Port of Seattle
Lora Lake Parcel

Remedial Investigation/ Feasibility Study Work Plan

Prepared for

Port of Seattle
Aviation Environmental Programs
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Acronym/ Abbreviation	Definition
1,2-DCA	1,2-Dichloroethane
AECOM	AECOM, Inc.
AO	Agreed Order
ARAR	Applicable, Relevant, and Appropriate Requirement
ARI	Analytical Resources, Inc.
ASTM	American Society of Testing and Materials
BTEX	Benzene, toluene, ethylbenzene, and xylene
cis-1,2-DCE	cis-1,2-Dichloroethene
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CSL	Cleanup Screening Level
CSM	Conceptual Site Model
DCA	Disproportionate cost analysis
EIM	Environmental Information Management
FAA	Federal Aviation Administration
FS	Feasibility Study
HASP	Health and Safety Plan
IDW	Investigation-derived Waste
KCHA	King County Housing Authority
LL	Lora Lake
MS/MSD	Matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act

Acronym/ Abbreviation	**Definition**
Nautilus	Nautilus Environmental
NRMP	National Resources Management Plan
PAH	Polycyclic aromatic hydrocarbon
PCE	Tetrachlorethene
PCP	Pentachlorophenol
Port	Port of Seattle
PQL	Practical quantitation limit
PSEP	Puget Sound Estuary Program
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RAO	Remedial action objective
RI	Remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative percent difference
RSS	Research Support Services, Inc.
SAP	Sampling and Analysis Plan
SIM	Select ion monitoring
Site	Lora Lake Apartments Site
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
SR518	State Route 518
STIA	Seattle-Tacoma International Airport
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE	Trichloroethene
TEE	Terrestrial ecological evaluation
TEF	Toxic equivalency factor
TEQ	Toxic equivalency quotient
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
trans-1,2-DCE	trans-1,2-Dichloroethene
USACE	U.S. Army Corps of Engineers
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

The Lora Lake Apartments Site (LL Apartments Site) is 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, as defined by the Model Toxics Control Act (MTCA) 173-340-200, includes the Lora Lake Apartments property, and areas beyond the property boundary where contamination originating at the Lora Lake Apartments property may have come to be located. This document presents the Draft Remedial Investigation/Feasibility Study (RI/FS) Work Plan for an area referred to as the Lora Lake Parcel (LL Parcel). The Washington State Department of Ecology (WSDOE) and members of the public have expressed concern that contaminants originating at the Lora Lake Apartments property may have come to be located at the LL Parcel. Where there is any conflict between the MTCA definition and this work plan in the use of the term Site, the MTCA definition shall govern.

As described in the Lora Lake Apartments Parcel (LL Apartments Parcel) Work Plan (Floyd|Snider 2010), the Port and WSDOE entered into Agreed Order (AO) No. DE 6703 for the LL Apartments Site 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 MTCA cleanup regulation, Chapter 173-340 WAC (WSDOE 2007).

The objective of the RI/FS for the LL Apartments Site is to complete a comprehensive site-wide evaluation that will support recommendation of a cleanup alternative to meet MTCA criteria and be consistent with the Port's future land-use goals. A series of upland environmental investigations have been conducted by the Port at the LL Apartments Parcel to support historical redevelopment activities and recent environmental data collection efforts as required by the AO. The Port has also conducted interim actions to support demolition of the former apartment building complex structures, and to evaluate the chemical quality of stormwater and sediments that are conveyed through the LL Apartment Parcel's existing stormwater drainage system. To date, only limited environmental investigations have been conducted at the LL Parcel related to the removal of home heating oil tanks between 1998 and 2002.

The Port will complete an investigation at the LL Parcel to determine if contamination associated with the LL Apartments Parcel has come to be located at the LL Parcel, and to determine whether the LL Parcel should be included as part of the LL Apartments Site. Results of this LL Parcel investigation will be, as appropriate, incorporated into the evaluation of applicable remedial technologies and development of remedial alternatives for the Site. Remedial alternatives will be evaluated relative to MTCA criteria in the feasibility study phase of the project and a preferred cleanup alternative for the Site will be identified in the RI/FS Report.

The LL Parcel is the location of a former residential area surrounding a small urban freshwater lake (Lora Lake) that was created as a result of peat mining activities that began sometime between 1936 and 1946 and continued until the mid- to late-1950s. The Port acquired the LL Parcel in the late 1990s as part of planning for construction of the STIA 3rd Runway Project. Construction of the STIA 3rd Runway was completed in 2008. Consistent with agreements with WSDOE and the U.S. Army Corps of Engineers (USACE), the Port constructed a habitat mitigation area, the "Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area," which includes the LL Parcel and other properties located adjacent to STIA. Operation and maintenance requirements for the habitat mitigation area are described in the Natural Resources Management Plan (NRMP; Parametrix 2001). Restrictive covenants and local zoning designations prohibit future development on the LL Parcel to assure permanent use of the property as a protected habitat area, and to recognize the unsuitability of development immediately adjacent to aircraft operations.

The proposed data collection effort for the LL Parcel, as described in this work plan, is anticipated to be completed in spring 2011. The current AO schedule calls for submittal of the final RI/FS Report to WSDOE in early 2012. It is the Port's current intention to integrate the findings of the Lora Lake Parcel investigations into the final Lora Lake Apartments RI/FS. However, the findings of the LL Parcel investigation may trigger additional activity that results in a separate, later submittal of LL Parcel results.

1.2 WORK PLAN PURPOSE AND ORGANIZATION

The purpose of the RI/FS Work Plans for the LL Parcel and the LL Apartments Parcel is to document the scope, technical approach, and implementation details for completing the site RI/FS. The site RI/FS may be documented in a single RI/FS Report, or may be completed as separate RI/FS reports for the two parcels, depending on the schedule and findings of the multiple phases of remedial investigation work proposed for the LL Apartments Parcel and the LL Parcel. The remedial investigation activities described in this document focus on the LL Parcel.

The scope of this work plan was developed to obtain necessary data from the LL Parcel to supplement the LL Apartments Parcel remedial investigation and to complete the RI/FS document that will be prepared under the current Lora Lake Apartments Site AO. However, if results of the proposed investigations at the LL Parcel indicate that other sources (i.e., sources other than the LL Apartments Parcel) of contaminants contribute, or have contributed to environmental conditions of the LL Parcel, then the Port and WSDOE will determine if a separate MTCA regulatory process for the LL Parcel should be established under a multiple responsible party AO.

This RI/FS Work Plan for the LL Parcel complies with MTCA requirements and is organized as follows:

- **Section 2.0—Site Description:** Provides information on the location, historical and current land use, and physical setting of the LL Parcel; including a general description of the origin of Lora Lake.

- **Section 3.0—Regulatory Framework:** Presents the current regulatory framework, AO and MTCA requirements for the Site, and other applicable or relevant and appropriate requirements (ARARs).
- **Section 4.0—Lora Lake Apartments Site 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.
- **Section 5.0—Conceptual Site Model and Contaminants of Concern:** Presents the preliminary Conceptual Site Model (CSM) for the LL Parcel and identifies the contaminants of concern (COCs) and exposure pathways on the property.
- **Section 6.0—Lora Lake Parcel Phase of the Site Remedial Investigation:** Details the approach for collecting soil and sediment data, and surveys at the LL Parcel to support development of the RI/FS for the Site, and references additional project plans including the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP).
- **Section 7.0—Remedial Investigation/Feasibility Study Report 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 for the LL Parcel.
- **Section 8.0—Project Team and Responsibilities:** Identifies the project team members, including the technical consultant, subconsultants, and site owner.
- **Section 9.0—References:** Presents the sources cited in this RI/FS Work Plan.

2.0 Site Description

2.1 LOCATION AND LAND USE HISTORY

2.1.1 Location

The LL Parcel is located in SeaTac, Washington, to the southeast of the LL Apartments Parcel, which is located at 15001 Des Moines Memorial Drive. The LL Parcel occupies approximately 7.1 acres that includes Lora Lake and constructed habitat mitigation area land. It is bounded to the north by the Washington Department of Transportation (WSDOT) State Route 518 (SR518) highway interchange, to the east and south by Port-owned habitat mitigation area land and the northern boundary of STIA, and to the west and northwest by Des Moines Memorial Drive and the LL Apartments Parcel (Figure 2.1). Land use to the north and northwest of the LL Parcel supports access to SR518 and the vacant LL Apartments Parcel, and the remainder of the surrounding property is reserved for habitat mitigation land and airport operations.

The parcel of land located to the north of the LL Parcel, which comprises the SR518 interchange, is owned and maintained by WSDOT as part of the highway interchange system, and the street right-of-way along the southeast side of Des Moines Memorial Drive is owned by the City of SeaTac.

The LL Parcel is located within a secured fence area. The lake is part of a series of habitat mitigation areas developed by the Port in compliance with permit conditions included in the Clean Water Act Section 404 Permit #1996-4-02325 issued by the USACE, associated with construction of the 3rd Runway. The mitigation area is designated in the NRMP as the Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area (Parametrix 2001). The LL Parcel 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 Property Ownership and Land Use

There is little readily available information regarding the LL Parcel history prior to 1936. A 1936 aerial photograph shows the parcel to be primarily composed of farm land, with what appears to be farm buildings along the northwestern boundary of the parcel, adjacent to Des Moines Memorial Drive (refer to historical aerial photos in Appendix A). The existing Des Moines Memorial Drive roadway is present in the 1936 aerial image; however SR518 is not present. Lora Lake is not present in this photograph; the future location of the lake appears to be farm land, bordered by residential homes and landscaping to the north.

The LL Parcel was converted from a farming parcel to peat mining sometime between 1936 and 1946. Lora Lake was created by the peat mining activities conducted by the Hi-Line Leaf Mold Products Company (AECOM 2009b). A 1946 aerial image shows the presence of a small water body (representing the initial formation of Lora Lake) near the northern portion of the parcel, and to the east of the current Des Moines Memorial Drive roadway (Appendix A). The same residential and landscape structure from the 1936 aerial is present in the 1946 image; however all but one of the farm buildings that were located along the roadway have been demolished. The evidence of mining activity is supported by the presence of heavy equipment and scarred landscape surrounding the small water body.

Historical records indicate that the Hi-Line Leaf Mold Products Company conducted peat mining activities at the LL Parcel through the mid-to-late 1950s. Review of publically available land survey information shows that the north end of the lake was platted for future residential development in the mid-to-late 1950s. Additional land platting was conducted along the western end of the lake (adjacent to Des Moines Memorial Drive) in the early 1960s. Residential land development single family home construction activities continued in the northern and western areas of the LL Parcel through the early 1990s as evidenced by the 1980, 1985, and 1992 aerial photographs (Appendix A). Land to the south of the LL Parcel was used primarily as farm land throughout this time period.

Historical records show that Lora Lake was dredged by King County in November/December of 1982 because of concerns regarding the accumulation of sediment within Lora Lake. Homeowners residing around the lake brought their concerns to King County beginning in the mid-1970s. Reportedly, King County removed approximately 12,000 cubic yards of sediment, resulting in a maximum Lora Lake depth of about 15 feet. The dredged sediment was placed in a bermed area on Port property, located approximately 400 feet northeast of Lora Lake. Additionally, to help prevent future accumulation of sediment within the lake, King County created a sediment settling basin in 1983 by constructing a rock berm just beyond the stormwater outfall located in the northwest corner of the lake.

2.1.3 Recent Property Ownership and Land Use

The LL Parcel habitat mitigation area is currently owned and maintained by the Port. The land surrounding Lora Lake within the LL Parcel was acquired by the Port in the late 1990s as part of planning for construction of the 3rd Runway at STIA. Residences were vacated and all structures within the LL Parcel were demolished by 2004 (Appendix A). Additionally, the Port decommissioned and removed home heating oil and septic tanks, and removed timber and concrete bulkhead structures that were located along the perimeter of Lora Lake as part of site preparation activities for constructing the LL Parcel habitat mitigation area.

The Port constructed a habitat mitigation area at the LL Parcel concurrent with construction of the 3rd Runway Project at STIA in order to offset habitat impacts associated with expansion of the airport. Construction of the habitat mitigation comprised developing gentle vegetated slopes leading to Lora Lake, wetlands, floodplains, and riparian buffer zones in the area surrounding Lora Lake and to the south of the LL Parcel. Within the mitigation area, immediately south of Lora Lake, a reach of Miller Creek was relocated as part of the habitat mitigation area construction effort.

Details regarding the operations and maintenance requirements for the habitat mitigation area are described in the NRMP (Parametrix 2001) and the restrictive covenants. Restrictive covenants were put into effect in 2003 for the habitat mitigation area and require that the Port maintain the property for use as a floodplain, wetlands, flood storage area, and/or riparian corridor (Port 2003).

2.2 FUTURE LAND USE

The Port's current objective for the LL Parcel is to conduct the RI proposed in this work plan, complete appropriate remediation of contamination if necessary, and, in conjunction with the WSDOE and the USACE, continue to operate and maintain the LL Parcel as a habitat mitigation area under the requirements of the NRMP, consistent with existing restrictive covenants. The restrictive covenants do not allow development activities comprising clearing, grading, filling, or construction of any building, structure, or other improvement as a future land use (Port 2003).

The Federal Aviation Administration (FAA) defines restrictions on allowable development and structures for runway and runway approach safety areas (AC/150 5300-13). Figure 2.2 shows where the FAA's Runway Protection & Approach Transition Zones for STIA overlay the LL Apartments Parcel and the LL Parcel. Portions of the LL Apartments Parcel are located within the Controlled Activity Area and the Extended Object Free Areas.

2.3 PHYSICAL SETTING

The LL Apartments Parcel and LL Parcel are located in the Puget Sound Lowlands, within the Miller Creek Watershed, just northwest of STIA. The LL Apartments Parcel is upgradient of the LL Parcel. The LL Apartments Parcel perimeter is directly bound by roadways on three sides, with some open lots to the south that were cleared of commercial buildings between about 1998 and 2002. The LL Apartments Parcel topography gradually slopes to the southeast with steeper slopes located adjacent to Des Moines Memorial Drive and from the SR518 embankment to the north, as shown on Figure 2.2. Existing LL Apartments Parcel topography was created during the construction of the apartment building complex in 1987. To the southeast of the existing property boundary, the topography continues to gradually slope towards Lora Lake.

The LL Parcel is located to the east and southeast of the LL Apartments Parcel, across Des Moines Memorial Drive. Consistent with airport safety considerations and mitigation area restrictive covenants required by the NRMP, public access to Lora Lake and the property is prohibited, and the area is protected within a fenced perimeter.

A detailed description of the geology and hydrogeologic conditions for the LL Apartments Parcel, as well as the LL Parcel, is provided in the LL Apartments Parcel RI/FS Work Plan (Floyd|Snider 2010).

Lora Lake receives stormwater runoff from the LL Apartments Parcel, City of Burien residential and commercial drainage area upgradient of the LL Apartments Parcel, and surrounding roadways downgradient of the LL Apartments Parcel (e.g., Des Moines Memorial Drive, SR518 interchange, City of SeaTac) through a single outfall located near the northwestern edge of the lake (Figure 2.3). This outfall discharges into the lake's sediment settling basin. An overflow discharge culvert and overflow berm is present at the southeast end of the lake. Seasonally, when Lora Lake surface water levels are elevated, lake water discharges to Miller Creek through the discharge culvert and by overtopping the overflow berm. When Miller Creek surface water elevations are elevated (i.e., during periods of heavy rainfall), Miller Creek surface water discharges to Lora Lake via the same culvert and overflow berm.

WAC 173-201A-600(1) requires that water quality in Lora Lake be protected for the following:

- Salmonid spawning, rearing, and migration
- Primary contact recreation
- Domestic, industrial, and agricultural water supply
- Stock watering
- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating
- Aesthetic values

At the same time, Miller Creek, to which Lora Lake seasonally discharges, has been closed to consumptive use (Water Resource Inventory Area 9, WAC 173-509(040); WSDOE 1988). Federally-mandated restrictive covenants provide that the lake will remain the property of the Port with strictly enforced public access prohibitions.

3.0 Regulatory Framework

3.1 REGULATORY FRAMEWORK

As described in the LL Apartments Parcel RI/FS Work Plan, the Port and King County Housing Authority (KCHA) filed a Voluntary Cleanup Program (VCP) application in April 2008 to enter WSDOE's voluntary cleanup process for the LL Apartments Parcel (Floyd|Snider 2010). In September 2008, the Port filed a Modified VCP application that removed KCHA from the process. The modified VCP application identified polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH; diesel range, gasoline range, and heavy oil range) and dioxins as soil contaminants and PAHs, TPH, dioxins, arsenic, tetrachloroethene (PCE), trichloroethene (TCE), and 1,2-dichloroethane (1,2-DCA) as groundwater contaminants. Following completion of additional soil, groundwater, and sub-slab vapor investigations conducted by AECOM, Inc. (AECOM) in 2008, WSDOE and the Port agreed to move forward with remediation planning under an AO. The LL Apartments Parcel was removed from the VCP register in January 2009.

The RI/FS will be completed according to procedures and guidance provided in MTCA WAC 173-340, for both the LL Apartments Parcel and the LL Parcel. Under MTCA, a RI/FS is required to be developed once a site is prioritized for remedial action (WAC 173-340-350; WSDOE 2007). 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 current AO includes the determination by WSDOE that the Port (as the owner of the LL Apartments Parcel and the LL Parcel, 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 parcels. 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 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. These documents are provided as appendices to this Lora Lake Parcel RI/FS Work Plan.

Additional chemical data collected as part of this investigation at the LL Parcel 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 will continue 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 a cleanup site. Action-specific ARARs include regulations or guidance governing any activities proposed to remediate a cleanup 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 Draft RI/FS Report.

The primary cleanup regulations that apply to the LL Apartments Parcel and LL Parcel are the MTCA Cleanup Regulation, Chapter 173-340 WAC, Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC (WSDOE), and federal surface water quality ARARs. Applicable additional cleanup regulations specific to the LL Parcel will be determined in consultation with WSDOE and are likely to include the 2010 WSDOE Draft Benthic Sediment Quality Values for Freshwater Sediments (Avocet Consulting 2010).

Consistent with the LL Apartments Parcel RI/FS Work Plan, site-specific cleanup levels, and remediation levels as appropriate, will be proposed in the RI/FS report for the LL Parcel as necessary. 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 the LL Parcel RI/FS 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.

4.0 Lora Lake Apartments Site RI/FS Objectives

The purpose of the Lora Lake Apartments Site RI/FS is to conduct a comprehensive evaluation of the LL Apartments Parcel and off-property contaminant migration so that a preferred remedial action that achieves MTCA compliance can be identified. 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 at the LL Apartments Parcel, and groundwater downgradient of the LL Apartments Parcel, and evaluate potential contaminant migration pathways.
- Collect additional soil and sediment data at the LL Parcel to determine if contamination associated with the LL Apartments Parcel has come to be located at the LL Parcel.
- Evaluate remedial actions for site soil, groundwater, and sediments as necessary, 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.

4.1 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 2007). 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 at the LL Apartments Parcel as necessary to meet MTCA cleanup standards and other standards applicable to the Site.
- Collect soil and sediment data at the LL Parcel to determine if contamination associated with the LL Apartments Parcel has come to be located at the LL Parcel. Pending results of the soil and sediment data collection and evaluation, remedial actions will be developed as necessary under the current, or a modified, regulatory agreement.
- Control contaminant migration pathways, including LL Apartment Parcel stormwater pathways, as necessary.

- 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 at the LL Parcel.

4.2 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.

Several investigation efforts have been completed to date at the LL Apartments Parcel in order to develop complete site characterization for the COCs currently listed in the AO. A summary of these investigation efforts is provided in the LL Apartments RI/FS Work Plan (Floyd|Snider 2010). An additional investigation effort was completed at the LL Apartments Parcel in summer 2010 to supplement the existing data set and further develop complete site characterization of the LL Apartments Parcel. An evaluation of data collected as part of this recent investigation effort will be provided in the RI/FS Report for the Site.

This work plan proposes data collection actions at the LL Parcel to determine if contamination associated with the LL Apartments Parcel has come to be located at the LL Parcel. To date, only limited environmental investigations have been conducted at the LL Parcel related to the removal of home heating oil tanks. Results of the data collection effort at the LL Parcel will be presented to WSDOE, and the Port will then coordinate with WSDOE to decide the appropriate path forward for additional site characterization and any remediation at the LL Parcel deemed necessary. All data collected as part of this proposed remedial investigation effort at the LL Parcel will be included in the data set evaluated for the LL Apartments RI/FS Report.

The proposed LL Parcel phase of the remedial investigation is detailed in Section 6.0.

4.3 DEFINE AND EVALUATE MTCA REMEDIAL ACTIONS

4.3.1 Model Toxics Control Act and State Dangerous Waste Act Compliance

The RI/FS will define remedial alternatives for soil and groundwater (and sediment and stormwater if found to be contaminated) 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, sediment, and groundwater quality, and migration of contaminated soil, groundwater, surface water, 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.

4.3.2 Off-property Migration Pathways

As discussed in the LL Apartments Parcel RI/FS Work Plan, the RI/FS for the Site will evaluate potential migration pathways identified in the CSM. These potential migration pathways are composed of soil leaching to groundwater, off-property migration of contaminated groundwater, and transport of contaminants to sediments and surface water via stormwater. The potential for contamination to migrate along preferential pathways in the subsurface, such as utility corridors, and through pipe bedding material will also be evaluated (Floyd|Snider 2010). In addition, the data collection effort proposed in this LL Parcel Work Plan focuses on evaluating migration pathways from the LL Apartments Parcel to the LL Parcel, and from Lora Lake to Miller Creek.

Evaluating migration pathways will consider off-property receptors, including residences, public right-of-ways, Lora Lake, and Miller Creek.

4.3.3 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 2007), and are defined further in Section 7.0.

The RI/FS will evaluate 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.

4.4 DEFINE SOURCE CONTROL REQUIREMENTS

As stated in the LL Apartments RI/FS Work Plan, the sources of contamination currently located in the core portion of the LL Apartments Parcel are associated with industrial operations that have long since been discontinued. The only known remaining “source” of core area contamination located on the LL Apartments Parcel is the potential release of contaminants from currently impacted media to other media. The scope of the RI includes evaluating the potential for current conditions to represent contamination sources and evaluating associated source control methods. Additionally, data obtained from the Stormwater Investigation Interim Action will be evaluated in development of the source control elements of the LL Apartments Site Remedial Action.

5.0 Conceptual Site Model and Contaminants of Concern

5.1 PRELIMINARY CONCEPTUAL SITE MODEL FOR THE LORA LAKE PARCEL

A preliminary CSM was developed for the LL Apartments Parcel by AECOM on behalf of the Port in 2009 as part of the Summary Report (AECOM 2009b). This preliminary CSM was based on findings from previous investigations and remedial actions on the LL Apartments Parcel. A detailed discussion of the preliminary CSM is provided in Section 7.0 of the LL Apartments RI/FS Work Plan (Floyd|Snider 2010).

Contaminants in soil and groundwater at the LL Apartments Parcel have the potential to migrate through a number of pathways to the LL Parcel, resulting in possible exposures to human and/or ecological receptors. This section presents a preliminary CSM for the LL Parcel. Data generated from the proposed LL Parcel investigation will be used to supplement the LL Apartments Parcel investigation data and to develop a comprehensive and updated CSM for the LL Apartments Site to be used during the RI/FS process.

5.1.1 Existing Subsurface Conditions of the Lora Lake Parcel

Past uses of the LL Parcel consisted of a peat mining operation and a single-family residential area along the northern and western areas of the parcel. The parcel is now part of a habitat mitigation area developed and owned by the Port. In developing the habitat mitigation area, the topography of the land surrounding the lake was modified during grading activities, particularly along the northern and western sides of the lake where the single-family residences were previously located. A fill unit is present in these modified portions of the parcel. Below this fill unit, the subsurface conditions are anticipated to be similar to the existing subsurface conditions below the fill unit on the LL Apartments Parcel, which were generally identified as native sand with gravel. A summary of the existing subsurface conditions on the LL Apartments Parcel is provided in Section 7.0 of the LL Apartments RI/FS Work Plan.

Lora Lake is a depositional environment, with soft, organic-rich sediments. Given the adjacent wetland surrounding the lake and the previous land use for peat mining, it is likely that the subsurface within Lora Lake consists of primarily organic-rich peat-dominated sediments.

5.1.2 Contaminant Transport and Exposure Routes

Possible contaminant transport routes from the LL Apartments Parcel were identified by AECOM in the Summary Report (AECOM 2009b). The primary transport routes identified in that report comprise soil to groundwater, groundwater to surface water, and stormwater to surface water. The routes are discussed in the Summary Report and are also described in Section 7.0 of the LL Apartments RI/FS Work Plan. Another primary transport route that should be considered is storm drain sediment to Lora Lake sediment. The transport pathways could possibly result in exposures to ecological receptors within Lora Lake and Miller Creek, and potential human receptors in Miller

Creek via fish consumption. The following section focuses on the possible transport pathways and exposure routes on the LL Parcel.

Data from the LL Apartments Parcel Investigation, the LL Parcel Investigation, and the Stormwater Interim Action Investigation will inform the evaluation of the potential that contaminants may have migrated in the past or may continue to migrate to the LL Parcel and the identification of associated exposure pathways.

5.1.2.1 Primary Transport Pathways

Lora Lake is secured with a fence around the parcel and public access is prohibited, eliminating the potential for human health exposure to any contaminants in the lake or lake sediments. Contaminants in stormwater and groundwater discharges from the LL Apartments Parcel may have and/or may be entering Lora Lake, resulting in potential exposures to ecological receptors within the lake. Potential contamination within Lora Lake may enter Miller Creek, resulting in potential exposures to ecological receptors, and potential human exposures. The primary transport pathways to and from the LL Parcel consist of the following:

- **Groundwater, Stormwater, and Storm Drain Sediment to Lora Lake Sediment—LL Apartments Parcel to LL Parcel.** Lora Lake surface water may receive discharges of groundwater, stormwater, and/or storm drain sediment from the LL Apartments Parcel, as well as groundwater, stormwater and storm drain sediment discharges from other sources. Such discharges have the potential to contaminate sediment within the lake. Sediment is the receiving endpoint within the lake and is where benthic organisms could be exposed to possible contamination.
- **Surface Water to Sediment—Lora Lake to Miller Creek.** Potentially impacted surface water leaving Lora Lake could also result in possible sediment contamination within Miller Creek. The existing chemistry of Miller Creek sediment on the LL Parcel is currently unknown.
- **Groundwater to Sediment—Lora Lake to Miller Creek.** The presence of and, if present, the properties of a groundwater hydraulic connection between Lora Lake and Miller Creek have been established. For the purpose of this preliminary CSM, there is an assumption that groundwater leaving Lora Lake may not enter Miller Creek. Therefore, there is a possibility that dissolved phase contamination from potentially impacted subsurface sediments within the lake may be transported to sediment within Miller Creek.
- **Soil to Soil—LL Apartments Parcel to LL Parcel.** Overland flow from the LL Apartments Parcel and/or the historical relocation of soil from the LL Apartments Parcel to the LL Parcel is a potential contaminant transport pathway.

5.1.2.2 Potential Receptors and Routes of Exposure

Potential receptors to possible contamination in soil, sediment, and surface water at the LL Parcel include ecological receptors within the LL Parcel and ecological and human receptors within Miller Creek.

The LL Parcel is actively managed as part of the Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area, and will remain so for the foreseeable future. The area is securely fenced, and human access to the LL Parcel is restricted. Therefore, the potential routes of human exposure associated with the LL Parcel are the consumption of fish caught in Miller Creek, contact with water in Miller Creek when Lora Lake is high enough to contribute flow to Miller Creek, and contact with any sediments that have entered Miller Creek from Lora Lake and migrated downstream.

Ecological receptors may be exposed to potentially contaminated soil, sediment, and surface water on the LL Parcel. A preliminary terrestrial ecological evaluation (TEE) was conducted for the LL Apartments Parcel by AECOM, and will be updated as appropriate with respect to the LL Parcel as part of the RI/FS process.

5.2 CONTAMINANTS OF CONCERN

Section 7.0 of the of the LL Apartments RI/FS Work Plan provides a detailed discussion of the analytical testing conducted during two previous environmental investigations at the LL Apartments Parcel and the resulting COC identification for site soils and groundwater (AECOM 2009a and GeoScience Management 2008). The following compounds were identified as COCs for additional characterization in the LL Apartments Parcel phase of the Site Remedial Investigation:

- Carcinogenic polycyclic aromatic hydrocarbon (cPAH)
- Dioxins
- Arsenic
- Lead
- Diesel range and heavy oil range hydrocarbons
- Gasoline range hydrocarbons
- Pentachlorophenol (PCP)
- Volatile organic compounds (VOCs; PCE, TCE and, 1,2-DCA)

In addition to analysis of these COCs, the soil and groundwater samples collected as part of the LL Apartments Parcel remedial investigation effort (completed in summer 2010) were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) to determine the appropriate gasoline range hydrocarbon cleanup level in the RI/FS. Additional analyses were conducted for the PCE and TCE breakdown products cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-dichloroethene (trans-1,2-DCE).

Since the LL Apartments Parcel is one of the potential sources of COC contamination to the LL Parcel, the LL Parcel COCs are effectively the same as the LL Apartments Parcel COCs. The chemicals to be analyzed for in samples to be collected as part of the LL Parcel remedial investigation are discussed in Section 6.0.

6.0 Lora Lake Parcel Phase of the Site Remedial Investigation

This LL Parcel data collection effort is being performed to supplement the LL Apartments remedial investigation and to determine if contamination from the LL Apartments Parcel has come to lie within the LL Parcel. Potential contamination transport pathways that will be evaluated in this phase of the site remedial investigation are those that have been discussed with WSDOE, and are responsive to questions that have been raised by the public. These include the potential discharge of impacted groundwater, stormwater, and storm drain sediments from the LL Apartments Parcel to Lora Lake and the potential transport of impacted soils from the LL Apartments Parcel to the LL Parcel via historical overland flow or relocation of soil.

In addition to identifying whether current LL Parcel conditions result from migration of contaminants from the LL Apartments Parcel, the LL Parcel remedial investigation will identify whether other potential sources of contamination may have impacted the LL Parcel.

6.1 OVERVIEW OF THE LORA LAKE PARCEL PHASE OF THE SITE REMEDIAL INVESTIGATION

The LL Parcel data collection activities will include the following:

- Identify input sources to Lora Lake.
- Survey physical drainage features.
- Monitor Lora Lake and Miller Creek surface water levels and LL Parcel and upgradient groundwater levels.
- A bathymetric survey of Lora Lake.
- A subsurface sediment investigation of Lora Lake.
- A surface sediment investigation of Lora Lake and Miller Creek.
- A shallow soil investigation adjacent to Des Moines Memorial Drive directly downgradient from the LL Apartments Parcel.

These LL Parcel remedial investigation activities will be conducted in coordinated field efforts. The proposed schedule for completing these field activities is summarized in the schedule table provided in Section 7.3. Data collected during this investigation will be used to develop the RAOs for the LL Parcel during the RI/FS process. The scope of this work plan has been developed to provide necessary data from the LL Parcel to supplement the LL Apartments Parcel remediation investigation, and to complete the RI/FS document under the requirements of the current AO.

In addition to the LL Parcel surveys and water level measurements, the scope of the LL Parcel remedial investigation will include collecting three sediment cores for chemical testing from Lora Lake, seven surface sediment grabs for chemical and biological testing from Lora Lake and Miller Creek, one additional surface sediment grab for chemical testing only from the settling basin area within Lora Lake, and shallow soil samples from six hand auger boring locations for chemical testing from the mitigation area adjacent to Des Moines Memorial Drive. The proposed sediment sampling and soil hand auger locations are shown on Figure 6.1. A summary of the proposed analyses at these exploration locations, along with specific sampling intervals to be analyzed, is presented in Table 6.1.

Sediment collected from the cores and grabs and soil collected from the hand augers will be described and classified according to the United Soil Classification System and photographed. Field sampling documentation will be recorded on sediment sampling field forms for the sediment grabs and cores and on geologic log forms for the soil hand augers. Additionally, each soil sample collected during the LL Parcel data collection effort will be field screened to identify potentially contaminated depth intervals using visual and olfactory indications of contamination and sheen testing. The sampling methods and procedures to be used during field activities are described in further detail in the Sampling and Analysis Plan (Appendix B). Additionally, the site-specific Health and Safety Plan (HASP) is presented in Appendix C.

WAC 173-340-740(7)(f) specifies procedures to be followed when measured chemical concentrations in soil are less than the PQL. Consistent with the specified procedures and opportunity for alternates in the regulation, dioxin and cPAH toxic equivalency quotient (TEQ) concentrations for both soil and sediment samples collected during the LL Parcel phase of the Site Remedial 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 further detail in the LL Apartment Parcel Work Plan, if the site-specific cleanup levels for dioxins and cPAHs are near the method reporting limits, 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 LL Apartments Parcel and LL Parcel (as necessary) will be evaluated in the RI/FS, and are not yet determined for use in this work plan. Laboratory 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 select ion monitoring (SIM) and low-level analyses for cPAHs, PCP, VOCs, and metals.

6.2 IDENTIFY INPUT SOURCES TO LORA LAKE

A review of relevant historical information on the LL Parcel is being conducted to supplement the current understanding of past land use, historical inputs into the lake, and any associated environmental concerns. Historical sources being collected and reviewed include aerial photographs, topographic maps, Sanborn Fire Insurance Maps, utility maps, and city directories. Refer to Section 2.1 for a summary of historical property ownership and land use based on historical documents and aerial photographs reviewed to date. A short summary of reviewed information on inputs to Lora Lake and uses of the LL Parcel is presented below.

Historical documents and aerial photographs that have been reviewed indicate that Lora Lake was created by peat mining excavations beginning between 1936 and 1946 and continuing until the mid- to late 1950s. . Following this peat mining operation, single family homes were constructed on the western and northern shorelines of the lake.

King County responded to resident concerns about the accumulation of sediment in Lora Lake by dredging the lake in 1982. The dredged sediment, reportedly approximately 12,000 cubic yards, was placed in a bermed area on Port property, located approximately 400 feet northeast of Lora Lake.[1] Following dredging of the lake, in 1983 King County constructed a rock berm just beyond the stormwater outfall into the northwest corner of the lake, creating a sediment settling basin.

Lora Lake and the surrounding wetlands currently function as a habitat mitigation area developed and owned by the Port. There is currently one City of Burien stormwater system outfall that discharges to Lora Lake. This outfall is located in the northwest corner of the lake (Figure 6.1). Water discharging from this outfall into the lake's settling basin contains input from the LL Apartments Parcel (approximately 8 acres) and the upgradient City of Burien drainage area (approximately 83 acres), as well as stormwater runoff from Des Moines Memorial Drive and possibly stormwater from WSDOT and the City of SeaTac (Figure 2.3).

A preliminary visual inspection for outfall structures along the shoreline of Lora Lake was performed in fall 2010 to identify any unknown current and/or historical input sources to Lora Lake. This preliminary inspection occurred concurrently with a survey of the known physical drainage features within Lora Lake (refer to Section 6.3). A second visual inspection of the shoreline will be performed in late winter or early spring 2011 when less shoreline vegetation is present, allowing improved visibility of the shoreline. This visual inspection will occur concurrently with a bathymetric survey of Lora Lake, described in Section 6.5.

6.3 SURVEY PHYSICAL DRAINAGE FEATURES

There are two currently identified physical drainage features associated with Lora Lake, the City of Burien stormwater outfall and a drainage culvert located along the

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[1] The Port plans to conduct an independent preliminary assessment of this dredge disposal placement area and will report these results to WSDOE.

southeastern side of Lora Lake (Figure 6.1). This culvert seasonally connects Lora Lake to Miller Creek. The diameters and bottom elevations of the storm drain outfall and the culvert were surveyed by the Port in fall 2010. Surveying activities were conducted compliant with the accuracy specifications outlined in Section VII.I of the Agreed Order, and are discussed in the SAP/QAPP (Appendix B).

Surveying the stormwater outfall and the drainage culvert will allow for elevation comparisons of the bottom of these features with Lora Lake and Miller Creek surface water elevations. Collection of the Lora Lake and Miller Creek surface water elevations is described below in Section 6.4. Collecting these elevations will assist with understanding the hydraulic connectivity and seasonal flow between Lora Lake and Miller Creek and assist in updating the LL Apartments Parcel and LL Parcel CSM.

6.4 WATER LEVEL MONITORING FOR LORA LAKE, MILLER CREEK, AND GROUNDWATER

The hydraulic connection between Lora Lake, Miller Creek, and the groundwater table will be evaluated by comparing surface water and groundwater elevations obtained in three water level monitoring field events. Measurements will be taken at the following LL Parcel locations, as shown in Figure 6.1:

- Lora Lake water level monitoring location
  - Near the drainage culvert to Miller Creek located on the south eastern side of Lora Lake.
- Miller Creek water level monitoring locations
  - Upgradient (east) of the Lora Lake culvert discharge to Miller Creek.
  - Directly downgradient (west) of the Lora Lake culvert discharge to Miller Creek.
  - Further downgradient (west) of the Lora Lake culvert discharge to Miller Creek.
- Groundwater level monitoring locations
  - Existing Piezometer HPA1-1 located between Lora Lake and Miller Creek.
  - Existing Monitoring Wells MW-8, MW-9, MW-10, and MW-11 located upgradient of Lora Lake, southeast of Des Moines Memorial Drive.

Surface water and groundwater levels will be measured during three field events. Two of these water level monitoring events have already been conducted, one in fall 2010 and one in winter 2011. The third water level monitoring event will occur in spring 2011. The winter water level monitoring event was conducted concurrently with the LL Apartments Parcel winter groundwater monitoring event to provide concurrent groundwater levels for all upgradient wells. As the fall 2010 LL Apartments Parcel groundwater monitoring event was already conducted prior to the fall 2010 LL Parcel water level monitoring event, groundwater levels were measured again at Monitoring Wells MW-8, MW-9, MW-10, and MW-11 in addition to the Lora Lake, Miller Creek, and piezometer locations during the fall 2010 water level monitoring event. The spring water level monitoring event will be conducted concurrently with the LL Apartments Parcel spring groundwater monitoring event.

Prior to conducting the fall 2010 water level monitoring event, the Lora Lake monitoring location and the three Miller Creek monitoring locations were selected and marked with rebar stakes. The use of these stakes within Lora Lake and Miller Creek allow measurement of water levels during the three field events at consistent locations. The lake and creek elevations at these marked locations were surveyed by the Port in fall 2010. Elevations will be used to translate lake and creek water level measurements into surface water elevations for each of the three monitoring events. Surveying activities were conducted compliant with the accuracy specifications outlined in Section VII.I of the AO, and are discussed in the SAP/QAPP (Appendix B).

The water level monitoring locations in Miller Creek were selected as described above, with the locations upgradient and downgradient of the Lora Lake discharge culvert determined based on field observations of the greatest extent of sediment accumulation. Locations of high sediment accumulation were targeted as these water level monitoring locations will also be the locations of surface sediment sampling, as described below in Section 6.7.

Water levels in the upgradient monitoring wells and Piezometer HPA1-1 will be recorded using an electronic water level indicator. These groundwater level monitoring locations have been previously surveyed by the Port.

6.5 BATHYMETRIC SURVEY OF LORA LAKE

A survey of the bathymetry of Lora Lake will be performed in late winter or early spring 2011, prior to the collection of the subsurface sediment samples in Lora Lake. The bathymetric data from the lake will be used to determine the deepest location within the lake, which will be the location for one of the three subsurface sediment cores to be collected as part of the sediment investigation (refer to Section 6.6).

The bathymetric survey will be performed by collecting water depth measurements using a lead line, along with GPS coordinates, at regular intervals along multiple transects across the lake. Transects will be set in both north-south and east-west alignments. The collected data will be used to create a bathymetric map of Lora Lake. Bathymetric survey details are discussed in the SAP/QAPP (Appendix B).

6.6 SUBSURFACE SEDIMENT INVESTIGATION OF LORA LAKE

To investigate potential historical or long-term contributions of contaminants to Lora Lake, the quality of the subsurface sediments will be evaluated through the collection and analysis of three subsurface sediment cores from the lake. The sediment core locations were selected in coordination with WSDOE to meet the project objectives and to provide adequate spatial coverage of Lora Lake. Sediment Core LL-SED1 will be located near the stormwater outfall discharge point, Sediment Core LL-SED3 will be located adjacent to the Lora Lake discharge culvert inlet point, and Sediment Core LL-SED2 will be located at the deepest point within Lora Lake, as determined during the bathymetric survey (refer to Section 6.5). The proposed subsurface sediment core locations are presented on Figure 6.1.

Lora Lake is a depositional environment that receives input of solids from storm drainage discharges. The lake also receives organic debris from the surrounding area. 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 northern outfall that discharges to the sediment settling basin within Lora Lake receives input from: the LL Apartments Parcel and the upgradient City of Burien drainage area, stormwater runoff from Des Moines Memorial Drive, and potentially stormwater runoff from WSDOT and the City of SeaTac. Solids (including typical roadway sediments and sand from winter road maintenance) have been conveyed through this system to Lora 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 close to the higher range of those rates that are well documented in the Puget Sound marine environment.

As agreed to by WSDOE, the Lora Lake sediment cores will be collected to a depth of 5.5 feet. This core depth will encompass deposition in Lora Lake following the 1982 dredging event as well as underlying sediment that was not dredged. The sediment cores will also provide chemical quality information for sediments underlying the biologically active zone to assist in any future potential remedial actions or management of Lora Lake. Each sediment core will be divided into three equal intervals for collecting samples for chemical analysis. The resulting sample intervals will be 56 cm (22 inches) each: 0–56 cm, 56–112 cm, and 112–168 cm. There is the potential for the sediment cores to penetrate into the lake's native peat material. If peat is observed in the bottom of a sediment core, then the bottom sediment core interval length may be modified based on observed field conditions and the location of the contact of sediment with the underlying native peat. Any adjustments to the sample intervals will be determined in coordination with WSDOE.

Subsurface sediment sampling in Lora Lake will be conducted using a sampling technique called freeze coring. This sampling methodology will be used due to the difficulty in sampling the loose, unconsolidated, peaty sediments that are expected to be present in Lora Lake, as well as restricted vessel access. Freeze coring consists of driving a hollow core tube into the lake sediment to the desired core depth (5.5 feet) and then freezing the lake sediment within the core tube in-situ using liquid carbon dioxide. This freezing causes the sediments to attach firmly to the outside of the core tube. The frozen core sample and tube will be extracted about 30 minutes after the injection of liquid CO_2. The freeze coring will be performed from a portable sediment coring vessel that will be constructed specifically for this project.

The cores will be visually classified and field screened for the presence of contamination. Observations will be documented on field sampling forms. If distinguishable, the depth of the biologically active layer in each of the cores will be noted. The depth of the biologically active layer will help determine the sampling depth for the surface sediment grabs to be collected in a separate field effort that follows the subsurface sediment sampling (refer to Section 6.7).

The subsurface sediment samples collected at each of the three intervals will be chemically analyzed for dioxins/furans, cPAHs, PCP, arsenic, lead, and total organic carbon (TOC). This analyte list matches the COC list for the LL Apartments Parcel (refer to Section 5.2), with the exception of petroleum hydrocarbons (diesel range, heavy oil range, and gasoline range), BTEX compounds, and VOCs. Consistent with typical sediment analytical programs, PAHs will be used as indicator chemicals for the petroleum hydrocarbon compounds, due to the highly volatile nature of gasoline petroleum and BTEX compounds, as well as their ability to readily undergo biodegradation in surface sediments results. Additionally, there are currently no freshwater sediment criteria for petroleum hydrocarbons or BTEX compounds. The subsurface sediment samples will not be analyzed for VOCs, including BTEX, as the freeze-coring methodology to be used potentially releases VOCs during freezing and thawing. Additionally, grain size and total solids analyses will not be performed on the subsurface sediment samples, as the freezing and thawing of the sediment cores can potentially alter the grain size distribution and the water content of the samples. The co-located surface sediment grab samples will be analyzed for VOC, grain size, and total solids (refer to Section 6.7).

6.7 SURFACE SEDIMENT INVESTIGATION OF LORA LAKE AND MILLER CREEK

To evaluate whether the surface sediments within Lora Lake and Miller Creek have been impacted from discharges via groundwater and/or stormwater migration from the LL Apartments Parcel, as well as other stormwater discharge sources, surface sediment samples will be collected from within both the lake and creek. All but one of the surface sediment samples from the lake and creek will be collected for both chemical and biological toxicity testing (bioassay testing). The surface sediment sample collected from the lake's sediment settling basin area will be collected for only chemical analysis, as detailed below. The chemical test results will be used to evaluate the quality of the surface sediments within Lora Lake and Miller Creek. The biological test results will be used to determine if there are adverse biological effects associated with the biologically active zone of surface sediments within Lora Lake and Miller Creek.

6.7.1 Lora Lake Surface Sediment Sampling

The scope of the surface sediment sampling and analysis activities in Lora Lake includes the collection of four surface sediment samples for chemical and freshwater biological testing and one surface sediment sample from the sediment settling basin for chemical testing.

The proposed surface sediment sample locations were selected to meet the project objectives and provide adequate spatial coverage of Lora Lake. The proposed sediment sampling locations are shown on Figure 6.1. Surface Sediment Sample LL-SED1 will be located in the northern portion of Lora Lake just outside of the settling basin area, Surface Sediment Sample LL-SED3 will be located in the southeastern portion of the lake in proximity to the Lora Lake discharge culvert inlet point, and Surface Sediment Sample LL-SED2 will be located at the deepest point within Lora Lake, as determined during the bathymetric survey. These three surface sediment sampling locations are co-located with the three subsurface sediment core sampling locations. The location of the fourth surface sediment sample LL-SED4 will be positioned away from the locations of the other surface sediment samples in order to obtain adequate spatial coverage of Lora Lake (e.g., if LL-SED2 is located in the northeastern corner of the lake, then LL-SED4 will be placed in the southwestern corner of the lake). Surface Sediment Sample LL-SED5 will be located within the shallow vegetated settling basin area near the mouth of the northern stormwater outfall discharge point.

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. However, due to the anticipated Lora Lake soft, organic rich, and potentially flocculent surface sediment composition, the biologically active zone for disturbance and exposure of benthic organisms may be deeper than the top 10 cm designated by the SMS. Therefore, surface sediment samples may be collected from a depth greater than 10 cm to fully capture the potentially biologically active zone.

The depth of Surface Sediment Samples LL-SED1 through LL-SED4 will be determined during the subsurface sediment coring by identifying the biologically active layer as described in Section 6.6. Depending on the depths of the biologically active layers observed in the three sediment cores, the Port and WSDOE will work together to determine the appropriate sampling depth. If the depth of the biologically active zone, or oxygenated zone, cannot be visually identified, then the default Lora Lake surface sediment sample collection depth for both chemical analysis and biological testing will be 0 to 15 cm. The surface sediment sample depth will be the same at each of these surface sediment sampling locations. The depth of Surface Sediment Sample LL-SED5, collected within the sediment settling basin, will be 0 to 15 cm, consistent with the default depth for the other surface sediment samples to be collected in Lora Lake.

Surface sediment samples LL-SED1 through LL-SED4 will be collected using diver-assisted sediment sampling due to the shallow depth of the lake and restricted vessel access. The diving and sediment sampling will be performed from an inflatable boat. The sediment samples will be collected using a 14-inch diver-assisted hand corer. The diver-assisted hand corer will be inserted into the upper 20 cm of the sediment column and brought to the surface for sample processing. This hand corer will also be used to collect sample LL-SED5; however, vegetation will likely have to be cleared from this sampling location prior to sampling. Sediment sampling will be performed at LL-SED5 by wading to this sampling location. Sample processing will occur on a second inflatable boat or on shore. Based on the volume of sediment needed for the required testing, multiple surface sediment grabs will be required at each sampling location. The sediment samples will be visually classified and field screened for the presence of contamination. Observations will be documented on field sampling forms.

Refer to Section 6.7.3 for a summary of the analyses and testing that will be performed on these Lora Lake surface sediment samples.

6.7.2 Miller Creek Surface Sediment Sampling

The potential transport of contaminants via groundwater and surface water flow from Lora Lake to Miller Creek will be evaluated by collecting and analyzing surface sediment samples in Miller Creek. Three Miller Creek surface sediment samples will be collected for chemical and freshwater biological testing. The locations of the three Miller Creek surface sediment samples (MC-SED1 through MC-SED3) are shown on Figure 6.1. Surface Sediment Sample MC-SED1 will be located upgradient from the Lora Lake discharge culvert to evaluate any potential upstream chemical contributions to the creek. Surface Sediment Sample MC-SED2 will be located directly downgradient of the Lora Lake discharge culvert and MC-SED3 will be located further downgradient from the Lora Lake discharge culvert. The exact surface sediment locations were determined based on field observations of the greatest extent of sediment accumulation. The surface sediment sample locations will be co-located with the Miller Creek water level monitoring locations that are marked with rebar stakes, as described above in Section 6.4.

The surface sediment samples will be collected by hand in Miller Creek using decontaminated trowels and/or shovels. Surface sediment samples will be collected from the target surface interval of 0 to 10 cm; however, the surface sampling interval may be shallower based on the thickness of surface sediment present in Miller Creek. The surface sediment sampling interval of 0 to 10 cm within Miller Creek is based on an assumed depth for the biologically active zone and the presence of consolidated surface sediment, consisting of primarily sandy material. This surface sediment sampling interval differs from the interval of 0 to 15 cm used in Lora Lake because of the potential difference in depth of the biologically active zone and the unconsolidated nature of the lake sediments. At each sampling location, sediment will be collected over a sufficient distance along the course of the creek to obtain the volume of sediment required for the biological testing, conventional analyses, and chemical analyses. The composite surface sediment sample from each sampling location will be tested as described in Section 6.7.3. The surface sediment samples will be visually classified and field screened for the presence of contamination. Observations will be documented on field sampling forms.

6.7.3 Surface Sediment Testing

Chemical and conventional analyses and biological testing will be conducted concurrently.

All surface sediment samples collected will be chemically analyzed for dioxins/furans, cPAHs, PCP, arsenic, lead, and VOCs (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and 1,2-DCA). The analyte list matches the COC list for the LL Apartments Parcel (refer to

Section 5.2), with the exception of petroleum hydrocarbons and BTEX compounds. As described above in Section 6.6, PAHs will be used as indicator chemicals for these compounds.

Conventional analyses to be performed on the surface sediment samples include total solids, TOC, grain size, ammonia, and total sulfides. The results from analysis of ammonia and total sulfides will also be used to provide information on the biological testing sediment conditions.

Biological testing will be performed on the Lora Lake and Miller Creek surface sediment samples, with the exception of Surface Sediment Sample LL-SED5. This testing will be performed by Nautilus Environmental laboratory in Tacoma, Washington, according to WSDOE, U.S. Environmental Protection Agency (USEPA), and American Society of Testing and Materials (ASTM) guidelines for the *Hyalella azteca* 10-day mortality test, *Chironomus dilutus* 20-day growth and mortality tests, and the Microtox® 100 percent sediment porewater extract test (WSDOE 2008, USEPA 2000, and ASTM 2000). The freshwater biological test results will be compared to one-hit (Cleanup Screening Level [CSL]) and two-hit (Sediment Quality Standard [SQS]) failure criteria for observed response in the test organisms according to the *Sediment Evaluation Framework for the Pacific Northwest* guidance document (RSET 2009) and the Draft Freshwater Benthic Sediment Quality Value technical report prepared for WSDOE (Avocet Consulting 2010). Test results will be compared to negative control results rather than reference sediment results, as described in the SAP/QAPP. In consultation with WSDOE, the overall pattern of the biological test results and the consistency between tests results will be used to assess sample location passes and failures. The sediment sample collection procedures, biological testing methods, Quality Assurance/Quality Control (QA/QC) procedures, and biological decision criteria are described in detail in the SAP/QAPP (Appendix B).

As stated above, surface sediment sample LL-SED5 will be obtained from the shallow sediment settling basin area in Lora Lake. Biological testing will not be performed at this sampling location as this environment is substantially different than other sediment sampling locations in Lora Lake and Miller Creek. While the remainder of the surface sediment samples will be collected from permanently submerged locations, the settling basin surface sediment sample will be collected in a manmade, shallow vegetated area that is seasonally submerged and dominated with macrophytes (large aquatic plants).

6.8 SHALLOW SOIL INVESTIGATION NEAR THE LORA LAKE APARTMENTS PARCEL

Previous investigations, including the most recent RI/FS investigation on the LL Apartments Parcel, have identified soil contamination in the eastern area of the LL Apartments Parcel where historical industrial and redevelopment earth moving activities were conducted. The LL Parcel is located southeast, directly across Des Moines Memorial Drive from the LL Apartments Parcel, and downgradient of this area. Public comments express concern that LL Apartment Parcel contaminants may have come to be located at the LL Parcel due to historical overland flow, and/or redevelopment earth moving. Additionally, several recent LL Apartments Parcel RI shallow soil samples from the eastern boundary of the LL Apartments Parcel contained dioxin concentrations above the LL Apartments Parcel Work Plan screening level of 5 ppt. In response, WSDOE requested and the Port agreed to collect shallow soil samples for chemical analysis from six locations on the LL Parcel between Des Moines Memorial Drive and Lora Lake. Sample locations were selected in coordination with WSDOE to meet the project objectives, including establishing a dioxin contamination boundary, and to address public comments.

Soil contamination originating from the LL Apartments is unlikely to be present at depth on the LL Parcel. Des Moines Memorial Drive divided the two parcels prior to the beginning of any historical operations on the LL Apartments Parcel, reducing the probability that soil contamination from the LL Apartments Parcel was moved to the LL Parcel at depth by either roadway construction, site regrading operations, or overland flow. Additionally, residences were present along the western side of the LL Parcel during the significant regrading work that was part of the 1986–1987 apartment complex development on the LL Apartments Parcel. The shallow soil samples will be collected at six locations (LL-SB1 through LL-SB6), directly downgradient from the LL Apartments Parcel and parallel to Des Moines Memorial Drive. The proposed soil sampling locations are presented on Figure 6.1. These locations were selected to obtain adequate spatial coverage of the upland area downgradient from the LL Apartments Parcel and Des Moines Memorial Drive in areas where historical fill may be present and to help bound the horizontal extent of shallow dioxin contamination along the eastern edge of the LL Apartments Parcel.

The shallow soil samples will be collected by hand using a hand-held auger. Soil samples will be collected from three depth intervals, 0–0.5 feet, 1.5–2 feet, and 2–4 feet. The soil samples will be visually classified and field screened for the presence of contamination. Observations will be documented on field sampling forms.

Samples collected at each interval will be analyzed for the LL Apartments Parcel list of COCs: dioxins/furans, cPAHs, PCP, arsenic, lead, petroleum hydrocarbons (diesel range, heavy oil range, and gasoline range), BTEX compounds, and VOCs (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and 1,2-DCA).

The shallow soil hand auger locations will be surveyed for reference and mapping purposes. Surveying activities will be conducted compliant with the accuracy specifications outlined in Section VII.I of the AO, and are discussed in the SAP/QAPP (Appendix B).

7.0 Remedial Investigation/Feasibility Study Report Preparation Methodology

7.1 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

This section summarizes the tasks to be completed for developing the RI/FS for the Lora Lake Apartments Site, and describes the methodology for preparing the RI/FS Report. 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 2007). This section describes the activities to be completed to achieve this purpose.

7.1.1 Remedial Investigation Tasks

Remedial investigation tasks will be conducted in accordance with MTCA WAC 173-340-350(7). The first phase of remedial investigation activities for preparing the Lora Lake Apartment Site RI/FS comprised additional on-property investigations and data collection to close remaining data gaps. The majority of the first phase of investigation, including all soil sample collection, monitoring well installation, and the first event of groundwater sample collection was completed in summer 2010. Two additional groundwater sample collection events are scheduled to occur in winter 2010/2011 and spring 2011. The second phase of remedial investigation is the proposed data collection effort described in the precedent sections of this work plan.

Following the data collection at the LL Parcel, transport pathways, potential receptors, and impacts of land use will be evaluated and the CSM previously developed for the LL Apartments Parcel by AECOM will be updated as appropriate for the entire Lora Lake Apartments Site. The updated CSM will be a primary 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 remaining data gaps. The collection and evaluation of these data will inform developing remedial action alternatives during the feasibility study process described below.

7.1.2 Feasibility Study Tasks

Feasibility study tasks will be conducted according to MTCA WAC 173-340-350 (8) and to the Sediment Management Standards, Ch. 173-204 WAC. 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 LL Apartments Parcel and LL Parcel (as necessary).

7.2 RI/FS REPORT PREPARATION

A RI/FS Report will be prepared to address the LL Apartments Parcel and LL Parcel (as necessary), 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.

7.3 SCHEDULE

The AO requirements for developing the LL Apartments RI/FS will be accomplished according to the schedule presented in the LL Apartments RI/FS Work Plan (Floyd|Snider 2010), which is based on the schedule in the existing AO and adjusted in coordination with WSDOE. That schedule is reprinted immediately below.

Document	Date	Notes
Monthly Progress Reports	On the 15th of the month following the reporting month	Progress report requirements are detailed in the AO.
Progress Meetings	Quarterly—Beginning Summer 2010	Quarterly meetings will be held to discuss project progress and assess any required adjustments based on data receipt and evaluation. Meetings will also include discussion of alternatives development and evaluation for remediation during the FS.

Document	**Date**	**Notes**
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	March 19, 2010	Includes results from the 1st and 2nd stormwater sampling events.
Stormwater Sampling Interim Data Report 2	March 19, 2010	Includes results of the catch basin sampling event.
Stormwater Sampling Final Report	August 2, 2010	Includes results of all stormwater sampling events.
Public Review Draft RI/FS Work Plan	April 1, 2010	
RI/FS Work Plan Public Comment (30-day Public Comment Period)	April 23–May 24, 2010	
Final RI/FS Work Plan	July 30, 2010	
LL Apartments Parcel Phase of the Site Remedial Investigation Field Work	- Soil boring and monitoring well installation—summer 2010[1] - Groundwater Monitoring—late summer 2010–spring 2011[1]	365 days following submittal of the Final RI/FS Work Plan.
Tiered Sampling Determination Consultation with WSDOE	Late summer 2010	Following receipt of analytical data from the LL Apartments Parcel Phase of Remedial Investigation Field Work, the Port will consult with WSDOE to determine path forward for tiered sampling of dioxin.
Agency Review Draft LL Parcel Phase RI Work Plan	Fall 2010	Submitted following scoping discussions with WSDOE.
LL Parcel Phase RI Work Plan Field Work	Winter / Spring 2010-2011	Following WSDOE approval of the LL Parcel Phase RI Work Plan.
Agency Review Draft RI/FS	Late August 2011	90 days following completion of remedial investigations.

Document	Date	Notes
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.

The following LL Parcel schedule presents milestone dates for LL Parcel activities only.

Document	Date	Notes
Agency Review Draft LL Parcel Phase RI/FS Work Plan	November 2010	Submitted following scoping discussions with WSDOE.
Agency Approval Draft LL Parcel Phase RI/FS Work Plan	January/February 2011	Agency approval required in this time frame in order to implement field data collection effort in March/April 2011.
LL Parcel Phase RI/FS Work Plan Field Work [1]	Spring 2011	Following WSDOE approval of the LL Parcel Phase RI/FS Work Plan.

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.

8.0 Project Team and Responsibilities

This section identifies the project team members involved with the LL Parcel remedial investigation work and defines their roles during this work. Additional discussion of project team members and their associated responsibilities throughout the RI/FS process is included in the LL Apartments RI/FS Work Plan (Floyd|Snider 2010).

8.1 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, adjustments to the work plan and schedule, and the RI/FS Report. Mr. David South is the Site Project Manager for WSDOE, and is responsible for overseeing implementation of the AO for the Site by the Port of Seattle. 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.

8.2 PORT OF SEATTLE

The Port is the current land owner and responsible party named by the existing 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.

8.3 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. Jessi Massingale, PE, is the Floyd|Snider Project Manager.

8.3.1 AMEC GeoMatrix Consultants, Inc.

AMEC GeoMatrix Consultants, Inc. (AMEC GeoMatrix), in Seattle, Washington, will perform the subsurface sediment freeze core sampling within Lora Lake. AMEC GeoMatrix will follow the sampling methodology outlined in the project SAP for this field effort (Appendix B).

8.3.2 Research Support Services, Inc.

Research Support Services, Inc. (RSS), in Bainbridge Island, Washington, will collect the diver-assisted surface sediment samples within Lora Lake. The sampling methodology outlined in the project SAP (Appendix B) for this diver-assisted sediment sampling will be followed by RSS.

8.3.3 Analytical Resources, Inc.

Analytical Resources, Inc. (ARI), in Tukwila, Washington, will work as subcontractor to Floyd|Snider providing primary laboratory chemical testing. ARI will test sediment and soil samples collected during the LL Parcel remedial investigation work. ARI is responsible for compliance with the quality control requirements outlined in the SAP/ QAPP (Appendix B). For specialty dioxin analyses, ARI will subcontract Frontier Analytical Laboratory.

8.3.4 Frontier Analytical Laboratory

Frontier Analytical Laboratory, in El Dorado Hills, California, will provide specialty dioxin/furan analytical testing of sediment and soil samples collected during the LL Parcel remedial investigation field activities. 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).

8.3.5 Nautilus Environmental

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

8.3.6 EcoChem, Inc.

EcoChem, Inc., in Seattle, Washington, 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).

8.3.7 Aspect Consulting, Inc.

As part of the LL Parcel remedial investigation, Aspect Consulting, Inc., in Seattle, Washington, will perform a hydrogeologic evaluation to examine the hydrogeologic connection between Lora Lake and Miller Creek using data collected as part of this field effort.

8.3.8 ESA Adolfson

ESA Adolfson, in Seattle, Washington, will aid Floyd|Snider to understand the obligations for accessing and performing the LL Parcel remedial investigation work in the Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area in compliance with the Natural Resource Mitigation Plan for STIA (Parametrix 2001). ESA

Adolfson will be responsible for reviewing this work plan, any adjustments to the work plan, and the RI/FS Report to support planning and implementation of the investigation work or proposed remedial actions. In addition, ESA Adolfson will provide input on the species to be evaluated in the TEE based on their knowledge of the mitigation area.

9.0 References

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Remedial Investigation/ Feasibility Study Work Plan

Tables

Table 6.1
Lora Lake Parcel Data Collection Analytical Program and Sample Numbers[1]

Sample Type and Sampling Depths	Site Contaminant of Concern Analyses														
			TPH												
	cPAHs	PCP	Diesel Range	Heavy Oil Range	Gasoline Range	BTEX	Arsenic	Lead	Dioxins	VOCs[2]	TOC	Grain size	Biological Testing[3]	Ammonia	Total Sulfides
Subsurface Sediment Samples															
0–56 cm below mudline	3	3					3	3	3		3				
56–112 cm below mudline	3	3					3	3	3		3				
112–168 cm below mudline	3	3					3	3	3		3				
Surface Sediment Samples															
0–15 cm or 0–10 cm[4]	8	8					8	8	8	8	8	8	7	8	8
Shallow Soil Hand Auger Samples															
0–0.5 feet bgs	6	6	6	6	6	6	6	6	6	6	6				
1.5–2 feet bgs	6	6	6	6	6	6	6	6	6	6	6				
2.0–4 feet bgs	6	6	6	6	6	6	6	6	6	6	6				

Notes:

Blank	Indicates no samples planned for that interval.
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, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and 1,2-dichloroethane.
3	Biological testing includes Hyalella azteca (10-day acute), Chironomus dilutus (20-day chronic), and Microtox.
4	Default depth for the Lora Lake sediment samples is 15 cm with the actual depth for samples LL-SED1 through LL-SED4 to be determined during subsurface sediment coring. Default depth for the Miller Creek sediment samples is 10 cm.

Abbreviations:

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

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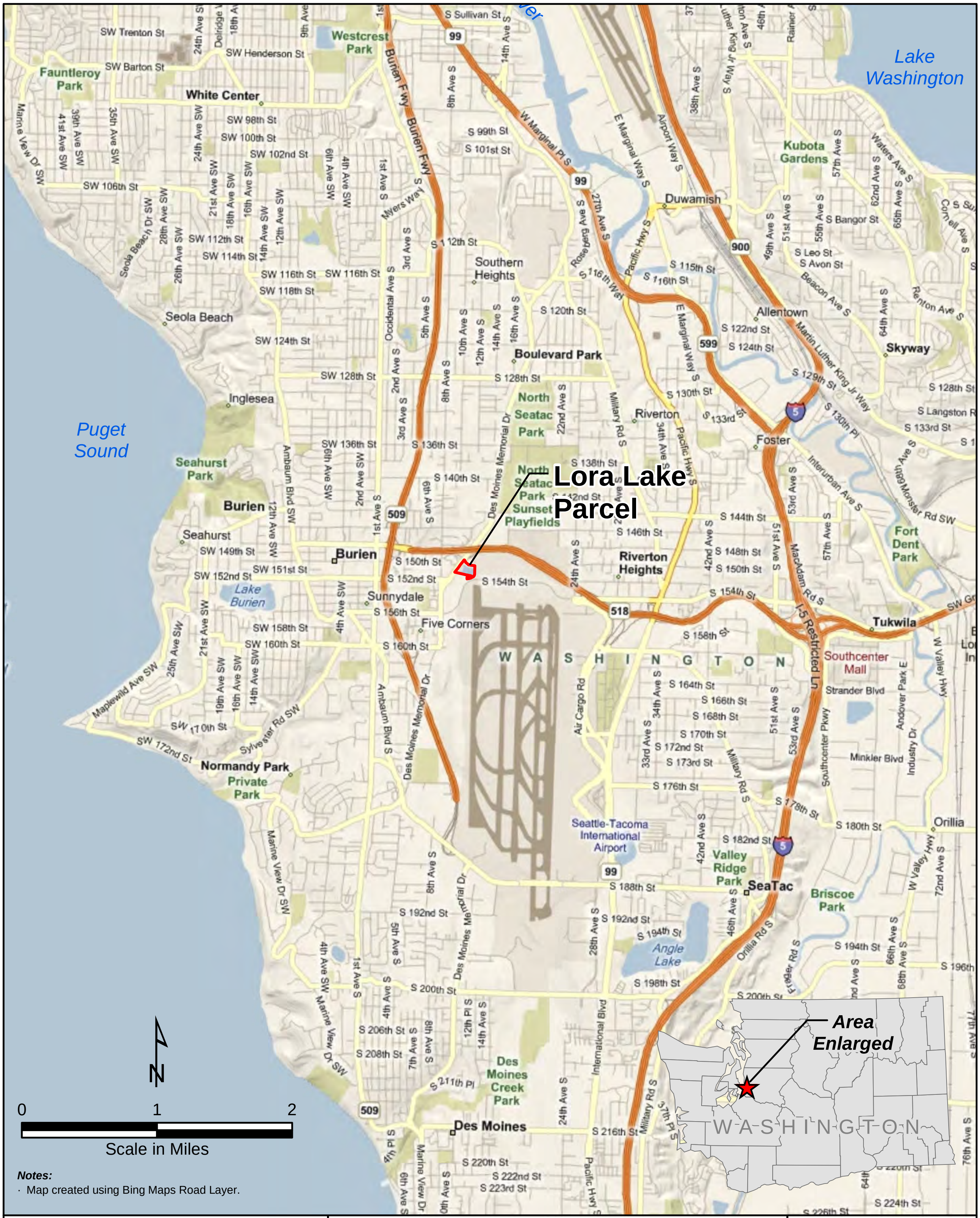
Figures



Notes:

- Map created using Bing Maps Road Layer.

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**Remedial Investigation/
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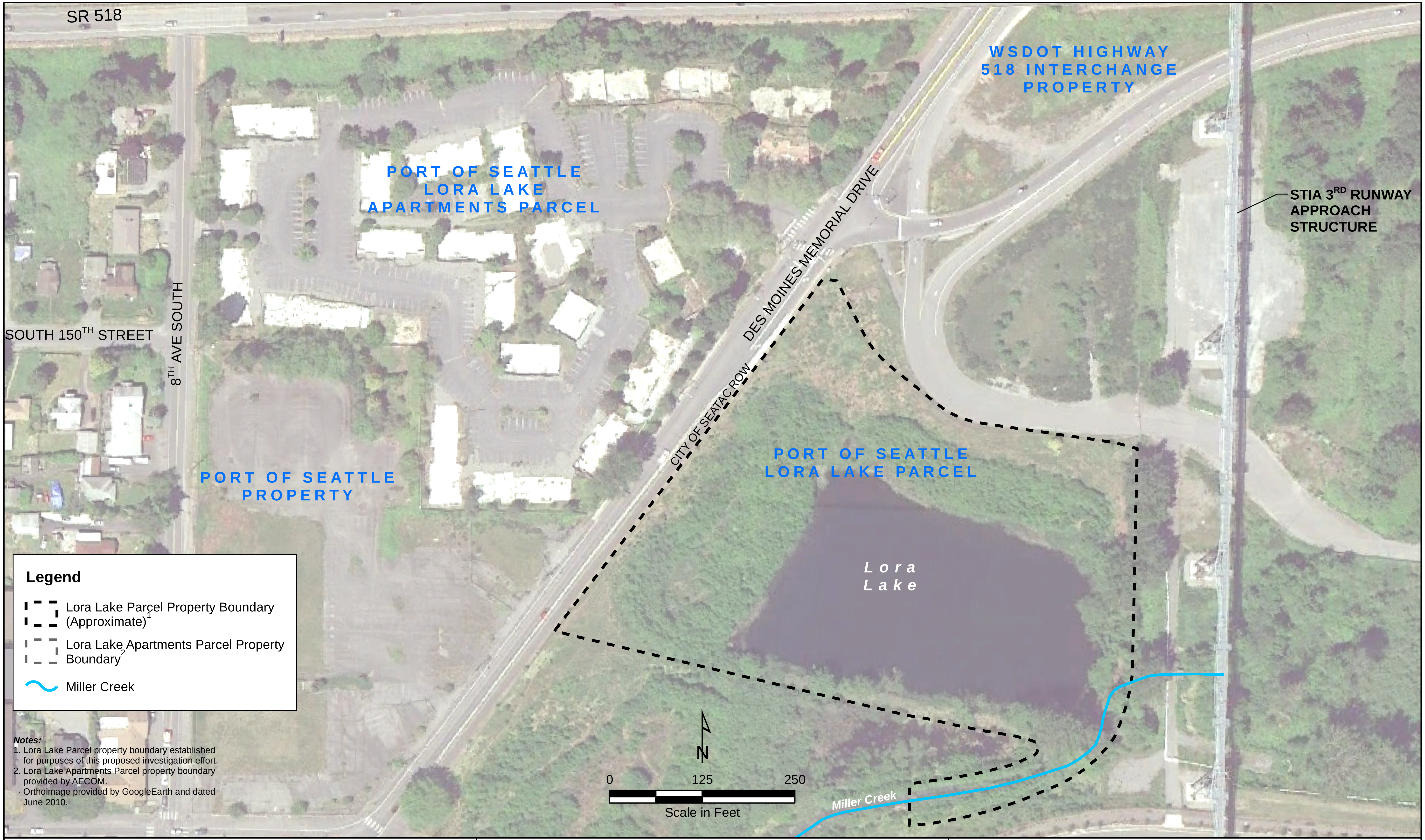
Lora Lake Parcel
SeaTac, Washington**

Figure 1.1
Vicinity Map

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure 1.1 (Vicinity Map).mxd
Date: 1/27/2011



Notes:

1. Lora Lake Parcel property boundary established for purposes of this proposed investigation effort.
2. Lora Lake Apartments Parcel property boundary provided by AECOM.

· Orthoimage provided by GoogleEarth and dated June 2010.

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Remedial Investigation/Feasibility Study Work Plan
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SeaTac, Washington

Figure 2.1
Lora Lake Parcel Map

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure 2.1 (Lora Lake Parcel Map REV Jan 27 2011).mxd
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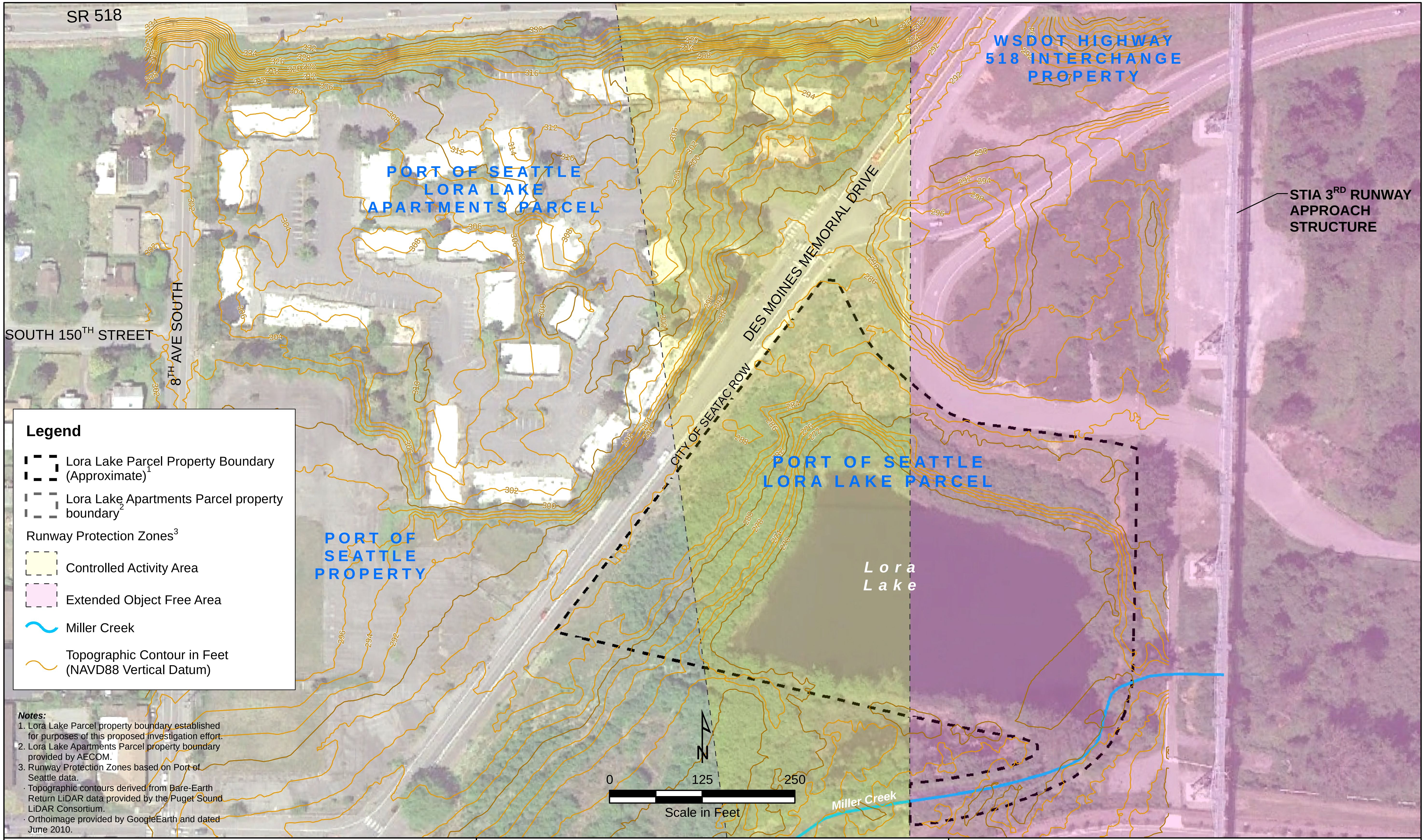

Notes:
1. Lora Lake Parcel property boundary established for purposes of this proposed investigation effort.
2. Lora Lake Apartments Parcel property boundary provided by AECOM.
3. Runway Protection Zones based on Port of Seattle data.

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

· Orthoimage provided by GoogleEarth and dated June 2010.

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Figure 2.2
Topographic Map

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure 2.2 (Topographic Map REV Jan 27 2011).mxd
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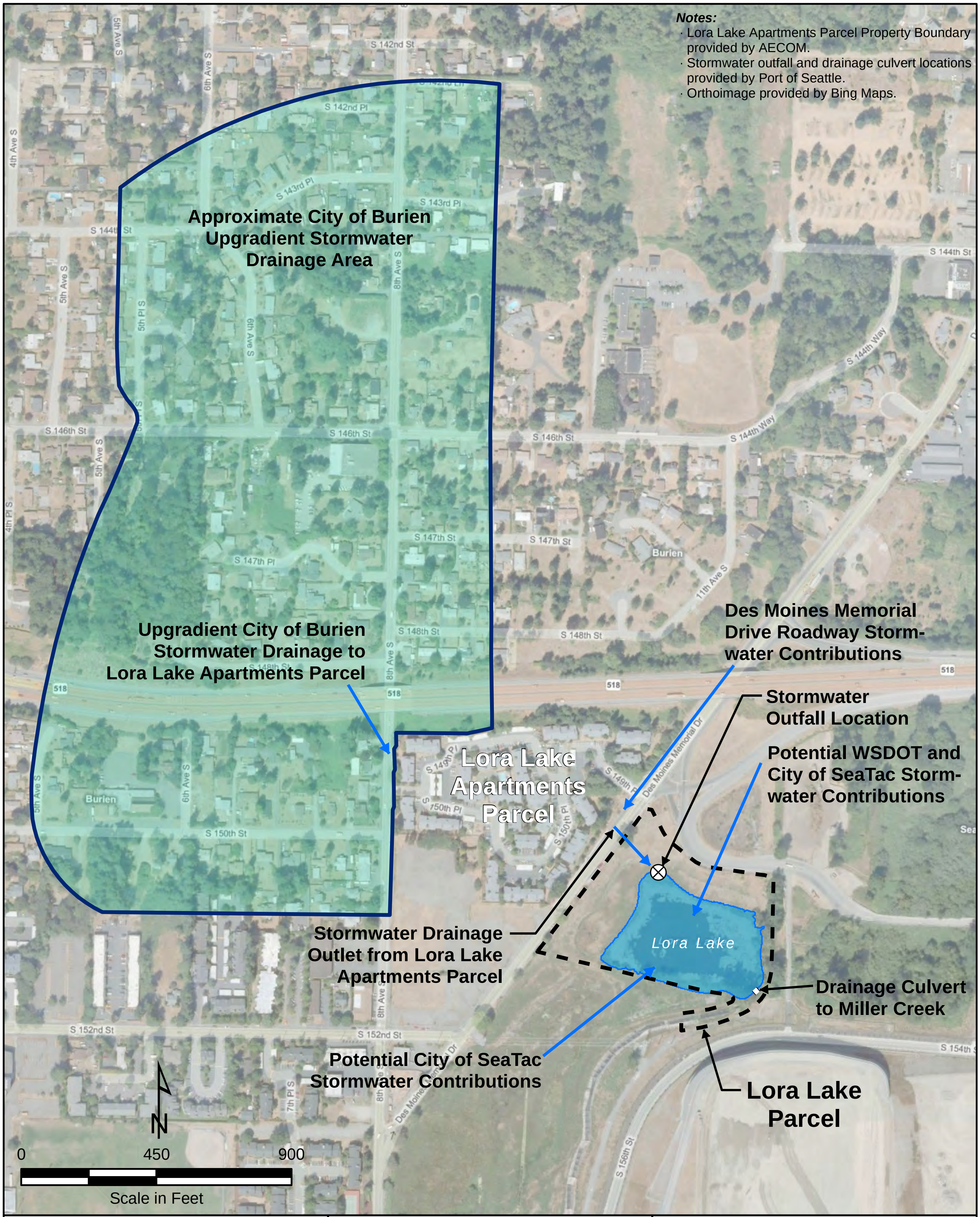
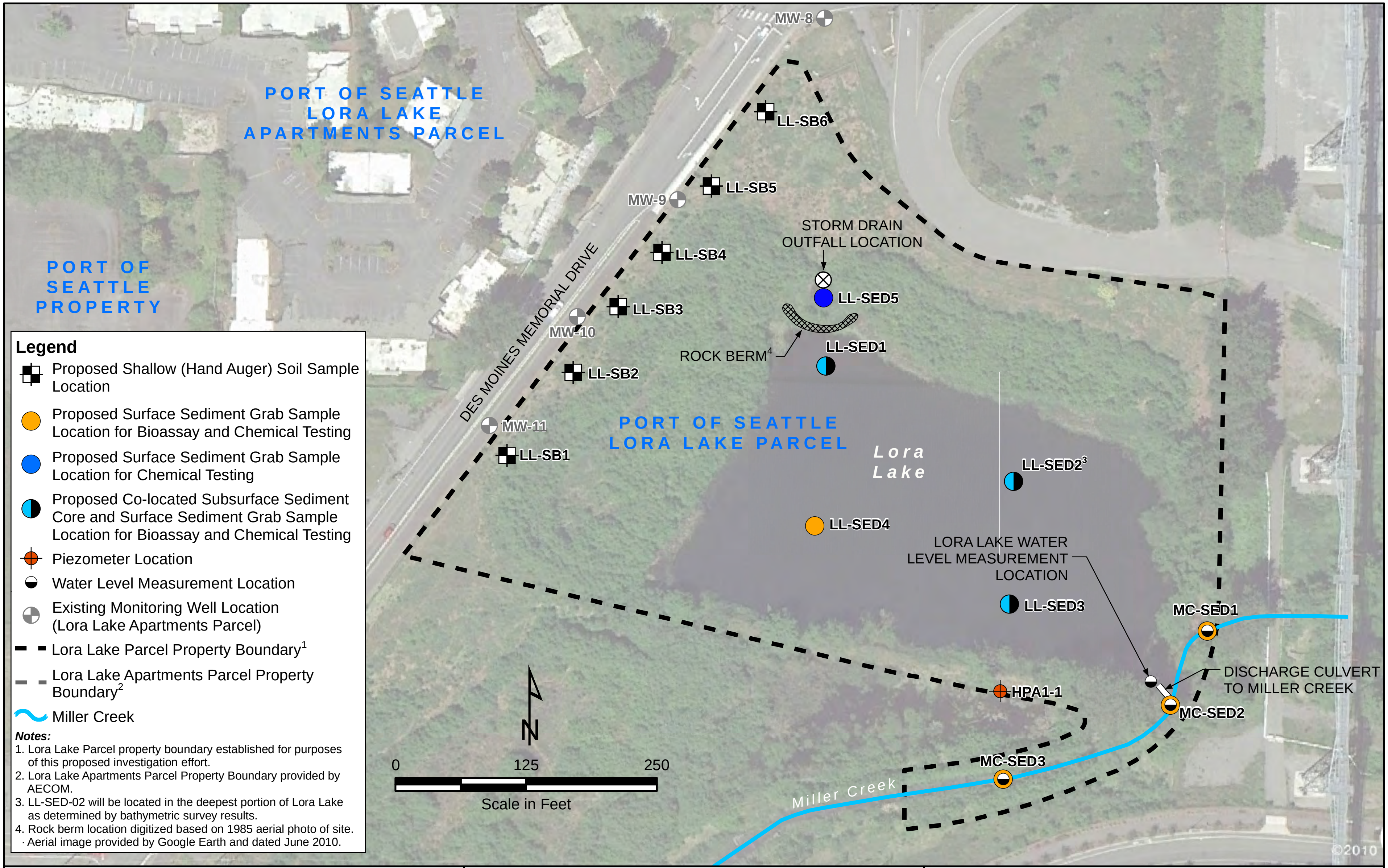


Notes:
- Lora Lake Apartments Parcel Property Boundary provided by AECOM.
- Stormwater outfall and drainage culvert locations provided by Port of Seattle.
- Orthoimage provided by Bing Maps.

FLOYD | SNIDER strategy • science • engineering	Remedial Investigation/ Feasibility Study Work Plan Port of Seattle Lora Lake Parcel SeaTac, Washington	Figure 2.3 Physical Drainage Features and Stormwater Contribution to Lora Lake

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure 2.3 (Physical Drainage Features and Stormwater Contribution to Lora Lake REV Jan 27 2011).mxd
Date: 1/27/2011



Legend

- Proposed Shallow (Hand Auger) Soil Sample Location
- Proposed Surface Sediment Grab Sample Location for Bioassay and Chemical Testing
- Proposed Surface Sediment Grab Sample Location for Chemical Testing
- Proposed Co-located Subsurface Sediment Core and Surface Sediment Grab Sample Location for Bioassay and Chemical Testing
- Piezometer Location
- Water Level Measurement Location
- Existing Monitoring Well Location (Lora Lake Apartments Parcel)
- Lora Lake Parcel Property Boundary[1]
- Lora Lake Apartments Parcel Property Boundary[2]
- Miller Creek

Notes:

1. Lora Lake Parcel property boundary established for purposes of this proposed investigation effort.
2. Lora Lake Apartments Parcel Property Boundary provided by AECOM.
3. LL-SED-02 will be located in the deepest portion of Lora Lake as determined by bathymetric survey results.
4. Rock berm location digitized based on 1985 aerial photo of site.

· Aerial image provided by Google Earth and dated June 2010.

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**Remedial Investigation/
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SeaTac, Washington**

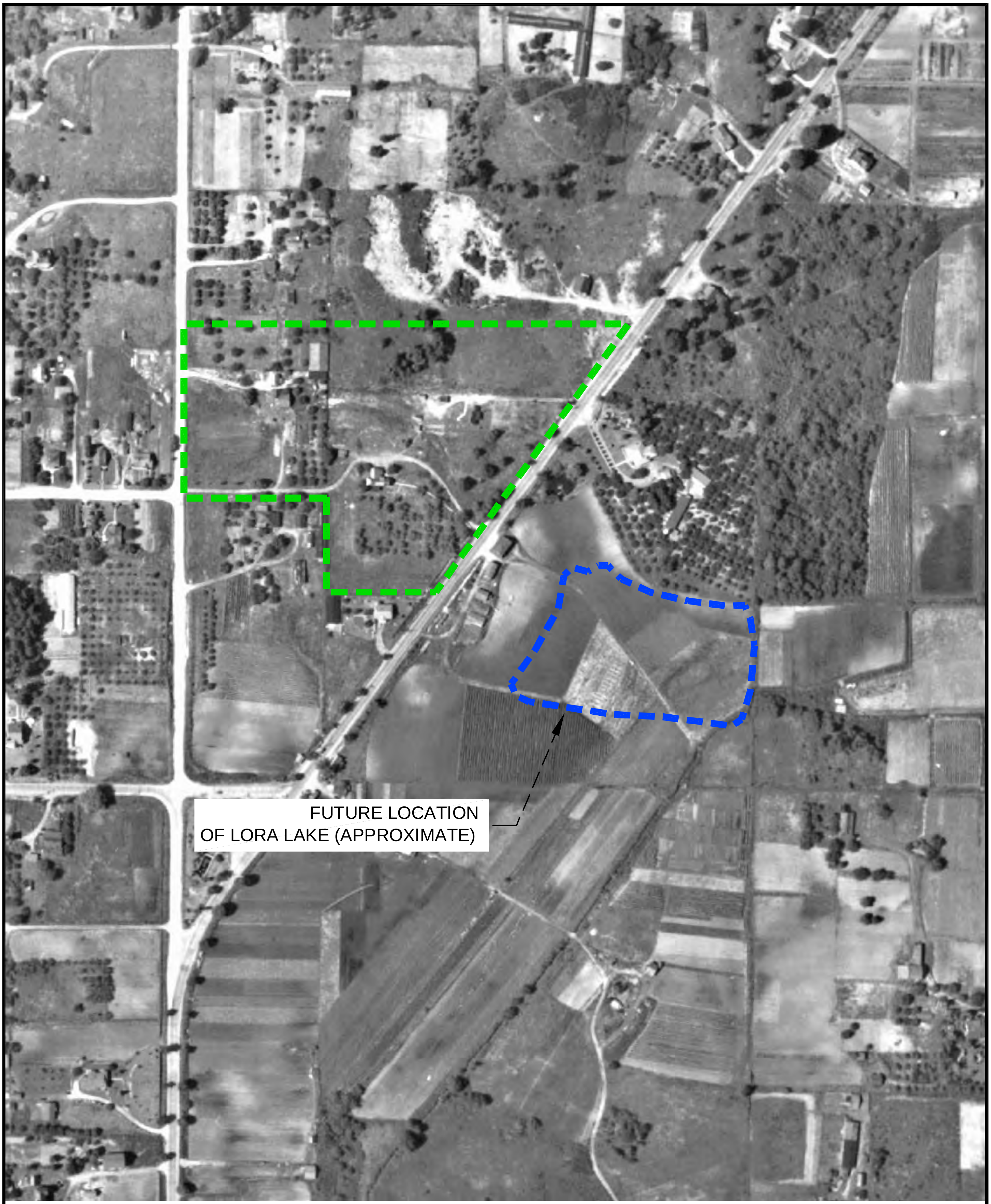
Figure 6.1
Proposed Lora Lake Parcel
Sampling Locations

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure 6.1 (Proposed Lora Lake Parcel Sampling Locations REV Jan 27 2011).mxd
Date: 2/1/2011

Port of Seattle
Lora Lake Parcel

Remedial Investigation/ Feasibility Study Work Plan

Appendix A
Historical Aerial Photos



▬ ▬ ▬ ▬ **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

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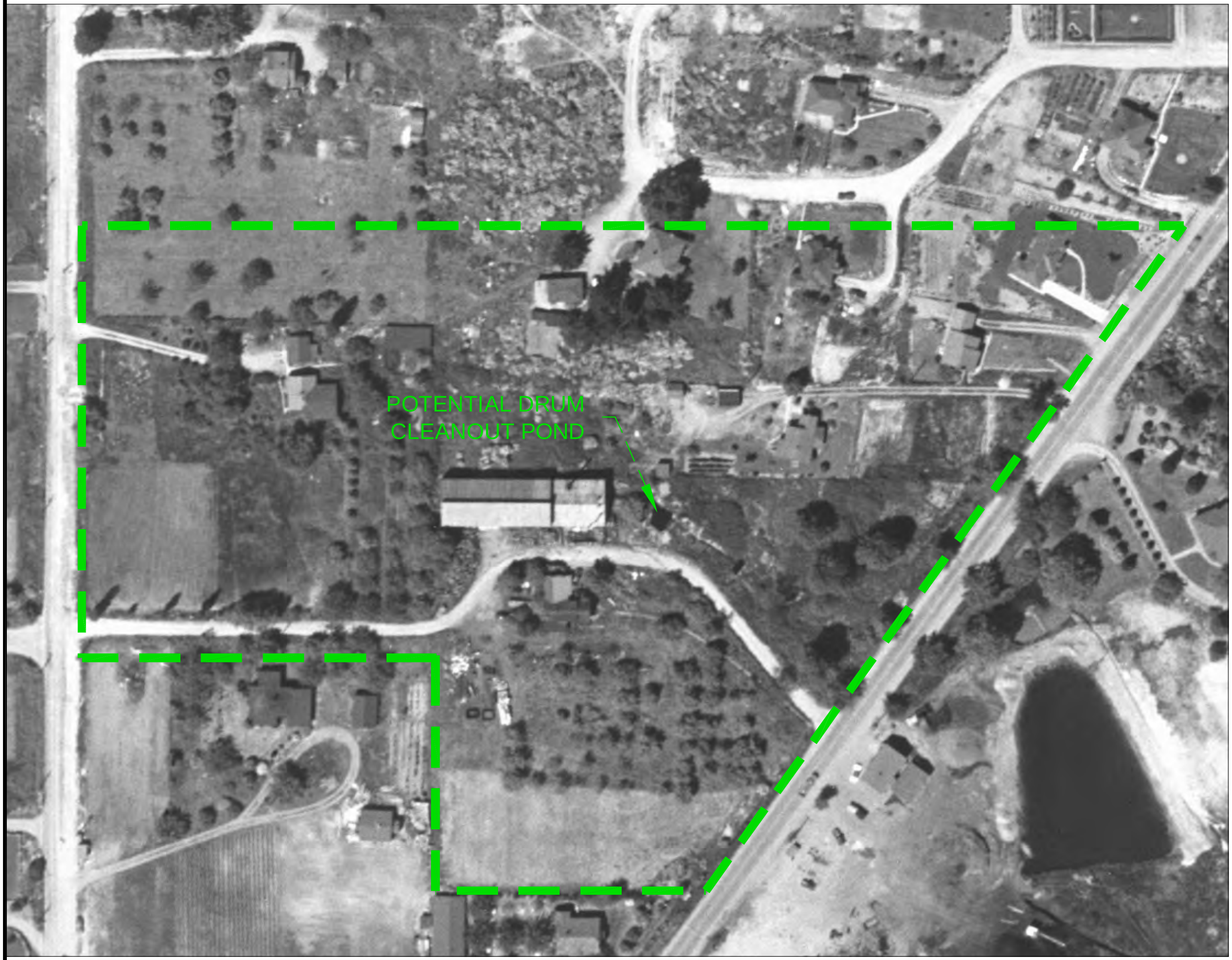

▬ ▬ ▬ ▬ **APPROXIMATE PROPERTY BOUNDARY**

AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1946

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

FIGURE

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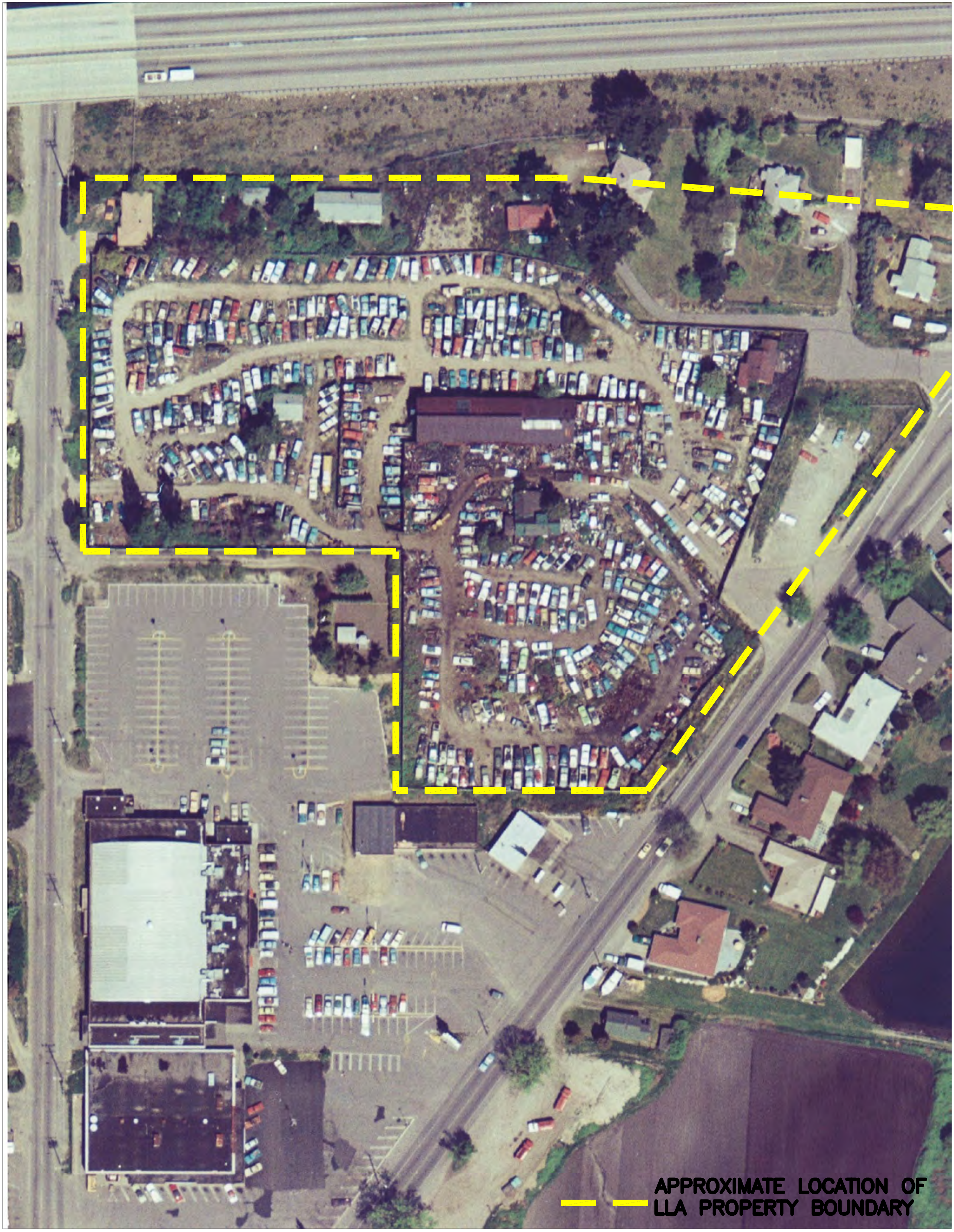

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ENSR | AECOM

LORA LAKES APARTMENTS
15001 DES MOINES MEMORIAL DRIVE
BURIEN, WASHINGTON

AERIAL PHOTOGRAPH 1980
BURIEN AUTO WRECKING

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

FIGURE

▬ ▬ ▬ ▬ **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

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▬ ▬ ▬ ▬ **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
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Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

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List of Attachments

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 Lora Lake Parcel (LL Parcel) data collection activities to be conducted as part of the RI/FS process for the Lora Lake Apartments Parcel (LL Apartments Parcel) located in Burien, Washington (Figure B.1). This data collection effort is being performed as part of the LL Apartments Parcel remedial investigation process (under the current requirements of the Agreed Order for the Site) to determine if contamination from the LL Apartments Parcel has come to be located within the LL Parcel.

Potential contamination transport pathways that have been discussed with the Washington State Department of Ecology (WSDOE), and concerns expressed by the Public, comprise the following:

- Potential discharge of impacted groundwater, stormwater, and/or storm drain sediment from the LL Apartments Parcel, as well as stormwater and storm drain sediment from other sources.
- Impacts to Lora Lake from historical operations conducted on the LL Parcel before the lake was created.
- Potential transport of impacted soils from the LL Apartments Parcel to the LL Parcel via historical overland flow.

It is not known if these potential contamination transport pathways have impacted sediments in Lora Lake at levels such that sediment cleanup in the lake would be required under current environmental regulations. Therefore, to evaluate these potential transport pathways, and to assist in developing the Conceptual Site Model (CSM) as part of the LL Apartments Parcel RI/FS, this SAP/QAPP focuses on the proposed LL Parcel remedial investigations to be conducted at Lora Lake and a portion of Miller Creek.

The objective of the LL Parcel data collection effort is to determine if contamination associated with the LL Apartments Parcel has come to be located at the LL Parcel. This phase of work was introduced in the LL Apartments Parcel Work Plan (Floyd|Snider 2010).

This SAP/QAPP provides guidance to field personnel involved in the LL Parcel data collection field activities to ensure that data quality is maintained. Any future changes to the LL Parcel data collection effort (such as changes in soil or sediment sample locations, sampling frequency, and/or chemical analyses) will be described in addenda to this SAP/QAPP and the LL Parcel Remedial Investigation/Feasibility Study Work Plan (LL Parcel RI/FS Work Plan). All such changes must be approved by WSDOE. Approval of any changes by WSDOE prior to implementation is preferred; however, it may be necessary to make changes in the field and submit the change for WSDOE review and approval after the field event.

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), Washington State Model Toxics Control Act (MTCA) WAC 173-340-820 (WSDOE 2007), and WSDOE's *Sediment Sampling and Analysis Plan Appendix* (WSDOE 2008).

Appendix C of the LL Parcel 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 LL Parcel data collection activities.

1.1 INTRODUCTION

This SAP/QAPP has been prepared by Floyd|Snider on behalf of the Port of Seattle (Port). The proposed LL Parcel data collection activities include the following:

- Survey the physical drainage features of Lora Lake and Miller Creek, including the diameters and bottom elevations of the Lora Lake outfall and discharge culvert to Miller Creek.
- Visually inspect the shoreline of Lora Lake for any potential additional input sources (e.g., outfalls).
- Conduct three rounds of water level measurements in Lora Lake, Miller Creek, and at an existing piezometer located between Lora Lake and Miller Creek.
- Conduct a bathymetric survey of Lora Lake.
- Collect subsurface sediment samples at locations within Lora Lake.
- Collect surface sediment samples at locations within Lora Lake and Miller Creek.
- Collect shallow soil samples within the Mitigation Area between Des Moines Memorial Drive and Lora Lake.
- Chemical analysis of subsurface sediment, surface sediment, and soil samples.
- Biological testing (e.g., bioassays) of surface sediment samples collected from Lora Lake and Miller Creek.

The rationale for the LL Parcel data collection activities is presented in the associated LL Parcel Work Plan.

2.0 Project Organization and Responsibility

Floyd|Snider will perform field activities, as authorized by the Port, with the assistance of the subconsultants identified below as part of the LL Parcel data collection effort to support the RI/FS process for the LL Apartments Parcel. Sediment sampling will be completed with support from Research Support Services Inc. (RSS) from Bainbridge Island, Washington and AMEC Geomatrix (AMEC) from Seattle, Washington, as described below. RSS will perform diver-assisted surface sampling, and AMEC will perform subsurface sediment sampling with freeze coring methodology. Analytical Resources, Inc. (ARI) in Tukwila, Washington, will be the primary analytical laboratory for chemical analysis, 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 (Nautilus) in Tacoma, Washington will perform all biological testing on samples that are collected and submitted during the investigation. 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 point of contact for the Port and control for matters concerning the project. He will perform the following:

- Define project objectives.
- Familiarize Floyd|Snider with any special considerations for the project.
- 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 Jessi Massingale—Floyd|Snider Project Manger

Jessi Massingale will have overall responsibility for project implementation. As Project Manager, she 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 Erin Breckel—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 LL Parcel data collection 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 will perform all biological testing services in support of the LL Parcel Phase of the Site Remedial Investigation activities.

2.3.2 Cat Curran—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 biological testing reports.
- Coordinating internal laboratory analyses.
- Supervising in-house chain-of-custody procedures.
- Scheduling sample analyses.
- Final review of biological testing results.

2.4 FIELD RESPONSIBILITIES

2.4.1 Erin Breckel—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 the following:

- 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.
- 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.
- Preparing the Data Report.

2.4.2 Eric Parker—Research Support Services Subconsultant

Research Support Services (RSS) will collect all surface sediment samples in Lora Lake, including samples for chemical analysis and samples for biological testing under the supervision of the Floyd|Snider Field QA Officer. The collection of surface sediment samples will be performed with diver-assisted hand corers, or “cookie cutters.”

Specific responsibilities include the following:

- Coordination with the Floyd|Snider Field QA Officer prior to sediment sampling.
- Follow field QA sampling procedures as detailed in this document and requested by the Floyd|Snider Field QA Officer during the field investigation.
- Ensuring that internal RSS staff and resources including a boat tender, a diver, and a back up diver are available and on-site.
- Adhering to work schedule.

2.4.3 Gary Maxwell—AMEC/Geomatrix Subconsultant

The AMEC/Geomatrix field officer will perform the collection of subsurface sediment cores within Lora Lake, under the supervision of the Floyd|Snider Field QA Officer. The subsurface sediment samples will be collected with a freeze coring methodology.

Specific responsibilities include the following:

- Coordination with Floyd|Snider Field QA Officer prior to sediment sampling event.
- Follow field QA sampling procedures as detailed in this document and requested by the Floyd|Snider Field QA Officer during the field investigation.
- Ensuring that internal AMEC sampling support staff and resources are available and on-site.
- Adhering to work schedule.
- Preparation of report-ready Core Interpretation Logs and a Navigation Report of the sampling, including core locations and time of collection.

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 LL Parcel. 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 LL Parcel data collection effort 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:

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

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:

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

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 data set 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 BIOLOGICAL TESTING QUALITY CONTROL PROCEDURES

For each sediment sample collected for biological testing, two freshwater benthic invertebrate test species and a bioluminescence bacteria species will be used: *Hyalella azteca* (10-day acute), *Chironomus dilutus* (20-day chronic), and the Microtox® 100 percent sediment porewater extract test (*Vibrio fischeri* 15-minute bioluminescence test). A total of three endpoints will be assessed with these biological tests: growth, survival, and luminescence. The biological tests, as described in Section 7.0, will incorporate standard QA/QC procedures to ensure valid test results, including a negative control, and positive control, as well as measurement of water quality during testing. Test quality control checklists will be used to ensure that the appropriate test elements are followed (Attachment B.1).

3.8.1 Replication

For freshwater biological tests, 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, USEPA, and WSDOE guidance (ASTM 2000, USEPA 2000, and WSDOE 2008).

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 is expected to produce low mortality. The overlying freshwater used in the toxicity test is the same as in the test samples. One negative control (five replicates) will be run with the batch of samples collected in this investigation.

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 freshwater 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 in this investigation.

3.8.4 Water Quality Monitoring

During the biological 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). Sulfide and ammonia will be measured in the sediment porewater at the time of porewater extraction for the Microtox® luminescence porewater toxicity tests. Biological testing laboratory performance standards are presented in Table B.2.

4.0 Lora Lake Parcel Field Investigation Program

4.1 SURVEY PHYSICAL DRAINAGE FEATURES AND VISUAL INSPECTIONS

4.1.1 Survey Physical Drainage Features

There are two currently identified physical drainage features associated with Lora Lake: the City of Burien stormwater outfall and a drainage culvert located along the southeastern side of Lora Lake (Figure B.2). Along the north side of Lora Lake, as shown in Figure B.2, there is a storm drain outfall that receives input from the Lora Lake Apartments Parcel and the upgradient City of Burien drainage area, stormwater runoff from Des Moines Memorial Drive, and possibly stormwater from WSDOT and the City of SeaTac. Along the southeastern side of Lora Lake there is a drainage culvert that seasonally connects Lora Lake to Miller Creek. To assist in understanding the connectivity and seasonal flow between Lora Lake and Miller Creek, and to assist with developing the CSM, the diameters and bottom elevations of both of these features (the storm drain outfall and the drainage culvert) were surveyed by the Port fall 2010. The drainage feature survey results will be used to compare the bottom elevation of these features to the Lora Lake and Miller Creek surface water elevations and bottom sediment elevations.

Additionally, to assist in understanding the hydraulic connection between Lora Lake and Miller Creek, bottom sediment elevations in Miller Creek at three locations were also surveyed. Water level measurements have been and will be collected from these three locations in Miller Creek, as described below in Section 4.2.

The physical drainage features were surveyed according to the requirements specified in the Agreed Order:

- Survey locations to a horizontal and vertical closure of 1:5,000.

Site mapping of the drainage features will be conducted using the Washington State Plane North Coordinate System. The survey data will be included a data report that will be presented as an appendix to the RI/FS Report.

4.1.2 Visual Inspections of the Lora Lake Shoreline

A preliminary visual inspection for outfall structures along the shoreline of Lora Lake was performed in fall 2010 to identify any unknown current and/or historical input sources to Lora Lake. This preliminary inspection occurred concurrently with a survey of the known physical drainage features within Lora Lake. As access along the lake shoreline was limited due to heavy vegetation, Floyd|Snider field staff used an inflatable raft to inspect the entire lake shoreline.

During the fall preliminary inspection, vegetation surrounding the lake was overgrown making the identification of outfalls along the shoreline difficult. For this reason, an additional inspection will be conducted in late winter/early spring 2011 when less shoreline vegetation is present, allowing improved visibility of the shoreline. This inspection will also be conducted using an inflatable raft. In support of this late winter/early spring 2011 visual inspection, photographs will be taken along the shoreline perimeter of Lora Lake and activities will be documented in a field logbook.

4.2 LORA LAKE, MILLER CREEK, AND GROUNDWATER WATER LEVEL MONITORING

After surveying the physical drainage features, the hydraulic connection between Lora Lake, Miller Creek, and the groundwater table will be evaluated by comparing surface water and groundwater elevations obtained in three water level monitoring field events. Measurements will be taken at the following LL Parcel locations, as shown in Figure B.3:

- Lora Lake water level monitoring locations:
  - Near the drainage culvert to Miller Creek located on the south eastern side of Lora Lake.
- Miller Creek water level monitoring locations:
  - Upgradient (east) of the Lora Lake culvert discharge to Miller Creek.
  - Directly downgradient (west) of the Lora Lake culvert discharge to Miller Creek.
  - Further downgradient (west) of the Lora Lake culvert discharge to Miller Creek.
- Groundwater level monitoring locations:
  - Existing piezometer HPA1-1 located between Lora Lake and Miller Creek.
  - Existing monitoring wells MW-8, MW-9, MW-10, and MW-11 located upgradient of Lora Lake, southeast of Des Moines Memorial Drive.

Surface water and groundwater levels will be measured during three field events. Two of these water level monitoring events have already been conducted: one in fall 2010 and one in winter 2011. The third water level monitoring event will occur in spring 2011. The winter water level monitoring event was conducted concurrently with the LL Apartments Parcel winter groundwater monitoring event to provide concurrent groundwater levels for all upgradient wells. As the fall 2010 LL Apartments Parcel groundwater monitoring event was already conducted prior to the fall 2010 LL Parcel water level monitoring event, groundwater levels were measured again at Monitoring Wells MW-8, MW-9, MW-10, and MW-11 in addition to the Lora Lake, Miller Creek, and piezometer locations during the fall 2010 water level monitoring event. The spring water level monitoring event will be conducted concurrently with the LL Apartments Parcel spring groundwater monitoring event.

4.2.1 Groundwater Level Monitoring Procedures

Water levels in monitoring wells and Piezometer HPA1-1 will be recorded using an electronic water level indicator. Consistent with the LL Apartments Parcel RI/FS Work Plan, the following field procedures will be completed during water level measurements.

1. Open protective casing. Observe and note on the field log the condition of monument/well or piezometer.
2. Decontaminate well sounder by rinsing with deionized water.
3. Drop the electronic water level indicator into well/piezometer 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 Level Monitoring Form (Attachment B.2) and in a field book as the static depth to water.

Groundwater level monitoring locations have already been previously surveyed by the Port.

4.2.2 Lora Lake Water Level Monitoring Procedures

Prior to conducting the first water level monitoring event, the Lora Lake monitoring location and the three Miller Creek monitoring locations were selected and marked with rebar stakes. The use of these stakes within Lora Lake and Miller Creek will allow measurement of water levels during the three field events at consistent locations. The lake and creek elevations at these marked locations were surveyed by the Port in fall 2010 and these elevations will be used to translate lake and creek water level measurements into surface water elevations for each of the three monitoring events.

The Lora Lake water level monitoring locations were surveyed according to the requirements specified in the Agreed Order:

- Survey locations to a horizontal and vertical closure of 1:5,000.
- Survey monitoring 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 appendix to the RI/FS Report.

4.2.3 Miller Creek Water Level Monitoring Procedures

As described above, prior to conducting water level monitoring at locations within Miller Creek, the locations were selected and marked with rebar stakes. The water level monitoring locations in Miller Creek were selected, as described above in Section 4.2, with the locations upgradient and downgradient of the Lora Lake discharge culvert determined based on field observations of the greatest extent of sediment accumulation. Locations of high sediment accumulation were targeted as these water level monitoring locations will also be the locations of surface sediment sampling, as described below in Section 4.5.

The use of the rebar stakes will allow measurement of water levels during the three field events at consistent locations. The Miller Creek bottom sediment elevations were surveyed by the Port. Stakes will remain in place until after completion of the third water level monitoring field event to be conducted in spring 2010.

The Miller Creek water level monitoring locations were surveyed according to the requirements specified in the Agreed Order:

- Survey locations to a horizontal and vertical closure of 1:5,000.
- Survey monitoring 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 appendix to the RI/FS report.

4.3 LORA LAKE BATHYMETRIC SURVEY

Little is known about the existing bathymetry of Lora Lake. To gain a better understanding of the bathymetry of Lora Lake, multiple transects will be conducted throughout the lake to measure water depths. The bathymetric survey will be conducted prior to the sediment sampling field effort so that the bathymetric survey can be used to inform the locations of subsurface sediment cores. One of the subsurface sediment cores will be located at the deepest point within the lake. An inflatable sampling vessel 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 vessel by lead line. Lead line water depth measurement locations will be recorded using a sub-meter accuracy GPS unit. 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.

4.4 SUBSURFACE SEDIMENT SAMPLING PROCEDURES

This section describes the sample collection and processing procedures for subsurface sediment 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).
- Puget Sound Estuary Program (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 data report for the LL Parcel that will be presented as an appendix to the RI/FS Report. All modifications must be approved by WSDOE. Prior approval of any changes by WSDOE is preferred, but it may be necessary to make changes in the field and submit the change later for approval.

4.4.1 Subsurface Sampling Location Rationale

Three subsurface sediment cores (LL-SED1, LL-SED2, and LL-SED3; sample nomenclature discussed in Section 5.2.2) will be collected within Lora Lake in this field investigation. The three proposed subsurface sediment sample locations were selected in coordination with WSDOE to meet the project objectives and provide adequate spatial coverage of Lora Lake. The subsurface sediment sampling locations are shown in Figure B.3.

Sediment Core LL-SED2 will be located at the deepest point of Lora Lake, which will be determined during the bathymetric survey. Sediment Core LL-SED1 will be located in the northern portion of Lora Lake just outside of the settling basin area, and Sediment Core LL-SED3 will be located in the southeastern portion of the lake, in proximity to the Lora Lake discharge culvert.

4.4.2 Positioning and Location Control

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

4.4.3 Sampling Methodology

The depth and sampling intervals of the subsurface sediment cores were determined in coordination with WSDOE. Sediment cores will be collected to a depth of 5.5 feet, which will encompass deposition in Lora Lake following the 1982 dredging event as well as underlying sediment that was not dredged. Each sediment core will be divided into three equal intervals for collection of chemical sampling analyses. The resulting sample intervals will be 56 cm (22 inches) each: 0–56 cm, 56–112 cm, and 112–168 cm. There is the potential for the sediment cores to penetrate into the lake's native peat material. If peat is observed in the bottom of a sediment core, then the bottom sediment core interval length may be modified based on observed field conditions and the location of the contact of sediment with the underlying native peat. Any adjustments to the sample intervals will be determined in coordination with WSDOE.

The Lora Lake subsurface sediment cores will be co-located with surface sediment samples to be collected in a separate sampling event following subsurface sediment sampling. Subsurface sediment cores will be collected prior to surface sediment sampling to assist with determining the depth of the biologically active surface layer. The depth of surface sediment sample collection will be based on the depth of the biologically active surface layer, as observed in the sediment cores and in coordination with WSDOE. The method for determining the surface sediment sample depth is described in detail below in Section 4.5.1.

Subsurface sediment sampling in Lora Lake will be conducted using a sampling technique called freeze coring. Freeze coring will be performed by AMEC under the supervision of Floyd|Snider field staff. This sampling methodology will be used due to the anticipated difficulty in sampling the loose, unconsolidated, peaty sediments that are expected to be present in Lora Lake, as well as restricted vessel access. Coring will be performed from a portable sediment coring vessel (shallow draft [less than 0.5 foot]) that will be constructed specifically for this project by the sampling subcontractor. The inflatable sampling vessel will be positioned at the proposed sampling location using the positioning and location control procedures as described above. Sediment core sample processing will occur on a nearby processing onshore station located along the Lora Lake shoreline.

Freeze core collection will be conducted by driving a hollow core tube with a pointed tip into the sediments. A hollow black iron pipe core tube will be constructed specifically for this project and will provide a maximum recovery of 5.5 feet. Depending on the physical properties of the sediments, and typically in soft unconsolidated sediments such as that suspected in Lora Lake, the core tube can be driven by hand power alone. If hand power is not sufficient to reach the target sampling depth, a hand-powered slide hammer will be used. Once the tube is inserted into the sediment, liquid carbon dioxide (CO_2) will be injected into the inside of the core tube to freeze the surrounding sediments. The CO_2 will be injected into the tube using a distribution manifold constructed on ¼-inch diameter stainless-steel pipe with orifices along its length to uniformly disperse the CO_2. The liquid CO_2 will be supplied from an industrial gas cylinder and transferred by means of a high-pressure cryogenic hose.

Rapid expansion and vaporization of the liquid CO_2 as it leaves the manifold generates temperatures of approximately -70 degrees Fahrenheit (ºF). These extreme temperatures will cause the sediments surrounding the core tube to freeze, thereby causing the sediments to attach firmly to the outside of the core tube.

The frozen core sample and tube will be extracted about 30 minutes after the injection of liquid CO_2. After extraction, the frozen core will be taken to the processing location, laid horizontally, and documented.

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 Subsurface Sediment Sample Collection Form (Attachment B.3). The sediment sample will be visually classified in accordance with ASTM D 2488.

If distinguishable, the depth of the biologically active layer will be noted. The depth of this layer will be used as the sampling depth for co-located surface sediment biological and chemical testing grabs to be collected in a separate field effort described in Section 4.5.1 below. Three of the surface sediment samples to be collected within Lora Lake will be co-located with the subsurface sediment cores. Sediment cores will be photographed for additional analysis of sediment characteristics, including the potential depth of the biologically active layer.

The sediment descriptions, along with the sampling time, sampling coordinates, and notes from the sampling subcontractor and Floyd|Snider field staff will be recorded on the Subsurface Sediment Sample Collection Form (Attachment B.3).

As part of sample collection, the following information will also be recorded on the subsurface sediment sample collection form:

- Date, time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Depth of water at the location
- Sediment sample depth
- Sample recovery
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation)
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts)
- Presence and description of sheen as applicable
- Apparent grain size
- Odor (e.g., hydrogen sulfide)

Decontamination procedures will be conducted for field sampling equipment as described below in Section 4.7.2.

It is estimated that two subsurface sediment cores will be collected at each sampling location in order to obtain sufficient sediment volume for chemical analyses. As stated above, each frozen sediment core will be divided into three equal intervals for sampling. The resulting sample intervals will be 56 cm each (equal to 22 inches): 0–56 cm, 56–112 cm, and 112–168 cm (sample nomenclature is described in Section 5.2.1). The frozen sediments will be broken off of the core tube using a hammer and a decontaminated cold chisel. The frozen sediment sample intervals from each core will be placed into the appropriate sediment sampling containers with completed sample labels, and the containers stored on ice. Each sample interval will be thawed and homogenized at ARI in preparation for analysis. The chain-of–custody, sample handling, and transport procedures for these sediment samples are described in Section 5.0, below. The subsurface sediment chemical analyses are described below in Section 6.1.1.

4.5 SURFACE SEDIMENT SAMPLING PROCEDURES

This section describes the sample collection and processing procedures for surface sediment sampling in Lora Lake and Miller Creek. 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 data report that will be presented as an appendix to the RI/FS Report. All modifications must be approved by WSDOE. Prior approval of any changes by WSDOE is preferred, but it may be necessary to make changes in the field and submit the change later for approval.

4.5.1 Lora Lake Surface Sediment Sampling Procedures

4.5.1.1 Surface Sampling Location Rationale

Surface sediment samples will be collected from a total of four locations within Lora Lake and from one location within the settling basin located in the northwestern corner of Lora Lake (Figure B.3). The five proposed surface sediment sample locations were selected in coordination with WSDOE to meet the project objectives and provide adequate spatial coverage of Lora Lake. Three of the five surface sediment sampling locations will be co-located with the three subsurface sediment core sampling locations.

Surface Sediment Sample LL-SED1 will be located in the northern portion of Lora Lake just outside of the settling basin area, and Surface Sediment Sample LL-SED3 will be located in the southeastern portion of the lake, in proximity to the discharge culvert inlet point. Surface Sediment Sample LL-SED2 will be located at the deepest point within Lora Lake, as determined by the bathymetric survey. The location of these three surface sediment sampling locations will be co-located with the three subsurface sediment core sampling locations, described in Section 4.4. The location for the fourth surface sediment sample, LL-SED4, will be separate from the locations of the other surface sediment samples in order to obtain adequate spatial coverage of Lora Lake (e.g., if LL-SED2 is located in the northeastern corner of the lake, then LL-SED4 would be placed in the southwestern corner of the lake). The location for the fifth surface sediment sample, LL-SED5, will be within the shallow vegetated settling basin area near the mouth of the stormwater outfall discharge point.

4.5.1.2 Positioning and Location Control

Positioning and navigation for the locations for surface sediment samples LL-SED1 through LL-SED4 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). The positioning system will be calibrated over a known coordinate prior to the initiation of field activities. Water depths will be measured directly by lead-line from the vessel at these four sediment sampling locations.

For surface sediment sample LL-SED5, the positioning data for this sampling location will be collected using a handheld GPS with sub-meter accuracy. The water depth will also be recorded at this location.

Horizontal data will be analyzed using the North American Datum 1983 High Accuracy Reference Network, Washington State Plane Coordinates North Zone in feet.

4.5.1.3 Sampling Methodology

Diver-assisted sediment sampling will be performed for surface sediment samples LL-SED1 through LL-SED4 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 or on shore.

Because surface sediment sample LL-SED5 is located in the shallow vegetated settling basin area, the inflatable sampling vessel will not be able to access this sampling location. Sediment sampling will be performed by wading to this sampling location. Sediment grab sample processing for this sample will occur on shore.

Surface sediment samples LL-SED1 through LL-SED4 will be collected using 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 20 cm of the sediment column and brought to the surface for sample processing. This hand corer will also be used to collect sample LL-SED5; however, vegetation will likely have to be cleared from this sampling location prior to sampling. Based on the volume of sediment required for the biological testing (to be conducted on surface sediment samples LL-SED1 through LL-SED4), conventional analyses, and chemical analysis, multiple surface sediment grabs will be required at each sampling location. 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.4). 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.3). Sediment samples will also be photographed.

As part of sample collection, the following information will also be recorded on the Surface Sediment Sample Collection Form:

- Date, time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Depth of water at the location
- Sediment sample depth
- Sample recovery
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation)
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts)
- Presence of oily sheen
- Apparent grain size
- Odor (e.g., hydrogen sulfide)

Decontamination procedures will be conducted for field sampling equipment as described below in Section 4.7.2.

The depth of surface sediment samples LL-SED1 through LL-SED4 will be determined during the subsurface sediment coring by identifying the biologically active layer as described in Section 4.4.3, above. Depending on the depths of the biologically active layers observed in the three subsurface sediment cores, the Port and WSDOE will work together to determine the appropriate sampling depth. If the depth of the biologically active zone, or oxygenated zone cannot be visually identified, then the default Lora Lake surface sediment sample collection depth for both chemical analyses and biological testing will be 0 to 15 cm for samples LL-SED1 through LL-SED4. The surface sediment sample depth will be the same at each of these four surface sediment sampling locations. The co-located replicate surface sediment samples from each sampling location will be combined in a decontaminated stainless steel bowl and homogenized to a uniform appearance after removing unrepresentative materials (e.g., woody debris, rocks). This composite surface sediment sample from each sampling location will be used for the biological testing, conventional analyses, and chemical analyses.

The depth of surface sediment sample LL-SED5 will be 0 to 15 cm, consistent with the default depth for the other surface sediment samples to be collected in Lora Lake. The co-located replicate surface sediment samples from this sampling location will be combined in a decontaminated stainless steel bowl and homogenized to a uniform appearance after removing unrepresentative materials (e.g., woody debris, rocks). This sample will be used for conventional and chemical analyses. Biological testing will not be performed at this sampling location because this environment is substantially different than other sediment sampling locations in Lora Lake as it is located in a manmade shallow vegetated area that is seasonally submerged and dominated with large aquatic plants.

Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completed, and the containers stored on ice. The chain-of–custody, sample handling, and transport procedures for these sediment samples are described in Section 5.0, below.

4.5.2 Miller Creek Surface Sediment Sampling Procedures

4.5.2.1 Surface Sampling Location Rationale

Surface sediment samples will also be collected from three locations in Miller Creek (MC-SED1 through MC-SED3), as shown in Figure B.3. Miller Creek surface sediment sample locations will be co-located with the water level monitoring rebar stake locations. Surface Sediment Sample MC-SED1 will be located upgradient (east) from the Lora Lake discharge culvert to Miller Creek. Surface Sediment Sample MC-SED2 will be located directly downgradient (west) of the Lora Lake discharge culvert, and MC-SED3 will be located further downgradient from the Lora Lake discharge culvert as shown in Figure B.3.

4.5.2.2 Positioning and Location Control

Miller Creek surface sediment samples will be collected from the locations of the three water level monitoring rebar stakes that were surveyed in fall 2010. Any offset distances of sample collection from the stakes, as necessary to obtain adequate sediment accumulation for collection, will be measured and recorded on the Surface Sediment Sample Collection Form (Attachment B.4). During surface sediment sample collection creek water depths will also be measured directly from the rebar stakes.

4.5.2.3 Sampling Methodology

Surface sediment samples will be collected by hand in Miller Creek using decontaminated trowels and/or shovels. Surface sediment samples will be collected from the target surface interval of 0 to 10 cm; however, the surface sampling interval may be shallower based on the thickness of surface sediment present in Miller Creek. The surface sediment sampling interval of 0 to 10 cm within Miller Creek is based on an assumed depth for the biologically active zone and the presence of consolidated surface sediment consisting of primarily sandy material. This surface sediment sampling interval differs from the interval of 0 to 15 cm used in Lora Lake because of the potential difference in depth of the biologically active zone and the unconsolidated nature of the lake sediments. It is anticipated that multiple surface sediment samples will be collected at each sampling location and sediment will be collected over a sufficient distance along the course of the creek to obtain the volume of sediment required for the biological testing, conventional analyses, and chemical analyses.

The sediment samples will be visually classified in accordance with ASTM D 2488. The sediment descriptions, along with the sampling time, sampling coordinates, and field notes will be recorded on a Surface Sediment Sample Collection Form (Attachment B.4). Sediment samples will also be photographed.

As part of sample collection, the following information will also be recorded on the Surface Sediment Sample Collection Form:

- Date, time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Depth of water at the location
- Sediment sample depth
- Sample recovery
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation)
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts)
- Presence of oily sheen
- Apparent grain size
- Odor (e.g., hydrogen sulfide)

Decontamination procedures will be conducted for field sampling equipment as described below in Section 4.7.2.

The surface sediment samples from each target location will be combined in a decontaminated stainless steel bowl and homogenized to a uniform appearance after removing unrepresentative materials (e.g., woody debris, rocks). The composite sediment sample from each location will be used for the biological testing and chemical analyses.

Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completed, and the containers stored on ice. The chain-of–custody, sample handling, and transport procedures for these sediment samples are described in Section 5.0, below.

4.6 SHALLOW SOIL SAMPLING PROCEDURES

This section describes the sample collection and processing procedures for shallow soil sampling within the Lora Lake Parcel. 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 of any changes by WSDOE is preferred, but it may be necessary to make changes in the field and submit the change later for approval.

4.6.1 Shallow Soil Sample Location Rationale

Shallow soil samples for chemical analysis will be collected from a total of six locations, located between Des Moines Memorial Drive and Lora Lake (Figure B.3). Shallow soil samples will be collected by hand using a hand-held auger where sampling locations are accessible by foot. The six proposed shallow soil sample locations were selected in coordination with WSDOE to meet the project objectives and address public comments regarding the potential historical overland flow and/or redevelopment earth moving pathways from the LL Apartments Parcel to the LL Parcel.

Shallow soil samples (LL-SB1through LL-SB6) will be collected directly downgradient to the southeast and parallel to Des Moines Memorial Drive on the LL Parcel. These locations were selected to obtain adequate spatial coverage of the upland area downgradient from the LL Apartments Parcel and Des Moines Memorial Drive and will also help bound the horizontal extent of shallow dioxin contamination along the eastern edge of the LL Apartments Parcel.

4.6.2 Sampling Methodology

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 sample collection for chemical analysis.

Shallow soil samples will be collected using an auger and/or trowel to scoop the surface and near-surface intervals of soil (0–0.5 foot, 1.5–2 feet and 2–4 feet), as measured with a ruler. Soil samples will be visually classified in accordance with Unified Soil Classification System and soil descriptions will be recorded on a Soil Boring Log (Attachment B.5) and photographed.

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 below in Section 4.7.3.

The soil will be placed in a decontaminated stainless steel bowl and homogenized until the soil is uniform in color and texture. 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.

Prior to sample homogenization, soil samples will be collected directly from the hand auger/trowel 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. Appropriate soil sampling containers will be filled with the homogenized soil, the sample labels completed, and the containers stored on ice.

4.6.2 Surveying

Shallow soil hand auger locations will be surveyed for reference and mapping purposes. Shallow soil hand auger locations will be surveyed according to the requirements specified in the Agreed Order, to a horizontal and vertical closure of 1:5,000. Site mapping will be conducted using the Washington State Plane North Coordinate System. Survey data will be included in the data report which will be presented as an appendix to the RI/FS Report.

4.7 DECONTAMINATION PROCEDURES

4.7.1 Water Level Monitoring Equipment Decontamination Procedures

The electronic water level indicator used for monitoring well and pieozmeter water level measurements 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 completing groundwater level monitoring at each monitoring well/piezometer and before moving to the next well location.

4.7.2 Sediment Sampling Equipment Decontamination Procedures

Non-dedicated field sampling equipment, such as the diver-assisted stainless steel hand core sampler, the freeze core tube, trowel, shovel, stainless steel bows and spoons, will be decontaminated by washing with an Alconox and tap water wash, and rinsing with deionized water prior to initiating sampling activities, between sampling locations, and following completion of sampling activities. Field technician nitrile gloves will be disposed of after processing or sampling of each sediment sample from each sampling location and before processing or collecting sediment from the next location.

4.7.3 Soil Sampling Equipment Decontamination Procedures

Field sampling equipment used in collecting soil samples (i.e., hand auger, 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. Field technician nitrile gloves will be disposed of after completing soil sampling at each hand auger location and before moving to the next soil sampling location.

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5.0 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.

5.1 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, project 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.

5.2 SAMPLE NOMENCLATURE

5.2.1 Subsurface Sediment Sample Nomenclature

The sample naming format that will be used for the subsurface sediment samples collected for chemical analyses number includes “Sample location–depth of sample–month/day/year of collection.” For example, a subsurface sample collected from location LL-SED2 from 0 to 56 cm on March 15, 2011, would be labeled LL-SED2–0-56–031511. Other information that will be included on the bottle label is the date, time, analyses, and initials of sampler. 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 5.2.4.

5.2.2 Surface Sediment Grab Sample Nomenclature

The sample naming format that will be used for the surface sediment samples collected for biological testing and chemical analyses number format will be “Sample location (LL or MC)–depth of sample–month/day/year of collection.” For example, a surface sample collected location LL-SED1 from 0 to 15 cm on March 15, 2011, would be labeled LL-SED1–0-15–031511. Other information that will be included on the bottle label is the date, time, analyses, and initials of sampler.

5.2.3 Soil Hand Auger Sample Nomenclature

The sample naming format that will be used for shallow soil samples will be “Sample location–depth interval–month/day/year of collection.” For example, a sample collected from hand auger location LL-SB1 from the 0–0.5 foot depth interval on March 15, 2011, would be labeled LL-SB1–0-0.5–031511.

5.2.4 Quality Control Sample Nomenclature

Quality control samples to be collected include field duplicates, equipment rinse samples, and trip blanks. The abbreviations for identifying these quality control samples will be as follows.

- "-D" for a field duplicate: A duplicate sample collected from the example subsurface sediment location LL-SED2 discussed above would be labeled LL-SED2–0-56–031511–D.
- "-ER" for an equipment rinse sample: An equipment rinse sample collected immediately following the example sample collection above would be named LL-SED2-0-56-031511-ER.
- "-TB" for a trip blank: For example, a trip blank placed in the cooler on the day the shallow soil samples are collected would be named LL-Soil-031511-TB.

In this way, every soil sample, sediment sample, and quality control sample has a unique identifier, with the collection date documented in the sample number.

5.3 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.

5.4 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.

5.5 SAMPLE TRANSPORT

Table B.3 summarizes sample size requirements, container type, preservation method and holding times for soil and sediment 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. Sediment and soil 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 biological testing samples collected from Lora Lake and Miller Creek will be shipped to Nautilus 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.

5.6 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.

6.0 Laboratory Chemical Analytical Program

6.1 ANALYSIS PROGRAM

Sediment and soil samples collected for each field activity will be analyzed for the following constituent groups using the methods presented below. The LL Parcel sediment and soil 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 sediment and soil sample locations. For sediment and soil samples, the chemical analyses will be performed by ARI with Frontier performing the dioxin analyses.

6.1.1 Subsurface Sediment Investigation

The collection of subsurface sediment samples from Lora Lake will be analyzed for the following constituents by the methods indicated below:

- Total organic carbon (TOC) by PSEP protocol
- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) by USEPA Method 8270C-Select Ion Monitoring (SIM; low level)
- Pentachlorophenol (PCP) by USEPA Method 8041
- Arsenic and lead by USEPA Method 6010B
- Dioxin/furans by USEPA Method 1613

The freezing coring methodology that will be used to collect subsurface sediment cores and samples, as described in Section 4.4, results in the potential release of VOCs during freezing and thawing, and potential alternation of the grain size distribution and water content. Therefore, subsurface sediment samples will not be analyzed for VOCs, grain size, and total solids; however, co-located surface sediment samples will be analyzed for these constituents.

6.1.2 Surface Sediment Investigation

Surface sediment samples collected from Lora Lake and Miller Creek will be analyzed for the following constituents by the methods indicated below:

- Total solids by USEPA Method 160.3
- TOC by PSEP protocol
- Grain size by PSEP protocol
- Ammonia by USEPA Method 350.1
- Total sulfides by PSEP protocol

- cPAHs by USEPA Method 8270C-SIM (low level)
- PCP by USEPA Method 8041
- Arsenic and lead by USEPA Method 6010B
- Dioxin/furans by USEPA Method 1613
- Tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and 1,2-dichloroethane (1,2-DCA) by USEPA Method 8260C

The analyses of ammonia and total sulfides will also be used to provide information on the biological testing sediment conditions.

6.1.3 Shallow Soil Hand Auger Investigation

The soil samples collected for the shallow soil hand auger investigation will be analyzed for the following constituents by the methods indicated below:

- cPAHs by USEPA Method 8270
- PCP by USEPA Method 8041
- Total petroleum hydrocarbons (TPH; diesel range 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
- PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and 1,2-DCA by USEPA Method 8260C

6.2 SAMPLE ARCHIVAL

Sample holding times for all analytes are presented in Table B.3. After all samples have been analyzed, any remaining sample volume will be archived and stored at ARI. Archived soil samples will be stored in a laboratory freezer maintained at a temperature range of -10 to -20 °F.

6.3 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.

6.4 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.

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7.0 Lora Lake Sediment Biological Testing Program

Freshwater biological toxicity testing (biological testing) is being performed on Lora Lake and Miller Creek sediments to determine if there are adverse biological effects in the biologically active zone of surface sediments. The biologically active zone is estimated to be at a depth of 0 to 15 cm in Lora Lake (with the actual biologically active layer depth in Lora Lake to be assessed during subsurface sediment coring) and the biologically active zone is estimated to be at a depth of 0 to 10 cm in Miller Creek. The deeper estimated depth in Lora Lake is related to the unconsolidated nature of the lake sediment. Seven surface sediment samples will be collected from Lora Lake and Miller Creek for freshwater biological testing (samples LL-SED1 through LL-SED4 and MC-SED1 through MC-SED-3). Surface sediment sample LL-SED5 that will be collected in the settling basin area of Lora Lake will not undergo biological testing, as previously discussed in Section 4.5.1.3. The proposed surface sediment sample locations are intended to meet the project objectives and provide adequate spatial coverage of Lora Lake and Miller Creek. The sediment sampling locations were selected with the rationale described in Section 6.0 of the LL Parcel RI/FS Work Plan and are shown in Figure B.3.

Project-specific reference sediment samples for biological testing will not be collected as part of this investigation. Sediment biological results will be compared to control tests conducted concurrently with the Lora Lake and Miller Creek sediment biological tests, as described below in Section 7.2 and consistent with WSDOE freshwater biological testing guidance (WSDOE 2008).

7.1 BIOLOGICAL TESTING METHODS

The species selected for the freshwater biological 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
- 15-minute 100 percent porewater Microtox® bacteria (*Vibrio fischeri*) bioluminescence test

Biological testing will be performed by Nautilus, a biological testing laboratory in Tacoma, Washington, according to guidelines for the *Hyalella azteca*, *Chironomus dilutus*, and Microtox® tests (USEPA 2000, ASTM 2000, and WSDOE 2008). 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.

The *Hyalella azteca* and *Chironomus dilutus* biological testing will be initiated within 1 week of sample collection, allowing a few days for animal equilibration before test initiation. However, the Microtox® porewater extraction test will be conducted as soon as possible following the laboratory's receipt of the sediment samples. It a test fails to meet

WSDOE 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. Biological testing laboratory performance standards are presented in Table B.2.

7.2 BIOLOGICAL TESTING DECISION CRITERIA

Biological test results will be evaluated by comparing test data to the criteria presented in the *Sediment Evaluation Framework for the Pacific Northwest* (RSET 2009) and the Draft Freshwater Benthic Sediment Quality Value technical report prepared for WSDOE (Avocet 2010). Currently, freshwater reference areas for collecting reference sediments for biological testing have not been identified. Therefore, the results of the Lora Lake and Miller Creek biological tests will be compared to the negative control tests conducted concurrently with the tests. The RSET freshwater decision criteria approach, which is consistent with WSDOE’s marine biological testing Sediment Quality Standards (SQS) and Cleanup Screening Level (CSL) criteria, will be used to evaluate the biological 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, equivalent to the WSDOE CSL and SQS one-hit, two-hit failures. The biological-testing-specific guidelines for each of these response categories are listed below. In general, a one-hit (CSL) failure is a marked response in any one biological test. A two-hit (SQS) 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 modification to the biological testing decision criteria is the two-hit (SQS) criteria for the 10-day amphipod mortality test. The decision criteria that will be used are consistent with the Draft Freshwater Benthic Sediment Quality Value technical report prepared for WSDOE (Avocet 2010).

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.

7.2.1 Freshwater Biological Tests One-Hit (CSL) Failure

Amphipod 10-day Survival Biological Test. For the amphipod biological test, 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 (CSL) failure.

Midge 20-day Survival/Growth Biological Test. 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 (CSL) failure.

Microtox® 15-minute Porewater Luminescence Biological Test. For the Microtox® 15-minute luminescence test, a mean test output less than 75 percent of the control mean output and statistically significantly different (alpha = 0.05) from the control mean output indicates a one-hit (CSL) failure.

7.2.2 Freshwater Biological Tests Two-Hit (SQS) Failure

Amphipod 10-day Survival Biological Test. For the amphipod biological test, 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 (SQS) failure.

Midge 20-day Survival/Growth Biological Test. 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 (SQS) failure.

Microtox® 15-minute Porewater Luminescence Biological Test. For the Microtox® 15-minute luminescence test, a mean test output less than 90 percent of the control mean output and statistically significantly different (alpha = 0.05) from the control mean output indicates a two-hit (SQS) failure.

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8.0 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.

8.1 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.

8.2 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.

8.3 BIOLOGICAL TEST DATA QUALITY REVIEW

A review of the biological tests conducted on surface sediment samples collected from Lora Lake and Miller Creek is necessary to confirm that appropriate and thorough laboratory testing and documentation procedures were followed. Biological 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 biological test laboratory will document and provide an explanation of any exceptions to the established procedures.

The data quality review will compare biological testing holding conditions, test setup, test implementation, and test termination to pertinent biological testing 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

8.4 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 process and data will be queried and provided to the Port and uploaded to WSDOE's Environmental Information Management (EIM) system. All collected field data—soil, sediment, and biological 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.

9.0 Corrective Actions

Corrective action procedures are described in this section.

9.1 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.

9.2 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 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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10.0 Waste Management

With the exception of waste personal protective equipment, minimal investigation-derived waste (IDW) will be generated during field activities. The excess sediment that is generated during the sediment sampling will be returned to approximately the location from which it was collected. Excess soil that is generated during the hand auger sampling will be placed back into the auger hole from which it was collected. Waste personal protective equipment will be collected in garbage bags, removed from the site, and disposed of as municipal waste.

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11.0 Data Reporting

The Lora Lake Apartments Draft RI/FS(s) will document activities associated with the collection, transportation, and laboratory analysis of all samples collected during the phases of remedial investigation work at the Site. The report(s) will include the following:

- A description of the purpose and goals of the phases of the remedial investigation conducted at the LL Apartments Parcel and the LL Parcel.
- A summary of the field sampling and laboratory analytical procedures, referencing this SAP/QAPP as well as the SAP/QAPP for the LL Apartments Parcel (Floyd|Snider 2010) and identifying any deviations resulting from field conditions.
- A general vicinity map showing the location of the LL Apartments Parcel and LL Parcel, 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, biological 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 revise the conceptual site models for the Site as needed. The results will also be evaluated relative to potential contamination sources.
- All analytical results will be compared to cleanup levels proposed in the Draft RI/FS report in coordination with WSDOE.

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12.0 References

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Port of Seattle
Lora Lake Parcel

Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Tables

Table B.1
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit/PQL[1]	Precision	Accuracy	Completeness	Reference
Sediment Samples							
Carcinogenic Polycyclic Aromatic Hydrocarbons	Sediment	µg/kg	5	± 50%	± 60%	95%	USEPA Method 8270D-SIM–Low Level
Pentachlorophenol	Sediment	µg/kg	6.25	± 50%	± 60%	95%	USEPA Method 8041
Arsenic (As) and Lead (Pb)	Sediment	mg/kg	As: 5.0 Pb: 2.0	± 20%	± 25%	95%	USEPA Method 6010B
Dioxin/Furans	Sediment	ng/kg	0.5–5	± 30%	± 30%	95%	USEPA Method 1613
Volatile Organic Compounds[2] Tetrachloroethene Trichloroethene 1,2-Dichloroethane cis-1,2-Dichloroethene trans-1,2-Dichloroethene	Sediment	µg/kg	1.0	± 50%	± 50%	95%	USEPA Method 8260C
Total Organic Carbon	Sediment	mg/kg or %	200 or 0.02	± 20%	± 20%	95%	PSEP 1997 (Plumb 1981)
Total Solids[2]	Sediment	%	0.1	± 25%	± 20%	95%	USEPA Method 160.3
Grain size[2]	Sediment	%	0.01	± 25%	± 20%	95%	PSEP 1997
Ammonia[2]	Sediment	mg/kg	0.1	± 25%	± 20%	95%	USEPA Method 350.1M
Total Sulfides[2]	Sediment	mg/kg	1.0	± 25%	± 20%	95%	PSEP 1997
Soil Samples							
Carcinogenic Polycyclic Aromatic Hydrocarbons	Soil	µg/kg	5	± 50%	± 60%	95%	USEPA Method 8270

Table B.1
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit/PQL[1]	Precision	Accuracy	Completeness	Reference
Soil Samples (continued)							
Pentachlorophenol	Soil	µg/kg	6.25	± 50%	± 60%	95%	USEPA Method 8041
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%	± 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 cis-1,2-Dichloroethene trans-1,2-Dichloroethene	Soil	µg/kg	1.0	± 50%	± 50%	95%	USEPA Method 8260C

Note:
1 All reporting limits shown are method PQLs from Analytical Resources, Inc. laboratory in Tukwila, Washington.
2 Analyzed on surface sediment samples only.

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

			Frequency of Water Quality Monitoring		**Recommended Control Limits**				**Performance Standards/Controls[1]**	
Toxicity Test & Species (Measurement Endpoint)	**Number of Laboratory Replicate Jars**	**Number of Organisms Per Jar**	**Overlying Water Temperature, Conductivity, Dissolved Oxygen, pH**	**Sulfides, Ammonia, Hardness, Alkalinity**	**Temp (ºC)**	**Conductivity/ Salinity**	**Dissolved Oxygen (Percent Saturation)**	**Water Renewal**	**Negative Control**	**Performance Standards for Control**
Amphipod *Haylelia azteca* 10-day acute (Mortality)	8	10	Daily	Beginning/ Day 5/ End	23 ± 1	< 15 ppt	> 2.5 mg/L (40-100)	2 times daily	Clean sediment	< 20% mortality
Larval Midge *Chironomus dilutus* 20-day chronic (Mortality & Growth)	8	12	Daily	Beginning/ Days 5, 10, & 15/ End	20 ± 1[2]	NA	> 2.5 mg/L (40-100)	2 times daily	Clean sediment	< 30% mortality; and mean dry weight per organism > 0.6 mg/ surviving organism or recommended equivalent 0.48 mg AFDW/surviving organism (ASTM 2000, WSDOE 2008)
Microtox® *Vibrio fisheri* 15-minute porewater (Luminescence)	5	NA	7.9 ≤ pH ≤ 8.2 salinity adjusted to 20 ±2 ppt	Sulfide and ammonia porewater at time of extraction	15	NA	50-100	NA	Deionized or distilled water, salinity, DO & pH adjusted like test	Mean light output of final control ≥ 72 percent of mean light output of initial control

Notes:

1 All bioassay tests will include positive control reference toxicant samples.

2 Lower temperature recommended by laboratory to prevent early emergence of pupae. USEPA and WSDOE method-specified 23ºC is often too high for chronic tests (USEPA 2000).

Abbreviations:

AFDW	Ash free dry weight
ASTM	American Society of Testing and Materials
USEPA	U. S. Environmental Protection Agency
WSDOE	Washington State Department of Ecology

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

Analyses	Method	Bottle Type	Preservative	Holding Time
Sediment Samples				
Carcinogenic Polycyclic Aromatic Hydrocarbons Pentachlorophenol	USEPA 8270D USEPA 8041	(2) 8 oz WMG	None, cool to 6˚C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Arsenic and Lead	USEPA 6010	Analyzed from cPAH/pentachlorophenol sample volume	None, cool to 6˚C	6 months (or freeze for 1 year)
Dioxin/Furans	USEPA 1613	(1) 8-oz WMG	None, cool to 6˚C	1 year
Volatile Organic Compounds[1]	USEPA 8260C	(3) 40 mL VOA vials[2]	(2) vials with sodium bisulfate, (1) vial with MeOH, cool to 6˚C	14 days to analyze
Total Organic Carbon	PSEP	(1) 4-oz WMG	None, cool to 6˚C	14 days to prep, then 6 months to analyze (or freeze for 1 year)
Total Solids[3]	USEPA Method 160.3	Take from TOC jar	None, cool to 6˚C	6 months or same as associated laboratory parameter
Grain Size[3]	PSEP	(1) 16-oz WM HDPE	None, cool to 6˚C	6 months
Ammonia[3]	USEPA Method 350.1	(1) 4-oz WMG	None, cool to 6˚C	7 days
Total Sulfides[3]	PSEP	(1) 4-oz WMG	Zinc acetate, cool to 6˚C	7 days
Soil Samples				
Carcinogenic Polycyclic Aromatic Hydrocarbons Pentachlorophenol	USEPA 8270D USEPA 8041	(2) 8 oz WMG	None, cool to 6˚C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Total Petroleum Hydrocarbons—Heavy Oil Range and Diesel Range	NWTPH-Dx	(1) 4 oz WMG (if no sample volume collected for cPAH/ pentachlorophenol analyses)	None, cool to 6˚C	14 days to extract, then 40 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—Gasoline Range	NWTPH-G	(2) 40 mL VOA vials[2]	MeOH, cool to 6˚C	14 days to analyze
Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)	USEPA 8021	Analyzed from TPH-Gasoline Range sample volume	MeOH, cool to 6˚C	14 days to analyze
Arsenic and Lead	USEPA 6010	Analyzed from cPAH/pentachlorophenol sample volume	None, cool to 6˚C	6 months (or freeze for 1 year)
Dioxin/Furans	USEPA 1613	(1) 8-oz WMG	None, cool to 6˚C	1 year
Volatile Organic Compounds[1]	USEPA 8260C	(3) 40 mL VOA vials[2]	(2) vials with sodium bisulfate, (1) vial with MeOH, cool to 6˚C	14 days to analyze

Notes:
1 Tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and 1,2-dichloroethane.
2 Samples for volatile organic compound and total petroleum hydrocarbon-gasoline range analyses collected using USEPA Method 5035A with a soil Teflon corer.
3 Analyzed on surface sediment samples only.

Abbreviations:

ASTM	American Society of Testing and Materials
cPAH	Carinogenic polycyclic aromatic hydrocarbon
HCl	Hydrochloric acid
HDPE	High-density polyethylene
H2SO4	Sulfuric acid
MeOH	Methanol
PSEP	Puget Sound Estuary Program
SIM	Select ion monitoring
TPH-G	Total petroleum hydrocarbons-gasoline range
USEPA	U. S. Environmental Protection Agency
WMG	Wide-mouth glass jar
WMGS	Wide-mouth glass jar with septa
WSDOE	Washington State Department of Ecology

Table B.4
Lora Lake Parcel Data Collection Analytical Program and Sample Numbers[1]

Sample Type 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	Grain size	Biological Testing[3]	Ammonia	Total Sulfides
Subsurface Sediment Samples															
0-56 cm below mudline	3	3					3	3	3		3				
56-112 cm below mudline	3	3					3	3	3		3				
112-168 cm below mudline	3	3					3	3	3		3				
Surface Sediment Samples															
0–15 cm or 0–10 cm[4]	8	8					8	8	8	8	8	8	7	8	8
Shallow Soil Hand Auger Samples															
0–0.5 feet bgs	6	6	6	6	6	6	6	6	6	6	6				
1.5–2 feet bgs	6	6	6	6	6	6	6	6	6	6	6				
2.0–4 feet bgs	6	6	6	6	6	6	6	6	6	6	6				

Notes:

Blank	Indicates no samples planned for that interval.
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, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and 1,2-dichloroethane.
3	Biological testing includes Hyalella azteca (10-day acute), Chironomus dilutes (20-day chronic), and Microtox.
4	Default depth for the Lora Lake sediment samples is 15 cm with the actual depth for samples LL-SED1 through LL-SED4 to be determined during subsurface sediment coring. Default depth for the Miller Creek sediment samples is 10 cm.

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
VOC	Volatile organic compound

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

Parameter	**Analysis Method**	**Detection Limit**	**Reporting Limit (PQL)[1]**
Sediment Samples			
cPAHs	USEPA Method 8270-SIM-Low Level	0.94–2.04 µg/kg	5 µg/kg
Pentachlorophenol	USEPA Method 8041	2.49 µg/kg	6.25 µg/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, cis-1,2-DCE, trans-1,2-DCE,1,2-DCA)	USEPA Method 8260C	PCE: 0.40 µg/kg TCE: 0.51 µg/kg Cis-1,2-DCE: 0.11 µg/kg Trans-1,2-DCE: 0.21 µg/kg 1,2-DCA: 0.35 µg/kg	1.0 µg/kg
Total Organic Carbon	PSEP	0.0029 % (29 mg/kg)	0.02 % (200 mg/kg)
Total Solids[2]	USEPA Method 160.3	NA	0.1%
Grain Size[2]	PSEP	NA	0.01 %
Ammonia[2]	USEPA Method 350.1M	0.0072 ppm	0.1
Total Sulfides[2]	PSEP	0.348	1.0
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, cis-1,2-DCE, trans-1,2-DCE, 1,2-DCA)	USEPA Method 8260C	PCE: 0.40 µg/kg TCE: 0.51 µg/kg Cis-1,2-DCE: 0.11 µg/kg Trans-1,2-DCE: 0.21 µg/kg 1,2-DCA: 0.35 µg/kg	1.0 µg/kg

Notes:

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

2 Analyzed on surface sediment samples only.

Abbreviations:

1,2-DCA	1,2-Dichloroethane
As	Arsenic
BTEX	Benzene, toluene, ethylbenzene, xylene
cis-1,-2-DCE	cis-1,2-Dichloroethene
Pb	Lead
PCE	Tetrachloroethene
PQL	Practical Quantitation Limit
trans-1,2-DCE	trans-1,2-Dichloroethene
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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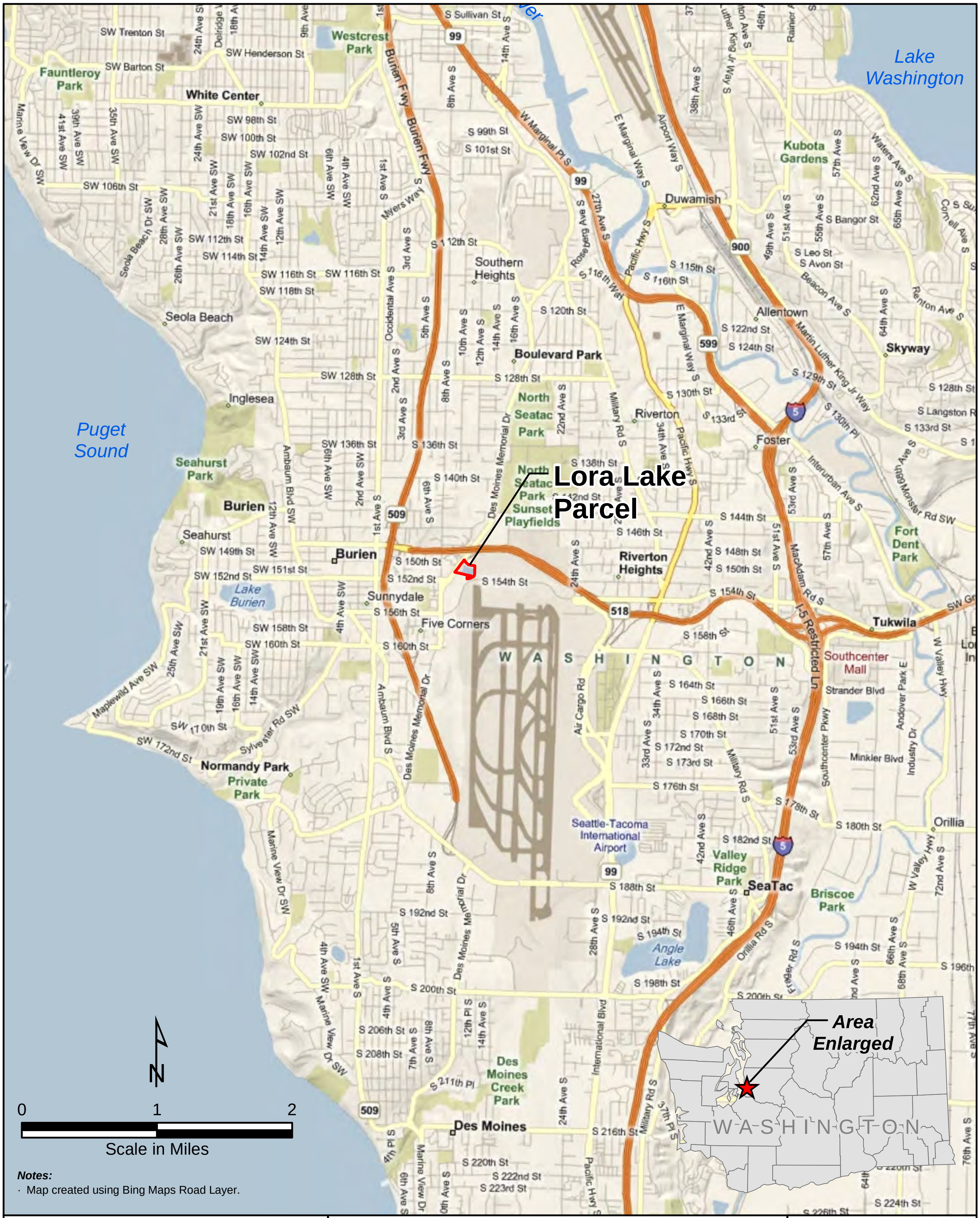
Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Figures



Notes:
- Map created using Bing Maps Road Layer.

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Sampling and Analysis Plan
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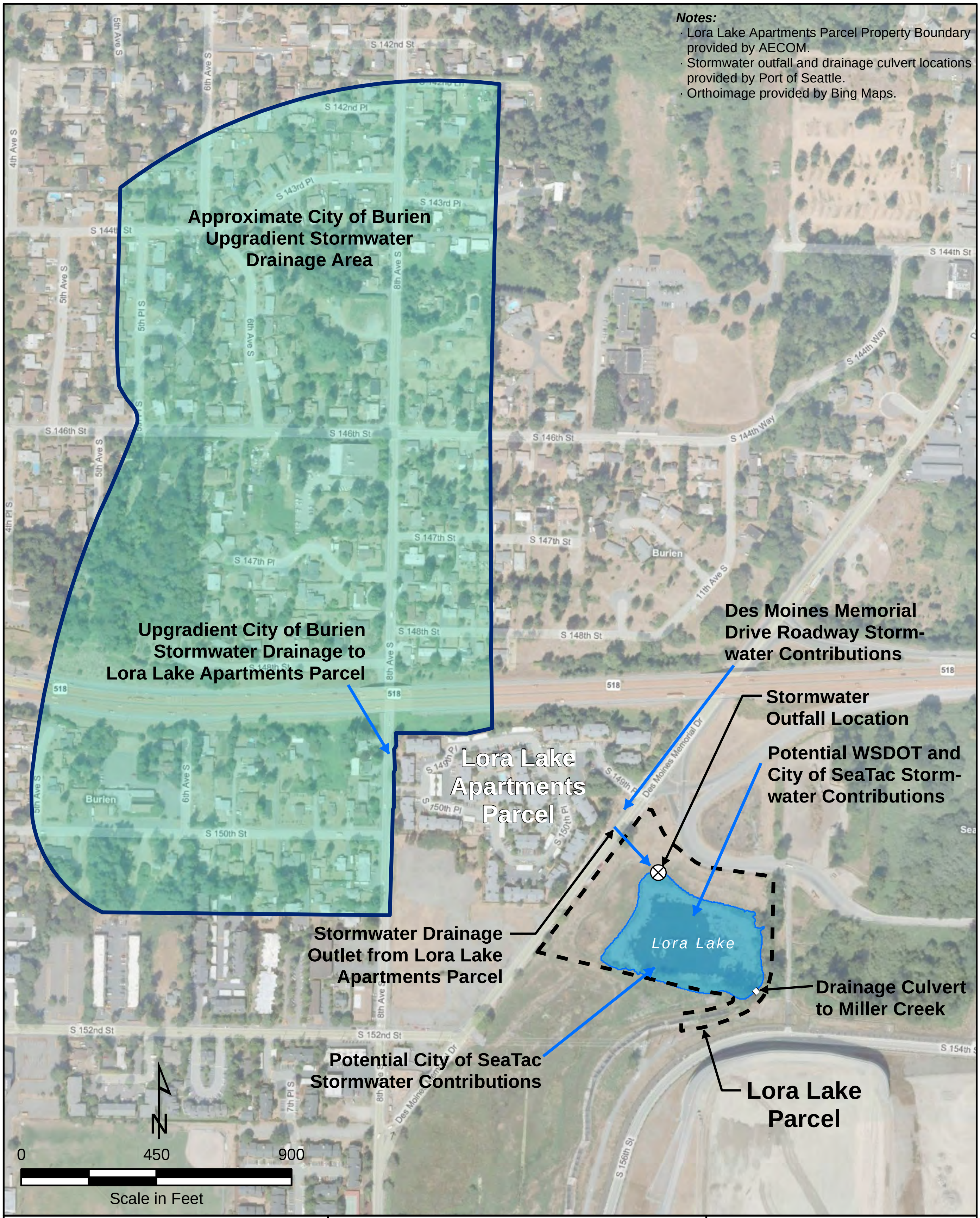
Lora Lake Parcel
SeaTac, Washington

Figure B.1
Vicinity Map

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure B.1 (Vicinity Map REV Jan 27 2011).mxd
Date: 1/27/2011



Notes:
- Lora Lake Apartments Parcel Property Boundary provided by AECOM.
- Stormwater outfall and drainage culvert locations provided by Port of Seattle.
- Orthoimage provided by Bing Maps.

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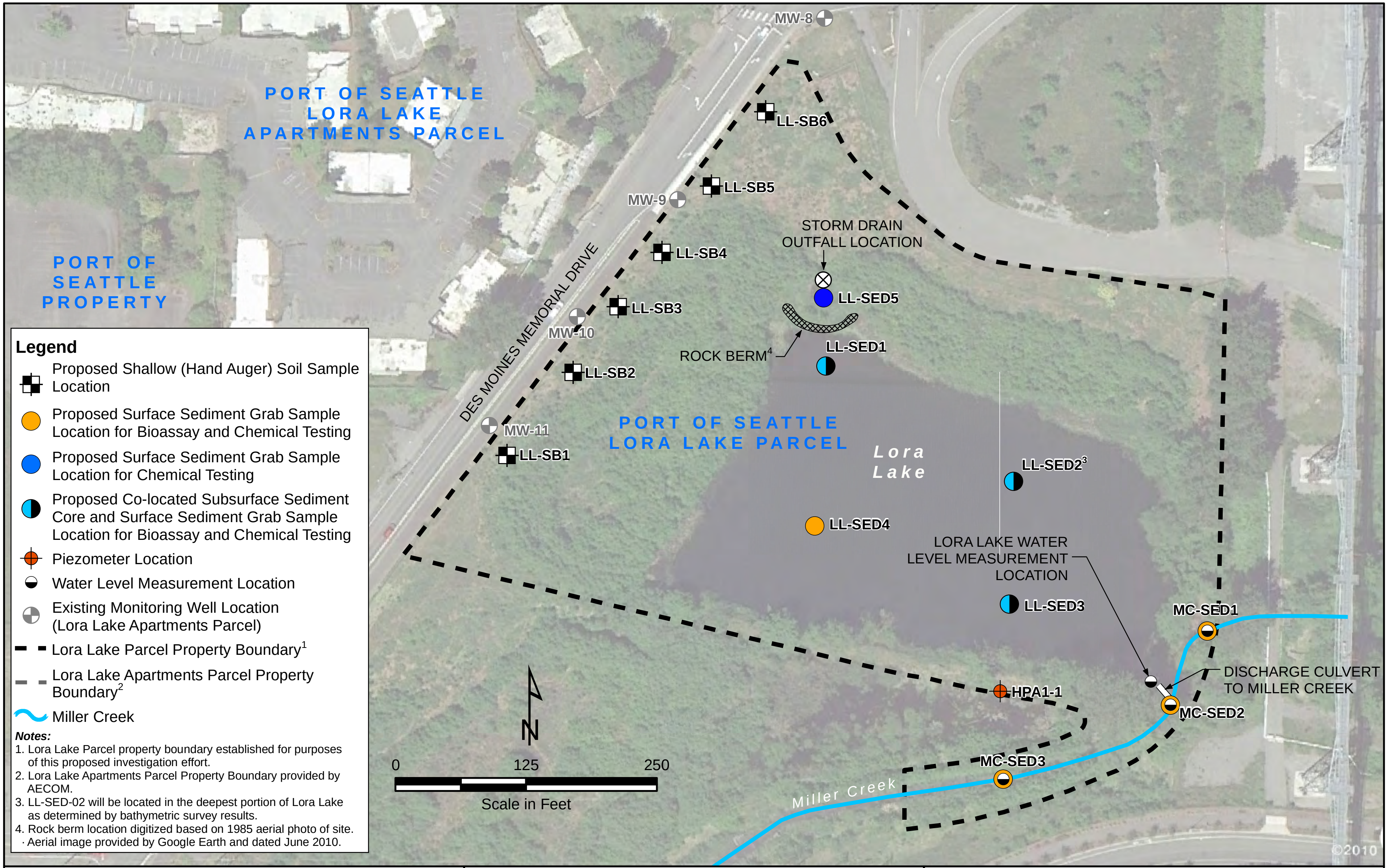
SeaTac, Washington

Figure B.2
Physical Drainage Features
and Stormwater Contribution
to Lora Lake

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure B.2 (Physical Drainage Features and Stormwater Contribution to Lora Lake REV Jan 27 2011).mxd
Date: 1/27/2011



Legend

- ⊞ Proposed Shallow (Hand Auger) Soil Sample Location
- ● Proposed Surface Sediment Grab Sample Location for Bioassay and Chemical Testing
- ● Proposed Surface Sediment Grab Sample Location for Chemical Testing
- ◐ Proposed Co-located Subsurface Sediment Core and Surface Sediment Grab Sample Location for Bioassay and Chemical Testing
- ⊕ Piezometer Location
- ◒ Water Level Measurement Location
- ◑ Existing Monitoring Well Location (Lora Lake Apartments Parcel)
- ▬ ▬ Lora Lake Parcel Property Boundary[1]
- ▬ ▬ Lora Lake Apartments Parcel Property Boundary[2]
- ∼ Miller Creek

Notes:

1. Lora Lake Parcel property boundary established for purposes of this proposed investigation effort.
2. Lora Lake Apartments Parcel Property Boundary provided by AECOM.
3. LL-SED-02 will be located in the deepest portion of Lora Lake as determined by bathymetric survey results.
4. Rock berm location digitized based on 1985 aerial photo of site.

· Aerial image provided by Google Earth and dated June 2010.

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Remedial Investigation/Feasibility Study
Sampling and Analysis Plan
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SeaTac, Washington

Figure B.3
Proposed Lora Lake Parcel
Sampling Locations

Path: F:\projects\POS-LL\GIS\MXD\T3030\Figure B.3 (Proposed Lora Lake Parcel Sampling Locations REV Jan 27 2011).mxd
Date: 2/1/2011

Port of Seattle
Lora Lake Parcel

Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Sampling and Analysis Plan/ Quality Assurance Project Plan

Attachments

List of Attachments

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 Ammonia (initiation & termination):
Overlying Sulfide (initiation & termination):
Overlying Dissolved Oxygen – daily (>2 mg/L):
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 (%):
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: ______________________ Project No: ______________________

Laboratory: ______________________ Responsible Technician: ______________________

Midge Species: ______________________ Test Method: ______________________

Date Sampled: ____________ Test Start Date: ____________ Completion Date: ____________

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 (12 per unit)? ______________

Light 16L:8D? ______________ Number of replicates per sample: ______________

Food 1 ml tetrafin daily? ______________ Avg. weight per animal: __NA__________________

If no, what food type: ______________ Any water quality adjustments: ______________

Age of organism at test initiation: ______________

Daily Monitoring Correct? ______________

Emergence: ☐ Yes ☐ No

Water renewal: ______________

Interstitial conductivity (initiation): ______________

Overlying Ammonia (initiation & termination): ______________ Overlying Temperature – daily (23 ºC): ______________

Overlying Sulfide (initiation & termination): ______________ Overlying Conductivity– daily: ______________

Overlying Dissolved Oxygen – daily (>2 mg/L): ______________ Overlying pH – daily (7 to 9) ______________

Aeration required? Date started ______________

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

Groundwater Level Monitoring Form

Project Name: ______________________ Monitoring Event: ______________________
Date: ______________________ Field Personnel: ______________________
Weather: ______________________

Well Information for Well:
Well Condition: ______________________ Time of Measurement: ______________
Depth to Water TOC (ft): ______________ Depth of well (ft): ______________
Well Diameter (inches): ______________ Feet of Water (ft): ______________
Product Observed: ☐ Yes ☐ No Product Thickness: ______________
Water level meter decontaminated prior to placement in well: ☐ Yes ☐ No

Well Information for Well:
Well Condition: ______________________ Time of Measurement: ______________
Depth to Water TOC (ft): ______________ Depth of well (ft): ______________
Well Diameter (inches): ______________ Feet of Water (ft): ______________
Product Observed: ☐ Yes ☐ No Product Thickness: ______________
Water level meter decontaminated prior to placement in well: ☐ Yes ☐ No

Well Information for Well:
Well Condition: ______________________ Time of Measurement: ______________
Depth to Water TOC (ft): ______________ Depth of well (ft): ______________
Well Diameter (inches): ______________ Feet of Water (ft): ______________
Product Observed: ☐ Yes ☐No Product Thickness: ______________
Water level meter decontaminated prior to placement in well: ☐ Yes ☐ No

Well Information for Well:
Well Condition: ______________________ Time of Measurement: ______________
Depth to Water TOC (ft): ______________ Depth of well (ft): ______________
Well Diameter (inches): ______________ Feet of Water (ft): ______________
Product Observed: ☐ Yes ☐ No Product Thickness: ______________
Water level meter decontaminated prior to placement in well: ☐ Yes ☐ No

ATTACHMENT B.3

SUBSURFACE SEDIMENT COLLECTION FORM AND LOG

Lora Lake Parcel Remedial Investigation
Date: ________________ Time: ________ ☐ am ☐ pm
Field Personnel: ________________
Weather: ________________

Sampling Location: ________________

Datum Horizontal: ________________

Datum Vertical: ________________

Lat/Northing: ________________

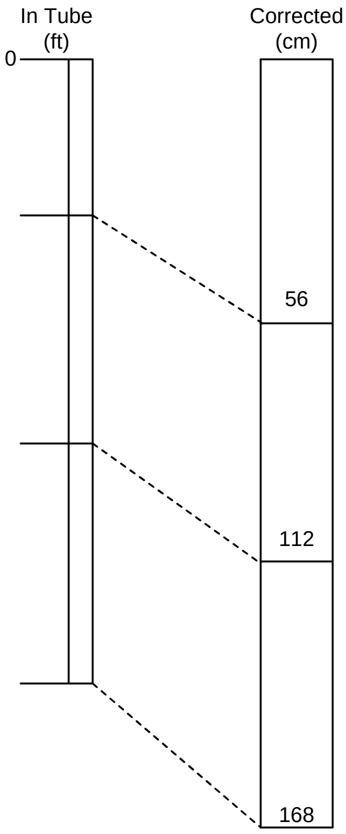
Long/Easting: ________________

Drive Method: Hand ☐ Slide Hammer ☐ Photograph: ☐ Yes ☐ No

Leadline Water Depth: ________ cm Core Tube Length: ________ cm

Drive Length: ________ cm Recovered Length: ________ cm

% Recovery (D/C x 100): ________



Drive Length (C)	Sample ID	Analytes*	Sediment Description Density, Moisture, Minor Constituents, Major Constituents, Odor, Organics, Sheen, Etc

*Note: See Table B.1 for Required Analytes

ATTACHMENT B.4

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:

ATTACHMENT B.5

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Auger ID:

Drill Date:
Logged By:
Drilled By:
Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

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

Client:
Project:
Task:
Address:

Remarks:

SHEEN	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		

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

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Remedial Investigation/ Feasibility Study Work Plan

Appendix C
Health and Safety Plan

Table of Contents

List of Attachments

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 inspections by boat, surveying of Lora Lake Parcel (LL Parcel) features, water level monitoring, a bathymetric survey in Lora Lake, subsurface sediment sample collection in Lora Lake, surface sediment sample collection in Lora Lake and Miller Creek, and shallow soil sample collection. This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. This plan consists of LL Parcel descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of LL Parcel zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel that will perform work at the LL Parcel. 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/ Supervisors' (HSO/S') 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 LL Parcel, or may be created as a result of proposed investigation activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of surrounding conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a condition that is not addressed by this HASP and have any questions or concerns about these conditions, they should immediately notify the HSO/S and an addendum will be provided to this HASP.

The HSO/S 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/S will conduct regular inspections to ensure that this HASP remains current with potentially changing conditions. The HSO/S has the authority to make health and safety decisions that may not be specifically outlined in this HASP, should these conditions warrant such actions. In the event that the HSO/S leaves the LL Parcel while work is in progress, an alternate Safety Officer (SO) 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/S prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with health and safety procedures. A copy of the HASP will be kept at the LL Parcel at all times.

2.0 Emergency Contacts and Information

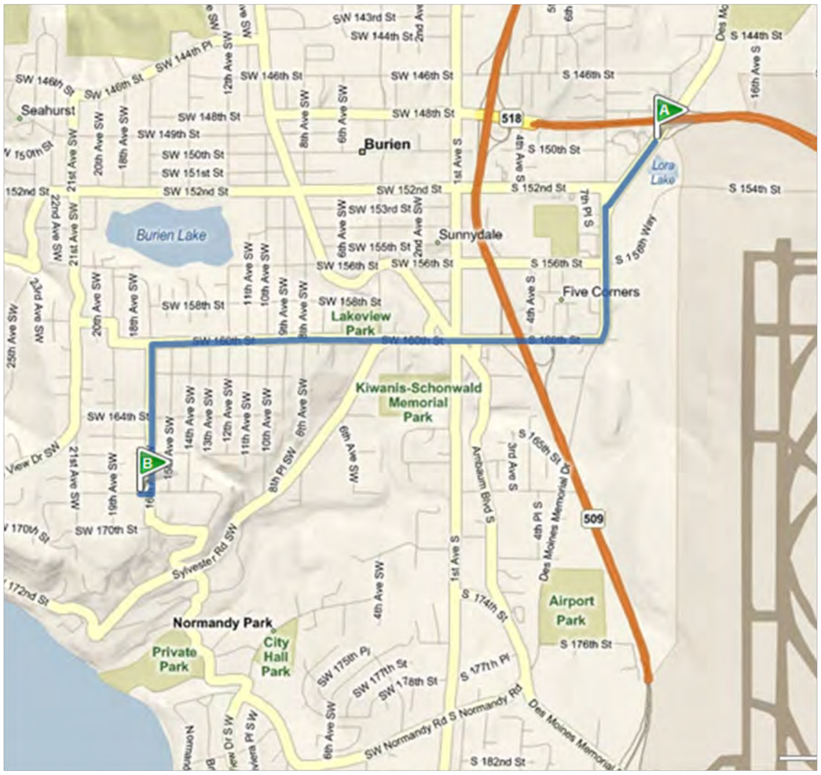
2.1 DIAL 911

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 C.1
Hospital Directions



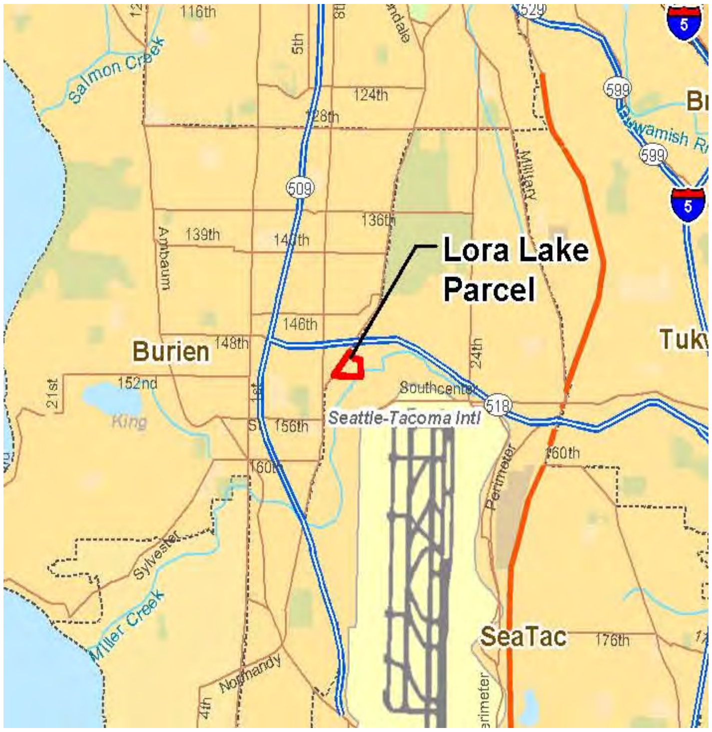
Leave LL Parcel Heading SOUTH on DES MOINES MEMORIAL DRIVE
Turn RIGHT onto SOUTHWEST 160th STREET, keep left
Turn LEFT onto 8th AVENUE SOUTHWEST
Turn LEFT into Hospital Emergency Room Entrance

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	
LL Parcel Location: Refer to Figure C.2 below for directions and map to the LL Parcel.	LL Parcel Opposite side of Des Moines Memorial Drive from 15001 Des Moines Memorial Drive Burien, WA (South of SR-518, West of SeaTac Airport) **LL Parcel:** the entrance to the LL Parcel is located on the east side of Des Moines Memorial Drive, SE of 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 C.2
Lora Lake Parcel Location



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
Jessi Massingale, Project Manager	(206) 292-2078	(206) 683-4307
Kate Snider, Principal		(206) 375-0762
Teri Floyd, Principal		(206) 713-1329
Erin Breckel, HSO/S		(425) 417-7895

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 LORA LAKE PARCEL BACKGROUND

Floyd|Snider will conduct field investigation and data collection activities on behalf of the Port of Seattle (Port) at the LL Parcel located in SeaTac, Washington, to the east of the Lora Lake Apartments Parcel (15001 Des Moines Memorial Drive in Burien, Washington). The LL Parcel consists of a Mitigation Area that is bounded to the north by State Route 518 (SR518), to the west by Des Moines Memorial Drive, to the east by 12th Avenue South, and to the south by 156th Avenue South (located directly north of SeaTac International Airport.

Access to the LL Parcel 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.

This investigation is being conducted in response to contamination encountered on the Lora Lake Apartments Parcel (LL Apartments Parcel) that may have come to be located at the LL Parcel. Contamination was encountered in both soil and groundwater at the LL Apartments Parcel.

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:

- Visual inspection of the shoreline of Lora Lake for any potential additional input sources (e.g., outfalls).
- Three rounds of water level measurements in Lora Lake, Miller Creek, and at an existing piezometer located between Lora Lake and Miller Creek. One round of water level measurement in existing monitoring wells east of Des Moines Memorial Drive.
- Bathymetric survey of Lora Lake.
- Subsurface sediment sample collection at locations within Lora Lake.
- Surface sediment sample collection at locations within Lora Lake and Miller Creek.
- Shallow soil sample collection within the Mitigation Area between Des Moines Memorial Drive and Lora Lake.

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4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The 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 LL Parcel. If the project scope changes, the PM will notify the HSO/S so that the appropriate addendum will be included in the HASP. The PM will ensure that all Floyd|Snider personnel performing work at the LL Parcel have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur at the property.

4.2 HEALTH AND SAFETY OFFICER AND SUPERVISOR

The HSO/S will approve this HASP and any amendments thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/S will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the LL Parcel. The HSO/S will specify required exposure monitoring to assess health and safety conditions, modify the HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/S will report all accidents and/or incidents to the PM. If the HSO/S observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/S will suspend all work until the hazard has been addressed.

4.3 SAFETY OFFICER

The Safety Officer (SO) may be a person dedicated to this task, to assist the HSO/S during field work activities. The SO will ensure that all personnel have appropriate personal protective equipment (PPE) at the LL Parcel and PPE is properly used. The SO will assist the HSO/S in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SO shall suspend all work activity. The SO will conduct safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SO 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/S or SO immediately. Employees will inform the HSO/S or SO 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 hazard briefing and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed LL Parcel soils or waste, sediment, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a emergency briefing and hazard orientation by HSO/S. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/S will have completed an 8-hour HAZWOP Supervisor training as required by WAC 296-843-20015. At least one person at the LL Parcel 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 at the Floyd|Snider office, and can be produced as needed for confirmation of training by contacting the Floyd|Snider office.

Additional LL Parcel-specific training that covers these hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/S before LL Parcel work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included in this HASP as Attachment C.1 or in the field logbook maintained by personnel at the LL Parcel.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial 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 LL Parcel 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 water level monitoring, the bathymetric survey, subsurface sediment core installation and sample collection, surface sediment sample collection, and shallow soil sample collection. Based on LL Parcel investigation information from the LL Apartments Parcel, the following chemicals may have migrated from the LL Apartments Parcel and be present at the LL Parcel, and have been retained as LL Parcel contaminants of concern (COCs):

- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in sediment, soil, and groundwater.
- Pentachlorophenol (PCP) in sediment, soil, and groundwater.
- Dioxins in sediment, soil, and groundwater.
- Arsenic in sediment, soil, and groundwater.
- Lead in sediment, soil, and groundwater.
- Diesel range and heavy oil range hydrocarbons in soil and groundwater.
- Gasoline range hydrocarbons in soil and groundwater.
- Volatile organic compounds (VOCs)—tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE) and1,2-dichloroethane (1,2-DCA)—in surface sediment, 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 LL Parcel activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during LL Parcel work is ingestion of contaminated sediment or soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals that may be encountered at the LL Parcel 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 the LL Parcel. 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 in Lora Lakes Apartment Parcel	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	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 in Lora Lakes Apartment Parcel**	**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.
Cis-1,2-Dichloroethene	200 ppm	Not Detected	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes; central nervous system depression; respiratory system damage.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration in Lora Lakes Apartment Parcel	Routes of Exposure	Potential Toxic Effects
Trans-1,2-Dichloroethene	200 ppm	Not Detected	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes; central nervous system depression; respiratory system damage.
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.
Carbon dioxide (pressurized)	5000 ppm / 30,000 ppm	Not applicable	Inhalation, Dermal contact, eye contact	Headache, dizziness, respiratory system distress, increased heart rate, blood pressure, frostbite.
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, particularly pressurized carbon dioxide for the freeze-core sampling. When on-property 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 LL Parcel, 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 personnel should plan all activities before starting any task. LL Parcel personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/S 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—steel-toed boots, high-visibility vests, personal flotation 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 at the LL Parcel during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
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 at the LL Parcel. 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 at the LL Parcel. 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 and sediment 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 or decontamination.
Mechanical hazards	Heavy materials such as sediment core tubes, slide hammers, etc.	Ensure the use of competent operators. Sub-contractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear OK before approaching or working near equipment. Floyd|Snider will minimize the number of staff present on the sampling vessel while freeze core sampling.
Noise damage to hearing	Activity 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 at the LL Parcel to document noise exposure.

Hazard	Cause	Prevention
Strains from improper lifting or twisting	Injury due to improper lifting techniques, over-reaching/ overextending, lifting overly heavy objects, twisting during hand auger use.	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. 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. Avoid quick, jerky movements and twisting motions while lifting or using the hand auger.
Heat Stress	Hot temperatures and related exposure.	Workers will ensure appropriate clothing, take rest breaks in a shaded or cooled environment, and drink water to stay hydrated. Further detail on heat stress is provided in Section 5.3.2.
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.
Traffic hazards	Vehicle traffic and hazards when working near public right-of-ways.	When working near the LL Parcel on the shoulder of the road, signs, signals, and/or barricades will be placed around the work area. High visibility reflective neon / orange vests safety vests will be worn at all times while conducting work away from the LL Parcel. Multiple field staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible.

Hazard	Cause	Prevention
Biohazards	Bees and other insects, urban wildlife.	Persons with allergies to bees will make the HSO/S 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/S and seek first aid, if necessary. LL Parcel 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 monitoring wells.
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 the late fall/winter and spring months and 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, personnel will stay dry and avoid exposure. LL Parcel personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. LL Parcel 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. LL Parcel 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.

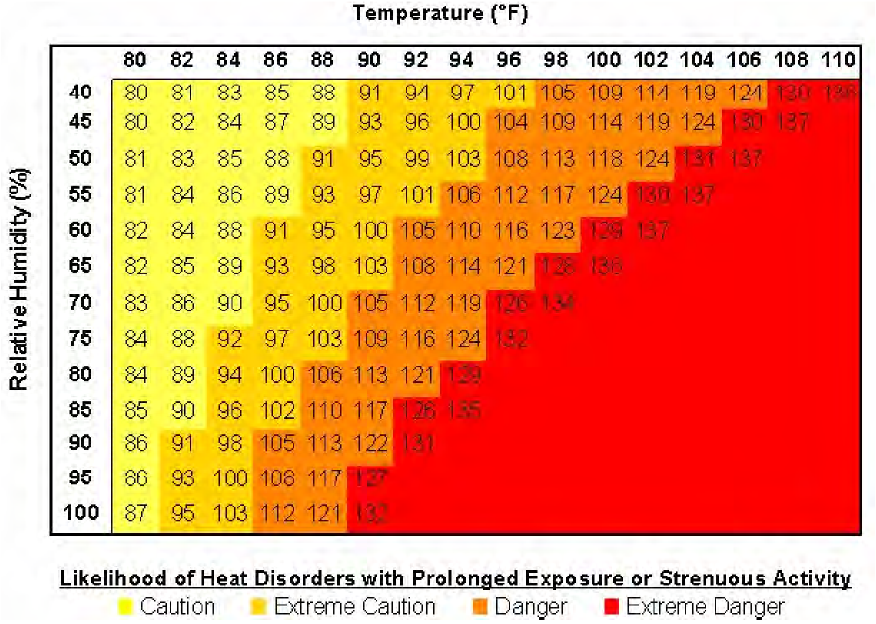
Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/S.

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.

Condition	Signs/Symptoms	Treatment
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 LL Parcel temperatures are forecast to exceed 85°F and physically demanding work will occur in impermeable clothing, the HSO/S 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/S 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/S and seek first aid, if necessary.

LL Parcel 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-property 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 Lora Lake Parcel Monitoring

The following sections describe LL Parcel monitoring techniques and equipment that are to be used during LL Parcel field activities. The HSO/S, or a designated alternate, is responsible for LL Parcel control and monitoring activities.

6.1 LORA LAKE PARCEL MONITORING

Air monitoring will not be conducted, as previous investigations at the LL Apartments Parcel, where industrial activities were conducted that may have been a potential source to contamination identified on the LL Parcel have adequately characterized the type and concentrations of chemicals possibly present at the LL Parcel. Of the COCs listed above in Section 5.1, gasoline, diesel, PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and 1,2-DCA are the only volatile chemicals present. Visual monitoring for dust will be conducted by the HSO/S 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 previously encountered at the LL Apartments Parcel are orders of magnitude lower than the exposure limits developed by OSHA. Since the concentrations of VOCs at the LL Parcel are expected to be lower, and all work will be conducted outdoors in an open-air ventilated environment, vapor concentrations are not expected to exceed allowable levels.

The HSO/S will visually inspect the work area 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
Physical inspection and bathymetric survey of Lora Lake	Chemical hazards include potential dermal or eye exposure to contaminants in surface water. 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.
Water level measurements in Lora Lake, Miller Creek, and groundwater monitoring wells	Chemical hazards include potential dermal or eye exposure to contaminants in surface or groundwater. Physical hazards include slip, trip, or fall hazards; traffic hazards; heat and cold exposure hazards; and biological hazards.
Sediment Sample Collection from Lora Lake and Miller Creek	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, noise hazards, biological hazards, and drowning while conducting field activities on the lake.
Soil Sample Collection using hand augers	Lifting/twisting hazards; dust inhalation hazards; potential dermal or eye exposure to contaminants in soil; fall hazards; traffic hazards; heat and cold exposure hazards.
Equipment Decontamination	Fall hazard from slippery or uneven surfaces, dermal or ingestion exposure to potentially contaminated sediments, soils or decontamination water, heat and cold exposure hazards.

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8.0 Personal Protective Equipment

Sediment sample collection oversight will proceed in modified Level D PPE, which shall include steel-toed rubber boots, eye protection, gloves, and water-protective outer work clothing.

Soil sample collection and water level monitoring will proceed in Level D PPE, which shall include steel-toed boots, eye protection, gloves, and sturdy cotton outer work clothing or removable cotton outer clothing.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/S whenever warranted by conditions present in the work area. The HSO/S will periodically inspect equipment such as gloves and hard hats for defects.

High visibility vests will be worn when working off-property on road shoulders.

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9.0 Lora Lake Parcel Control and Communication

9.1 CONTROL

The LL Parcel is fenced, and pedestrians and other unauthorized personnel will not be allowed in the work areas. Access to the work area will be restricted to designated personnel. The purpose of LL Parcel control is to minimize the public's potential exposure to 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-property 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 LL Parcel investigation activities, and transfer of contaminated media from one area of the LL Parcel to another. The support zone (SZ) for the LL Parcel 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 LL Parcel. Only authorized personnel shall be permitted access to the EZ/CRZ. For work being conducted outside the limits of the LL Parcel (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.

9.2 COMMUNICATION

All LL Parcel work will occur in teams and the primary means of communication on-property and with off-property 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-property spread of contaminated sediment, soil or water. The HSO/S 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 LL Parcel. It will be rehearsed with all LL Parcel personnel and reviewed whenever the plan is modified or the HSO/S believes that LL Parcel personnel are unclear about the appropriate emergency actions.

A muster point of refuge (that is clear of adjacent hazards and not located downwind of LL Parcel investigation activities) will be identified by the HSO/S and communicated to the field team each day. In an emergency, all LL Parcel personnel and visitors will evacuate to the muster point for roll call. It is important that each person on-property 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-property 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 LL Parcel 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/S.

- 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-property personnel to a safe place in an upwind direction until the HSO/S 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-property 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-property and functional at all times:

- First Aid Kit—contents approved by the HSO/S, including two blood borne pathogen barriers.
- 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/S, or a designated alternate, will be responsible for keeping attendance lists of personnel present at LL Parcel 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/S if LL Parcel conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

Port of Seattle
Lora Lake Parcel

Remedial Investigation/ Feasibility Study Work Plan

Attachment C.1
Daily Tailgate Safety Meeting Form

Attachment C.1
Daily Tailgate Safety Meeting

Date: ________ Time: ________________________

Project Name: Lora Lake Parcel 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 Parcel

Remedial Investigation/ Feasibility Study Work Plan

Attachment C.2
Material Safety Data Sheets

CUSTOMER P.O. NO. K300660

DATE 10/30/00 **MATERIAL SAFETY DATA SHEET** PAGE 1

SECTION I -GENERAL INFORMATION

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO 1486650
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
C20H12 N/A N/A
50 MG/KG SUBCUTANEOUS RAT SEE FOOTNOTE(2,8)
METHANE, DICHLORO-
METHYLENE CHLORIDE 99.98 75-09-2
CH2C12 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
C02
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.

DATE 10/30/00 MATERIAL SAFETY DATA SHEET

CATALOG NO 48755-U (REORDER PRODUCT BY THIS NO.)
PRODUCT NAME PAH KIT 610-S
DATA SHEET NO I486650
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 CH2Cl2 EXPOSURE.
INCREASED SENSITIVITY OF THE HEART TO ADRENALIN MAY BE CAUSED BY OVEREXPOSURE TO CH2Cl2.

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

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.

CH_2CL_2 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

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

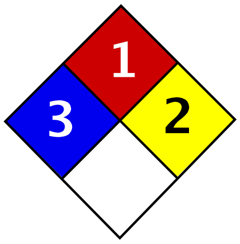
CAUTION: SUBSTANCE NOT YET FULLY TESTED.
HIGHLY FLAMMABLE
TOXIC
R 11
HIGHLY FLAMMABLE.
R 23/24/25
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
S 16
KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE 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.



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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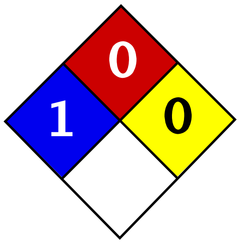


Health	1
Fire	0
Reactivity	0
Personal Protection	E

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.
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
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.

Created: 10/10/2005 08:21 PM

Last Updated: 11/06/2008 12:00 PM

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
Acute oral LD50 (rats): 9 ml/kg
Primary dermal irritation: extremely irritating (rabbits)
Draize eye irritation: non-irritating (rabbits)
Guinea pig sensitization: negative

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

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.

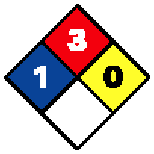
Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

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 ^{o}F (-43^{o}C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 ^{o}F (>280 ^{o}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 ^{o}F (39 to 200 ^{o}C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 ^{o}F (38 ^{o}C) (275-475 mm Hg @ 68 ^{o}F (20 ^{o}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 ^oF). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^oF); 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)

PLACARD:

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

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

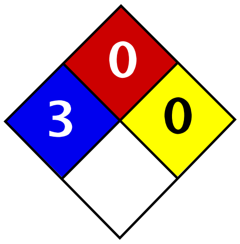
ACRONYMS:

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.

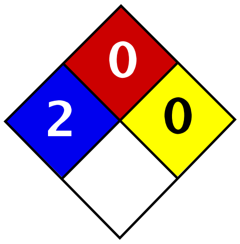
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 11:12 AM

Last Updated: 11/06/2008 12:00 PM



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: C2-Cl4

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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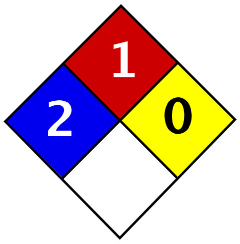

Health	2
Fire	1
Reactivity	0
Personal Protection	H

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

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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
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.

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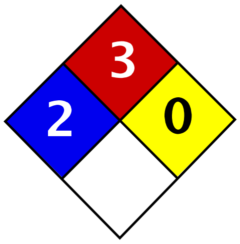

Health	2
Fire	3
Reactivity	0
Personal Protection	H

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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Last Updated: 11/06/2008 12:00 PM

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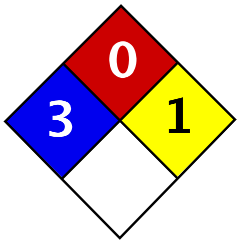

Health	3
Fire	0
Reactivity	1
Personal Protection	

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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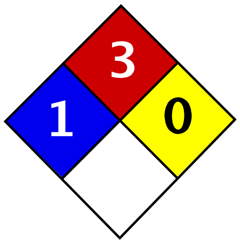

Health	2
Fire	3
Reactivity	0
Personal Protection	H

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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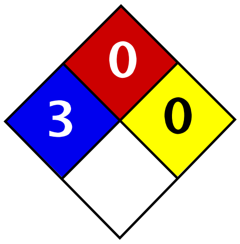

Health	3
Fire	0
Reactivity	0
Personal Protection	J

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: $NaHSO_4$

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
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 H2SO4.

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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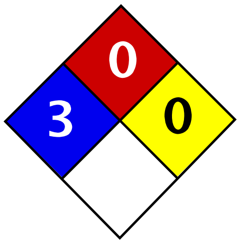

Health	3
Fire	0
Reactivity	0
Personal Protection	

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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