42	< 0.45	< 0.27	< 0.7	< 0.46	< 0.41	< 0.57	< 0.35
Copper			590	< 0.34	< 0.3	< 0.3	< 0.57	< 0.47	< 0.44	< 0.23	< 0.26
Lead	15			< 0.026	< 0.025	< 0.023	< 0.054	< 0.007	< 0.02	< 0.019	< 0.026
Nickel				**4.61**	**11.6**	**2.08**	**2.74**	**4.74**	**4.63**	**2.5**	**3.3**
Selenium				< 0.2	< 0.3	< 2	< 1	< 1	< 1	< 0.4	< 1
Silver				< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.019
Thallium				< 0.004	< 0.004	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.007
Zinc			4800	< 2.32	< 2.5	< 2.06	< 1.55	< 1.39	< 1.04	< 2.06	< 2.04
Mercury	2		4.8	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Semi-volatile Organic Compound EPA Method 8151M (µg/L)											
Pentachlorophenol		0.73	480	< 0.5	< 0.5	**1.5**	< 0.5	**0.58** J	**0.56** J	< 0.5	< 0.5
Polynuclear Aromatic Hydrocarbons EPA Method 8270C SIM (µg/L)											
2-Methylnaphthalene			32	< 0.016	< 0.016	< 0.016	**0.0067** J	< 0.016	< 0.016	< 0.016	< 0.016
Acenaphthene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Acenaphthylene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Anthracene			4800	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Benzo(a)anthracene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Benzo(a)pyrene		0.01		< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Benzo(b)fluoranthene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Benzo(g,h,i)perylene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Benzo(k)fluoranthene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Chrysene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Dibenz(a,h)anthracene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Dibenzofuran				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Fluoranthene			640	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Fluorene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
* Indeno(1,2,3-cd)pyrene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Naphthalene	160		160	**0.0078** J	**0.023**	**0.016**	**0.015** J	**0.011** J	**0.01** J	**0.0089** J	**0.0088** J
Phenanthrene				< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
Pyrene			480	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016
NWTPH-Dx (µg/L)											
Diesel Range Hydrocarbons	500			< 25	< 22	< 48	< 34	< 29	< 24	< 21	< 23
Residual Range Organics (RRO)	500			< 44	< 64	< 59	< 85	< 110	< 74	< 38	< 69
Conventionals											
Hardness as $CaCO_3$ (mg/L)				**60**	**87**	**112**	**113**	**126**	**127**	**96**	**68**
pH				**6.57** J	**6.51**	**6.68**	**6.7** J	**6.37** J	**6.39** J	**6.72** J	**6.59** J
Field Turbidity (NTU)				**2.75**	**3.39**	**1.27**	**23.8**	**4.08**	**4.08**	**2.29**	**2.49**

Shaded and Bold -	Value exceeds Method B CUL (or Method A if no Method B value is available)
Bold -	Value dectected above the MRL
J -	Estimated concentration (value less than calculated reporting limit)
*	cPAH

Table F-4-5 Groundwater Analytical Results: Total Metals Results Compared to Surface Water Toxic Substance Critera (WAC 173-201A-240) (August 2008)

						Fresh Water Toxic Substance Criteria	
Pollutant	**Monitoring Well #**	**Hardness (µg/L)**	**Conversion Factor Acute**	**Conversion Factor Chronic**	**Analytical Value (µg/L)**	**Acute (µg/L) Upper Limit**	**Chronic (µg/L) Upper Limit**
Arsenic	**3**	**60**	—	—	0.770	360.000	190.000
	4	87	—	—	0.660	360.000	190.000
	5	112	—	—	2.760	360.000	190.000
	8	113	—	—	0.920	360.000	190.000
	9	127	—	—	0.220	360.000	190.000
	9	126	—	—	0.320	360.000	190.000
	10	96	—	—	0.590	360.000	190.000
	11	68	—	—	0.330	360.000	190.000
Cadmuim	**3**	60	0.965	0.930	< 0.024	1.304	1.495
	4	87	0.950	0.915	< 0.027	1.950	1.968
	5	112	0.939	0.904	< 0.039	2.565	2.373
	8	113	0.939	0.904	< 0.010	2.589	2.388
	9	127	0.934	0.899	< 0.020	2.939	2.603
	9	126	0.934	0.899	< 0.020	2.914	2.588
	10	96	0.946	0.911	< 0.010	2.170	2.117
	11	68	0.960	0.925	0.066	1.493	1.640
Chromium**	**3**	60	—	—	< 0.420	15.000	10.000
	4	87	—	—	< 0.450	15.000	10.000
	5	112	—	—	< 0.270	15.000	10.000
	8	113	—	—	< 0.700	15.000	10.000
	9	127	—	—	< 0.410	15.000	10.000
	9	126	—	—	< 0.460	15.000	10.000
	10	96	—	—	< 0.570	15.000	10.000
	11	68	—	—	< 0.350	15.000	10.000
Copper	**3**	60	—	—	< 0.340	11.444	9.079
	4	87	—	—	< 0.300	16.242	12.472
	5	112	—	—	< 0.300	20.606	15.476
	8	113	—	—	< 0.570	20.779	15.594
	9	127	—	—	< 0.440	23.196	17.231
	9	126	—	—	< 0.470	23.024	17.115
	10	96	—	—	< 0.230	17.820	13.566
	11	68	—	—	< 0.260	12.877	10.104
Lead	**3**	60	0.865	0.865	< 0.026	24.754	0.398
	4	87	0.811	0.811	< 0.025	37.240	0.598
	5	112	0.774	0.774	< 0.023	49.034	0.788
	8	113	0.773	0.773	< 0.054	49.509	0.796
	9	127	0.756	0.756	< 0.020	56.181	0.903
	9	126	0.757	0.757	< 0.007	55.704	0.895
	10	96	0.797	0.797	< 0.019	41.466	0.666
	11	68	0.847	0.847	< 0.026	28.418	0.457
Mercury	**3**	60	—	—	< 0.200	2.100	0.012
	4	87	—	—	< 0.200	2.100	0.012
	5	112	—	—	< 0.200	2.100	0.012
	8	113	—	—	< 0.200	2.100	0.012
	9	127	—	—	< 0.200	2.100	0.012
	9	126	—	—	< 0.200	2.100	0.012
	10	96	—	—	< 0.200	2.100	0.012
	11	68	—	—	< 0.200	2.100	0.012
Nickel	**3**	60	—	—	4.610	547.514	85.283
	4	87	—	—	11.600	749.744	116.783
	5	112	—	—	2.080	928.363	144.606
	8	113	—	—	2.740	935.371	145.698
	9	127	—	—	4.630	1032.518	160.829
	9	126	—	—	4.740	1025.635	159.757
	10	96	—	—	2.500	814.856	126.926
	11	68	—	—	3.300	608.670	94.809
Selenium	**3**	60	—	—	< 0.200	20.000	5.000
	4	87	—	—	< 0.300	20.000	5.000
	5	112	—	—	< 2.000	20.000	5.000
	8	113	—	—	< 1.000	20.000	5.000
	9	127	—	—	< 1.000	20.000	5.000
	9	126	—	—	< 1.000	20.000	5.000
	10	96	—	—	< 0.400	20.000	5.000
	11	68	—	—	< 1.000	20.000	5.000
Silver	**3**	60	—	—	< 0.020 🟨	0.013	—
	4	87	—	—	< 0.020	0.025	—
	5	112	—	—	< 0.020	0.038	—
	8	113	—	—	< 0.020	0.039	—
	9	127	—	—	< 0.020	0.048	—
	9	126	—	—	< 0.020	0.047	—
	10	96	—	—	< 0.020	0.029	—
	11	68	—	—	< 0.020 🟨	0.016	—
Zinc	**3**	60	—	—	< 2.320	65.099	60.351
	4	87	—	—	< 2.500	89.187	82.682
	5	112	—	—	< 2.060	110.471	102.414
	8	113	—	—	< 1.550	111.306	103.188
	9	127	—	—	< 1.040	122.885	113.922
	9	126	—	—	< 1.390	122.065	113.162
	10	96	—	—	< 2.060	96.945	89.874
	11	68	—	—	< 2.040	72.382	67.103

🟨 If the Analytical Value is greater than the Chronic or Acute value.

** Note: Analytical results are reported as total chromium. The Toxic Substance Criteria chromium values are reported as either trivalent or hexavalent chromium. Hexavalent is more restrictive and used as the comparison in this table.

Table F-4-6 Groundwater Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ) (August 2008)

Location ID Sample ID Sample Date			MW-3 MW-3-081908 8/19/2008			MW-4 MW-4-082008 8/20/2008			MW-5 MW-5-082008 8/20/2008			MW-8 MW-8-081908 8/19/2008			MW-9 MW-9-081908 8/19/2008			MW-9 MW-90-081908 8/19/2008			MW-10 MW-10-081908 8/19/2008			MW-11 MW-11-081908 8/19/2008		
Chemical Name	**TEFs**	**Unit**																								
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	pg/L	< 5.01	0.0008	U	**106**	**0.0318**		**366**	**0.1098**		< 15.9	0.002385	U	**292**	**0.0876**	J	**51.2**	**0.01536**	J	**7570**	**2.271**		< 4.86	0.000729	U
1,2,3,4,6,7,8,9-OCDF	0.0003	pg/L	< 1.14	0.0002	U	< 15.3	0.00230	U	< 27	0.00405	U	< 3.06	0.00046		< 21.8	0.00327	U	< 7.04	0.001056	U	**505**	**0.1515**		< 0.44	0.000066	
1,2,3,4,6,7,8-HpCDD	0.01	pg/L	< 1.43	0.0072	U	< 15.2	0.076	U	**37.1**	**0.371**		< 6.26	0.0313	U	**39.4**	**0.394**		< 12.3	0.0615	U	**723**	**7.23**		< 1	0.005	U
1,2,3,4,6,7,8-HpCDF	0.01	pg/L	< 0.757	0.003785	U	< 3.12	0.01560	U	< 4.57	0.023	U	< 0.91	0.00455		< 5.42	0.0271	U	< 0.971	0.004855		**78**	**0.78**		< 0.398	0.00199	U
1,2,3,4,7,8,9-HpCDF	0.01	pg/L	< 0.333	0.001665		< 0.952	0.005		< 0.948	0.005		< 1.19	0.006		< 0.493	0.002465		< 1.27	0.00635		**4.13**	**0.0413**	J	< 0.343	0.001715	
1,2,3,4,7,8-HxCDD	0.1	pg/L	< 0.367	0.02		< 1.08	0.05		< 0.992	0.05		< 0.965	0.05		< 0.596	0.03		< 1.53	0.08		**2.64**	**0.26**	J	< 0.4	0.02	
1,2,3,4,7,8-HxCDF	0.1	pg/L	< 0.265	0.01		< 0.494	0.02		< 0.697	0.03		< 0.534	0.03		< 0.328	0.02		< 0.771	0.04		**1.86**	**0.19**	J	< 0.211	0.01	
1,2,3,6,7,8-HxCDD	0.1	pg/L	< 0.3	0.0		< 1.07	0.05		< 0.983	0.05		< 0.956	0.05		< 1.49	0.07	U	< 1.52	0.08		< 15.7	0.79	U	< 0.327	0.02	
1,2,3,6,7,8-HxCDF	0.1	pg/L	< 0.247	0.01		< 0.516	0.03		< 0.727	0.04		< 0.558	0.03		< 0.306	0.02		< 0.805	0.04		**0.716**	**0.07**	NJ+	< 0.197	0.01	
1,2,3,7,8,9-HxCDD	0.1	pg/L	< 0.329	0.0		< 1.08	0.05		< 0.995	0.05		< 0.968	0.05		< 0.532	0.03		< 1.54	0.08		**8.01**	**0.80**	J	< 0.357	0.02	
1,2,3,7,8,9-HxCDF	0.1	pg/L	< 0.304	0.0152		< 0.638	0.03		< 0.899	0.04		< 0.689	0.03		< 0.377	0.02		< 0.994	0.05		< 0.459	0.02		< 0.243	0.01	
1,2,3,7,8-PeCDD	1	pg/L	< 0.41	0.2		< 0.714	0.4		< 0.761	0.4		< 0.997	0.5		< 0.377	0.2		< 0.735	0.4		**1.05**	**1.1**	NJ+	< 0.372	0.2	
1,2,3,7,8-PeCDF	0.03	pg/L	< 0.268	0.00402		< 0.598	0.009		< 0.342	0.005		< 0.526	0.008		< 0.258	0.00387		< 0.544	0.00816		< 0.322	0.00483		< 0.269	0.004035	
2,3,4,6,7,8-HxCDF	0.1	pg/L	< 0.279	0.01395		< 0.546	0.03		< 0.77	0.04		< 0.59	0.03		< 0.346	0.02		< 0.851	0.04		**1.24**	**0.12**	J	< 0.223	0.01	
2,3,4,7,8-PeCDF	0.3	pg/L	< 0.262	0.04		< 0.588	0.09		< 0.337	0.05		< 0.516	0.08		< 0.252	0.04		< 0.534	0.08		< 0.313	0.05		< 0.262	0.04	
2,3,7,8-TCDD	1	pg/L	< 0.345	0.2		< 0.7	0.35		< 0.699	0.35		< 0.765	0.38		< 0.311	0.16		< 0.567	0.28		< 0.384	0.19		< 0.346	0.17	
2,3,7,8-TCDF	0.1	pg/L	< 0.34	0.017		< 1.02	0.051		< 0.825	0.041		< 0.443	0.022		< 0.314	0.0157		< 0.667	0.03335		< 0.401	0.02005		< 0.276	0.0138	
Total TCDD TEQ (1)				**0.556**			**1.26**			**1.64**			**1.30**			**1.11**			**1.26**			▨ **14.04**			**0.52**	
Total TCDD TEQ (2)				**NA**			**0.032**			**0.481**			**NA**			**0.482**			**0.015**			▨ **12.97**			**NA**	

Notes

Total TCDD and TCDF equivalents calculated using WHO 2005 Toxicity Equivalency Factors (MTCA, 2007).

(1) One-half the estimated detection limit used for non-detect results

(2) Non-detect results excluded from TEQ calculation

Qualifiers

- J = estimated concentration (value less than calculated reporting limit)
- N = analyte is tentatively identified (validator qualifier)
- J+ = estimated concentration, biased high
- U = false positive; non-detect at the original result

Method B CUL - 5.8 pg/L

▨ Shaded value exceeds MTCA Method B CUL

Table F-4-7 Groundwater Analytical Results: Metals, PCP, TPH-Dx and Conventionals (December 2008)

			Location ID	MW-2	MW-6	MW-7	MW-7	MW-10
			Sample ID	LL-MW2-120308	LL-MW6-120308	LL-MW70-120308	LL-MW7-120308	LL-MW10-120308
			Sample Date	12/3/2008	12/3/2008	12/3/2008	12/3/2008	12/3/2008
Chemical Name	MTCA A		MCTA B Non-Carcinogenic					
Conventionals								
Antimony			6.4	NA	**0.139**	< 0.05 U	< 0.05 U	NA
Arsenic	5	0.058	4.8	NA	**0.73**	**0.6**	**0.7**	NA
Metals EPA Method 6020/7470A (µg/L)								
Beryllium			32	NA	**0.016 J**	< 0.02	< 0.02	NA
Cadmium	5		8	NA	**0.178**	< 0.02	**0.01 J**	NA
Chromium	50			NA	**1.15**	< 0.2 U	< 0.2 U	NA
Copper			590	NA	**7.91**	**0.21**	**0.19**	NA
Lead	15			NA	**0.117**	< 0.02 U	**0.023 J+**	NA
Mercury	2		4.8	NA	< 0.2	< 0.2	< 0.2	NA
Nickel			320	NA	**14.3**	**2.09**	**2.13**	NA
Selenium			80	NA	< 1	< 1	< 1	NA
Silver				NA	**0.153**	< 0.02 U	< 0.02 U	NA
Thallium			1.1	NA	< 0.02 U	< 0.02	< 0.02 U	NA
Zinc			4800	NA	**3.7**	**1.3 J**	**2.7 J**	NA
Semi-volatile Organic Compound EPA Method 8151M (µg/L)								
Pentachlorophenol		0.73	480	< 0.50 U	< 0.5 U	< 0.5	< 0.5	NA
NWTPH-Dx (ug/L)								
Diesel Range Hydrocarbons	500			NA	**3,600 J**	**13 J**	**19 J**	NA
Residual Range Organics (RRO)	500			NA	**710 NJ**	< 520 U	< 520 U	NA
Conventionals								
pH				**6.5 J**	**6.07 J**	**6.82 J**	**6.87 J**	**6.8 J**
Total Organic Carbon (mg/L)				**0.7**	**14**	**0.6**	**0.6**	**0.33 J**
Total Suspended Solids (mg/L)				< 5	**21**	< 5	< 5	< 5

Shaded and Bold=	Value exceeds Method B CUL (or Method A if no Method B value is available)
Bold=	Value dectected above the MRL
J=	Estimated concentration
J+=	Estimated concentration, biased high
N=	Analyte is tentatively identified
U=	False positive; non-detect at the original result
FD=	Field duplicate

Table F-4-8 Groundwater Analytical Results: Dioxin-Furan Total Toxic Equivalency Quotient (TEQ) (December 2008)

Location ID			MW-2			MW-6			MW-7			MW-7 DUP			MW-10		
Sample ID			LL-MW2-120308			LL-MW6-120308			LL-MW7-120308			LL-MW70-120308			LL-MW10-120308		
Sample Date			12/3/2008			12/3/2008			12/3/2008			12/3/2008			12/3/2008		
Chemical Name	**TEFs**	**Unit**															
Dioxins/Furans			**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**		**Reported Value**	**TEQ**	
1,2,3,4,6,7,8,9-OCDD	0.0003	pg/L	**< 10.9**	**0.001635**	**U**	**< 11.5**	**0.001725**	**U**	**< 6.47**	**0.0009705**	**U**	**< 82.7**	**0.012405**	**U**	**< 9.73**	**0.0015**	**U**
1,2,3,4,6,7,8,9-OCDF	0.0003	pg/L	**< 0.934**	**0.00014**	**U**	**< 1.08**	**0.000162**	**U**	< 0.295	0.00004	**U**	**< 9.21**	**0.0013815**	**U**	< 0.392	0.0001	**U**
1,2,3,4,6,7,8-HpCDD	0.01	pg/L	**< 1.78**	**0.0089**	**U**	**< 1.39**	**0.00695**	**U**	**< 1.01**	**0.00505**	**U**	**< 15.6**	**0.078**	**U**	**< 1.78**	**0.0089**	**U**
1,2,3,4,6,7,8-HpCDF	0.01	pg/L	**< 0.417**	**0.00209**	**U**	< 0.23	0.001		< 0.159	0.000795		**< 2.02**	**0.0101**	**U**	**< 0.36**	**0.0018**	**U**
1,2,3,4,7,8,9-HpCDF	0.01	pg/L	< 0.298	0.001		< 0.313	0.002		< 0.216	0.001		< 0.835	0.004175		< 0.292	0.00146	
1,2,3,4,7,8-HxCDD	0.1	pg/L	< 0.222	0.01		< 0.289	0.01		< 0.162	0.01		< 0.329	0.02		< 0.231	0.01	
1,2,3,4,7,8-HxCDF	0.1	pg/L	< 0.106	0.01		< 0.189	0.01		< 0.129	0.01		< 0.383	0.02		< 0.156	0.01	
1,2,3,6,7,8-HxCDD	0.1	pg/L	< 0.197	0.01		< 0.256	0.01		< 0.143	0.01		< 0.292	0.01		< 0.205	0.0	
1,2,3,6,7,8-HxCDF	0.1	pg/L	< 0.102	0.01		< 0.182	0.01		< 0.124	0.01		< 0.368	0.02		< 0.149	0.01	
1,2,3,7,8,9-HxCDD	0.1	pg/L	< 0.214	0.01		< 0.277	0.01		< 0.156	0.01		< 0.317	0.02		< 0.223	0.0	
1,2,3,7,8,9-HxCDF	0.1	pg/L	< 0.132	0.01		< 0.236	0.01		< 0.162	0.01		< 0.479	0.02		< 0.195	0.00975	
1,2,3,7,8-PeCDD	1	pg/L	< 0.238	0.1		< 0.245	0.1		< 0.225	0.1		< 0.354	0.2		< 0.227	0.1	
1,2,3,7,8-PeCDF	0.03	pg/L	< 0.189	0.003		< 0.215	0.003		< 0.147	0.002		< 0.295	0.004425		< 0.179	0.002685	
2,3,4,6,7,8-HxCDF	0.1	pg/L	< 0.114	0.01		< 0.202	0.01		< 0.138	0.01		< 0.411	0.02		< 0.167	0.00835	
2,3,4,7,8-PeCDF	0.3	pg/L	< 0.187	0.03		< 0.213	0.03		< 0.146	0.02		< 0.292	0.04		< 0.177	0.03	
2,3,7,8-TCDD	1	pg/L	< 0.167	0.08		< 0.228	0.11		< 0.148	0.07		< 0.148	0.07		< 0.198	0.1	
2,3,7,8-TCDF	0.1	pg/L	< 0.214	0.011		< 0.26	0.013		< 0.206	0.010		< 0.147	0.00735		< 0.179	0.009	
Total TCDD TEQ (1)				**0.31**			**0.38**			**0.28**			**0.54**			**0.331**	

Notes

Total TCDD and TCDF equivalents calculated using WHO 2005 Toxicity Equivalency Factors (MTCA, 2007).
(1) One-half the estimated detection limit used for non-detect results

Method B CUL - 5.8 pg/L

Qualifiers
B **Organic**: The analyte was found in the associated method blank at a level that is significant relative to the sample result.
J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
U Evaluated to be undetected at the reporting limit/concentration, due to evidence of contamination

Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Appendix D
Health and Safety Plan

PUBLIC REVIEW DRAFT

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1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities comprising soil boring installation, monitoring well installation and development, groundwater monitoring, soil and groundwater sample collection, hydraulic conductivity testing, and sediment bioassay sample collection at the Lora Lake Apartments Site (Site) and neighboring Lora Lake. This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. This plan consists of site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities described herein are required to develop and comply with their own HASP. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisors' (HSO/SS') copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP and have any questions or concerns about site conditions, they should immediately notify the HSO/SS and an addendum will be provided to this HASP.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP, should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

2.0 Emergency Contacts and Information

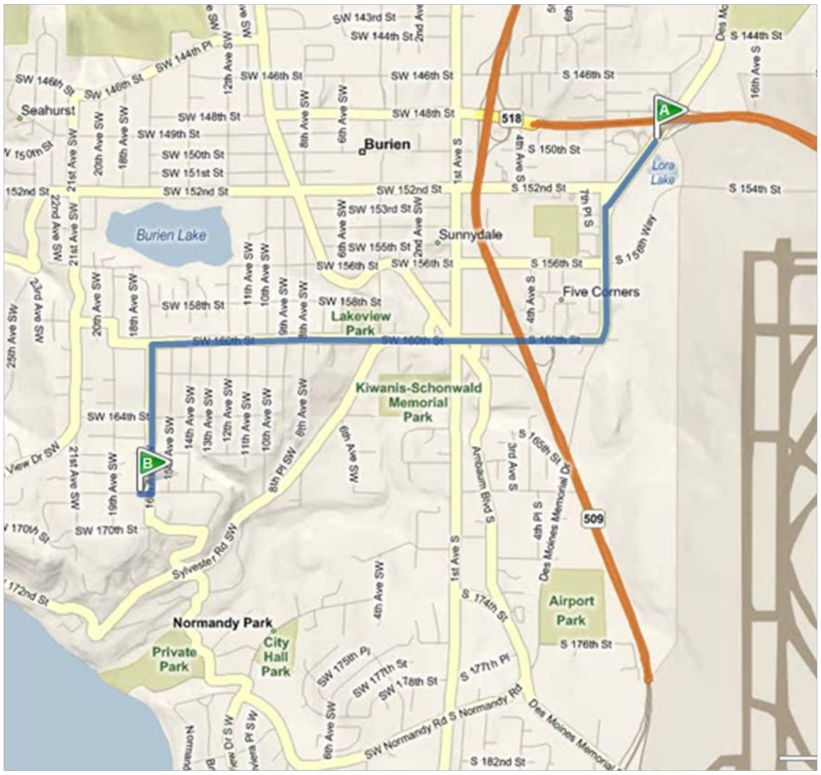
2.1 DIAL 911

In the event of any emergency, dial 911 to reach fire, police, and first aid.

2.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone: Refer to Figure D.1 below for map and directions to the hospital.	Highline Medical Center—Main Campus 16251 Sylvester Road SW Burien, WA 98166 (206) 431-5314
Washington Poison Control Center:	(800) 222-1222

Figure D.1
Hospital Directions



Leave Site Heading SOUTH on DES MOINES MEMORIAL DRIVE
Turn RIGHT onto SOUTHWEST 160th STREET, keep left
Turn LEFT onto 8th AVENUE SOUTHWEST
Turn LEFT into Hospital Emergency Room Entrance

2.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to Give to Emergency Personnel	
Site Location: Refer to Figure D.2 below for directions and map to the Site.	Lora Lake Apartments Site 15001 Des Moines Memorial Drive Burien, WA (South of SR-518, West of SeaTac Airport) **Site:** the entrance to the Site is located on the west side of Des Moines Memorial Drive, at the stop light for the freeway entrance to SR-518, immediately south of SR-518, and immediately west of the NW corner of the SeaTac Airport.
Number that You are Calling from:	Look on the phone you are calling from.
Type of Accident or Type(s) of Injuries:	Describe accident and/or incident and numbers of personnel needing assistance.

Figure D.2
Lora Lake Apartments Site

2.4 FLOYD|SNIDER AND PORT OF SEATTLE EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider Project Manager, or a Principal to report the emergency. The Floyd|Snider Contact may then contact the Port of Seattle, or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Matt Woltman, Project Manager	(206) 292-2078	(206) 852-8556
Kate Snider, Principal		(206) 375-0762
Teri Floyd, Principal		(206) 713-1329
Megan McCullough, HSO/SS		(206) 291-7713

Port of Seattle Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Don Robbins	(206) 787-4918	(206) 369-0808
Paul Agid	(206) 787-6604	(206) 559-8394

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3.0 Background Information

3.1 SITE BACKGROUND

Floyd|Snider will conduct field investigation and data collection activities on behalf of the Port of Seattle (Port) at the Site located at 15001 Des Moines Memorial Drive in Burien, Washington and the adjacent Lora Lake located to the east across Des Moines Memorial Drive. The Site occupies approximately 8.3 acres of currently vacant land that is bounded to the north by State Route 518 (SR518), to the east and southeast by Des Moines Memorial Drive, to the west by 8th Avenue South, and to the south by an open area that has been cleared from prior industrial and commercial land use. Land use to the west and north of the Site is primarily residential and light commercial.

A parcel of land located directly east of the Site is owned and maintained by the Washington State Department of Transportation (WSDOT) as part of the highway interchange system. The street right-of-ways are owned by the City of SeaTac to the southeast of Des Moines Memorial Drive and by the City of Burien to the northwest.

In 1940, the property served as an orchard, farm, and private residence. The Site was first converted to industrial use in the early to mid-1940s, when the Novak family purchased the property and established the Novak Barrel Cleaning Company. The Novak Barrel Cleaning Company continued operations at the Site until the 1960s when the property became the Burien Auto Wrecking facility. The Site was operated as an auto wrecking facility from the 1960s through the 1980s, and by 1985 the auto wrecking yard had ceased operations and vacated the Site, leaving only the few remaining buildings and fences as markers of the past industrial operations. The property was purchased for residential development by The Mueller Group (Mueller) in 1986. Mueller constructed the Lora Lake Apartments at the Site in 1987. The Site is currently owned by the Port. The Port entered into a Remedial Investigation/Feasibility Study (RI/FS) Agreed Order (AO) for the Site with the Washington State Department of Ecology in July 2009. The apartment buildings were demolished in August and September 2009 as part of an AO Interim Action.

Contamination was first encountered on the Site by the Mueller Group during grading activities in preparation for apartment construction. A limited soil excavation was conducted prior to apartment construction, and subsequent environmental investigations have encountered soil and groundwater contamination in multiple areas of the Site.

Lora Lake, east of the Site, is located on Port-owned property adjacent to the Seattle Tacoma International Airport (STIA). Access to the lake is restricted by fencing as an airport security measure. The lake is a man-made feature resulting from peat mining activities conducted in the 1940s and 1950s. The lake is approximately 135,000 square feet. The depth of the lake is unknown.

3.2 SCOPE OF WORK

The scope of work for this field investigation and data collection activities is described in detail in the Work Plan. Floyd|Snider will conduct the following field work activities:

- Install soil borings, including Geoprobe, hollow-stem auger (HSA), and hand auger borings, and collect soil samples for analytical testing. Geoprobe and HSA borings will be completed on-site. Hand auger borings will be completed off-site (on the shoulders of road right of ways).
- Construct groundwater monitoring wells in boring locations completed with HSA, and collect soil samples for analytical testing.
- Develop new monitoring wells and redevelop existing monitoring wells.
- Collect groundwater samples.
- Slug testing.
- Measure depths in Lora Lake by dropping a lead line from an inflatable raft or canoe/row boat along transects across the lake.
- Collect sediment samples from Lora Lake with diver assistance. Floyd|Snider personnel will process sediment samples retrieved from the bottom of Lora Lake by a diving subcontractor. Personnel will be required to work in a boat, but will not enter the lake.

4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The Project Manager (PM) will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum will be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess site health and safety conditions, modify the site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The Site Safety Officer (SSO) may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas. Employees will report all accidents and/or incidents or other unsafe working conditions to the HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations (HAZWOP), administered by the Washington State Department of Labor and Industries (L&I). Project personnel will be 40-hour HAZWOP trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/SS will have completed an 8-hour HAZWOP Supervisor training as required by WAC 296-843-20015. At least one person on-site during field work will have current CPR/First Aid certification. All field personnel will have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor. Documentation of all required training will be maintained in a 3-ring binder, or similar, on-site and kept either in the HSO/SS vehicle or equipment storage bin.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included in this HASP as Attachment D.1.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial audiometric and physical examinations for employees involved in HAZWOPER projects. The program requires medical clearance before respirator use or participating in HAZWOPER activities. Medical examinations must be completed before conducting field work activities and on a biennial basis.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil boring installation, monitoring well installation and development, groundwater monitoring, soil and groundwater sample collection, and hydraulic conductivity testing. Based on previous site investigation information, the following chemicals are present at this Site and have been retained as site contaminants of concern (COCs):

- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in soil and groundwater
- Dioxins in soil and groundwater
- Arsenic in soil and groundwater
- Lead in soil
- Diesel range and heavy oil range hydrocarbons in soil and groundwater
- Gasoline range hydrocarbons in soil and groundwater
- Pentachlorophenol (PCP) in soil and groundwater
- Volatile organic compounds (VOCs)—tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA)—in soil and groundwater

Human health hazards of these chemicals are presented in the table below. This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water or soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals that may be encountered at this Site are not expected to be present at concentrations that could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site. The use of appropriate PPE and decontamination practices will assist in controlling exposure through all pathways to the contaminants listed in the table below.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Carcinogenic Polycyclic Aromatic Hydrocarbons	0.2 mg/m^3 / 0.6 mg/m^3 (as coal tar pitch volatiles)	0.243 mg/kg in soil	Inhalation	Dermatitis, bronchitis, lung, skin, and stomach cancer.
Dioxins	None established	2.34E-7 mg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Eye irritation, allergic dermatitis, chloracne; GI distress; liver, kidney damage. Breast and other cancers.
Arsenic	0.01 mg/m^3 in air	11.2 mg/kg in soil	Inhalation, skin absorption, ingestion, skin/eye contact	Ulceration of nasal septum; dermatitis; GI disturbance; respiratory irritation; hyper-pigmentation of skin. Skin and lung cancer.
Lead	0.05 mg/m^3 / Action Level of 0.03 mg/m^3	370 mg/kg in soil	Inhalation, ingestion, skin/eye contact	Weakness, insomnia, facial pallor, weight loss, constipation, abdominal pain, anemia, tremors, eye irritation, hypotension, central nervous system deficits, reproductive toxin.
Diesel Range and Heavy Oil Range Hydrocarbons	None established	17,000 mg/kg in soil	Inhalation, skin/eye contact	Irritation to eyes, pulmonary function, central nervous system.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Gasoline Range Hydrocarbons	300 ppm / 500 ppm	1900 mg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage.
Pentachlorophenol	0.5 mg/m^3 / 1.5 mg/m^3 (skin)	15 mg/kg (soil)	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, nose, throat; sneezing, coughing, weakness; weight loss; sweating; headache; dizziness; nausea; chest pain; fever; dermatitis.
Tetrachloroethene	25 ppm / 38 ppm	0.23 µg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, nose, throat, nausea, flushed skin, vertigo, dizziness, incoherence, sleepiness, liver damage.
Trichloroethene	50 ppm / 200 ppm	0.17 µg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin; headache; vertigo; vision disturbance; fatigue; tremors/jitters; sleepiness; nausea; dermatitis; cardiac arrhythmia; paresthesia; liver injury.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
1,2-Dichloroethane	1 ppm / 2 ppm	Not Detected	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes; corneal opacity; central nervous system depression; nausea; dermatitis; liver, kidney, cardiovascular system damage.
Laboratory Preservatives (HCl, MeOH, Sodium Bisulfate, HNO_3)	Not Applicable	Not Applicable	Dermal contact, eye contact	Irritation to skin or eyes. Avoid contact through proper use of PPE during sample handling and collection.

5.2 FIRE AND EXPLOSION HAZARDS

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the property to support heavy equipment. When on-site storage is necessary, such material will be stored in containers approved by the WSDOT in a location not exposed to strike hazards and provided with secondary containment. A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site, such as fuel for the sediment sampling boat, are responsible for providing appropriate material for containment and spill response, and should be addressed in their respective HASP. Transferring of flammable liquids (e.g., gasoline) will occur only after making positive metal to metal connection between the containers, which may be achieved by using a bonding strap. Storage of ignition and combustible materials will be kept away from fueling operations.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, all site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner, and if personnel have any reasons for concern or uncertainty.

All field personnel will adhere to general safety rules including wearing appropriate PPE—hard hats, steel-toed boots, high-visibility vests, personal floatation devices, safety glasses, gloves, and hearing protection, as appropriate. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during drilling activities and around large, heavy equipment.
Foot/ankle twist, crush, slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Care must be taken when entering / exiting the sediment sampling boat, as the lake bank may be wet and uneven. Workers will enter and exit the boat safely to maintain balance, and avoid falls. Keep work areas organized and free from unmarked trip hazards.
Hand cuts, splinters and chemical contact	Hands or fingers pinched or crushed, chemical hazards including dermal exposure to laboratory sample preservatives. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to preventive measures for mechanical hazards below.

Hazard	Cause	Prevention
Eye damage from flying materials, or splash hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures, sediment sampling and groundwater sampling to avoid splashing, or dropping equipment into decontamination water, or into Lora Lake. Face shields may be worn over safety glasses if splashing is occurring during sampling, decontamination, or well slug testing.
Electrical hazards	Underground utilities, overhead utilities. Electrical cord hazards, such as well development pumps.	Utility locator service will be used prior to any investigation to locate all underground utilities. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an "-A" extension is acceptable for either) and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must either be a double-insulated design or grounded with a ground-fault circuit interrupter (GFCI).
Mechanical hazards	Heavy equipment such as drill rigs, service trucks, mowing equipment, saws, drills, etc. Conducting work in road right of ways (on the road shoulder).	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear OK before approaching or working within swing radius of heavy equipment, staying clear of swing radius. Obey on-site speed limits.

Hazard	Cause	Prevention
Traffic Hazards	Vehicle traffic and hazards when working near public right-of-ways.	When working off-site on the shoulder of the road, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work off-site. Multiple field staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible. **Further detail on traffic hazards is provided in Section 5.3.4.**
Noise damage to hearing	Machinery creating more than 85 decibels TWA, less than 115 decibels continuous noise, or peak at less than 140 decibels.	Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains from improper lifting	Injury due to improper lifting techniques, overreaching/ overextending, lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to lifting.
Cold stress	Cold temperatures and related exposure	Workers will ensure appropriate clothing, stay dry, and take breaks in a heated environment when working in cold temperatures. **Further detail on cold stress is provided in Section 5.3.1.**

Hazard	Cause	Prevention
Heat exposure	High temperatures exacerbated by PPE, dehydration.	Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. **Further detail on heat stress is provided in Section 5.3.2.**
Accidents due to inadequate lighting	Improper illumination.	Work will proceed during daylight hours only, or under sufficient artificial light.
Drowning	Unsafe entering water during sediment sample collection, or lake depth measurements.	Personnel will wear personal floatation devices at all times when on sampling boats, rafts, canoes or row boats in Lora Lake. Field staff will move cautiously on the vessel to avoid falling into the lake, and enter/exit vessels only when they are securely docked onshore.

5.3.1 Cold Stress

Field work is expected to be completed in spring or summer months; however, if additional phases of work are required, or activities are conducted in winter months, exposure to cold temperatures may occur. Exposure to moderate levels of cold can cause the body’s internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech, mental confusion, forgetfulness, memory lapses, lack of coordination, and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Personnel will wear water-protective gear, such as rain coats and pants, during sediment sampling to avoid getting clothing wet. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below.

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90° F)
    - Shivering
    - Lack of coordination, stumbling, fumbling hands
    - Slurred speech
    - Memory loss

  - Pale, cold skin
- Moderate hypothermia (body temperature of 90–86° F)
  - Shivering stops
  - Unable to walk or stand
  - Confused and irrational
- Severe hypothermia (body temperature of 86–78° F)
  - Severe muscle stiffness
  - Very sleepy or unconscious
  - Ice cold skin
  - Death

Treatment of Hypothermia—Proper Treatment Depends on the Severity of the Hypothermia

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes and replace with dry clothes or blankets and cover the head.
  - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
  - All of the above, plus:
    - call 911 for an ambulance,
    - cover all extremities completely,
    - place very warm objects such as hot packs or water bottles on the victim's head, neck, chest and groin.
- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30°F or lower, wind chill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feeling in the frostbitten area followed by numbness and skin discoloration from red to purple, then white or very pale skin. Should any of these symptoms be observed, wrap the area in soft cloth, do not rub the affected area, and seek medical assistance. Call 911 if the condition is severe.

Protective Clothing

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear *at least three layers* of clothing
    - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
    - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
    - An inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking—Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule—If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System—Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually when workers are exposed to temperatures greater than 89°F when wearing breathable clothing, greater than 77°F when wearing double-layered woven clothing (such as jackets or coveralls) or greater than 52°F when wearing non-breathing clothing such as chemical resistant suits or tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including, but not limited to, the provision of rest breaks that are adjusted for environmental factors, and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature-controlled environments (i.e., air conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or if medical attention is necessary.

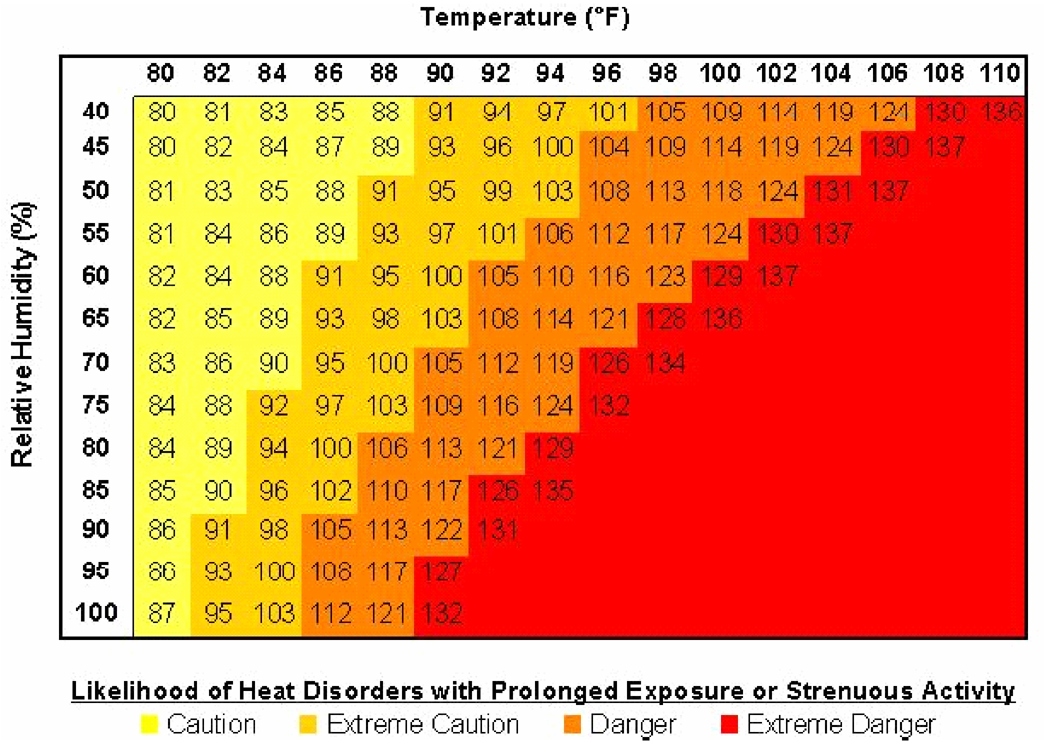
Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress include the following:

Condition	Signs/Symptoms	Treatment
Heat cramps	Painful muscle spasms and heavy sweating.	Increase water intake, rest in shade/cool environment.
Heat syncope	Brief fainting and blurred vision.	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches.	Increase water intake, rest in shade/cool environment.
Heat exhaustion	Pale and clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving sweating, blurred vision, body temperature slightly elevated.	Lie down in cool environment, water intake, loosen clothing, and call 911 for ambulance transport if symptoms continue once in cool environment.

Heat stroke	Cessation of sweating, skin hot and dry, red face, high body temp, unconsciousness, collapse, convulsions, confusion or erratic behavior, life threatening condition.	**Medical Emergency!! Call 911** for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85°F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress.



Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

🟨 Caution 🟨 Extreme Caution 🟧 Danger 🟥 Extreme Danger

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid, if necessary.

Site personnel will maintain a safe distance from any urban wildlife encountered, including stray dogs, raccoons, and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

While work is being conducted nearby or alongside a roadway, signs, signals, and barricades should be utilized. Because signs, signals, and barricades do not always provide appropriate protection, spotters will be used to ensure traffic is monitored during work activities along roadways. All workers will wear high visibility reflective neon / orange vests. Although lane closures are not anticipated for off-site work, traffic control plans and City-issued permits will be required for any lane closures. If lane closures are required, an addendum to this HASP will be required to document the health and safety procedures associated with lane closure and use of flaggers.

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6.0 Site Monitoring

The following sections describe site monitoring techniques and equipment that are to be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

6.1 SITE MONITORING

Since the Site is currently vacant, and noise generating activities will be conducted within the 8-acre site boundary, noise levels are expected to be less than the allowable levels at the site boundaries. All noise generating activities will be conducted during the allowable noise-generating hours as stated by the City of Burien. Construction Noise Hours for the City of Burien are between 7:00AM and 10:00PM Monday through Friday.

Air monitoring will not be conducted, as previous investigations have adequately characterized the type and concentrations of chemicals present at the Site. Of the site COCs listed above in Section 5.1, gasoline, diesel, PCE, TCE, and 1,2-DCA are the only volatile chemicals present. Visual monitoring for dust will be conducted by the HSO/SS to ensure that inhalation of contaminated soil particles does not occur. If visible dust is present in the work area, work will cease, and the area will be cleared until the dust settles. Water may be used to suppress any dust clouds generated during work activities. The concentrations of VOCs encountered at the Site are orders of magnitude lower than the exposure limits developed by OSHA. Since the concentrations of VOCs are low, and all work will be conducted outdoors in an open-air ventilated environment, vapor concentrations are not expected to exceed allowable levels. A photoionization detector (PID) will be used on-site for characterization of soil samples collected. This PID will also be used to monitor vapor concentrations in breathing air of total VOCs in parts per million. Should the PID read a sustained concentration of total VOCs greater than the lowest action level (4 ppm for 1,2-DCA) sustained for 5 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background levels. If necessary, actions may be taken to reduce vapor concentrations in the work area by covering exposed soil in drums, or drilling cuttings, or using fans to dissipate vapors from the work area.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

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7.0 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 3.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Installation of Soil Borings and Wells, Soil Sampling	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat and cold exposure hazards.
Groundwater Sampling from Monitoring Wells, Well Development, Decontamination, and Slug Testing	Chemical hazards include potential dermal or eye exposure to site contaminants in groundwater. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.
Sediment Sample Collection from Lora Lake, and Lake Depth Measurement	Chemical hazards include potential dermal or eye exposure to laboratory preservatives during sediment sample collection. Physical hazards include slip, trip or fall hazards when entering/exiting the vessel, heat and cold exposure, biological hazards, and drowning while conducting field activities on the lake.

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8.0 Personal Protective Equipment

All work involving heavy equipment, drilling, and well installation will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, eye protection, gloves, and sturdy cotton outer work clothing or removable cotton outer clothing.

Sediment sample collection oversight will proceed in modified Level D PPE, which shall include rubber boots, eye protection, gloves, and water-protective outer work clothing.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil, sediment, or groundwater, workers will wear nitrile gloves and Level D PPE.

High visibility vests will be worn when working around heavy equipment, and off-site on road shoulders.

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9.0 Site Control and Communication

9.1 SITE CONTROL

The Site is vacant and fenced, as is Lora Lake. Pedestrians and other unauthorized personnel will not be allowed in the work areas. Access to the work site will be restricted to designated personnel. The purpose of site control is to minimize the public's potential exposure to site hazards, to prevent vandalism in the work area and access by transients, children, and other unauthorized persons, and to provide adequate facilities for workers.

Activities conducted off-site in the public roadway shoulders will be controlled through the use of barricades, flagging, or similar measures. If members of the public enter the work area, field staff will stop work until the public have left the work area.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the Site includes all areas outside the work area and decontamination areas. An exclusion zone/contamination reduction zone (EZ/CRZ), and SZ will be set up for work being conducted within the limits of the Site. Only authorized personnel shall be permitted access to the EZ/CRZ. For work being conducted outside the limits of the Site (road shoulders), the EZ/CRZ around work locations will be demarcated with cones and/or barrier hazard tape as needed to effectively limit unauthorized access. Staff will decontaminate all equipment and gear as necessary prior to exiting the CRZ. Decontamination areas will be constructed with plastic sheeting on the ground, to reduce transport of contaminated soils from the EZ to the SZ. During sediment sample collection, the sampling boat will act as the EZ/CRZ.

9.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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10.0 Decontamination

Decontamination procedures will be strictly followed to prevent off-site spread of contaminated soil or water. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection. Refer to the Sampling Analysis Plan/Quality Assurance Project Plan (SAP/QAPP; Appendix B of the RI/FS Work Plan) for additional details.

Before eating, drinking, and use of tobacco, hands must be thoroughly washed.

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11.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all site personnel and reviewed whenever the plan is modified or the HSO/SS believes that site personnel are unclear about the appropriate emergency actions.

A muster point of refuge (that is clear of adjacent hazards and not located downwind of site investigation activities) will be identified by the HSO/SS and communicated to the field team each day. In an emergency, all site personnel and visitors will evacuate to the muster point for roll call. It is important that each person on-site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

11.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other on-site personnel to a safe place in an upwind or cross-wind direction until it is safe for work to resume.
- If serious injury or a life-threatening condition exists, call **911** for paramedics, fire department, and police.

  Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.

- Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
- Call the PM and HSO/SS.
- Immediately implement steps to prevent recurrence of the accident.

Refer to Figure D.1 in Section 2.2 for a map showing the nearest hospital location with phone number and address.

11.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, contact 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1-800-258-5990 to report the release.
6. Initiate cleanup.
7. The PM will submit a written report to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

11.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified if the emergency poses a continuing hazard by calling 911.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

11.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn or car horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

11.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS, including two blood borne pathogen barriers.
- Sorbent materials capable of absorbing the volume of liquids / fuels brought to the Site by Floyd|Snider personnel.
- Portable fire extinguisher (2-A:10 B/C min).
- A copy of the current HASP.

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12.0 Administrative

12.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

12.2 RECORDKEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

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13.0 Approvals

______________________________ ______________

Project Manager Date

______________________________ ______________

Project Health & Safety Officer Date

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14.0 Signature Page

I have read this Heath and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

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Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Attachment D.1
Daily Tailgate Safety Meeting Form

PUBLIC REVIEW DRAFT

Attachment D.1
Daily Tailgate Safety Meeting

Date: ____________________________ Time: ___________________________

Project Name: Lora Lake Apartments Site Remedial Investigation

Location: ____

Meeting Conducted by: ____

Topics Discussed:

Physical Hazards: ____

Chemical Hazards: ____

Personal Protection: ____

Decontamination: ____

Special Site Considerations: ____

____

____

On-site Emergency Contact:, Emergency Dispatch 911

Hospital: Highline Medical Center – Main Campus
16251 Sylvester Rd SW
Burien, WA 98166
(206) 431-5314

Tailgate Safety Meeting Attendees

Name/Company (printed)	Signature

Conducted by: ____________________ ____________________ ____________

Name Signature Date

Port of Seattle
Lora Lake Apartments

Remedial Investigation/ Feasibility Study Work Plan

Attachment D.2
Material Safety Data Sheets

PUBLIC REVIEW DRAFT

Attachment D.2
List of Material Safety Data Sheets

Benzo(a)pyrene
2,3,7,8-Tetrachlorodibenzo-p-dioxin
Arsenic
Lead
Diesel
Gasoline
Pentachlorophenol
Tetrachloroethene
Trichloroethene
1,2-Dichloroethane
Hydrochloric acid
Methyl alcohol
Sodium bisulfate
Nitric acid

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CUSTOMER P.O. NO. K300660

DATE 10/30/00

MATERIAL SAFETY DATA SHEET

SECTION I -GENERAL INFORMATION

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO I486650
BENZO(A)PYRENE
FORMULA MIXTURE FORMULA WEIGHT
CAS NRTECS
SYNONYM ANALYTICAL STANDARD IN METHYLENE CHLORIDE
MANUFACTURER SUPELCO INC. PHONE 814-359-3441
ADDRESS SUPELCO PARK, BELLEFONTE, PA 16823-0048

SECTION II - HAZARDOUS INGREDIENTS OF MIXTURES

CHEMICAL NAME
COMMON NAME - PERCENTAGE - CAS #
(FORMULA) - PEL(UNITS) - TLV(UNITS)
LD50 VALUE - CONDITIONS

BENZO{A}PYRENE
BENZO(A)PYRENE 0.02 50-32-8
$C_{20}H_{12}$ N/A N/A
50 MG/KG SUBCUTANEOUS RAT SEE FOOTNOTE(2,8)
METHANE, DICHLORO-
METHYLENE CHLORIDE 99.98 75-09-2
CH_2Cl_2 500 PPM 50 PPM
2524 MG/KG ORAL RAT SEE FOOTNOTE(3,6,8)

FOOTNOTES

2 CLASSIFIED BY IARC AS A CLASS 2A CARCINOGEN.
3 CLASSIFIED BY IARC AS A CLASS 2B CARCINOGEN.
6 SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III, SECTION 313.
8 CLASSIFIED BY NTP AS A GROUP B CARCINOGEN.

SECTION III - PHYSICAL DATA

BOILING POINT 40 C MELTING POINT -97 C
VAPOR PRESSURE 349 MM 20.0 C VAPOR DENSITY (AIR=1) 2.93 20.0 C
SPECIFIC GRAVITY 1.320 G/ML C (WATER=1) PERCENT VOLATILE BY VOLUME 100
WATER SOLUBILITY 1.6 EVAPORATION RATE 0.71 (ETHER=1)
APPEARANCE CLEAR COLORLESS LIQUID
ODOR ETHER-LIKE ODOR

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT N/A FLAMMABLE LIMITS LEL 12.0 UEL 19.0

EXTINGUISHING MEDIA

WATER
CO_2
DRY CHEMICAL

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF CONTAINED BREATHING APPARATUS WHEN FIGHTING A CHEMICAL FIRE.

UNUSUAL FIRE AND EXPLOSION HAZARDS

THE FOLLOWING TOXIC VAPORS ARE FORMED WHEN THIS MATERIAL IS HEATED TO DECOMPOSITION.

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO 1486650
BENZO(A)PYRENE

* CONTINUED *

HYDROGEN CHLORIDE, PHOSGENE.

SECTION V - HEALTH HAZARD DATA

LD50 2524 MG/KG ORAL RAT TLV 50 PPM
PEL 500 PPM

EMERGENCY AND FIRST AID PROCEDURES

EYES

FLUSH EYES WITH WATER FOR 15 MINUTES.

SKIN

PROMPTLY WASH SKIN WITH MILD SOAP AND LARGE VOLUMES OF WATER.
REMOVE CONTAMINATED CLOTHING.

INHALATION

IMMEDIATELY MOVE TO FRESH AIR.
GIVE OXYGEN IF BREATHING IS LABORED
IF BREATHING STOPS, GIVE ARTIFICIAL RESPIRATION
CONTACT A PHYSICIAN.
NEVER ADMINISTER ADRENALIN FOLLOWING CH_2Cl_2 EXPOSURE.
INCREASED SENSITIVITY OF THE HEART TO ADRENALIN MAY BE CAUSED BY OVEREXPOSURE TO CH_2Cl_2.

INGESTION

NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON
NEVER TRY TO MAKE AN UNCONSCIOUS PERSON VOMIT
DO NOT INDUCE VOMITING.
IMMEDIATELY CONTACT A PHYSICIAN.

EFFECTS OF OVEREXPOSURE

MAY BE FATAL IF INHALED
HARMFUL IF SWALLOWED
CONTAINS MATERIAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.
LACHRIMATION
IRRITATES SKIN
DERMATITIS
HEADACHE
DIZZINESS
NARCOSIS
LIVER DAMAGE
KIDNEY DAMAGE
SEVERAL CHRONIC INHALATION STUDIES REPORTED BY NIOSH REVEALED THAT TEST ANIMALS EXPOSED TO METHYLENE CHLORIDE CONCENTRATIONS AS HIGH AS 10,000PPM SHOWED SLIGHT LIVER & KIDNEY CHANGES. METHYLENE CHLORIDE HAS BEEN SHOWN TO INCREASE THE RATE OF SPONTANEOUSLY OCCURING MALIGNANT

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO I486650
BENZO(A)PYRENE

SECTION V - HEALTH HAZARD DATA

* CONTINUED *

TUMORS IN ONE STRAIN OF LABORATORY MICE & BENIGN TUMORS IN LABORATORY RATS. OTHER ANIMAL STUDIES, AS WELL AS SEVERAL HUMAN EPIDEMIOLOGY STUDIES, HAVE INDICATED A NEGATIVE RESPONSE. METHYLENE CHLORIDE IS NOT BELIEVED TO POSE A CARCINOGENIC RISK TO MAN WHEN HANDLED AS RECOMMENDED. METHYLENE CHLORIDE IS LISTED IN GROUP 2B BY IARC & NOT LISTED BY NTP OR OSHA.

CH2CL2 IS METABOLIZED TO CO AND CAN STRESS THE CARDIOVASCULAR SYSTEM DUE TO INCREASED CARBOXYHEMOGLOBIN.

IN RATS METHYLENE CHLORIDE HAS BEEN SHOWN TO PRODUCE A SIGNIFICANT INCREASE IN SALIVARY GLAND TUMORS.

SECTION VI - REACTIVITY DATA

STABILITY STABLE.

CONDITIONS TO AVOID

N/A

INCOMPATIBILITY

STRONG BASES
OXIDIZING AGENTS

HAZARDOUS DECOMPOSITION PRODUCTS

HYDROGEN CHLORIDE, PHOSGENE.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

CONDITIONS TO AVOID

LIQUID OXYGEN OR OTHER STRONG OXIDANTS MAY FORM EXPLOSIVE MIXTURES WITH METHYLENE CHLORIDE.

THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE GAS AND TRACES OF PHOSGENE.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

TAKE UP WITH ABSORBENT MATERIAL.

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO I486650
BENZO(A)PYRENE

SECTION VII - SPILL OR LEAK PROCEDURES

* CONTINUED *
VENTILATE AREA.
METHYLENE CHLORIDE VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.

WASTE DISPOSAL METHOD

COMPLY WITH ALL APPLICABLE FEDERAL, STATE, OR LOCAL REGULATIONS

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFIC TYPE)

WEAR FACE MASK WITH ORGANIC VAPOR CANISTER.
WEAR NIOSH/OSHA APPROVED RESPIRATORY PROTECTION.

PROTECTIVE GLOVES

WEAR NEOPRENE GLOVES.

EYE PROTECTION

WEAR PROTECTIVE GLASSES.

VENTILATION

USE ONLY IN WELL VENTILATED AREA.

SPECIAL

N/A

OTHER PROTECTIVE EQUIPMENT

N/A

SECTION IX - SPECIAL PRECAUTIONS

STORAGE AND HANDLING

STORE IN SEALED CONTAINER IN COOL, DRY LOCATION.

OTHER PRECAUTIONS

POSSIBLE CANCER HAZARD.

CATALOG NO 48755-U   (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO I486650
BENZO(A)PYRENE

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LAST REVISED 1/01/99

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 48599
NAME: 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN 1X1ML TOL 10UG/ML

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #:NONE

HAZARDOUS INGREDIENTS

CONTAINS TOLUENE, CHEMICAL ABSTRACTS REGISTRY NUMBER 108-88-3.

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS

FLAMMABLE (USA)
HIGHLY FLAMMABLE (EU)
TOXIC
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
CALIF. PROP. 65 REPRODUCTIVE HAZARD.
CAUSES SEVERE IRRITATION.
TARGET ORGAN(S):
LIVER
KIDNEYS
BRAIN
BLADDER
KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
STORE UNDER NITROGEN.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -

IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN IMMEDIATELY.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.
IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

SECTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
WATER MAY BE EFFECTIVE FOR COOLING, BUT MAY NOT EFFECT EXTINGUISHMENT.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.
FLAMMABLE LIQUID.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSED CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
USE NONSPARKING TOOLS.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
WASH THOROUGHLY AFTER HANDLING.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
SELF-CONTAINED BREATHING APPARATUS SHOULD BE WORN.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
CHEMICAL SAFETY GOGGLES.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

PHYSICAL PROPERTIES

BOILING POINT: 110.6 - 111 C
MELTING POINT: -93 C
FLASHPOINT 40 F
4 C
EXPLOSION LIMITS IN AIR:

UPPER	7 %
LOWER	1 %

VAPOR PRESSURE: 26 MMHG
SPECIFIC GRAVITY: 0.865
VAPOR DENSITY: 3.2 G/L

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

STABILITY
STABLE.
INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE
HAZARDOUS POLYMERIZATION
WILL NOT OCCUR.

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
CAUSES SEVERE SKIN IRRITATION.
TOXIC IF ABSORBED THROUGH SKIN.
CAUSES SEVERE EYE IRRITATION.
TOXIC IF INHALED.
HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO THE TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TOXIC IF SWALLOWED.
EXPOSURE CAN CAUSE:
LUNG IRRITATION, CHEST PAIN AND EDEMA WHICH MAY BE FATAL.
MAY CAUSE NERVOUS SYSTEM DISTURBANCES.
INHALATION STUDIES ON TOLUENE HAVE DEMONSTRATED THE DEVELOPMENT OF INFLAMMATORY AND ULCEROUS LESIONS OF THE PENIS, PREPUCE AND SCROTUM IN ANIMALS.
CHRONIC EFFECTS
TARGET ORGAN(S):
BRAIN
LIVER
KIDNEYS
BLADDER

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT SUPELCO, INC. FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

EUROPEAN INFORMATION
CAUTION: SUBSTANCE NOT YET FULLY TESTED.
HIGHLY FLAMMABLE
TOXIC
R 11
HIGHLY FLAMMABLE.
R 23/24/25
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
S 16
KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
S 26
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
S 36/37/39
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
U.S. INFORMATION
CALIFORNIA PROPOSITION 65:
THIS PRODUCT IS OR CONTAINS CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE DEVELOPMENTAL TOXICITY.

SECTION 16. - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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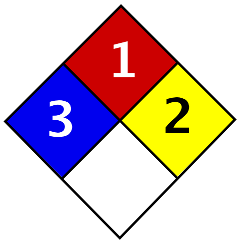

Health	3
Fire	1
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Arsenic MSDS

Section 1: Chemical Product and Company Identification

Product Name: Arsenic

Catalog Codes: SLA1006

CAS#: 7440-38-2

RTECS: CG0525000

TSCA: TSCA 8(b) inventory: Arsenic

CI#: Not applicable.

Synonym:

Chemical Name: Arsenic

Chemical Formula: As

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Arsenic	7440-38-2	100

Toxicological Data on Ingredients: Arsenic: ORAL (LD50): Acute: 763 mg/kg [Rat]. 145 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, the nervous system, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat, of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits highly toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 from ACGIH (TLV) [United States] [1995]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 74.92 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: Sublimation temperature: 615°C (1139°F)

Critical Temperature: Not available.

Specific Gravity: 5.72 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 145 mg/kg [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
Causes damage to the following organs: kidneys, lungs, the nervous system, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Arsenic UNNA: UN1558 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Arsenic
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic
Pennsylvania RTK: Arsenic
Massachusetts RTK: Arsenic
TSCA 8(b) inventory: Arsenic

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R22- Harmful if swallowed.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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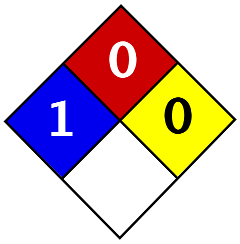

Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Lead MSDS

Section 1: Chemical Product and Company Identification

Product Name: Lead

Catalog Codes: SLL1291, SLL1669, SLL1081, SLL1459, SLL1834

CAS#: 7439-92-1

RTECS: OF7525000

TSCA: TSCA 8(b) inventory: Lead

CI#: Not available.

Synonym: Lead Metal, granular; Lead Metal, foil; Lead Metal, sheet; Lead Metal, shot

Chemical Name: Lead

Chemical Formula: Pb

Contact Information:

Sciencelab.com, Inc.
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Houston, Texas 77396

US Sales: **1-800-901-7247**
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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Lead	7439-92-1	100

Toxicological Data on Ingredients: Lead LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (permeator).
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to blood, kidneys, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Non-flammable in presence of open flames and sparks, of shocks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes of lead.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.05 (mg/m3) from ACGIH (TLV) [United States]
TWA: 0.05 (mg/m3) from OSHA (PEL) [United States]
TWA: 0.03 (mg/m3) from NIOSH [United States]
TWA: 0.05 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 207.21 g/mole

Color: Bluish-white. Silvery. Gray

pH (1% soln/water): Not applicable.

Boiling Point: 1740°C (3164°F)

Melting Point: 327.43°C (621.4°F)

Critical Temperature: Not available.

Specific Gravity: 11.3 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, excess heat

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials.
Incompatible with sodium carbide, chlorine trifluoride, trioxane + hydrogen peroxide, ammonium nitrate, sodium azide, disodium acetylide, sodium acetylide, hot concentrated nitric acid, hot concentrated hydrochloric acid, hot concentrated sulfuric acid, zirconium.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC.
May cause damage to the following organs: blood, kidneys, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential:
Skin:
Lead metal granules or dust: May cause skin irritation by mechanical action.
Lead metal foil, shot or sheets: Not likely to cause skin irritation
Eyes:
Lead metal granules or dust: Can irritate eyes by mechanical action.

Lead metal foil, shot or sheets: No hazard. Will not cause eye irritation.
Inhalation:
In an industrial setting, exposure to lead mainly occurs from inhalation of dust or fumes.
Lead dust or fumes: Can irritate the upper respiratory tract (nose, throat) as well as the bronchi and lungsby mechanical action. Lead dust can be absorbed through the respiratory system. However, inhaled lead does not accumulate in the lungs. All of an inhaled dose is eventually abssorbed or transferred to the gastrointestinal tract. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include metallic taste, chest pain, decreased physical fitness, fatigue, sleep disturbance, headache, irritability, reduces memory, mood and personality changes, aching bones and muscles, constipation, abdominal pains, decreasing appetite. Inhalation of large amounts may lead to ataxia, deliriuim, convulsions/seizures, coma, and death.
Lead metal foil, shot, or sheets: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count.
Ingestion:
Lead metal granules or dust: The symptoms of lead poisoning include abdominal pain or cramps (lead cholic), spasms, nausea, vomiting, headache, muscle weakness, hallucinations, distorted perceptions, "lead line" on the gums, metallic taste, loss of appetite, insomnia, dizziness and other symptoms similar to that of inhalation. Acute poisoning may result in high lead levels in the blood and urine, shock, coma and death in extreme cases.
Lead metal foil, shot or sheets: Not an ingestion hazard for usual industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Lead
California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Lead
California prop. 65: This product contains the following ingredients for which the State of California has found to

cause reproductive harm (male) which would require a warning under the statute: Lead
California prop. 65 (no significant risk level): Lead: 0.0005 mg/day (value)
California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Lead
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Lead
Connecticut hazardous material survey.: Lead
Illinois toxic substances disclosure to employee act: Lead
Illinois chemical safety act: Lead
New York release reporting list: Lead
Rhode Island RTK hazardous substances: Lead
Pennsylvania RTK: Lead

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R20/22- Harmful by inhalation and if swallowed.
R33- Danger of cumulative effects.
R61- May cause harm to the unborn child.
R62- Possible risk of impaired fertility.
S36/37- Wear suitable protective clothing and gloves.
S44- If you feel unwell, seek medical advice (show the label when possible).
S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types) **MSDS No. 9909**

EMERGENCY OVERVIEW

CAUTION!

OSHA/NFPA COMBUSTIBLE LIQUID - SLIGHT TO MODERATE IRRITANT

EFFECTS CENTRAL NERVOUS SYSTEM

HARMFUL OR FATAL IF SWALLOWED

Moderate fire hazard. Avoid breathing vapors or mists. May cause dizziness and drowsiness. May cause moderate eye irritation and skin irritation (rash). Long-term, repeated exposure may cause skin cancer.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

NFPA 704 (Section 16)

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800) 424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732) 750-6000
MSDS INTERNET WEBSITE:	www.hess.com (See Environment, Health, Safety & Social Responsibility)

SYNONYMS: Ultra Low Sulfur Diesel (ULSD); Low Sulfur Diesel; Motor Vehicle Diesel Fuel; Diesel Fuel #2; Dyed Diesel Fuel; Non-Road, Locomotive and Marine Diesel Fuel; Tax-exempt Diesel Fuel

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Diesel Fuel (68476-34-6)	100
Naphthalene (91-20-3)	Typically < 0.01

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher. Diesel fuel may be dyed (red) for tax purposes. May contain a multifunctional additive.

3. HAZARDS IDENTIFICATION

EYES

Contact with liquid or vapor may cause mild irritation.

SKIN

May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	> 125 ^{o}F (> 52 ^{o}C) minimum PMCC
AUTOIGNITION POINT:	494 ^{o}F (257 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS:	2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%):	0.6
UPPER EXPLOSIVE LIMIT (%):	7.5

FIRE AND EXPLOSION HAZARDS
Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA
SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY'S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Diesel fuel, and in particular low and ultra low sulfur diesel fuel, has the capability of accumulating a static electrical charge of sufficient energy to cause a fire/explosion in the presence of lower flashpoint products such as gasoline. The accumulation of such a static charge occurs as the diesel flows through pipelines, filters, nozzles and various work tasks such as tank/container filling, splash loading, tank cleaning; product sampling; tank gauging; cleaning, mixing, vacuum truck operations, switch loading, and product agitation. There is a greater potential for static charge accumulation in cold temperature, low humidity conditions.

Documents such as 29 CFR OSHA 1910.106 "Flammable and Combustible Liquids, NFPA 77 Recommended Practice on Static Electricity, API 2003 "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents and ASTM D4865 "Standard Guide for Generation and Dissipation of Static

Electricity in Petroleum Fuel Systems" address special precautions and design requirements involving loading rates, grounding, bonding, filter installation, conductivity additives and especially the hazards associated with "switch loading." ["Switch Loading" is when a higher flash point product (such as diesel) is loaded into tanks previously containing a low flash point product (such as gasoline) and the electrical charge generated during loading of the diesel results in a static ignition of the vapor from the previous cargo (gasoline).]

Note: When conductivity additives are used or are necessary the product should achieve 25 picosiemens/meter or greater at the handling temperature.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

Components (CAS No.)	Source	Exposure Limits TWA/STEL	Note
Diesel Fuel: (68476-34-6)	OSHA	5 mg/m, as mineral oil mist	
	ACGIH	100 mg/m^3 (as totally hydrocarbon vapor) TWA	A3, skin
Naphthalene (91-20-3)	OSHA	10 ppm TWA	
	ACGIH	10 ppm TWA / 15 ppm STEL	A4, Skin

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile, neoprene, or PVC are recommended. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE

Clear, straw-yellow liquid. Dyed fuel oil will be red or reddish-colored.

ODOR

Mild, petroleum distillate odor

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	320 to 690 oF (160 to 366 ^{o}C)
VAPOR PRESSURE:	0.009 psia @ 70 ^{o}F (21 ^{o}C)
VAPOR DENSITY (air = 1):	> 1.0
SPECIFIC GRAVITY (H_2O = 1):	0.83 to 0.88 @ 60 ^{o}F (16 ^{o}C)
PERCENT VOLATILES:	100 %
EVAPORATION RATE:	Slow; varies with conditions
SOLUBILITY (H_2O):	Negligible

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers; Viton ®; Fluorel ®

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY

Acute dermal LD50 (rabbits): > 5 ml/kg
Primary dermal irritation: extremely irritating (rabbits)
Guinea pig sensitization: negative
Acute oral LD50 (rats): 9 ml/kg
Draize eye irritation: non-irritating (rabbits)

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenic: OSHA: NO IARC: NO NTP: NO ACGIH: A3

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

MUTAGENICITY (genetic effects)

This material has been positive in a mutagenicity study.

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Diesel Fuel
HAZARD CLASS and PACKING GROUP:	3, PG III
DOT IDENTIFICATION NUMBER:	NA 1993 (Domestic) UN 1202 (International)
DOT SHIPPING LABEL:	None

Placard (International Only):

Use Combustible Placard if shipping in bulk domestically

15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the *de minimis* levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

CALIFORNIA PROPOSITON 65 LIST OF CHEMICALS

This product contains the following chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986:

INGREDIENT NAME (CAS NUMBER)	**Date Listed**
Diesel Engine Exhaust (no CAS Number listed)	10/01/1990

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 3 (Combustible Liquid) and Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION

NFPA® HAZARD RATING		
	HEALTH:	0
	FIRE:	2
	REACTIVITY:	0

Refer to NFPA 704 “Identification of the Fire Hazards of Materials” for further information

HMIS® HAZARD RATING			
	HEALTH:	1 *	* Chronic
	FIRE:	2	
	PHYSICAL:	0	

SUPERSEDES MSDS DATED: 02/28/2001

ABBREVIATIONS:

AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212) 642-4900
API	American Petroleum Institute (202) 682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Canadian Workplace Hazardous Materials Information System

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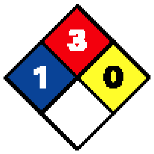
Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD



NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732)750-6000
MSDS Internet Website	www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 “Low Expansion Foam - 1994 Edition.”

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******

******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	**TWA (ppm)**	**STEL (ppm)**	**Note**
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O):	Non-oxygenated gasoline - negligible (< 0.1% @ 77 ^{o}F). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^{o}F); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg	Acute Oral LD50 (rat): 18.75 ml/kg
Primary dermal irritation (rabbits): slightly irritating	Draize eye irritation (rabbits): non-irritating
Guinea pig sensitization: negative	

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

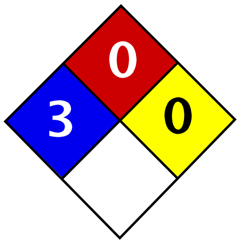
ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.



Health	3
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Pentachlorophenol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Pentachlorophenol

Catalog Codes: SLP3943, SLP1126

CAS#: 87-86-5

RTECS: SM6300000

TSCA: TSCA 8(b) inventory: Pentachlorophenol

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C_6Cl_5OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Pentachlorophenol	87-86-5	100

Toxicological Data on Ingredients: Pentachlorophenol: ORAL (LD50): Acute: 27 mg/kg [Rat]. 117 mg/kg [Mouse]. VAPOR (LC50): Acute: 502 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation. Slightly hazardous in case of skin contact (corrosive, sensitizer). Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, lungs, the nervous system, liver, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human

organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Do not ingest. Do not breathe dust. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 (mg/m3) from ACGIH
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Pungent. (Strong.)

Taste: Not available.

Molecular Weight: 266.34 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: Decomposes. (310°C or 590°F)

Melting Point: 188°C (370.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.987 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 9.2 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 27 mg/kg [Rat].
Acute toxicity of the vapor (LC50): 502 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion.
Hazardous in case of skin contact (permeator), of inhalation.
Slightly hazardous in case of skin contact (corrosive, sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Chlorophenol, solid : UN2020 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Pentachlorophenol
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Pentachlorophenol
Pennsylvania RTK: Pentachlorophenol
Massachusetts RTK: Pentachlorophenol
TSCA 8(b) inventory: Pentachlorophenol
SARA 313 toxic chemical notification and release reporting: Pentachlorophenol

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R48/20- Harmful: danger of serious damage to health by prolonged exposure through inhalation.
R48/25- Toxic: danger of serious damage to health in case of prolonged exposure if swallowed.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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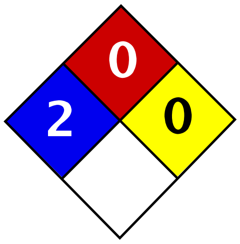

Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C_2-Cl_4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States]
TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States]
TWA: 170 (mg/m3) from OSHA (PEL) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane.
It dissolves in most of the fixed and volatile oils.
Solubility in water: 0.015 g/100 ml @ 25 deg. C
It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents.
Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium.
Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 2629 mg/kg [Rat].
Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract,

skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation.
Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc:
LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg
LDL [Dog] - Route: Oral; Dose: 4000 mg/kg
LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic).
May affect genetic material (mutagenic).
May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts.
Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain.
Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema
Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation.
Chronic Potential Health Effects:
Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation.
Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene
Connecticut hazardous material survey.: Tetrachloroethylene
Illinois toxic substances disclosure to employee act: Tetrachloroethylene
Illinois chemical safety act: Tetrachloroethylene
New York release reporting list: Tetrachloroethylene
Rhode Island RTK hazardous substances: Tetrachloroethylene
Pennsylvania RTK: Tetrachloroethylene
Minnesota: Tetrachloroethylene
Michigan critical material: Tetrachloroethylene
Massachusetts RTK: Tetrachloroethylene
Massachusetts spill list: Tetrachloroethylene
New Jersey: Tetrachloroethylene
New Jersey spill list: Tetrachloroethylene
Louisiana spill reporting: Tetrachloroethylene
California Director's List of Hazardous Substances: Tetrachloroethylene
TSCA 8(b) inventory: Tetrachloroethylene
TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97
SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene
CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S23- Do not breathe gas/fumes/vapour/spray
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S37- Wear suitable gloves.
S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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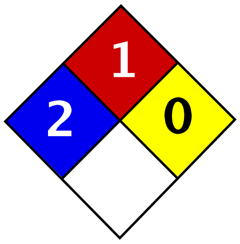

Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the

product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV)
TWA: 269 STEL: 1070 (mg/m3) from ACGIH
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone.
Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum.
Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse].
Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH.
The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene
Pennsylvania RTK: Trichloroethylene
Florida: Trichloroethylene
Minnesota: Trichloroethylene
Massachusetts RTK: Trichloroethylene
New Jersey: Trichloroethylene
TSCA 8(b) inventory: Trichloroethylene
CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:54 PM

Last Updated: 11/06/2008 12:00 PM

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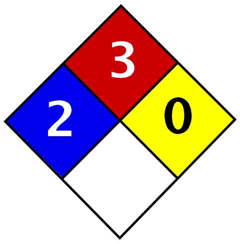

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,2-Dichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,2-Dichloroethane

Catalog Codes: SLD2521, SLD3721

CAS#: 107-06-2

RTECS: KH9800000

TSCA: TSCA 8(b) inventory: 1,2-Dichloroethane

CI#: Not available.

Synonym: Ethylene dichloride

Chemical Formula: C2H4CL2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,2-}Dichloroethane	107-06-2	100

Toxicological Data on Ingredients: 1,2-Dichloroethane: ORAL (LD50): Acute: 670 mg/kg [Rat]. 413 mg/kg [Mouse]. DERMAL (LD50): Acute: 2800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 1414.2 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of ingestion. Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant). Corrosive to skin and eyes on contact. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
Very hazardous in case of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. Classified 2 (Reasonably anticipated.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.

The substance is toxic to lungs, the nervous system, liver, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 413°C (775.4°F)

Flash Points: CLOSED CUP: 13°C (55.4°F). OPEN CUP: 18°C (64.4°F).

Flammable Limits: LOWER: 6.2% UPPER: 15.6%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks.
Slightly flammable to flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive to explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Corrosive liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 CEIL: 75 (ppm) from ACGIH (TLV)
TWA: 40 CEIL: 300 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 98.96 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 83.5°C (182.3°F)

Melting Point: -35.3°C (-31.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.2351 (Water = 1)

Vapor Pressure: 61 mm of Hg (@ 20°C)

Vapor Density: 3.42 (Air = 1)

Volatility: Not available.

Odor Threshold: 26 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, n-octanol, acetone.
Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 413 mg/kg [Mouse].
Acute dermal toxicity (LD50): 2800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 1414.2 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC.
Classified 2 (Reasonably anticipated.) by NTP.
The substance is toxic to lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Extremely hazardous in case of ingestion.
Very hazardous in case of inhalation.
Hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in animal. Excreted in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Ethylene dichloride : UN1184 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: 1,2-Dichloroethane
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,2-Dichloroethane
Pennsylvania RTK: 1,2-Dichloroethane

Massachusetts RTK: 1,2-Dichloroethane
TSCA 8(b) inventory: 1,2-Dichloroethane
CERCLA: Hazardous substances.: 1,2-Dichloroethane

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R11- Highly flammable.
R20/22- Harmful by inhalation and if swallowed.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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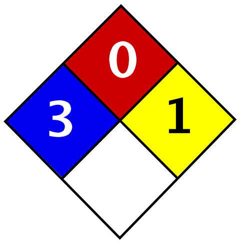

Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].
MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible.
Calcium carbide reacts with hydrogen chloride gas with incandescence.
Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine.
Rubidium acetylene carbides burns with slightly warm hydrochloric acid.
Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved.
Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas.
Cesium acetylene carbide burns hydrogen chloride gas.
Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute.
Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:
Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate.
Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture.
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States]
CEIL: 7 (mg/m3) from OSHA (PEL) [United States]
CEIL: 5 from NIOSH
CEIL: 7 (mg/m3) from NIOSH
TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)]
TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water)
83 C @ 760 mm Hg (for 31% HCl in water)
50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water)
-46.2 C (31.24% HCl in water)
-25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1)
1.10 (20%and 22% HCl solutions)
1.12 (24% HCl solution)
1.15 (29.57% HCl solution)
1.16 (32% HCl solution)
1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals.
Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316).
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product.
Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C.
Sodium reacts very violently with gaseous hydrogen chloride.
Calcium phosphide and hydrochloric acid undergo very energetic reaction.
It reacts with oxidizers releasing chlorine gas.
Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates.
Reacts with most metals to produce flammable Hydrogen gas.
Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure)
Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid.
Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction.
Hydrogen chloride causes aldehydes and epoxides to violently polymerize.
Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:
Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions).
It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys.
No corrosivity data on zinc, steel.
Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse].
Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].
May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin,

eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, .
Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL)
LDL [Man] -Route: Oral; 2857 ug/kg
LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M
LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity).
May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Corrosive. Causes severe skin irritation and burns.
Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis.
Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure,
occur, particularly if exposure is prolonged. May affect the liver.
Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis).
Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel.
Chronic Potential Health Effects:
dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental
control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid
Illinois toxic substances disclosure to employee act: Hydrochloric acid
Illinois chemical safety act: Hydrochloric acid
New York release reporting list: Hydrochloric acid
Rhode Island RTK hazardous substances: Hydrochloric acid
Pennsylvania RTK: Hydrochloric acid
Minnesota: Hydrochloric acid
Massachusetts RTK: Hydrochloric acid
Massachusetts spill list: Hydrochloric acid
New Jersey: Hydrochloric acid
New Jersey spill list: Hydrochloric acid
Louisiana RTK reporting list: Hydrochloric acid
Louisiana spill reporting: Hydrochloric acid
California Director's List of Hazardous Substances: Hydrochloric acid
TSCA 8(b) inventory: Hydrochloric acid
TSCA 4(a) proposed test rules: Hydrochloric acid
SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid
SARA 313 toxic chemical notification and release reporting: Hydrochloric acid
CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns.
R37- Irritating to respiratory system.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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Last Updated: 09/14/2009 10:34 AM

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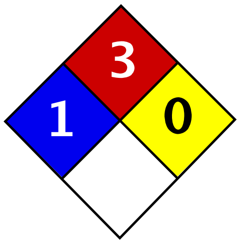

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Methyl alcohol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Methyl alcohol

Catalog Codes: SLM3064, SLM3952

CAS#: 67-56-1

RTECS: PC1400000

TSCA: TSCA 8(b) inventory: Methyl alcohol

CI#: Not applicable.

Synonym: Wood alcohol, Methanol; Methylol; Wood Spirit; Carbinol

Chemical Name: Methanol

Chemical Formula: CH3OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Methyl alcohol	67-56-1	100

Toxicological Data on Ingredients: Methyl alcohol: ORAL (LD50): Acute: 5628 mg/kg [Rat]. DERMAL (LD50): Acute: 15800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 64000 ppm 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Classified POSSIBLE for human.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to eyes.
The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve.

Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 12°C (53.6°F). OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 6% UPPER: 36.5%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.

LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition, it emits acrid smoke and irritating fumes. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME

Special Remarks on Explosion Hazards:
Forms an explosive mixture with air due to its low flash point.
Explosive when mixed with Choroform + sodium methoxide and diethyl zinc. It boils violently and explodes.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Poisonous liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 from OSHA (PEL) [United States]
TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) [United States] [1999]
STEL: 250 from NIOSH [United States]

TWA: 200 STEL: 250 (ppm) from NIOSH SKIN
TWA: 200 STEL: 250 (ppm) [Canada]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Alcohol like. Pungent when crude.

Taste: Not available.

Molecular Weight: 32.04 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 64.5°C (148.1°F)

Melting Point: -97.8°C (-144°F)

Critical Temperature: 240°C (464°F)

Specific Gravity: 0.7915 (Water = 1)

Vapor Pressure: 12.3 kPa (@ 20°C)

Vapor Density: 1.11 (Air = 1)

Volatility: Not available.

Odor Threshold: 100 ppm

Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.8

Ionicity (in Water): Non-ionic.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizers. Violent reaction with alkyl aluminum salts, acetyl bromide, chloroform + sodium methoxide, chromic anhydride, cyanuirc chlorite, lead perchlorate, phosphorous trioxide, nitric acid.
Exothermic reaction with sodium hydroxide + chloroform.
Incompatible with beryllium dihydride, metals (potassium and magnesium), oxidants (barium perchlorate, bromine, sodium hypochlorite, chlorine, hydrogen peroxide), potassium tert-butoxide, carbon tetrachloride, alkali metals,

metals (aluminum, potassium magnesium, zinc), and dichlormethane.
Rapid autocatalytic dissolution of aluminum, magnesium or zinc in 9:1 methanol + carbon tetrachloride - sufficiently vigorous to be rated as potentially hazardous.
May attack some plastics, rubber, and coatings.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 5628 mg/kg [Rat].
Acute dermal toxicity (LD50): 15800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 64000 4 hours [Rat].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Classified POSSIBLE for human.
Causes damage to the following organs: eyes.
May cause damage to the following organs: blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Passes through the placental barrier.
May affect genetic material.
May cause birth defects and adverse reproductive effects(paternal and maternal effects and fetotoxicity) based on animal studies.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 29400 mg/l 96 hours [Fathead Minnow].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation:
Methanol in water is rapidly biodegraded and volatilized. Aquatic hydrolysis, oxidation, photolysis, adsorption to sediment, and bioconcentration are not significant fate processes. The half-life of methanol in surfact water ranges from 24 hrs. to 168 hrs.
Based on its vapor pressure, methanol exists almost entirely in the vapor phase in the ambient atmosphere. It is degraded by reaction with photochemically produced hydroxyl radicals and has an estimated half-life of 17.8 days. Methanol is physically removed from air by rain due to its solubility. Methanol can react with NO2 in pollulted to

form methyl nitrate.
The half-life of methanol in air ranges from 71 hrs. (3 days) to 713 hrs. (29.7 days) based on photooxidation half-life in air.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Methyl alcohol UNNA: 1230 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Methyl alcohol
Illinois toxic substances disclosure to employee act: Methyl alcohol
Illinois chemical safety act: Methyl alcohol
New York release reporting list: Methyl alcohol
Rhode Island RTK hazardous substances: Methyl alcohol
Pennsylvania RTK: Methyl alcohol
Minnesota: Methyl alcohol
Massachusetts RTK: Methyl alcohol
Massachusetts spill list: Methyl alcohol
New Jersey: Methyl alcohol
New Jersey spill list: Methyl alcohol
Louisiana spill reporting: Methyl alcohol
California Directors List of Hazardous Substances (8CCR 339): Methyl alcohol
Tennesse Hazardous Right to Know : Methyl alcohol
TSCA 8(b) inventory: Methyl alcohol
SARA 313 toxic chemical notification and release reporting: Methyl alcohol
CERCLA: Hazardous substances.: Methyl alcohol: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
Class D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable.
R23/24/25- Toxic by inhalation, in contact with skin and if swallowed.
R39- Danger of very serious irreversible effects. R39/23/24/25- Toxic: danger of very serious

irreversible effects through inhalation,
in contact with skin and if swallowed.
S7- Keep container tightly closed.
S16- Keep away from sources of ignition - No smoking.
S36/37- Wear suitable protective clothing and gloves.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
LOLI, HSDB, RTECS, HAZARDTEXT, REPROTOX databases

Other Special Considerations: Not available.

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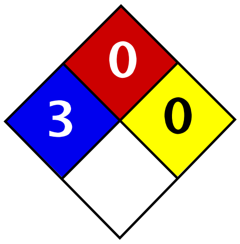

Health	3
Fire	0
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Sodium bisulfate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium bisulfate

Catalog Codes: SLS2104, SLS4258

CAS#: 7681-38-1

RTECS: VZ1860000

TSCA: TSCA 8(b) inventory: Sodium bisulfate

CI#: Not available.

Synonym: GBS; Nitre cake; Sodium acid sulfate; Sodium pyrosulfate; Sodium hydrogen sulfate; Sulfuric acid, monosodium salt.

Chemical Name: Sodium Bisulfate

Chemical Formula: NaHSO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium bisulfate	7681-38-1	100

Toxicological Data on Ingredients: Sodium bisulfate: ORAL (LD50): Acute: 2800 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator). The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Granular solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 120.6 g/mole

Color: Off-white.

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: 157.22°C (315°F)

Critical Temperature: Not available.

Specific Gravity: 2.435 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Easily soluble in hot water.
Soluble in cold water.
Soluble in 2 parts cold water.
Soluble in 1 part boiling water.
Decomposed by alcohol into sodium sulfate and free H_2SO_4.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, moisture

Incompatibility with various substances: Reactive with oxidizing agents, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Do not mix with liquid chlorine bleach (hypochlorites), ammonia cleansers or similar products, or alcohols.
Hygroscopic; keep container tightly closed.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 2800 mg/kg [Rat].

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Hazardous in case of skin contact (corrosive, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:

Skin: Can cause severe skin irritation or burns.
Eyes: Can cause severe irritation or burns of the eyes.
Inhalation: It is destructive to the mucous membranes of the upper respiratory tract. Causes irritation and chemical burns to the respiratory tract with burning pain in the nose and throat, coughing , wheezing, shortness of breath, and pulmonary edema. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema.
Ingestion: Causes gastrointestinal tract irritation and burns. Symptoms may include nausea and vomiting. May cause severe and permanent damage to the digestive tract.
Chronic Potential Health Effects:
Repeated exposure may cause erosion of teeth, lung irritation, bronchitis, persistant coughing,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Corrosive Solid, n.o.s.(Sodium Bisulfate) UNNA: 1759 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Sodium bisulfate
New Jersey: Sodium bisulfate
TSCA 8(b) inventory: Sodium bisulfate

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):
R34- Causes burns.
R41- Risk of serious damage to eyes.

S24/25- Avoid contact with skin and eyes.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/37/39- Wear suitable protective clothing, gloves and eye/face protection.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Synthetic apron.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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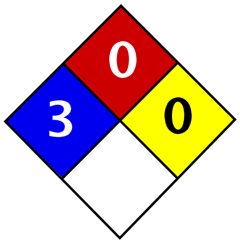

Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Nitric Acid, 1.0N MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric Acid, 1.0N

Catalog Codes: SLN1744

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Nitric acid, fuming

CI#: Not applicable.

Synonym: Nitric Acid solution, 1 N

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	93.7
Nitric acid, fuming	7697-37-2	6.3

Toxicological Data on Ingredients: Nitric acid, fuming LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to lungs, mucous membranes, upper respiratory tract, eyes, teeth.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Slightly explosive in presence of reducing materials, of organic materials, of metals, of alkalis.
Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Reacts exlposively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine.
Can react explosively with many reducing agents.
Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid.
Cesium and rubidium acetylides explode in contact with nitric acid.
Explosive reaction with Nitric Acid + Nitrobenzene + water.
Detonation with Nitric Acid + 4-Methylcyclohexane.
(Nitric acid, fuming)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Oxidizing material.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as alkalis.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Nitric acid, fuming
TWA: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States] [1999]
TWA: 2 STEL: 4 (ppm) [Australia]
TWA: 2 STEL: 4 from NIOSH
TWA: 5 STEL: 10 (mg/m3) from NIOSH
TWA: 2 STEL: 4 (ppm) from OSHA (PEL) [United States]

TWA: 5 STEL: 10 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: Not applicable.

Color: Not available.

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 83°C (181.4°F) (Nitric acid, fuming). Weighted average: 99.23°C (210.6°F)

Melting Point: May start to solidify at -41.6°C (-42.9°F) based on data for: Nitric acid, fuming.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.02 (Water = 1)

Vapor Pressure: The highest known value is 6.4 kPa (@ 20°C) (Nitric acid, fuming). Weighted average: 2.49 kPa (@ 20°C)

Vapor Density: The highest known value is 2.3 (Air = 1) (Nitric acid, fuming). Weighted average: 0.7 (Air = 1)

Volatility: Not available.

Odor Threshold: The highest known value is 0.29 ppm (Nitric acid, fuming)

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in cold water, hot water.
Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances:
Reactive with alkalis.
Slightly reactive to reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of copper.
Non-corrosive in presence of glass, of aluminum, of stainless steel(304), of stainless steel(316).

Special Remarks on Reactivity:
A strong oxidizer.

Reacts violently with alcohol, organic material, turpene, charcoal.
Violent reaction with Nitric acid + Acetone and Sulfuric acid.
Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors.
(Nitric acid, fuming)

Special Remarks on Corrosivity:
Severe corrosive effect on brass.
No corrosive effect on bronze.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, .
Hazardous in case of skin contact (corrosive), of eye contact (corrosive).
Slightly hazardous in case of inhalation (lung sensitizer, lung corrosive, skin permeator).

Special Remarks on Toxicity to Animals: LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (effects on newborn and fetotoxicity) based on animal data. (Nitric acid, fuming)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes severe skin irritation with possible burns. It may be absorbed through the skin
Eyes: Severely irritates eyes with possible eye burns.
Ingestion: Harmful if swallowed. Causes serious gastrointestinal tract irritation with possible burns, nausea, vomiting, severe abdominal pain.
Inhalation: May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting.
Chronic Potential Health Effects:
Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contaction or spasticity, weakness, loss of coordinaton, mental confusion), and urinary system (kidney faillure, decreased urinary output after several hours of uncorrected circulatory collapse).
Repeated exposure may cause discoloration and/or errosion of teeth (dental enamel).
Eye irritation and respiratory tract signs and symptoms resembling those of frequent upper respiratory viral infections have been associated with chronic nitric acid exposure.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Nitric Acid UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Nitric acid, fuming
Rhode Island RTK hazardous substances: Nitric acid, fuming
Pennsylvania RTK: Nitric acid, fuming
Florida: Nitric acid, fuming
Minnesota: Nitric acid, fuming
Massachusetts RTK: Nitric acid, fuming
New Jersey: Nitric acid, fuming
TSCA 8(b) inventory: Water; Nitric acid, fuming
SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming
SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming
CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive liquid.

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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