Public Review Draft Final Remedial Investigation Report

7100 1st Avenue South Site
Seattle, Washington

for
7100 1st Ave. S. Seattle LLC

August 19, 2019

GeoEngineers
Earth Science + Technology

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File No. 0275-015-02

August 19, 2019

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

ABBREVIATIONS AND ACRONYMS

7100 LLC	7100 1st Ave. S. Seattle LLC
AET	apparent effect threshold
Agreed Order	Agreed Order No. DE 8258
ARI	Analytical Resources Inc.
ASTM	ASTM International
bgs	below ground surface
CAS	Columbia Analytical Services
Cascade	Cascade Drilling, PL
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	conversion factor
CLARC	Cleanup Levels and Risk Calculations Volume 3.1
COPC	contaminant of potential concern
CSL	cleanup screening levels
CSM	conceptual site model
Cw	groundwater concentration protective of sediment
D&M	Dames & Moore
DCAP	Draft Cleanup Action Plan
DEA	David Evans Associates, Inc.
DF	dilution factor
DOF	Dalton, Olmsted & Fuglevand, Inc.
DP	direct-push
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
EPA	United States Environmental Protection Agency
f_{OC}	fraction organic carbon
FS	Feasibility Study
GC/MS	gas chromatography/mass spectrometer
GeoEngineers	GeoEngineers, Inc.
GIS	geographic information system
GPR	ground penetrating radar

HA	hand auger
HCID	hydrocarbon identification
HSA	hollow-stem auger
H:V	horizontal to vertical
ICS	Industrial Container Services-WA, LLC
K_{OC}	soil organic carbon-water partitioning coefficient
K_d	distribution coefficient (soil-water portioning coefficient)
LDW	Lower Duwamish Waterway
MHHW	mean higher high water
MLLW	mean lower low water
MOU	Memorandum of Understanding
MTCA	Model Toxics Control Act
NAD83/07	North American Datum 1988 and 2007
NAVD88	North American Vertical Datum 1988
NTU	nephelometric turbidity unit
PID	photoionization detector
Property	7100 1st Avenue South Property
PQL	practical quantitation limit
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RI	remedial investigation
RM	river mile
ROD	Record of Decision
SAIC	Science Applications International Corporation
SCO	sediment cleanup objectives
SCUM II	Sediment Cleanup Users' Manual II
Site/7100 Site	7100 1st Avenue South Site
SL	screening level
SMS	Sediment Management Standards
SPU	City of Seattle Department of Public Utilities
SR99	State Route 99
SW-IN	stormwater samples collected from the influent

SW-OUT	stormwater collected from the treatment system effluent
TDS	total dissolved solids
TEE	terrestrial ecological evaluation
TEQ	toxicity equivalency
TOC	total organic carbon
TPH	total petroleum hydrocarbon
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UST	underground storage tank
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

UNITS OF MEASURE

cm	centimeter
ft	feet
ft/day	feet per day
gpd/ft	gallons per day per foot
gpd/ft^2	gallons per day per square foot
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ppm	parts per million
µg/kg	microgram per kilogram
µg/L	microgram per liter

CHEMICALS

BETX	benzene, ethylbenzene, toluene, and xylenes
cPAH	carcinogenic polycyclic aromatic hydrocarbons
LNAPL	light non-aqueous phase liquid
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
SVOCs	semi-volatile organic compounds
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

Introduction

This remedial investigation (RI) report has been prepared for 7100 1st Ave. S. Seattle LLC (7100 LLC) to meet the requirements of the 2011 Agreed Order No. DE-8258. Work was completed in general accordance with the scope of work described in the Washington State Department of Ecology (Ecology)-approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan. The purpose of the RI was to evaluate the nature and extent of chemical contamination at the 7100 1st Avenue South Site (Site, or 7100 Site) and associated human and ecological health risks. The Site includes, and is limited to, the 7100 1st Avenue South property (Property).

Site Description

The Site has approximately 700 feet of frontage along the Lower Duwamish Waterway (LDW) and approximately 480 feet along the Trotsky Inlet. A majority of the shoreline is covered with concrete riprap and/or quarry spalls. A soil berm rises above the riprap and contains a narrow (approximately 3 to 10 feet wide) riparian zone adjacent to the Trotsky Inlet that is vegetated with grasses, Himalayan blackberry, shrub willow and alder. The upland portion of the Site is relatively flat with a slight downward slope toward the LDW (to the east).

To the south of the Site is the Industrial Container Services (ICS) property, which encompasses the majority of the Trotsky Inlet. The ICS property is the location of a historic and present-day drum refurbishing business. The ICS property is the subject of a separate RI being performed under a Model Toxics Control Act (MTCA) agreed order by Herman and Jacqualine Trotsky and Industrial Container Services – WA, LLC. Selected environmental data from the ICS RI are incorporated in this RI (the RI for the 7100 Site) to support development of the conceptual site model (CSM).

Prior to 1969, the footprint of the 7100 Site was part of the LDW tidal marshland. Between 1960 and 1969, dredge materials and/or construction debris were reportedly used as fill to create the upland portion of the present-day Site. Subsurface conditions beneath the Site reflect this filling history; fill that ranges in thickness from about 10 to 25 feet overlies native soil that was once part of the LDW tide flat. Historic industrial activities such as drum reconditioning occurred on the nearby ICS property as early as the 1930s, and before fill was placed to produce the 7100 Site. The nature and extent of contamination at the Site is described (below) within the context of the shallower fill versus the deeper native soil units.

The 7100 Site was developed for industrial use after the upland property was produced by the waterfront filling activities described above. Between approximately 1969 and 1977, the southern portion of the property was occupied by a ready-mix concrete plant, while the northern portion of the property was used as a cargo terminal and as a sand and gravel batch plant. In 1978 a 100-foot by 50-foot addition to the existing warehouse/garage building and a stormwater drainage system was constructed and the property was paved with asphalt and concrete. Between 1978 and 1984, the property was primarily used for school bus maintenance, including the use of two 10,000-gallon gasoline underground storage tanks (USTs), a 10,000-gallon diesel UST and associated fuel dispensers. In 1984, Alaska Marine Lines began using the Property as a freight management facility for the transfer of shipping containers between barges and trucks, and for container and equipment storage. One gasoline UST was reportedly removed from the property in 1986, and the remaining gasoline and diesel USTs were removed from the property in 1991.

Previous Investigations and Cleanup Actions

Environmental investigations began at the Site in 1990 in the vicinity of the USTs. Soil, soil vapor and groundwater explorations were completed at that time. Total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs) including benzene, toluene and xylenes, and polyclyclic aromatic hydrocarbons (PAHs) were detected in soil at concentrations exceeding applicable screening levels. TPH, benzene, ethylbenzene, toluene and xylenes (BETX) were detected in groundwater at concentrations exceeding screening levels. The footprint of the TPH and BETX screening level exceedances in groundwater were limited to the vicinity of the USTs and did not extend to the shoreline.

In response to the investigations described above, the remaining USTs were removed from a single excavation at the Site (in 1991). Soil conditions at the base of the UST excavation were evaluated by collecting a single soil sample; petroleum hydrocarbon concentrations were less than screening levels in this sample. Soil removed from the excavation was used to backfill the excavation after the USTs were removed.

Groundwater in the vicinity of the former USTs was sampled for four quarters after the USTs were removed. Gasoline- and diesel-range hydrocarbon concentrations in most groundwater samples were lower than MTCA cleanup levels in effect at that time, with few exceptions. BETX concentrations exceeded screening levels by a greater magnitude and across a broader footprint.

Remedial Investigation Scope

The scope of this RI included investigations to fill data gaps identified in the RI/FS Work Plan (GeoEngineers 2013). The investigation data was used to evaluate the nature and extent of contamination for the purpose of developing and evaluating cleanup alternatives. The RI Work Plan included investigations of soil, groundwater, stormwater and storm drain solids.

Soil sampling activities included the completion of hand auger explorations near the northern shoreline of the Trotsky Inlet, hollow-stem auger explorations in the northeastern portion of the Site, and direct-push explorations in the vicinity of the former USTs. Soil boring locations were selected to address specific data gaps and provide general spatial coverage of the Site. Soil samples collected from the explorations were submitted for chemical analysis of the contaminants of potential concern (COPCs) identified in the RI/FS Work Plan, including metals, semivolatile organic compounds (SVOCs), VOCs, polychlorinated biphenyls (PCBs), pesticides, and petroleum hydrocarbons.

Groundwater investigations were completed to define the nature and extent of groundwater contamination and evaluate groundwater flow characteristics at the Site. New and existing groundwater monitoring wells, as well as groundwater seeps in the inland reach of the Trotsky Inlet were sampled for four quarters and analyzed for the same COPCs as soil samples. In addition, parameters such as chloride, total dissolved solids, dissolved oxygen, oxidation-reduction potential, and salinity were measured to evaluate overall groundwater conditions.

The RI also included an investigation of the layout and condition of the Site stormwater system. Stormwater quality was evaluated by collecting stormwater samples and analyzing them for the COPCs described above. The RI scope also included sampling and analysis of catch basin solids; however, storm drain solids were not present in the catch basins during RI sampling activities.

Nature and Extent of Contamination

The nature and extent of contamination on and adjacent to the Site was evaluated using available data from previous investigations, as well as data collected during the RI. In addition, data collected by other parties as part of the RI for the adjacent ICS site were used to develop a more comprehensive CSM for the 7100 Site.

Potential risks to human health and the environment associated with Site chemicals were evaluated by comparing the RI data to screening levels (SLs) developed in accordance with MTCA (Washington Administrative Code [WAC] 173-340-720 through 740). SLs selected to evaluate potential upland exposures are based on unrestricted land use even though the Site is used for industrial purposes. This is a conservative approach used for screening the RI data, although more appropriate land use assumptions will be considered when evaluating potential cleanup actions. Soil and groundwater SLs developed for the RI include values protective of off-site receptors (sediment and surface water), including criteria recently proposed by Ecology for upland sites adjacent to the LDW (Ecology 2017).

The data screening process identified several chemicals in Site soil and groundwater that have been observed at concentrations exceeding their respective SLs. These chemicals are considered to be COPCs and belong to the following chemical groups: petroleum hydrocarbons, VOCs, SVOCs, PAHs, PCBs, pesticides and metals. All chemicals on the COPC list were evaluated based on their frequency of detection, the magnitude by which they exceeded their respective SL (an indicator of risk) and geographic footprint of occurrence. This screening process reduced the COPC list to a subset of chemicals defined as contaminants of concern (COCs). These COCs are the most prevalent chemicals at the Site and pose the greatest risk to human health and the environment. COCs defined by this process include gasoline- and diesel/heavy oil-range hydrocarbons, three VOCs, two SVOCs, carcinogenic PAHs (cPAH), three non-carcinogenic PAHs, PCBs and numerous pesticides. These COCs encompass the footprint of all COPCs at the Site.

The nature and extent of contamination at the Site can be broadly described in terms of the shallower fill unit and the deeper native soil unit. Petroleum-related contamination associated with the former on-site USTs is present in the fill unit. A broader spectrum of contaminants unrelated to Site activities is present in the underlying native soil unit. This deeper contamination appears to have originated from historical (drum refurbishing) operations on the ICS property south of the Site. Contaminant releases from the ICS site apparently impacted the original tide flats beneath the 7100 Site before the Site existed. Contamination associated with the off-site (ICS) source includes all of the 7100 Site COCs (PCBs, pesticides, PAHs and petroleum-related compounds).

With few exceptions, the petroleum-related contamination associated with historical Site activities occurs in the area surrounding the former on-Site garage and USTs. SL exceedances of these COCs, however, are sporadic and inconsistent even in the vicinity of the former USTs. This indicates that contaminants have been naturally degrading over a long period of time since the source was removed. The RI data further indicates that the petroleum-related contamination associated with the former USTs does not pose a risk to surface water and sediment in the adjacent LDW.

All of the COCs are present in the deeper native soil unit, reflecting impacts to the LDW mudflat sediment prior to placement of fill to construct the Property. This deeper unit contains petroleum-hydrocarbons, PAHs, PCBs and pesticides at concentrations significantly greater than SLs. These COCs also are present at some locations in the overlying fill unit, but the general vertical (upward) decrease of concentrations indicates

that the source of these COCs in Site fill is the underlying, more heavily contaminated native soil unit. These COCs also have substantially greater concentrations at the Trotsky Inlet and ICS site, located south of the 7100 Site. This combination of lateral and vertical concentration gradients suggests that deeper contamination beneath the 7100 Site and adjacent Trotsky Inlet likely originated from historical releases at the nearby drum refurbishing facility (ICS site).

Unlike petroleum-related contamination at the Site, PCBs and pesticides exceed groundwater SLs in a more widespread area, including locations near the Site boundary (adjacent to the LDW and Trotsky Inlet shorelines). The highest concentrations of PCBs and pesticides in groundwater have been observed at a groundwater seep on the south side of the Trotsky Inlet and beneath the adjacent ICS site further south, further suggesting that the ICS site is the likely source of these COCs.

Potential Exposure Pathways and Receptors

Potential exposure pathways at the Site are best described in terms of contaminant sources: the shallower petroleum-related contamination associated with former on-Site USTs versus the deeper contamination associated with off-site (ICS) activities.

Potential exposures to the UST-related contamination are limited to direct contact with petroleum-related soil contamination at depths shallower than 15 feet below ground surface (bgs) in the vicinity of the former USTs. This depth (15 feet bgs) is the standard point of compliance under MTCA for the direct contact exposure pathway, and there are few SL exceedances in this depth range. Petroleum-related groundwater contamination in the vicinity of the USTs does not pose a risk to humans because Site groundwater is non-potable. In addition, this groundwater contamination does not pose a risk to humans or ecological receptors via exposures to sediment or surface water adjacent to the 7100 Site.

There is a potential direct contact exposure pathway to deeper contamination associated with historical releases from the ICS site. People on the 7100 Site could potentially be exposed to this contamination at locations where it is shallower than 15 feet bgs. Most of the ICS-related contamination, however, is deeper than 15 feet bgs. ICS-related contamination in groundwater beneath the 7100 Site does not pose a risk to human health because Site groundwater is non-potable, as described above. Some ICS-related groundwater contamination (PCBs and pesticides) appears to extend to the shoreline beneath the southern portion of the 7100 Site at concentrations that exceed groundwater SLs based on the protection of surface water and/or sediment. This suggests that aquatic organisms could potentially be exposed to PCBs and pesticides in surface water and/or sediment adjacent to the Site. Humans and higher trophic level ecological receptors also could potentially be exposed to these contaminants via the food chain.

1.0 INTRODUCTION

This report presents the results of the remedial investigation (RI) completed for the 7100 1st Avenue South Site (the "7100 Site" or "Site") located in Seattle, Washington (Figure 1). RI activities were performed by 7100 1st Ave. S. Seattle LLC ("7100 LLC") pursuant to Washington State Department of Ecology (Ecology) Agreed Order DE 8258 (Agreed Order). The 7100 Site as currently defined in the Agreed Order is generally located at 7100 2nd Avenue SW (Figure 1), alternatively referred to as 7100 1st Avenue South, on the western bank of the Lower Duwamish Waterway (LDW) and is listed in the Ecology database as Facility/Site No. 97573251. The LDW has been designated as a Superfund site for sediments by the United States Environmental Protection Agency (EPA). Ecology is working with EPA to identify and manage upland sources of contamination to the LDW. The 7100 Site has been identified by Ecology as requiring additional investigation as part of this process.

The 7100 Site is located on the LDW waterfront. It is situated on upland that was produced in the 1960s by placing fill along the LDW intertidal shoreline. The 7100 Site has been used for industrial purposes associated with the loading of barges, a ready-mix concrete facility, transfer of aggregates, school bus parking and bus maintenance. Historical facilities located at the 7100 Site have included underground storage tanks (USTs), fueling islands and bus maintenance facilities. Currently, the 7100 Site is being used as a staging area and auxiliary storage facility for shipping containers, intermittent storage of bulk materials, and as a temporary covered work space for equipment repairs.

Previous environmental investigations conducted by 7100 LLC and other parties have identified detectable concentrations of metals, polychlorinated biphenyls (PCBs), pesticides, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), and/or petroleum hydrocarbons in soil and groundwater.

Pursuant to the Agreed Order, this RI report has been prepared by compiling data collected during current RI activities, previous environmental investigations conducted at the 7100 Site, as well as data collected on adjacent sites including the LDW. Investigation activities were performed by 7100 LLC in accordance with the Ecology-approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan (GeoEngineers 2013) under Agreed Order DE 8258.

1.1. Purpose of the RI

The purpose of the RI is to evaluate existing and new environmental data to characterize the nature and extent of contamination at the Site, including data collected to address data gaps identified in the RI/FS Work Plan. Sampling and analysis has been performed to evaluate the presence of multiple chemical groups, including metals (arsenic, cadmium, total chromium, copper, lead, mercury, nickel, silver and zinc), petroleum hydrocarbons, SVOCs, VOCs, and/or PCBs. The results of the RI will be used to prepare a FS that will identify and evaluate cleanup action alternatives, and present the preferred cleanup alternative for addressing site contamination.

The following terminology is used in this report:

- 7100 1st Avenue South Property ("Property"): Land owned and operated by 7100 LLC at 7100 1st Avenue South, as shown on Figure 2. A small parcel south of the Trotsky Inlet owned by 7100 LLC is not subject to this RI.

- 7100 1st Avenue South Site ("7100 Site" or "Site"): The 7100 Site was defined in the 2011 Agreed Order as approximately the full extent of contamination caused by the release of hazardous substances at the Site. The limits of the 7100 Site are currently delineated as equivalent to the limits of the Property, as shown on Figure 2.
- Washington State Department of Transportation Lease Area ("WSDOT Lease Area"): Land owned by WSDOT located west of the Property and east of 1st Avenue South that is being leased to 7100 LLC to support current facility operations (Figure 2). This parcel is not a portion of the 7100 Site as defined in the 2011 Agreed Order.
- Lower Duwamish Waterway Superfund Site ("LDW Site"): Historical industrial use within the Duwamish River Valley has resulted in sediment contamination in the LDW. Ecology and the EPA are working together to remediate the LDW and identify and control upland sources of contamination that might recontaminate the LDW after cleanup (Figure 2).
- Industrial Container Services Property ("ICS Property"): Land owned by Herman & Jacqualine Trotsky and operated by the Industrial Container Services-WA, LLC ("ICS"). The ICS Property is located at 7152 1st Avenue South, south of the 7100 1st Avenue South Property, and includes the majority of the Trotsky Inlet (Figure 2).
- Industrial Container Service Site ("ICS site"): The full extent of contamination originating from historical operations at the Industrial Container Service Property. The ICS site was defined in a 2010 Agreed Order as the limits of the ICS Property, including the portion associated with the Trotsky Inlet, as shown on Figure 2.
- Trotsky Inlet: Intertidal inlet located south of the Property. The majority of the Trotsky Inlet is included within the boundaries of the ICS site (Figure 2).

1.2. Report Organization

This RI report is organized as follows:

- Section 1.0 (Introduction) introduces the document with a brief description of the 7100 Site, and the objective and organization of the RI report.
- Section 2.0 (Background Information) presents a summary of the Property description including location and legal description, property layout, historical use and current operations, relationship to other sites in the vicinity of the 7100 Site, environmental setting, previous environmental investigations and current regulatory status.
- Section 3.0 (Remedial Investigation Methods and Procedures) presents a description of the RI field program.
- Section 4.0 (Environmental Setting) describes the key elements of the environmental setting of the 7100 Site, including physical conditions, geology and hydrogeology, natural resources, historical and cultural resources, and land and navigation uses.
- Section 5.0 (Screening Levels and Contaminants of Concern) describes the development of screening levels used to assess risks posed by 7100 Site contaminants and which contaminants exceed those screening levels.

- Section 6.0 (Nature and Extent of Contamination) presents a summary of the RI results for soil and groundwater including a comparison of the analytical data to screening levels.
- Section 7.0 (Contaminant Fate and Transport) describes fate and transport processes affecting contaminants of potential concern (COPCs) identified in soil and groundwater at the 7100 Site.
- Section 8.0 (Conceptual Site Model [CSM]) presents the conceptual model for potential contaminant transport and exposure pathways at the 7100 Site.
- Section 9.0 (References) presents the references used in preparing this report.

2.0 BACKGROUND INFORMATION

This section presents background information for the Property, including a description of the Property location, historical, current, and future uses, regional environmental setting, summary of previous environmental investigations, identification of COPCs, and the regulatory framework for evaluating the nature and extent of COPCs.

2.1. Location

The Property is located on the western bank of the LDW between river mile (RM) 2.1 and 2.2 (as measured from the southern end of Harbor Island) in the northwest quarter of Section 29, Township 24 North, Range 4 East, Seattle South Quadrangle (USGS 1983), at approximately latitude N47°32'23.77" and longitude W122°19'59.87" (Figure 1). The Property is located within the City of Seattle at 7100 1st Avenue South, King County, Washington. The Property is bordered on the northeast by the LDW, on the south by Trotsky Inlet, which is a portion of the ICS Property, and on the west by the WSDOT lease area (Figure 2). The Property and adjacent properties are zoned Industrial General 1, Unlimited 85 (IG1 U85), which includes site uses for general and heavy manufacturing and commercial activities.

2.2. Legal Description

The Property consists of one tax parcel (King County Parcel No. 2924049090) covering a total of approximately 3.09 acres (134,600 square feet) of land located approximately 3 miles south of downtown Seattle. Currently, 7100 LLC is using the WSDOT Lease Area (approximately 1.2 acres) to support their operations on the Property. This lease area is not subject to investigation under the Agreed Order.

The location of the Property is shown relative to the LDW and the surrounding area on Figure 2. The layout of the Property is shown on Figure 3. Tax parcel information and a legal description for the Property is summarized in the following table.

Property Address	7100 2nd Avenue SW Seattle, Washington 98106 Alternatively: 7100 1st Avenue South, Seattle, Washington 98106
Parcel Number	292404-9090
Property Owner	7100 1st Ave. S. Seattle LLC
Legal Description	POR OF NW 29-24-04 DAF - POR ABANDONED DUWAMISH RIVER BED LY SWLY OF SWLY MGN COMMERCIAL WW DIST #1 R/W & LY ELY SD R/W & SD R/W EXT S PER REC #4362487 5-3-53 TO ST HWY DEPT & N OF A LN DESC PER SCC #732439 SD LN BEG ON WLY MGN SD DIST #1 AT APT N42-24-31W ALG R/W 127.52 FT FROM NXN WITH N LN BLK 1 PORTLAND & PUGET SOUND RAILWAY ADD TH S 86-42-16 W ALG SD LN 433.36 FT TH S 23-37-09 W ALG SD LN 46.48 FT TO N LN SEAPORT ADD EXT TH S 86-02-59 W ALG SD SLY 150FT M/L LESS POR IF LY WITHIN LOT 6 BLK5 SEAPORT ADD

2.3. Historical Development and Operations

The LDW was filled, dredged, and channelized in the late 1800s and early 1900s. Prior to development, the footprint of the present-day Property consisted of tidal marshland adjacent to the LDW (Appendix A, Figure A-1). At that time, the footprint of the Property was part of Duwamish Waterway Turning Basin No. 2 (SAIC 2008c). Businesses operating in the vicinity of the Property included the Pacific Metal and Salvage Company and the Seabell Shipbuilding Company. These businesses apparently operated on and adjacent to over-water structures in the waterway before fill was placed in the tidal marshland to produce the upland on which the Property is currently situated. The Pacific Metal and Salvage Company specialized in the dismantling, wrecking and salvaging marine vessels. Pieces of dismantled ships reportedly fell in the water during demolition. In addition, one ship reportedly sank during the demolition process and released oil into the waterway (Foster 1945). The Seabell Shipbuilding Company specialized in the construction of large wooden marine vessels. Wood scraps from the Seabell Shipbuildling Company were burned at an unknown location and local sewage was discharged to the waterway at this location. Wood timbers present in the Trotsky Inlet are likely associated with the Seabell Shipbuilding Company. From the early 1930s, and for a period of at least 30 years, drum reconditioning activities occurred on the adjacent ICS property with releases to the surrounding tidal marsh prior to fill being placed to construct the Property. (DOF 2016; see also SAIC 2009).

In 1962, the footprint of the Property, referred to in real estate contracts as “a portion of the abandoned beds of the Duwamish River,” was sold to John Farrell, operator of Duwamish Marina, by the Commercial Waterway District No. 1 of King County. In 1964, Farrell transferred the Property to Western Marine Construction, Inc. and Associated Engineers & Contractors, Inc. These entities constructed the Property by placing fill in the LDW tidal marshland between 1964 and 1966. Dredge materials and/or construction debris (concrete and brick) were reportedly used as fill (SAIC 2008a).

Between approximately 1969 and 1977, the southern portion of the Property was occupied by a ready-mix concrete plant, Seattle Ready Mix (Pioneer Title Insurance Company 1981), while the northern portion of the Property was used as a cargo terminal and as a sand and gravel batch plant (SAIC 2008c). Around this time, historical aerial photographs (Appendix A) show a large rectangular building (warehouse or garage) measuring approximately 100 feet long by 60 feet wide. Historic buildings on the Property are shown on Figure 3. In 1978, authorization from the Seattle Building Department was granted to repair the existing bulkhead along the LDW (City of Seattle 1978), a Shoreline Substantial Development Permit (SMA 78-41)

was granted to construct a 100-foot by 50-foot addition to the existing warehouse/garage building and the addition was constructed, a stormwater drainage system was constructed, and the Property and WSDOT Lease Area were paved with asphalt and concrete. As part of the paving project, an extruded concrete curb was installed along the top of the embankment/bulkhead paralleling the northeastern Property boundary. This curb was installed to serve as a safety measure for vehicular activity and to prevent surface runoff from entering the LDW main channel.

Between 1978 and 1984, the Property was primarily used for school bus maintenance and servicing, and auxiliary parking. During this time, the Property contained three buildings, which included a warehouse, garage (addition to the warehouse) and an office building, as shown on Figure 3. In addition, six fuel dispensers supplied by a 10,000-gallon gasoline UST (tank T-1; Figure 3) and a 10,000-gallon diesel UST (tank T-2; Figure 3) were in operation near the southeast corner of the warehouse structure. A fuel island with three fuel dispensers, reportedly supplied by a 10,000-gallon gasoline UST (tank T-3, Figure 3), was in operation east of the warehouse structure; however, the exact locations of former tank T-3 and its dispensers are unknown.

In 1984, Alaska Marine Lines began using the Property as a freight management facility for the transfer of shipping containers between barge and truck, and for container and equipment storage. Historical aerial photographs show that by 1984, the garage attached to the warehouse had been demolished, and by 2006, the warehouse had been demolished. Tank T-3 was reportedly removed from the Property in 1984 (D&M 1991a), and the USTs historically used to support school bus maintenance operations (tanks T-1 and T-2) were removed from the Property in 1991.

Current and historical Property features, including the locations of the former warehouse, garage, and USTs, are shown on Figure 3. Historical aerial photographs of the Property and surrounding area are presented in Appendix A.

2.4. Property Description

The Property has approximately 700 feet of frontage along the LDW and approximately 480 feet along the Trotsky Inlet. A majority of the shoreline is covered with concrete riprap and/or quarry spalls. A soil berm rises above the riprap and contains a narrow (approximately 3 to 10 feet wide) riparian zone adjacent to Trotsky Inlet that is vegetated with grasses, Himalayan blackberry, shrub willow and alder (City of Seattle 1998). The upland portion of the Property is relatively flat with a slight downward slope to the east. Elevations (referenced to the North American Vertical Datum 1988 [NAVD88]) across the Property generally range from approximately +18 feet on the western boundary to +16 feet on the northern and eastern boundaries. Tidal fluctuations within the adjacent LDW referenced from the Eighth Avenue South Tide Station (Station No. 9447029), which is located approximately 1 mile upriver of the Property, range by 11.1 feet between mean higher high water (MHHW) and mean lower low water (MLLW) tidal stages. The elevation of these tidal stages are 8.59 feet for MHHW and -2.51 for MLLW, relative to the vertical datum NAVD88, which is the datum used for figures in this RI.

Figure 3 presents the location of current and former structures located on the Property. Structures formerly present at the Property included an approximate 9,000 square foot warehouse and 5,800 square foot garage attached to the warehouse, an office building, and a loading dock. The warehouse and garage were demolished by 1984 and 2006, respectively. Existing structures include the historical office building near the southwest corner of the Property (no longer in service) and a loading dock near the north end of the

Property. New structures at the Property include three mobile office trailers, a restroom facility, and a maintenance shed (constructed of three container boxes welded together). The upland area of the Property surrounding the existing structures consists of asphalt paved surfaces. The floor of the former warehouse, which serves as a working surface, is made of concrete. Along the northeast shoreline, a loading dock extends over the water to provide access to moored barges. In addition, two access ramps are present along the LDW shoreline extending approximately a quarter of the way down the sloped shoreline. Access to the Property (including the WSDOT Lease Area) is restricted by a chain link fence. Vehicles and pedestrians enter and exit the Property through a remotely operated gate from 1st Avenue South.

Information concerning the former USTs at the Site includes the following:

- Two 10,000-gallon USTs (T-1 and T-2) used for gasoline and diesel storage, respectively, were located southeast of the former warehouse building (Figure 3). These USTs were decommissioned and removed from the Property in 1991. UST closure activities are presented in Dames & Moore's UST Site Assessment Report (D&M 1991b) and summarized in Section 2.8.1.
- A 10,000-gallon UST (T-3) used for gasoline storage was located east of the former warehouse building (Figure 3). This UST was reportedly decommissioned and removed from the Property in 1984. No removal or decommissioning records could be identified for this UST.
- A waste oil UST of unknown size, was suspected to be present in the general vicinity of the former warehouse building. However, no records identifying the location of this tank or removal of this tank could be found.

Stormwater originating on the Property is generally collected in a network of catch basins that conveys the stormwater either to the LDW or to the City of Seattle sanitary sewer system. For the majority of the Property, stormwater runoff is collected in one of four catch basins that discharge to the LDW after passing through a stormwater treatment system (Figure 3). The stormwater discharge to the LDW is permitted under Ecology's Water Quality Program (stormwater discharge permit number WAR002471-D). In a limited area in the southwest portion of the Property, stormwater collected in catch basins is conveyed to the City of Seattle sanitary sewer system. Precipitation infiltrates in the limited unpaved areas that border the Property.

2.5. Relationship to Other LDW Projects

In April 2002, EPA and Ecology signed an interagency Memorandum of Understanding (MOU), dividing federal and state work responsibilities for the cleanup actions being performed for the LDW Superfund Site[1] (EPA and Ecology 2002). This MOU was revised in 2004 (EPA and Ecology 2004) to reflect ongoing work in the LDW. Under the current agreement, EPA is the lead respondent for the sediment investigation work while Ecology is the lead respondent for coordinating and implementing the upland source control work for the LDW Superfund Site.

[1] The Lower Duwamish Waterway Superfund Site is a 5-mile stretch of the Duwamish River that flows into Elliott Bay in Seattle, Washington. The waterway is flanked by industrial corridors, as well as the South Park and Georgetown neighborhoods. As a result of the industrial use of the LDW during the past century, river sediments have become contaminated locally with metals, PAHs, PCBs and dioxins/furans. Cleanup actions planned for the marine portion of the LDW Superfund Site are presented in the Lower Duwamish Waterway Superfund Site Record of Decision (EPA, 2014). To prevent recontamination following cleanup of the LDW, remedial actions to identify and mitigate upland contaminant sources are being conducted through Ecology.

As part of the initial source control efforts (2002–2013), three upland source control areas and/or cleanup sites have been identified in the vicinity of the 7100 Site. Source control areas and/or cleanup sites adjacent to the 7100 Site are summarized in the following sections (Sections 2.5.1 through 2.5.3) and shown on Figure 2.

2.5.1. First Avenue South Storm Drain Source Control Area

The 1st Avenue South Storm Drain Source Control Area is located along the western side of the LDW at RM 2.1. This source control area is south of the Port of Seattle's Terminal 115, east of Highland Park Way SW, west of the Trotsky Inlet and Riverside Drive Source control areas, and extends south to SW Roxbury Street. Stormwater in the 1st Avenue South storm drainage basin is conveyed via underground pipes and surface ditches to a series of wetlands that discharge to an intertidal slough north of the Property and in the vicinity of the outfall that discharges treated stormwater from the Property. The 1st Avenue South storm basin outlets are shown on Figure 2. Ecology's Facility/Site Database identifies 73 upland facilities in the 1st Avenue South Storm Drain Source Control Area. Releases from these facilities could potentially affect LDW sediment in the vicinity of RM 2.1 (Ecology 2013).

COPCs from upland sources identified for the 1st Avenue South Storm Drain Source Control Area include:

- Metals (mercury)
- PCBs
- SVOCs
- Dioxins/furans

Transport pathways associated with the 1st Avenue South Storm Drain Source Control Area include direct discharges to, or surface runoff (sheet flow) from, properties adjacent to the wetlands. In addition, bank erosion, groundwater discharges, air deposition, and spills to the wetlands may also contribute to the transport of contaminants to sediments within the LDW. Currently, Ecology developed a Source Control Action Plan for the 1st Avenue South Storm Drain Source Control Area (Ecology 2013). This plan describes source control actions to reduce the potential of sediment recontamination after implementation of the LDW cleanup action. Detailed information regarding the 1st Avenue South Storm Drain Source Control Area is presented in Ecology's Source Control Action Plan (2013) and the LDW RM 2.1 West 1st Avenue South Storm Drain Existing Information and Data Gaps Report (SAIC 2012).

2.5.2. Trotsky Inlet (Former Early Action Area 2)

Trotsky Inlet was identified as a high priority site requiring sediment cleanup (Early Action Area 2) based on work conducted for the adjacent LDW Superfund Site. Trotsky Inlet is located on the western bank of the LDW, south of the 1st Avenue South Bridge, and consists of a small inlet, approximately 80 feet wide at its mouth and tapering to a narrow stream at its head (Figures 2 and 3). Trotsky Inlet is located at approximately RM2.2, on the west bank of the LDW. The inlet is privately owned and falls mostly within the boundaries of the ICS Property, with a small portion at the westernmost extent falling within the boundaries of the 7100 Property. The Trotsky Inlet is being evaluated in the RI/FS for the ICS site. The draft ICS site RI was submitted to Ecology in September 2016 (DOF 2016).

Detailed information regarding previous investigation activities and results for the Trotsky Inlet is presented in the LDW Early Action Area 2 Site Investigation Reports (SAIC 2007, 2008 and 2009). Trotsky Inlet has

since been eliminated as an Early Action Area (EAA) and is currently being evaluated for cleanup action as a portion of the ICS site described in Section 2.5.3 below. Initial investigations completed to evaluate sediments within the inlet have identified the following COPCs:

- Metals (including cadmium, chromium, copper, lead, mercury, silver, and zinc)
- PCBs
- Pesticides
- SVOCs

2.5.3. Industrial Container Services LLC Site

The ICS site is located at 7152 1st Avenue South, Seattle, on the western bank of the LDW and is bordered by Boyer Towing to the east, the 7100 Site to the north, 1st Avenue South to the west and DaVinci Gourmet to the south (Figure 2). Trotsky Inlet (described above) comprises the northern portion of this site. Historically, drum reconditioning and manufacturing operations on the property date back to as early as the 1930s. In the early 1940s, Mitzel & Co. reportedly refurbished 1,500 drums per month for the U.S. government during World War II. These operations occurred before fill was placed in the tidal flat to produce the present-day 7100 1st Avenue South Property. In 1953, the Trotsky family purchased the property for the operation of Northwest Cooperage, which continued drum refurbishing operations. Currently, ICS leases the property and continues to operate a drum reconditioning facility. Operations at the site include storage, cleaning, and repainting of used drums, some of which may have contained food products, petroleum products, solvents, resins, paints, adhesives and hazardous wastes (SAIC 2007a).

Initial soil, groundwater and sediment investigation activities at the ICS site completed in 1986 and 1991 identified metals, VOCs, and pesticides in soil; metals and VOCs (including vinyl chloride, toluene, ethylbenzene, xylenes, and 2,4-dimethylphenol) in groundwater; and metals, VOCs, SVOCs and PCBs in sediment. In 2007, Ecology completed groundwater, seep, sediment and stormwater outfall investigation activities. Contaminants detected in the soil, groundwater, and sediments included metals, PCBs, pesticides, petroleum hydrocarbons, and PAHs. Seep samples contained metals, PCBs and PAHs. The stormwater outfall samples contained metals.

Currently, remedial investigation activities are being performed at the ICS site under an Ecology Agreed Order to further evaluate the nature and extent of contamination. Detailed information regarding site history, previous environmental investigations and proposed remedial investigation activities is presented in the RI/FS work plan for the ICS site (DOF 2012). Selected environmental data collected to support the ICS site RI were incorporated into this RI (the RI for the 7100 Site) to evaluate the relationship of subsurface contamination beneath the ICS property to contamination beneath the Property. These data include the results of soil and groundwater sampling performed on the 7100 Property to support the draft ICS site RI (DOF 2016).

Parties conducting the RI/FS for the ICS site are developing plans to perform an interim action to address contaminated sediment in the Trotsky inlet as well as upland sources of contamination potentially affecting the inlet.

2.5.4. Proposed LDW Cleanup Under CERCLA

EPA's proposed cleanup action for the LDW Site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; also known as Superfund) is published in the Record of Decision (ROD; EPA 2014). The selected remedy in the ROD indicates that contaminated sediment south of the Site (in the Trotsky Inlet) and east of the Site (along the western shoreline of the LDW) will be dredged. Contaminated sediment north of the Site, where the 1st Avenue South Storm Drain discharges, will be addressed by natural recovery processes.

Although cleanup of the Trotsky Inlet is included in the ROD as part of the broader LDW remedy, parties associated with the ICS site are developing plans to clean up the inlet as an interim action, as discussed above.

2.6. Summary of Previous Investigations and Cleanup Actions

Environmental investigations to evaluate subsurface conditions at the Site first began in 1990, culminating in the 2014 soil and groundwater investigations conducted pursuant to the RI/FS Work Plan. The 2014 investigation activities are summarized in Section 3.0. Previous environmental investigations and cleanup actions at the Site are summarized in the following sections (Sections 2.6.1 through 2.6.3).

Environmental data from these previous investigations for which sampling locations and data quality could be verified were incorporated into this RI to evaluate the nature and extent of contamination in the subsurface. A discussion of the previous analytical results and data quality is presented in the RI/FS Work Plan. The data collected by Science Applications International Corporation (SAIC) under contract with Ecology for the EAA-2 investigation phases were validated in accordance with steps outlined in the Sampling and Analysis Plan for the EAA-2 sampling activities (SAIC 2008b). Samples collected by Dames and Moore (D&M) during UST removal and investigation activities in 1990 through 1992 included the collection and analysis of quality assurance/quality control (QA/QC) samples to evaluate data quality.

Tabulated chemical analytical results from previous investigations are presented in Appendix G. Soil analytical results are presented in Tables G-1 through G-3, and groundwater analytical results are presented in Tables G-4 through G-6.

2.6.1. Underground Storage Tank Investigation and Removal Activities (1990-1992)

D&M conducted a soil vapor investigation in the vicinity of USTs T-1, T-2 and T-3 in 1990 (Figure 3; D&M 1990). This investigation included the installation of 32 soil vapor probes to depths of approximately 3 feet below ground surface (bgs). Based on the elevated photoionization detector (PID) readings observed during this study, it was concluded that there was a likely release from one or more of the USTs.

Based on the findings of the soil vapor investigation, a supplemental soil and groundwater investigation was completed to evaluate whether a release had indeed occurred from the USTs (D&M 1991a). Between October and December of 1990, 13 soil borings (SB-1 through SB-5, MW-1 through MW-7 and SG-1) were completed (Figure 4). Seven of these borings were completed as groundwater monitoring wells (MW-1 through MW-7) and one boring was completed as a soil vapor extraction well (SG-1; Figure 5). The borings were completed to depths ranging between 11 and 33 feet bgs to evaluate the vertical and lateral extent of petroleum hydrocarbons in soil. The monitoring wells were screened across the groundwater table and to maximum depths ranging between 19 and 20 feet bgs. Results of soil sampling identified total petroleum hydrocarbons (TPH), VOCs (benzene, toluene and xylenes), and/or PAHs in each of the 29 soil samples submitted for chemical analysis; the highest concentrations were detected in the vicinity of tanks T-1 and

T-2 and the fuel dispensers located at the southeast corner of the former warehouse building. Results of groundwater sampling identified TPH and benzene, ethylbenzene, toluene and xylenes (BETX) in groundwater in the vicinity of the USTs at concentrations exceeding screening levels (Model Toxics Control Act [MTCA] values effective 1991). The sampling results indicated that the TPH and BETX detections in groundwater were localized and did not extend to the Property shoreline.

On January 24, 1991, D&M observed the removal and closure of the 10,000-gallon gasoline UST (tank T-1) and 10,000-gallon diesel UST (tank T-2) at the 7100 Site (D&M 1991b). An excavation measuring approximately 35 feet long by 20 feet wide by 15 feet deep was completed to remove these tanks. Petroleum staining was observed in the excavated soil. To evaluate soil conditions in the UST excavation, a soil sample (SS-1) was obtained from the base of the excavation and submitted for TPH analysis using EPA Method 8015-Modified. TPH was detected in sample SS-1 at a concentration of 95 milligrams per kilogram (mg/kg), which is lower than the 200 mg/kg MTCA cleanup level from 1991. The excavated soil was used to backfill the excavation. A geotextile fabric was reportedly used to line the excavation prior to backfilling. The geotextile fabric was not identified in the boring logs for soil sample SS-1, monitoring well MW-12, or direct push boring DP-5, all of which were completed within the footprint of the tank T-1/T-2 excavation area.

Following the UST removal activities, groundwater in monitoring wells MW-1 through MW-7 was sampled to assess the potential presence of gasoline- and diesel-range petroleum hydrocarbons and BETX. Four quarterly sampling events were completed at monitoring wells MW-1 through MW-4 and MW-7 between September 1991 and August 1992, whereas wells MW-5 and MW-6 were sampled only during the final three quarterly events. In addition, permeability tests were completed to estimate groundwater flow velocities, evaluate confining conditions, and to estimate transport rates for petroleum-related contaminants in groundwater. Groundwater sampling results indicated that the detected concentrations of gasoline- and diesel-range hydrocarbons generally decreased over time and were generally lower than respective 1991 MTCA cleanup levels. Detected concentrations of toluene, ethylbenzene and xylenes either showed a downward trend over time or remained unchanged, with broader occurrances of MTCA exceedances than for hydrocarbons. In monitoring wells MW-3 and MW-4, the detected concentrations of benzene consistently exceeded MTCA cleanup levels and generally increased over time; D&M concluded that the increasing concentrations of benzene in groundwater were due in part to tidal fluctuation and the relatively high solubility of benzene in comparison to the other gasoline-related constituents (D&M 1992).

During a tidal study performed by D&M, measured water levels in the LDW fluctuated 11.5 feet; corresponding groundwater level fluctuations in the monitoring wells ranged from 0.64 feet in MW-5 to 0.70 feet in MW-7. The peaks in groundwater level fluctuations lagged the peaks in the two daily tidal cycles by approximately 1 hour. The highest-amplitude groundwater level fluctuations were observed in monitoring wells MW-5 and MW-6, while the lowest-amplitude fluctuations were observed in MW-7. D&M concluded that groundwater northeast of MW-7 generally flows toward the LDW, while groundwater southwest of MW-7 generally flows toward Trotsky Inlet. D&M also estimated that soil below the water table at the Property has an average hydraulic conductivity of 0.46 feet per day (D&M 1992).

Investigation and UST removal activities completed by D&M are detailed in the RI/FS Work Plan. The approximate soil and groundwater sampling locations and the locations of the former gasoline and diesel USTs are shown on Figures 4 and 5. Previous soil and groundwater investigation results are discussed further in Section 6.0.

2.6.2. Former Early Action Area 2 and Industrial Container Services Investigation Activities (1986-2009)

In 1986 and 1987, Hart Crowser investigated soil and groundwater conditions in the vicinity of Northwest Cooperage (now the ICS Property; Hart Crowser 1987). Investigation activities were completed in two phases. Soil and groundwater samples obtained during the first phase of investigation were analyzed for metals, VOCs, SVOCs, pesticides and PCBs. In 1987, Hart Crowser installed two additional monitoring wells and conducted a tidal and hydraulic conductivity study to evaluate groundwater conditions. As part of this phase of investigation, groundwater samples and selected soil samples (obtained by EPA) were analyzed for metals, VOCs, SVOCs, pesticides and PCBs.

In 1991, Parametrix and SAIC completed a Site Hazard Assessment for Ecology (Parametrix & SAIC 1991). As part of this assessment, three Trotsky Inlet sediment samples were collected on the ICS site for analysis of PAHs, VOCs, organochlorine pesticides, PCBs, cyanide and total metals. Following this initial investigation, several subsequent sediment sampling events were completed between 1998 and 2006 to evaluate sediment conditions within and/or at the mouth of the inlet. One sediment core was completed in February 2006 in the LDW channel near the mouth of the inlet to a depth of approximately 13 feet below mudline. Sediment samples collected as part of these studies were submitted for chemical analysis of metals, SVOCs, pesticides, PCBs, total organic carbon (TOC) and/or dioxins and furans.

In July 2008, Dalton, Olmsted & Fuglevand, Inc. (DOF) completed 10 soil probes on the upland portion of the Trotsky property to depths of approximately 20 feet (DOF 2007). Soil conditions encountered by the probes were logged, and soil samples were obtained for laboratory analysis of petroleum hydrocarbons, lead and PCBs.

Between 2007 and 2009, SAIC, on behalf of Ecology, conducted a soil, sediment, seep and groundwater assessment within and surrounding the Trotsky Inlet (i.e., on both the ICS and 7100 Properties) to identify potential contaminant sources in conjunction with Ecology's EAA-2. Investigation activities completed by SAIC on behalf of Ecology are summarized in the Lower Duwamish Waterway, Early Action Area 2 Site Characterization Report (SAIC 2009). Samples collected as part of the SAIC investigation were submitted for chemical analysis of total and/or dissolved metals, SVOCs, pesticides, PCBs, gasoline-, diesel- and heavy oil-range petroleum hydrocarbons, TOC and/or total solids. Based on the results of this investigation, SAIC concluded that a variety of chemicals, including metals, PCBs, and SVOCs, are present in the Trotsky Inlet sediments. Soil and groundwater samples collected at locations on the ICS site near these sediment samples indicated the presence of many of these same COPCs at concentrations significantly greater than screening levels (MTCA Method A and B Cleanup Levels). SAIC determined that during low tide conditions, groundwater flows from the ICS Property toward Trotsky Inlet and the LDW (SAIC 2009). The EAA-2 investigations concluded that concentrations of COPCs at the 7100 Site are generally lower than concentrations of the same COPCs at the ICS Property (SAIC 2009).

2.6.3. LDW Sediment Investigation (1990 – 2010)

Multiple environmental investigations have been completed as part of the LDW remedial investigation since 1990. These investigations are summarized in the Lower Duwamish Waterway Remedial Investigation Report (Windward 2010). As part of these investigations, extensive sediment sampling has been completed in the vicinity of the Property to evaluate both surface and subsurface conditions. Details regarding these investigations are presented in the following reports:

- Elliott Bay Sediment Survey (PTI & Tetra Tech 1988)
- Duwamish Waterway Sediment Characterization Study (NOAA 1998)

- Lower Duwamish River. RM 2.5-11.5 Site Inspection Report (Weston 1999)
- Lower Duwamish River Sediment Investigation Round 1 Surface Sediment Sampling (Windward 2005a)
- Lower Duwamish River Sediment Investigation Round 2 Surface Sediment Sampling (Windward 2005b)
- Lower Duwamish River Benthic Study (Windward 2005c)
- Lower Duwamish River Subsurface Sediment Investigation (Windward 2007)
- Sediment Profile Imaging Feasibility Study for the Lower Duwamish Waterway (Ecology 2007a)
- Lower Duwamish River surface sediment sampling for dioxins and furans and other chemicals (Windward 2010)

Sediment samples obtained as part of these investigations were submitted for chemical analysis of metals, PCBs, pesticides, SVOCs and/or dioxins and furans. Results associated with these investigations are discussed further in the RI/FS Work Plan. For the purpose of this RI, the LDW sediment data were used to develop screening levels for the upland media (soil and groundwater) that are the focus of this RI. Section 5.1 describes how the sediment data were used to develop preliminary cleanup levels for upland soil and groundwater that are protective of LDW sediment.

2.7. Regulatory Framework

On May 6, 2011, 7100 LLC entered into Agreed Order No. DE-8258 with Ecology. Work to be performed under the Agreed Order included completing the scope of remedial investigation activities outlined in the Ecology-approved RI/FS Work Plan (described below in Section 3.0). In addition, the requirements of the Agreed Order include preparation of an FS and a Draft Cleanup Action Plan (DCAP). This RI report and future FS and DCAP documents will complete the work requirements described in the Agreed Order.

3.0 REMEDIAL INVESTIGATION METHODS AND PROCEDURES

The scope of the RI consisted of reviewing existing soil and groundwater data, identifying data gaps, and collecting new environmental data from the Property to delineate the nature and extent of contamination. New environmental data was obtained to fill the data gaps identified in the RI/FS Work Plan for the purpose of developing and evaluating cleanup action alternatives. As required by the Agreed Order, the RI included the investigation of soil, groundwater and stormwater/catch basin solids. The findings from the RI/FS field investigation and previous environmental data from the Property and adjacent EAA-2 and LDW are presented in Section 6.0. Details regarding the RI field investigation and data set used in preparing this RI are presented in the following sections:

- Section 3.1 – Geophysical Survey
- Section 3.2 – Soil Investigation
- Section 3.3 – Groundwater Investigation
- Section 3.4 – Stormwater System Investigation
- Section 3.5 – Deviations from the Work Plan
- Section 3.6 – Data Used in this RI

Field procedures and copies of exploration/monitoring well installation logs for the recent RI activities are presented in Appendix B. Copies of exploration/monitoring well installation logs from previous environmental studies are presented in Appendix C.

Tabulated chemical analytical results from the RI, including results from previous investigations, are presented in Appendix G. Soil analytical results are presented in Tables G-1 through G-3, groundwater analytical results are presented in Tables G-4 through G-6, stormwater and surface water results are presented in Table G-7, and outfall sediment results are presented in Table G-8.

3.1. Geophysical Study

Documentation for the removal of a waste oil UST in the vicinity of the former warehouse and/or garage was not found during our review of historical records and reports. Based on this uncertainty, a geophysical survey was completed by Pacific Geophysics on July 2, 2013 to evaluate whether a potential waste oil UST remained at the 7100 Site. Geophysical methods included electromagnetic surveying and ground penetrating radar (GPR; Pacific Geophysics 2013). The area of interest in which the geophysical survey was completed and the resulting magnetic contour map are shown on Figure 6. The complete report is included in Appendix J.

A Geometrics G-858 Cesium magnetometer was used to scan parts of the 7100 Site that were expected to possibly overlie the historical waste oil UST. Ten magnetic anomalies were identified as part of this survey in areas within, east and south of the former warehouse/garage. The identified magnetic anomalies were further evaluated using a Schonstedt Magnetic Gradiometer, an Aqua-Tronics A6 Tracer metal detector and a GSSI SIR 2000 GPR system coupled to a 270 MHz antenna. Based on the results of the supplemental survey, no GPR anomalies indicative of a UST were identified.

3.2. Soil Investigation

The objective of the upland soil investigation was to fill the data gaps identified in the RI/FS Work Plan and to define the nature and extent of soil contamination. Soil sampling activities included the completion of three hand auger explorations (HA-1 through HA-3) near the northern shoreline of the Trotsky Inlet, seven hollow-stem auger (HSA) explorations (MW-2A and MW-13 through MW-18) within the northeastern portion of the Property, and eight direct-push (DP) explorations (DP-1 through DP-8) in the vicinity of the former gasoline and diesel USTs (Figure 7). Soil boring locations were selected to address identified data gaps and provide adequate spatial coverage of the Property. Information obtained from previous environmental investigations was used to support selection of these soil sampling locations.

During the soil investigation, four additional soil explorations (MW-19 and DP-10 through DP-12) were completed to further evaluate soil conditions in the vicinity of monitoring well MW-4, in which visual evidence of contamination was observed during groundwater monitoring activities (further described in Section 6.0) and to provide greater spatial coverage downgradient of the former USTs.

Soil sampling locations for this RI are shown relative to the Property and historical features on Figure 7. Field methods and procedures, exploration logs and field screening results are presented in Appendix B. Soil sampling and analysis is summarized in the following section (Section 3.2.1).

3.2.1. Soil Sampling and Analysis

Soil samples were screened in the field for the presence of petroleum-related contamination. Field screening consisted of visual observations for the potential presence of contamination (i.e., staining, etc.), water sheen testing and organic vapor monitoring. Field screening procedures are described in Appendix B. In general, samples with the greatest field screening evidence of contamination were submitted for chemical analysis from each exploration. Samples with no evidence or lesser evidence of contamination were archived for potential follow-up analysis based on the initial analytical data. A total of 45 soil samples were submitted for chemical analysis of COPCs based on field screening results, previous sample results, presence of fill, and proximity to specific Site features (i.e., former USTs). Selected soil samples were submitted for one or more of the following analyses:

- Metals (arsenic (total), chromium (total), cadmium, copper, lead, mercury, nickel, silver and zinc) by EPA Methods 200.8 and 7470.
- SVOCs including PAHs by EPA Method 8270/SIM.
- VOCs by EPA Method 8260 (or BETX only by EPA Method 8021).
- PCBs by EPA Method 8082.
- Pesticides by gas chromatography/mass spectrometer (GC/MS) methods.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-G.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- TOC by EPA Method 9060.

Soil samples were submitted for chemical analysis to Analytical Resources Inc. (ARI) of Tukwila, Washington, an Ecology-certified laboratory. The analytical testing program for samples obtained during the RI soil investigation are summarized in Table 1.

3.3. Groundwater Investigation

The objective of the groundwater investigation was to address the data gaps identified in the RI/FS Work Plan, to define the nature and extent of groundwater contamination, and to evaluate groundwater flow characteristics and gradients at the Property. In accordance with the RI/FS Work Plan, existing monitoring wells MW-1, MW-3 through MW-5, and MW-8 through MW-12, newly installed monitoring wells MW-2R and MW-13 through MW-18, and seep sampling locations SEEP-1 and SP-1 were used to evaluate groundwater conditions at the Property (Figure 8). New monitoring well locations were positioned to address identified data gaps and to provide comprehensive coverage of the Property. Information obtained from previous environmental investigations was used to support selection of these groundwater sampling locations.

As described in the preceding section, an additional exploration that was not previously described in the RI/FS Work Plan (MW-19) was completed to provide additional spatial distribution downgradient of the former USTs.

Field methods and procedures to complete the new monitoring wells, including installation, well development, surveying and well construction details are presented in Appendix B. Logs for monitoring wells installed during previous environmental studies are presented in Appendix C. Activities completed to evaluate aquifer characteristics and groundwater gradients at the Property are summarized in Section 3.3.1. Groundwater sampling activities completed as part of the groundwater investigation are summarized in Section 3.3.2.

3.3.1. Aquifer Testing

Hydraulic conductivity testing and a 72-hour tidal study were performed to characterize hydrogeologic conditions and gradients at the Property. In accordance with the RI/FS Work Plan, the hydraulic conductivity was estimated by conducting slug tests in monitoring wells MW-2R, MW-14 and MW-16. To evaluate groundwater elevation changes in response to tidally-influenced surface water changes in the LDW, electronic water level measurements were recorded in monitoring wells MW-5, MW-9, MW-11, MW-12, MW-13, MW-16 and the LDW using transducers/data loggers over a 72-hour period.

Hydrogeologic conditions of the Property are further described in Section 4.1. Field procedures and methods for performing the hydraulic conductivity test and 72-hour tidal study are presented in Appendix D. An evaluation of the groundwater data collected during the hydraulic conductivity test and details of the 72-hour tidal study are presented in Section 4.2.

3.3.2. Groundwater Sampling and Analysis

Four quarterly groundwater sampling events were completed in accordance with the RI/FS Work Plan to evaluate groundwater conditions at the Property. To the extent practical, groundwater samples were obtained during a low or outgoing tide on the day of sampling. Groundwater sampling activities were completed as follows:

- **Round 1 Groundwater Monitoring Event –** Monitoring wells MW-1, MW-2R, MW3 through MW-5 and MW-8 through MW-19 were sampled between August 14 and August 20, 2013. Seep samples were collected between September 3 and September 4, 2013. Shoreline monitoring wells (MW-8, MW-9 and MW-13 through MW-15) and seeps were sampled during hours of low or ebbing tides. In addition, a baseline sample of surface water from the LDW was obtained from the northern side of the loading dock on September 3, 2013 to evaluate surface water quality conditions.
- **Round 2 Groundwater Monitoring Event –** Monitoring wells MW-1, MW-2R, MW3 through MW-5 and MW-8 through MW-19 were sampled between December 16 and December 22, 2013. Seep samples were not collected during this monitoring event because the time of low tide (late night) made access to the seep locations difficult and unsafe. Shoreline monitoring wells (MW-8, MW-9 and MW-13 through MW-15) were sampled during hours of low or ebbing tides.
- **Round 3 Groundwater Monitoring Event –** Monitoring wells MW-1, MW-2R, MW3 through MW-5 and MW-8 through MW-19, seeps SEEP-1 and SP-1, and a sample of surface water from the LDW (northern side of the loading dock) were sampled between March 17 and March 20, 2014. Shoreline monitoring wells (MW-8, MW-9 and MW-13 through MW-15) were sampled during hours of low or ebbing tides.
- **Round 4 Groundwater Monitoring Event –** Monitoring wells MW-1, MW-2R, MW3 through MW-5 and MW-8 through MW-19, seeps SEEP-1 and SP-1, and a sample of surface water from the LDW (northern side of the loading dock) were sampled between July 14 and July 17, 2014. Shoreline monitoring wells (MW-8, MW-9 and MW-13 through MW-15) were sampled during hours of low or ebbing tides.

Groundwater, seep and LDW samples collected during the groundwater investigation were submitted for chemical analysis of COPCs selected based on previous sample results, presence of fill, and proximity to specific past investigation activities at the Property. In addition, groundwater samples were analyzed for chloride to determine the of the degree of mixing between groundwater and surface water from the LDW. Water samples were submitted for the following analyses:

- Chloride by EPA 300.0.
- Total dissolved solids by EPA Method 160.1.
- Total and dissolved metals (arsenic, chromium, cadmium, copper, lead, nickel, silver and zinc) by EPA Method 200.7/200.8.
- Total and dissolved mercury by EPA Method 1631-E.
- SVOCs including PAHs by EPA Method 8270/SIM.
- VOCs by EPA Method 8260.
- PCBs by EPA Method 8082.
- Pesticides by EPA Method 8081B.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-G.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.

Water samples obtained during the groundwater investigation were submitted to ARI for chemical analysis. Additional details regarding the methods and procedures for the collection, handling and transport of water samples to the testing laboratory are presented in Appendix B. The analytical tesing programs for water samples obtained during the RI investigation are summarized in Table 2. Well completion details are summarized in Table 3.

Initial groundwater monitoring observations in July 2013 identified approximately 4 inches of floating product in monitoring well MW-4. Ecology was notified of the unexpected finding, and procedures to address the presence of free product were added to the RI scope. The product was clearly a floating separate phase material, indicative of a light non-aqueous phase liquid (LNAPL) and was of unknown origin. Well MW-4 was installed during investigation activities associated with the former USTs at the Site (D&M 1992), and had relatively low concentrations of contaminants in soil and groundwater. Sampling of groundwater at MW-4 conducted in 1990-1992 to support UST removal and in 2007 to support the Ecology EAA-2 investigation (SAIC 2009) did not indicate the presence of LNAPL and relatively low concentrations of contaminants were detected in groundwater samples. The origin of the LNAPL observed in MW-4 is unknown. A sample of the LNAPL was collected for hydrocarbon identification (HCID) analysis to evaluate the petroleum type, which indicated that the LNAPL was a blend of gasoline-, diesel-, and heavy oil-range petroleum hydrocarbons. LNAPL was removed from well MW-4 in September 2013. LNAPL was not observed in MW-4 during any of the following three quarterly sampling events.

3.4. Stormwater System Investigation

The objective of the stormwater system investigation was to evaluate whether the stormwater conveyance system is a potential pathway for contaminant migration from the Property to the LDW. The stormwater system investigation consisted of: (1) surveying the stormwater conveyance network at the Property (including the locations and elevations of all components of the stormwater conveyance system, catch basins and other access points); and (2) collection of stormwater system samples to characterize stormwater being conveyed to the LDW. The stormwater system survey and sampling activities are summarized in the following sections (Section 3.4.1 and 3.4.2).

3.4.1. Stormwater System Survey

A land survey of the Property was completed by David Evans Associates, Inc. (DEA) of Bellevue, Washington between July 22 and August 9, 2013 to map the locations of the Property features (including composition of the ground surface, location of existing offices, foundation slab for the former warehouse, ground surface elevations, as well as the locations and elevations of all components of the stormwater conveyance system). In addition, the catch basins and other access points for the stormwater system were inspected and surveyed by DEA. City of Seattle side sewer cards for the Property and surrounding area were reviewed to confirm that the stormwater conveyance lines located in the southwestern portion of the Property discharge to the sanitary sewer system. The stormwater system is shown relative to the Property on Figure 9. An evaluation of the stormwater system based on the results of the land survey is discussed in Section 4.1.

3.4.2. Stormwater System Sampling

In accordance with the RI/FS Work Plan, a sample of the catch basin solids was to be collected from catch basin CB-5, which is located at the furthest downstream collection point (Figure 9). The purpose of this sample was to obtain a representative sample of the solid materials captured by the catch basin system. However, solids were not present in CB-5 or in other catch basins at the Property during RI field activities.

In 2012, 7100 LLC installed and began operation of an above-ground stormwater treatment system for stormwater generated at the Property prior to discharge to the LDW. Components of the stormwater treatment system include: (1) a sump in which stormwater from the northeastern portion of the Property collects; (2) a settling tank; and (3) a multi-stage filter pack consisting of sand and granular activated carbon. Bladder floats activate an electric pump located within the sump. To characterize stormwater generated from the Property, influent (pre-treatment) and effluent (post-treatment) stormwater samples were collected. These samples were obtained during the fall of 2013 and winter of 2014.

In addition to the stormwater sampling, a surface sediment sample was collected from the vicinity of the stormwater outfall. At sampling location Outfall-SED (Figure 9), a single surface sample (0 to 10 centimeter [cm] depth) was collected for chemical analysis.

Stormwater influent and effluent samples and the sediment sample collected near the location of the stormwater outfall were submitted for one or more of the following physical and chemical analysis:

- TOC by SW-846 Method 9060.
- Grain size (solids) by Puget Sound Estuary Program methods.
- Total metals (arsenic, chromium, cadmium, copper, lead, mercury, nickel, silver and zinc) by EPA Method 200.8 and 7470.
- SVOCs including PAHs by EPA Method 8270/SIM.
- VOCs by EPA Method 8260.
- PCBs by EPA Method 8082.
- Pesticides by EPA Method 8081B.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-G.

- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- Dioxins/furans by EPA Method 8290A (surface sediment sample).

Water and sediment samples obtained during the stormwater system investigation were submitted to ARI for chemical analysis. Additional details regarding the methods and procedures for the collection, handling and transport of sediment and water samples to the testing laboratory are presented in Appendix B. The analytical testing program for sediment and water samples collected during the RI stormwater investigation are summarized in Tables 1 and 2, respectively.

3.5. Deviations From the Work Plan

Conditions encountered in the field necessitated relatively minor deviations from the RI Work Plan. The most notable deviation consisted of performing additional investigations in the vicinity of former UST T-3 based on preliminary observations in monitoring well MW-4. Work Plan deviations were approved by Ecology prior to implementation.

3.5.1. Additional Investigation Near Former UST T-3

During the first phase of RI field work, a small quantity of hydrocarbon free product was observed in monitoring well MW-4, as described in Section 3.3.2. The free product was unexpected based on previous monitoring results. In order to better characterize the soil and groundwater surrounding MW-4, two additional DP borings (DP-10 and DP-11) and one additional monitoring well (MW-19) were completed in the vicinity of MW-4 (Figure 7). Sampling in these explorations was generally consistent with the procedures outlined in the Work Plan. However, additional soil samples were submitted from DP-10 from above and below the zone with elevated field screening results to evaluate the vertical extent of potential contamination. In addition to soil samples, grab water samples were also obtained from DP-10 and DP-11 for SVOC, VOC, PCB and TPH analysis to evaluate groundwater conditions downgradient of MW-4.

3.5.2. Catch Basin Solids Samples

As outlined in the Work Plan, both stormwater and catch basin solids samples were proposed to be collected on a quarterly basis for the RI. However, due to improvements to the Site stormwater system, stormwater solids were not present in the catch basins in sufficient quantities for sampling. Therefore, the planned stormwater catch basin solids sampling outlined in the Work Plan was not performed.

3.6. Data Used in this RI Report

Data sources for this RI report include data collected in accordance with the RI/FS investigation described above as well as data collected during previous soil and groundwater investigations for the 7100 Site. Additional data sources for this RI Report include soil, groundwater (including seep) and/or sediment data collected to support preparation of the RI for the ICS site. This data includes soil and groundwater samples collected from soil borings and wells installed within the 7100 Property for the purpose of characterizing the ICS site. These data sources were utilized to develop an understanding of the environmental and physical conditions at the 7100 Site, including the interpretation of geologic and hydrogeologic conditions described in Section 4.0.

Environmental data obtained from the recent RI study have been entered into Ecology's Environmental Information Management (EIM) System under Study ID AODE8258. Existing environmental data for soil, groundwater, stormwater and sediment samples used in this RI to evaluate site conditions were obtained

and are referenced from the previous studies described in Section 2.6 and/or Ecology's EIM database. The chemical analytical data used to evaluate the nature and extent of contamination in this RI are described below in Sections 3.5.1 through 3.5.3. The date ranges for the chemical analytical data used for this RI are as follows:

- Soil (Tables G-1 through G-3); 1990 to 2015
- Groundwater (Tables G-4 through G-6): 1990 to 2016
- Stormwater and Surface Water (Table G-7): 2013
- Outfall Sediment (Table G-8): 2013
- Sediment (Tables 12 through 14 in the RI/FS Work Plan[GeoEngineers 2013]): 1985 to 2009

3.6.1. Soil

The soil chemical analytical data set for this RI includes all soil samples obtained during previous investigation activities at the Property. Historic soil samples collected from the early 1990s by D&M (1991a) were analyzed by an outdated analytical method for TPH, EPA Method 8015-Modified, that quantifies the concentration of total petroleum hydrocarbons while only allowing a qualitative evaluation of the range of hydrocarbons present (gasoline, diesel, or heavy oil). The early soil TPH data are included in this RI for comparison purposes, but the data are not considered of the same quality as more recent analyses using current TPH analytical methods.

3.6.2. Groundwater

The network of wells used to evaluate hydrogeologic conditions is comprised of 17 monitoring wells screened in the shallow unconfined aquifer. Well completion logs for the monitoring well network are presented in Appendices B and C.

The groundwater chemical analytical data set for this RI consists of groundwater, seep and LDW surface water samples obtained by GeoEngineers, Inc. (GeoEngineers) between August 2013 and July 2014 from new and existing monitoring wells at the Property. Some of the early groundwater samples collected at the site were analyzed by the outdated TPH method described above for soil. The TPH results from 1990 and 1991 groundwater samples collected by D&M (1991a, 1992) are included in data tables for reference, as described in Section 6.0, but are generally not used for evaluation of groundwater conditions at the 7100 Site due to their age and the qualitative nature of the results relative to the current TPH analytical methods.

3.6.3. Stormwater

The stormwater chemical analytical data set for this RI consists of stormwater samples obtained by GeoEngineers between July 2013 and April 2014 from the Property.

3.6.4. Sediment

The sediment chemical analytical data used for this RI primarily includes Trotsky Inlet sediment samples collected by others in support of characterization of ICS site contaminants. LDW sediment data was reviewed for this RI primarily for the purpose of developing screening levels for upland media, as described in Section 5.1.

3.6.5. Technical Quality of the Data Set

GeoEngineers performed EPA-defined Stage 2B data validation of the analytical data collected by GeoEngineers in 2013 and 2014 to fulfil the requirements of the RI Work Plan (GeoEngineers 2013); the data validation reports are included in Appendix I. The data were reviewed for technical quality, including sampling methods, field procedures, analytical methods and laboratory qualifiers. Based on this technical review, the data were determined to be of acceptable quality, as qualified by the analytical laboratory.

Sediment data used in this RI was obtained from the EIM database and cross-referenced to the data set used by the LDW RI (Windward 2010). We assumed that sediment data acceptable for use by LDW RI was also acceptable for use for this RI as qualified in the EIM database.

3.6.6. Datum

The horizontal datum for this RI is the North American Datum 1983/2007 (NAD83/07). The vertical datum for this RI is NAVD88. The conversion between NAVD88 and MLLW is -2.42 feet (an elevation of 0-feet relative to MLLW is equivalent to an elevation of -2.42 relative to NAVD-88 datum) based on United States Army Corps of Engineers (USACE) Duwamish Waterway Tidal Datum No. 92 for the North Puget Sound Region.

4.0 ENVIRONMENTAL SETTING

This section describes key elements of the environmental setting of the 7100 Site, including physical conditions, geology and hydrogeology, natural resources, historical and cultural resources, and land and navigation uses.

4.1. Physical Conditions

The following subsections describe the physical conditions at the 7100 Site, including climate and the nature of the upland and marine environments that comprise the 7100 Site.

4.1.1. Climate

The Puget Sound Basin has a temperate marine climate with cool, wet winters and warm, relatively dry summers. Mean annual precipitation is about 37.4 inches with rainfall being the highest during October through March (3.5 to 6.6 inches per month) and lowest during the summer months (less than 1 inch in July). The average yearly temperature is 50 degrees Fahrenheit, with temperatures ranging between a monthly average low in January of 37 degrees to a July/August monthly average high of 76 degrees Fahrenheit. Below freezing temperatures, while uncommon, occasionally occur, typically during the months of December and January.

4.1.2. Topography

The Property is located within the Duwamish River Valley (Figure 1). The Property is generally flat with elevations ranging from +18 to +16 feet (Figure 3). The top of the bank along the LDW and Trotsky Inlet shoreline has an approximate elevation of +16 feet. The toe of the slope within the inlet ranges between +4 and 0 feet in elevation, while the toe of the slope along the LDW is at approximately elevation -22 feet. The bank slope is generally inclined at 1.5 feet horizontal to 1 foot vertical (1.5H:1V) with a small section of the slope being vertical within the Trotsky Inlet (beneath the vacant office building). The shoreline bank

is generally covered with armoring consisting of riprap and concrete debris. Surface topography is referenced from the King County geographic information system (GIS) database and 2013 DEA survey completed at the Property.

4.1.3. Property Drainage and Stormwater

Stormwater originating on the Property is collected through a network of catch basins that transfer the stormwater either to the LDW or to the City of Seattle sanitary sewer system. The limited areas of unpaved surfaces around the perimeter of the Property likely allow minimal infiltration of stormwater. Based on the results of the 2013 DEA survey (Section 3.4), stormwater for the majority of the Property is collected in one of four catch basins (CB-1 through CB-4; Figure 9) and is discharged to the LDW after passing through a stormwater treatment system. A fifth manhole, referred to as CB-5 (Figure 9), is located downstream from the four catch basins. As indicated above, the stormwater entering CB-1 through CB-4 is conveyed to a collection sump located in the northern portion of the Property. A bladder float-activated pump transfers the collected stormwater to the above-ground stormwater treatment unit. Within the treatment unit, stormwater passes through a settling tank to remove suspended particles prior to passing through a multi-stage filter pack consisting of sand and granular activated carbon. The treated stormwater is then conveyed to a vegetated drainage swale northwest of the WSDOT Lease Area where it flows overland to the LDW.

In the southwest portion of the Property, stormwater is collected in one of two catch basins located within the southern portion of the WSDOT Lease Area. The catch basins are connected to the City of Seattle sanitary sewer system. Stormwater from the Property is discharged under Ecology stormwater permit number WAR002471-D.

4.1.4. Off-site Stormwater Outfalls

Three piped outfalls have been observed in the vicinity of the Property, including one outfall northwest of the Property and two outfalls within Trotsky Inlet. These outfalls are discussed further in the following sections.

4.1.4.1. 1st Avenue South Outfall (Outfall No. 2508/2509/2121)

A 12-inch-diameter concrete pipe outfall discharges to the LDW northwest of the Property. Prior to discharge, stormwater passes through a vegetated drainage swale. Based on the alignment of the pipe, this outfall is likely connected to a series of surface drains located between 1st Avenue South and the WSDOT Lease Area/Trotsky Property. No additional information about the source of discharges from this outfall was identified.

4.1.4.2. Reservoir Outfall (Outfall No. 2120)

A second outfall, located at the head of Trotsky Inlet, has been observed to discharge to EAA-2. This pipe is labeled on Seattle City Light maps as "unknown." A City of Seattle drinking water reservoir or water tower is located upland of the head of the inlet. Overflow from the reservoir/tower reportedly drains through EAA-2 via this outfall (SAIC 2007a). No additional information about the source of discharges from this outfall was identified.

4.1.4.3. Second Avenue South Outfall (Outfall No. 2118)

Trotsky Inlet is located at the north end of the Second Avenue South drainage area of the South Park Basin (Ecology 2007b). In general, the South Park Basin is served by a mixture of combined storm/sanitary sewer systems and separated storm drain systems. In some areas, particularly along the river, there are no piped drainage or sewer systems.

The South Park Basin was identified in the 1995 City of Seattle Department of Public Utilities (SPU) Comprehensive Drainage Plan update as having numerous drainage problems resulting from poor roadway grading, inadequate capacity of existing storm drain systems, lack of storm drainage infrastructure in some areas, and topographic constraints such as low elevation and tidal influence (SPU 2005). Tidal influence in the LDW causes some gravity storm drain systems to back up and flood low-lying areas.

The Second Avenue South drainage basin covers the area between State Route 99 (SR99) and the LDW, from about South Austin Street to Trotsky Inlet; the northern extent of the drainage basin is shown on Figure 9. The drainage basin is served by a system of ditches and culverts, with northward conveyance to the inlet (SPU 2005). The main drainage ditch leading to this outfall runs along Second Avenue South, along the eastern boundary of the ICS Property. According to a 1987 investigation of groundwater on the ICS Property (Hart Crowser 1987), this drainage ditch appears to be a source of recharge to groundwater for the ICS Property. The relative elevation of a concrete culvert invert in the ditch is at or higher in elevation than the groundwater levels measured in wells away from the tidal effects of the inlet.

4.1.5. Shoreline Features

4.1.5.1. LDW Shoreline

The Property shoreline along the LDW primarily consists of riprap with small patches of vegetation characterized by invasive species commonly found in industrial shoreline environments, including Himalayan blackberry (*Rubus discolor*), Douglas' spiraea (*Spiraea douglasii*), and upland weedy species. The Duwamish River provides limited habitat opportunities for salmon and other fish, birds, mammals, and other wildlife; however, habitat conditions in the vicinity of the Property are highly modified from natural conditions.

In early 2012, approximately 100 linear feet of the Property's shoreline bank were repaired to protect against the lateral migration of the LDW and wave erosion from vessel traffic. Prior to stabilization, portions of the bank were observed to be eroding. Bank stabilization was achieved by the removal of invasive plant species and placement of approximately 75 cubic yards of medium-sized rock keyed in with occasional larger material. The rock was placed over approximately 25 cubic yards of a gravel filter layer. Currently, the bank slopes at approximately 2H:1V or steeper from the top of bank (approximately +16 feet) to the toe (approximately -2 feet). The bathymetry waterward of the toe of the bank slopes gently toward the LDW navigation channel. The substrate is composed of mostly riprap above the bank toe and a mix of sand and silt waterward of the bank toe. Six offshore pile groups are used for barge mooring (Figure 3). Aquatic vegetation is not known to exist in the vicinity of the LDW shoreline.

4.1.5.2. Trotsky Inlet Shoreline

The Property shoreline along the Trotsky Inlet primarily consists of vegetated slopes with remnant wood sea walls, occasional piles, and patches of concrete/asphalt riprap. Vegetation is characterized by invasive species including Himalayan blackberry, Douglas' spiraea, and upland weedy species.

The northern bank of the Trotsky Inlet slopes at approximately 1.5H:1V or steeper from the from the top of bank (approximately +16 feet) to the toe (approximately +6 feet). The intertidal area of the inlet slopes from approximately +6 feet toward the Duwamish River channel (Figure 3). Within the central and western portions of the inlet, a relatively hard "cap" is present and appears to consist of consolidated sand and sediment. Concrete, asphalt and wood debris are present within the inlet (primarily at the western end). Wood piling and heavy, pile-supported timbers are present in the central portion of the inlet.

4.1.6. Surface Water

The Duwamish River comprises the lower 10 miles of the Green-Duwamish River Watershed system, which is comprised of a series of rivers and tributaries that flow to Elliot Bay from headwaters in the Cascade Mountains. The Green-Duwamish River Watershed covers approximately 483 square miles in northwestern Washington (Ecology 1980). The LDW, which comprises the lowermost extent of the Green-Duwamish River Watershed, is influenced by tidal variations within Elliot Bay and Puget Sound.

The LDW is a typical saltwater wedge estuary that has a density-driven, two-layer flow system. Under typical conditions (average flows), the less dense freshwater flows downstream in the surface layer and the denser saline water from Elliot Bay moves upstream on flood tides in the bottom layer, forming a saltwater wedge thickest at the downstream end and tapering to zero upstream. Under average flow conditions (1,340 cubic feet per second) the toe of the saltwater wedge extends to between RM 4.3 and RM 5.5, depending on the height of the tide (Windward 2008 and Pritchard 1955). Under higher flow conditions, the toe of the saltwater wedge extends to between RM 1.8 and RM 3.1 depending on the height of the tide. The saltwater wedge has been observed to extend upstream as far as RM 10.2 at high tide during periods of low freshwater inflow (Stoner 1967). Because the Property is located between RM 2.1 and RM 2.2, the saltwater wedge is present adjacent to the Property under most flow and tidal conditions.

4.2. Geology and Hydrogeology

4.2.1. Geology

The landscape in the Project vicinity has been influence by both glaciofluvial and river flow processes as well as extensive human modification through the channelization of the Duwamish River and filling activities along historical river banks. During the Pleistocene Epoch, the Duwamish Valley was created by advancing ice sheets of the Vashon Stade approximately 17,000 years ago. Vashon glacial deposits were deposited over older upland deposits of Pleistocene and Tertiary age. Following volcanic activity of Mount Rainier approximately 5,700 years ago, vast quantities of sediment from the Osceola Mudflow were deposited into the White River Valley. Through natural river processes, these sediments were eroded and redeposited downstream to create the floodplain of the Duwamish River Valley.

In general, the Lower Duwamish valley deposits consist of approximately 50 to 100 feet of alluvium (Q_{oal}) representing sand and silt estuarine deposits that contain discontinuous gravel lenses, shells, and some wood. These Q_{oal} deposits are capped by silty and sandy sediments with abundant wood debris and organics, indicative of channel and floodplain deposits laid down by the modern Duwamish River. Within the last 100 years, the delta/estuary has been extensively modified by hydraulic dredging and filling, leading to large-scale industrial development of the LDW. Detailed information regarding the geology and depositional processes for the Duwamish River Valley is presented in the LDW RI (Windward 2010). Local geology based on explorations completed at the Property is discussed in the following section.

4.2.1.1. Local Geology

Historically, the Property and surrounding area received alluvial and floodplain deposits consisting of silt, clay, and sand prior to industrialization of the lower Duwamish River Valley in the early 1900s. Prior to filling, the Property consisted of intertidal aquatic lands (mudflats) near the western bank of the Duwamish River. The location of the former river bank west and south of the present-day Property (prior to filling), is visible in a historical aerial photograph dated around 1956 (Figure A-1 in Appendix A).

The former tidal mudflat beneath the present-day 7100 Site (before filling) is visible during low tide conditions in the circa 1956 aerial photograph (Figure A-1). In this photograph, two channels extend in a northerly direction across the mudflat, indicating northerly drainage beneath the footprint of the 7100 Site before the 7100 Site existed. One of these channels is an extension of the former drainage ditch located on the eastern portion of the ICS site. This former drainage ditch (currently the Second Avenue South storm drain) contains elevated concentrations of PCBs and other contaminants associated with historic drum recycling operations on the ICS site (DOF 2016). Contaminants transported to the mudflats by the drainage ditch (and other release points from drum recycling facility) would have been dispersed throughout the mudflats by daily tidal fluctuations in the LDW. These circa 1956 drainage features along with chemical analytical data (discussed later) support a key aspect of the CSM for the 7100 Site: that deeper contamination beneath the 7100 Site originated from historic operations on the ICS site.

During the 1960s, fill material was placed to create land that would become the Property and the adjacent WSDOT Lease Area. Using land-based equipment, fill material was placed behind a dike spanning from the 1st Avenue South Bridge to the mouth of Trotsky Inlet. During reconstruction of the 1st Avenue South Bridge in the mid-1990s, filled land northwest of the Property was removed to facilitate construction of an engineered wetland, which comprises the northern portion of the 1st Avenue storm drainage basin.

Based on subsurface investigations and review of the development history, the stratigraphy of the Property generally consists of three fill units overlying native mudflat and associated alluvial deposits. Two geologic cross-sections (Figures 10 and 11) illustrate the native soil and fill units at the Property. The interpretations reflected in these cross-sections are based on soil types encountered in subsurface explorations at or adjacent to the Property and information from historical aerial photographs. The boundary between the fill and native units is further informed by the vertical profile of contaminant concentrations. Descriptions of the native and fill units are presented below. Historical photographs documenting changes to the Property and surrounding area are presented in Appendix A. Exploration logs detailing soil types are presented in Appendices B and C.

- **Upper Fill Unit:** Fill material was reportedly imported during the 1960s and placed using land-based equipment (Figure A-2; Appendix A) to create land for industrial use. The upper fill unit is variable in thickness ranging from approximately 5 feet in the southwestern portion of the Property to approximately 11 feet in the northeastern portion portion of the Property. This unit is generally characterized by medium dense silty sands and gravels. Concrete debris was identified in the upper 5 feet of explorations DP-9 through DP-11, MW-13 and MW-16 through MW-18. In addition, wood debris was also observed in explorations MW-13 and MW-19. Other debris or waste materials were not observed in the shallow fill unit.
- **Lower Fill Unit:** Dredged material from the LDW was reportedly placed during the 1960s to create land for industrial use. The lower fill unit fill is variable in thickness, ranging from approximately 5 feet in the southwestern portion of the Property up to approximately 17 feet thick in the northeastern portion portion of the Property. The lower fill is generally characterized as loose, silty fine to medium sand with colors ranging from dark brown to black and gray. Occasional wood debris was observed in explorations MW-2R and MW-17. Other debris or waste materials were not identified in the lower fill unit.
- **UST Backfill Unit:** During decommissioning and removal activities for USTs T-1 and T-2, material generated by the excavation as well as imported material were reportedly reused for backfill (D&M 1991b).

- **Native Soil Unit:** The Native Soil Unit is generally characterized by alluvial deposits and is comprised of clay, silt and silty fine to medium sand with occasional organic debris (roots and branches) with colors ranging from dark bown to gray and back. Due to the similarity between the native river sediments and the dredged material that comprises the lower fill unit, the contact between this fill unit and the underlying native deposits is difficult to distinguish.

4.2.2. Hydrogeology

The groundwater table at the 7100 Site occurs within the lower part of the upper fill unit and upper part of the lower fill unit. Groundwater elevations were measured during each of the four quarterly sampling events performed at the 7100 Site. Table 4 summarizes the groundwater elevation data collected during the RI. Shallow groundwater elevations range from approximately 5 feet to 9 feet (NAVD88). Groundwater elevation varies seasonally, with elevations observed during spring (March 2014) being higher than elevations observed during summer (August 2013 and July 2014) by approximately 0.5 to 2 feet. Wells closest to the LDW exhibited the least seasonal groundwater elevation fluctuations, while the greatest seasonal fluctuation (2 feet) was observed at well MW-12, which is located in the center of the Property and farther away from the LDW than any other well at the 7100 Site.

A tidal study was performed as part of the RI to further evaluate hydrogeologic conditions at the 7100 Site. The tidal study included monitoring groundwater levels in six monitoring wells located at varying distances from the shoreline of the LDW to evaluate the tidal influence on groundwater across the Property. Water levels in monitoring wells MW-5, MW-9, MW-11, MW-12 and MW-13 and the elevation of surface water in the LDW were monitored for a period of 14 days between August 7 and August 21, 2013; one well (MW-16) was monitored for a period of 7 days between August 14 and August 21, 2013. Appendix D provides additional details concerning the methodology and results of the tidal study. Figures D-1 through D-16 in Appendix D present graphical representations of the measurements and analyses during the tidal study.

The results of the tidal study were evaluated to identify where tidal effects were observed in groundwater at the 7100 Site. A 72-hour period, between August 18 and 20, 2013, was selected for this analysis because that period had the largest range of tidal fluctuations (up to 13 feet) during the tidal monitoring period. Where present, the effects of tidal fluctuations on groundwater levels in individual monitoring wells were analyzed to identify the following:

- The effect of tidal fluctuations on groundwater gradients (Section 4.2.2.1);
- The length of time it took for the changing tide observed at the shoreline to reach an individual monitoring well location, which is identified as the time lag and presented in hours; and
- The magnitude of the groundwater level change in the well relative to distance from the shoreline, which is identified as the stage ratio and presented as a percent (%).

The time lag and stage ratio were then used to calculate the diffusivity for the shallow unconfined aquifer, which relates to transmissivity, storativity, and hydraulic conductivity which control the storage and flow of groundwater in the aquifer. This analytical method estimates “bulk” hydraulic parameters, which provide an overall estimate for the aquifer where the testing is performed, in contrast to the hydraulic parameters measured at individual monitoring well locations (slug tests) that provide hydraulic parameters for a specific location or portion of the aquifer. The monitoring wells used in the tidal study, as well as the mean groundwater elevation and calculated time lag and stage ratios, are presented in Table 6. Hydraulic conductivity values determined based on tidal study and slug test results are discussed in Section 4.2.3.3 below.

Groundwater levels in four wells (MW-9, MW-12, MW-13, and MW-16) observed during the tidal study showed a direct hydraulic response to tidal fluctuations in the LDW. Groundwater levels were observed to be tidally influenced as much as 150 feet from the shoreline in MW-16. Because the 7100 Site is bounded on two sides by surface water that is tidally-influenced (i.e., the LDW and Trotsky Inlet), the distance to the nearest shoreline was used for the analysis of data from the tidal study. Water levels in MW-11 showed very little response to tidal fluctuations, and appeared to be partially controlled by unknown non-tidal effects, and thus were not used to calculate aquifer parameters from the tidal study data. Little tidal response was observed in MW-5 during the tidal study; the water level remained within 0.094 feet of the initial water level for the duration of the 72-hour study.

In the tidally-influenced wells, the time lag ranged from approximately 0.82 hours (49 minutes) for the well located approximately 30 feet from the shoreline (MW-9) to approximately 8.4 hours for the well located approximately 150 feet from the shoreline (MW-16). Figure 12 presents a comparison of the water level in the LDW to the groundwater levels in the tidally-influenced monitoring wells. Monitoring wells MW-9 and MW-13 are located approximately 30 and 35 feet from the shoreline, respectively, and have a strong correlation with the tidal fluctuations measured in the LDW. Monitoring wells MW-12 and MW-16 are located approximately 100 and 150 feet from the shoreline, respectively, and show a much lower magnitude of tidal influence (3 percent stage ratio). The average groundwater elevations in the tidally-influenced wells were relatively similar, ranging between 6.37 feet in MW-16 to 6.0 feet in MW-12.

The tidal responses shown in Figures D-1 through D-12 (Appendix D) indicate some irregularities in the response curves for the tidally-influenced wells. Well MW-9 showed a shift in the response curve at approximate elevations 7.7 and 6.3 feet during falling tides (Figure D-1b). This could be related to heterogeneity in the portion of the fill unit in which this well is screened, which was observed to contain cobbles and concrete (Appendix C). Wells MW-9 and MW-13 showed a delay in response to falling tides starting at approximately 6.0 feet, as indicated by a shift in the response curve below this elevation (Figures D-1b and D-2b). This could be the result of water ponding in Trotsky Inlet during the lowering tide, which may influence groundwater levels by effectively delaying the drop in groundwater elevation due to falling tides at these two wells. Additionally, wells MW-12, MW-13, and MW-16 show occasional “blips” in the response curves at the same time, indicating potential ground disturbance or vibration at the Property during the tidal study. This could be attributed to trucks or containers being moved in the vicinity of these wells during operations at the dock.

The results for wells that showed little to no tidal response (MW-5 and MW-11) are presented on Figure 13. The groundwater level in MW-11 showed some correlation with tidal fluctuations in the LDW. However, the magnitude of tidal influence was low (3 percent stage ratio) and the effects were not entirely cyclical, indicating other non-tidal effects were influencing water levels in MW-11 during the tidal study; for these reasons, data from MW-11 were not used in the calculation of time lag and stage ratio from the tidal study data. Well MW-11 is the furthest west (upgradient) well used for the tidal study and the average groundwater elevation (6.62 feet) was the highest of the wells used for the tidal study.

As identified in Figure 13, there is no discernible effect of the river stage height (i.e., water level in the LDW) on the groundwater level in MW-5 as the groundwater level remained relatively unchanged through multiple tidal cycles that included up to approximately 13 feet of change in the adjacent water level in the LDW. The average water level elevation in MW-5 during the tidal study was 5.17 feet, which is the lowest average water level of the wells monitored during the tidal study. The absence of water level variation in MW-5 during the tidal study was unanticipated as the well was re-developed prior to the tidal study and had previously responded to tidal fluctuations (up to 0.26 feet over 24 hours) during groundwater monitoring

conducted by D&M (1992). It is possible the well has been damaged since the 1992 study or is no longer functioning properly.

4.2.2.1. Groundwater Gradients and Flow Direction

The average groundwater elevation for each well included in the tidal study was calculated by averaging the groundwater elevations measured over the 72-hour tidal study using the Serfes (1991) Method, as discussed in Appendix D. This data was evaluated for use in estimating groundwater gradients and flow direction beneath the Site. However, the data is not particularly well suited for this purpose because of its limited spatial extent. This is particularly true if data from MW-5 is not used because of the suspect integrity of the well.

As an alternative, groundwater gradients and flow direction beneath the Site were evaluated based on the most recent site-wide monitoring event. These data were collected by Dalton Olmsted Fuglevand (DOF) on February 6, 2018 to support the ICS site RI but the data have not yet been published. On this date, groundwater elevations were measured twice in all Site monitoring wells: once during low tide and once during high tide. These measurements were obtained during intervals spanning the high tide at 9:23 a.m. (+11.8 feet MLLW) and the low tide at 4:09 p.m. (+2.5 feet MLLW). The two measurements in each well were used to estimate average groundwater elevations (Figure 14). As expected, this data suggests there is a meaningful and reasonably consistent groundwater gradient in the most upgradient wells, where tidal fluctuations have less influence on groundwater. The gradient in this area slopes toward the southeast (e.g. near wells MW-1, MW-12, MW-3, MW-19, MW-16 and MW-4). The more limited tidal influence in this area is illustrated by the tidal study results for MW-12 and MW-16 (Figure 12). The lowest average groundwater elevations occur in the vicinity of wells MW-2R and MW-10. Average groundwater gradients along most of the LDW and Trotsky Inlet shorelines are very muted because of the diurnal tidal fluctuations of surface water in the LDW. The limited gradients that do exist in these areas slope toward the interior of the 7100 Site. The interpolated groundwater elevation contours shown in Figure 14 incorporate data from MW-5, but this interpretation would not substantively change if data from MW-5 were excluded.

In general, groundwater gradients based on the average elevations range from about 0.0182 feet per foot (ft/ft) at upgradient locations (vicinity of wells MW-16 and MW-3) to 0.0022 ft/ft in areas closer to the shoreline (between wells MW-13 and MW-18). The general conclusion based on this groundwater elevation data is that, on average, constantly fluctuating tides in the LDW reduce groundwater flux from the 7100 Site. This is evidenced by gradients along the shoreline that are relatively flat or, if anything, slope slightly toward the interior of the Site. The significant influence of surface water intrusion into the shallow aquifer near the shoreline not only mutes groundwater gradients, but significantly increases chloride concentrations (Figure 15). Sampling data from the July 2014 monitoring event reveal elevated chloride concentrations in shoreline wells (1,870 to 7,370 mg/L) compared to much lower concentrations in the interior portion of the site (40.3 to 84.8 mg/L near the former garage).

4.2.2.2. Hydraulic Conductivity

The hydraulic conditions at the Site were evaluated using information from slug tests on three wells as well as the tidal study described above (Table 7). Analytical methodology and procedures for calculating the hydraulic conductivities are presented in Appendix D.

Slug tests were performed on three monitoring wells (MW-2A, MW-14, and MW-16) to supplement the tidal study and to provide data for comparison of calculated hydraulic conductivities. Hydraulic conductivity (K) values calculated from slug test data ranged from approximately 0.97 feet per day (ft/day) to 4.90 ft/day. The average hydraulic conductivity for the aquifer based on slug test data is 2.32 ft/day. The hydraulic

conductivity values calculated for the aquifer based on slug test data are consistent with conductivity values for unconsolidated silt and silty sand. Boring logs for wells constructed at the site (Appendices C and D) indicate that the materials in which the slug tested wells were screened is predominantly silty sand.

The values resulting from slug data are considered estimates of the hydraulic conductivity at the test location or in a localized portion of the aquifer where the test was performed due to the relatively small radius of influence generated during slug testing. The hydraulic conductivity values determined from slug testing are presented in Table 7.

Hydraulic conductivity values were also calculated from the tidal study data using aquifer diffusivity values calculated from both time lag and stage ratio. Hydraulic conductivity values calculated using tidal studies are considered bulk values representative of the entire aquifer within the test area. The results of the tidal study can be considered an average for the portion of the aquifer monitored during the tidal study.

Based on the observed tidal responses in the aquifer, the calculated bulk hydraulic conductivity values were 0.17 to 2.9 ft/day for the time lag and stage ratio methods, respectively. These values are similar to the values calculated from slug test data (i.e., between 0.97 and 4.90 ft/day). The hydraulic conductivity values determined for the aquifer, based on the tidal study, are consistent with average conductivity values for unconsolidated fine sand and silt deposits (Driscoll 1986).

4.2.2.3. Groundwater Potability

Drinking water for the Property vicinity is currently supplied by the City of Seattle. Water supply wells are not known to exist at or near the 7100 Site, and groundwater beneath the 7100 Site is not used as drinking water. Groundwater beneath the 7100 Site is classified as non-potable based on the criteria specified in Washington Administrative Code (WAC) 173-340-720(2), as follows:

> (2)(a) *The ground water does not serve as a current source of drinking water.*
>
> Applicability: Drinking water is currently supplied by the City of Seattle. Water supply wells are not known to exist at or near the 7100 Site.
>
> (2)(c) *The department determines it is unlikely that hazardous substances will be transported from the contaminated ground water to ground water that is a current or potential future source of drinking water, as defined in (a) and (b) of this subsection [i.e., -720(2)], at concentrations which exceed ground water quality criteria published in Chapter 173-200 WAC.*
>
> Applicability: Contaminated groundwater beneath the 7100 Site occurs in the uppermost groundwater-bearing zone comprised of fill. Shallow groundwater discharges directly into the LDW and will not flow toward other aquifers that may be a current or potential future source of drinking water.
>
> (2)(d) *Even if ground water is classified as a potential future source of drinking water..., the department recognizes that there may be sites where there is an extremely low probability that the ground water will be used for that purpose because of the site's proximity to surface water that is not suitable as a domestic water supply. An example of this situation would be shallow ground waters in close proximity to*

marine waters such as on Harbor Island in Seattle. At such sites, the department may allow ground water to be classified as non-potable if each of the following conditions can be demonstrated. These determinations must be for reasons other than that the ground water or surface water has been contaminated by a release of a hazardous substance at the site.

(2)(d)(i) There are known or projected points of entry of the ground water into the surface water.

Applicability: Groundwater at the 7100 Site is in close proximity to the tidally fluctuating LDW, resulting in the tidal exchange of saline surface water and upland groundwater within the Site. Table 5 presents the results of groundwater field measurements made during groundwater sampling, and laboratory analysis of chloride and total dissolved solids (TDS) in groundwater. The chloride and TDS results for several wells on the 7100 Site indicate saline conditions resulting from LDW surface water entering the Site; chloride concentrations above the EPA Secondary Maximum Contaminant Level of 250 milligrams per liter (mg/L) and TDS concentrations indicative of slightly saline (greater than 1,000 mg/L TDS at several wells) to highly saline (greater than 10,000 mg/L TDS at wells MW-9, MW-11, and MW-13).

(2)(d)(ii) The surface water is not classified as a suitable domestic water supply source under Chapter 173-201A WAC.

Applicability: The LDW is a marine surface water body, and is not suitable as a domestic water supply under Chapter 173-201A WAC.

(2)(d)(iii) The ground water is sufficiently hydraulically connected to the surface water that the ground water is not practicable to use as a drinking water source.

Applicability: The shallow aquifer beneath the 7100 Site is directly connected with and discharges into the LDW. It is not practicable to utilize the shallow aquifer for water supply due to the potential for drawing saline water into the aquifer (salt water intrusion).

4.3. Natural Resources

Due to the industrial developed land use of the Property and surrounding areas, limited additional investigation was performed to evaluate natural resources at the 7100 Site. The ground surface across the Property is predominantly paved by concrete or asphalt. Typical of industrialized waterfronts, the shoreline adjacent to the LDW is armored with riprap to prevent erosion, with minimal vegetation that would serve as riparian habitat. The shoreline along Trotsky Inlet is partially exposed and contains pile-supported structures as well as remnant piles from previous structures that have been removed.

4.4. Land Uses

The Property and adjacent properties are zoned for industrial use and are characterized by manufacturing, shipping, warehousing, bulk material storage, transportation, and other industrial uses. The Property is currently used for staging and storage of shipping containers and other marine transportation and shipping-related equipment. The Property has moorage along the LDW, which is actively used for loading and

unloading of barges. It is anticipated that the current use will continue into the foreseeable future. There are no plans to develop the Property or to change the type of use.

5.0 SCREENING LEVELS AND IDENTIFICATION OF CONTAMINANTS OF CONCERN

5.1. Screening Levels

This section summarizes the development of screening levels (SLs) for soil and groundwater at the 7100 Site for use in evaluating potential risks to human health and the environment. These SLs have been developed in accordance with MTCA (WAC 173-340-720 through 740).

Screening levels were developed for those constituents that have numerical regulatory standards or toxicity data that can be used to calculate protective criteria. Soil and groundwater SLs were developed for various pathways and all constituents analyzed at the 7100 Site. Although the current and anticipated future land use is industrial, the SLs are based on an unrestricted land use scenario for upland receptors. This is a conservative approach used for screening data in the RI. During later phases of the project, land uses will be re-evaluated to support the development of cleanup levels.

Soil and groundwater SLs also were developd based on protection of off-site receptors (sediment and surface water). Sediment screening levels used in this process were derived using the framework described in Ecology's Sediment Cleanup Users' Manual II (SCUM II) guidance (Ecology 2015) and the risk assessment approach followed in the LDW RI report (LDWG 2007). Soil and groundwater concentrations protective of these sediment screening levels were then calculated. This process was completed only for those constituents that were analyzed in upland media and detected in adjacent LDW sediment at concentrations greater than sediment SLs.

5.1.1. Sediment Screening Levels

Sediment screening levels were developed solely to support the development of Site soil and groundwater screening levels protective of LDW sediment, as described above. Sediment screening levels otherwise have no significance to the 7100 Site because the 7100 Site does not extend into the LDW, nor is sediment investigation included in the scope of the Agreed Order. The screening levels identified for sediment are discussed below and presented in Appendix E.

The sediment screening levels developed for this RI are based on protection of benthic organisms; people that may come into direct contact with sediment during beach play, clamming, and net fishing; and people and ecological receptors that may consume seafood foraged from sediments that border the 7100 Site (bioaccumulation pathway). The criteria based on people directly contacting sediment adjacent to the 7100 Site have been included solely for purposes of screening the RI data, and because the LDW ROD identifies this portion of the shoreline as being accessible to the public. This is discussed in more detail below. The potential for beach play, clamming and net fishing is low in front of this industrial site, which has no accessible shoreline and is not available for public access. Accordingly, although criteria based on these potential direct-contact exposure pathways are used to screen data in the RI, it is unlikely that they would be considered when evaluating upland cleanup actions for the 7100 Site.

According to the Sediment Management Standards (SMS) regulations, sediment criteria are selected from among the sediment cleanup objectives (SCOs) and cleanup screening levels (CSLs). In general, SCOs and CSLs for a sediment contaminant are set as the highest of the following levels:

- The lowest risk-based level protective of benthic invertebrate communities (direct contact), human health (direct contact and bioaccumulation), or higher trophic level ecological receptors (bioaccumulation);
- Background (natural or regional); or
- Practical quantitation limits (PQL).

The upper tier values (CSLs), which should be considered when developing cleanup levels for sediment remedial actions, were not considered an appropriate starting point for back-calculating upland concentrations from a source control perspective, as they are less conservative than SCO values. For this reason, only SCO values were derived.

Table E-1 of Appendix E includes values selected or derived for each of these criteria and the proposed sediment SLs (SCOs) for each sediment analyte.

Protection of Benthic Organisms: Two sets of marine sediment criteria are used to protect benthic organisms: SMS marine sediment criteria (used if sediment TOC is between 0.5 and 4.0 percent) and marine sediment apparent effects threshold (AET) criteria (used if sediment organic carbon is less than 0.5 percent or greater than 4.0 percent). The SMS criteria were obtained from Table III of the revised SMS (Chapter 173-204 WAC); these values were also used as sediment cleanup levels for protection of benthic organisms in the LDW ROD. The AET values were obtained from Ecology's SCUM II guidance (Ecology 2015; Table 8-1). The LDW-wide average TOC is 2 percent and the average TOC for sediment samples obtained in front of the Site is 2.3 percent; therefore, only the SMS marine sediment criteria were used to derive sediment SLs (SCOs) in Table E-1 of Appendix E.

Protection of Human Health (Direct Contact): Sediment screening levels were calculated based on human health exposure to sediment in the LDW via dermal contact and ingestion. The equations and parameter values used to calculate the sediment screening levels are from the LDW RI Baseline Human Health Risk Assessment (Tables B.3-15 and B.3-16 [net fishing], Tables B.3-19 and B.3-20 [beach play], and Tables B.3-23 and B.3-24 [clamming]; LDWG 2007). These exposure scenarios are inconsistent with current site use and expected future site use, and are therefore overly conservative. Nevertheless, these exposure scenarios were used for consistency with the LDW RI. Also, to be consistent with the LDW RI, the carcinogenic polycyclic aromatic hydrocarbons (cPAH) toxicity equivalency (TEQ) beach play sediment screening levels were adjusted to "account for potential greater susceptibility of children from 0 to 2 and from 2 to 6 years of age compared with older children and adults." The equations and parameter values used in this RI and the LDW RI are similar to those presented in Ecology's SCUM II guidance (Ecology 2015; Equations 9-1 and 9-2 and Table 9-1). The sediment screening levels based on sediment ingestion and dermal contact shown in Table E-1 of Appendix E represent the values for three potential receptors evaluated including a child exposed during beach play, an adult exposed during clamming and an adult exposed during net fishing (subsistence harvesting). The LDW RI (LDWG 2010), FS (LDWG 2012), and ROD (EPA 2014) identified the sediment adjacent to the 7100 Site as a beach play area, a potential clamming area, and a net fishing area. The applicability of these exposure scenarios to portions of the LDW adjoining

the 7100 Site will be further evaluated at a later date, if needed, as previously described. The SCO values are based on an excess cancer risk of 1×10^{-6} or a hazard quotient of 1.

Sediment screening levels for beach play, clamming and net fishing were not developed for lead using the procedures outlined in the LDW RI or Ecology's SCUM II guidance because EPA has not identified the necessary consensus toxicity factors for lead. The MTCA Method A soil cleanup level for lead in an unrestricted land use scenario is 250 mg/kg and is based on an exposure frequency of 365 days per year. The exposure frequencies assumed in the LDW risk assessment for the beach play, clamming and netfishing sediment exposure scenarios are 65, 120, and 119 days per year, respectively. Because the assumed sediment exposure frequencies are much lower than those assumed for unrestricted land use, the benthic SCO value of 450 mg/kg for lead is assumed to be protective of direct contact with sediment via the beach play, clamming and netfishing sediment exposure scenarios.

Children exposed to sediment during beach play and adults during clamming are assumed to be exposed primarily to intertidal, shoreline sediment. The net fishing potential exposure scenario includes exposure to both intertidal and subtidal sediment.

Bioaccumulation: LDW sediment risk drivers for the bioaccumulation pathway are arsenic, cPAH TEQ, dioxin/furan TEQ and total PCBs (EPA 2014). Sediment cleanup levels identified in the LDW ROD that are protective of the bioaccumulation pathway are used to derive the sediment screening levels presented in Table E-1 of Appendix E. Bioaccumulation sediment cleanup levels were not identified in the LDW ROD for arsenic or cPAHs because data collected during the RI/FS showed little relationship between concentrations of arsenic or cPAH in sediment and their concentrations in clam tissue. According to the LDW ROD, sediment cleanup areas will be determined using other cleanup levels for these two analytes. For this reason, bioaccumulation-based sediment criteria are not included in Table E-1 of Appendix E for arsenic and cPAHs. Dioxins and furans are not considered upland (soil and groundwater) contaminants of concern for the 7100 Site; therefore, a bioaccumulation-based sediment screening level for dioxin/furan TEQ is not required.

For total PCBs, the SCO bioaccumulation-based sediment screening level is set at the LDW ROD human seafood consumption sediment cleanup level of 2 micrograms per kilogram (µg/kg), which is the natural background level for total PCBs (Tables 3 and 19, LDW ROD). This value is also protective of the bioaccumulation pathway for ecological receptors; the LDW ROD ecological (river otter) sediment cleanup level for total PCBs is 128 µg/kg. EPA, Ecology and other stakeholders are planning to develop regional background values for the LDW. If a regional background total PCB value is developed, the sediment screening level for total PCBs would not be lower than the regional background total PCB value.

Background: According to the revised SMS, natural background values are considered in the development of SCOs, while regional background values are considered in the development of CSLs.

Natural background values for total PCBs, arsenic, and cPAH TEQ are presented in the LDW ROD, and are based on the 95th percentile upper confidence limit on the mean (95 percent UCL; Table 3, LDW ROD). These values are included in Table E-1 of Appendix E.

As discussed above, EPA, Ecology and other stakeholders are planning to develop regional background values for the LDW. Because regional background values are currently not available, the natural background values from the LDW ROD are included in Table E-1 of Appendix E.

PQL: The sediment PQLs listed in Table E-1 of Appendix E were obtained from ARI and Columbia Analytical Services (CAS), both of which are Washington-certified laboratories.

Sediment Screening Levels: For purposes of developing soil and groundwater screening levels for this RI, the sediment screening levels are established at the SCO (Table E-1 of Appendix E). These screening levels may be revised in the future if/when regional background values become available, especially for total PCBs.

5.1.2. Groundwater Screening Levels

As described above in Section 4.1.6.6, groundwater beneath the 7100 Site is classified as non-potable based on the criteria specified in WAC 173-340-720(2). The SLs developed to evaluate Site groundwater data were primarily based on the protection of LDW surface water and sediment. The existing and future land use at the 7100 Site was used as the basis for eliminating vapor intrusion. The potential vapor intrusion pathway was not addressed because there are no permanent, occupied structures at the 7100 Site. Structures present at the 7100 Site include an abandoned and unused wood structure formerly used as an office, and portable structures placed on the paved surface used for support of site operations. There are no plans to change the general use of the 7100 Site or to construct permanent structures.

The groundwater SLs are presented in Table 8. The groundwater SLs are based on protection of the following media/exposure scenarios:

- **Protection of Marine Surface Water.** Groundwater numerical criteria protective of marine surface water are based on MTCA standard Method B surface water cleanup levels prescribed in WAC 173-340-730(3)(b). The Method B surface water cleanup levels are protective of aquatic organisms and human health. MTCA Method B standard formula values based on the protection of human health via the consumption of aquatic life were obtained from Ecology's "CLARC Master Spreadsheet.xlsx" dated August 2015 and adjusted to account for fish consumption rate and fish diet fraction assumptions developed in the LDW RI. The SLs in Table 8 are based on a fish consumption rate of 97.5 grams per day and a fish diet fraction of 1. The MTCA Method B standard formula values in the CLARC Master Spreadsheet are based on a fish consumption rate of 54 grams per day and a fish diet fraction of 0.5. As noted in WAC 173-340-730(3)(b)(iii), the standard formula values are necessary when sufficiently protective criteria have not been established under applicable state and federal laws. Ecology considers a criteria sufficiently protective if the excess cancer risk is not greater than 1×10^{-5} or the hazard quotient is not greater than 1 (Ecology 2005). State or federal criteria that are not sufficiently protective were adjusted to a cancer risk of 1×10^{-5} or a hazard quotient of 1. These adjusted values are presented in Table 8 in the columns "Carc. Adjusted" and "Non-Carc. Adjusted," respectively.
- **Protection of Sediment.** Groundwater numerical criteria protective of marine sediment were calculated using the proposed sediment SLs in Table E-1 of Appendix E. These criteria were only calculated for groundwater constituents that were detected at concentrations greater than sediment screening levels in sediment samples located downgradient of the 7100 Site. Methods used to calculate groundwater concentrations protective of sediment are described below.

Groundwater concentrations protective of sediment were calculated assuming equilibrium partitioning between sediment and groundwater in sediment pore spaces. The following equation was used to calculate groundwater concentrations protective of dry weight SCO criteria:

$Cw = SCO/(CF \times DF [K_d + \theta_w/\rho_b])$

Where:

Cw = groundwater concentration protective of sediment (µg/L)
SCO = sediment cleanup objective (WAC 173-204-560[3]) (mg/kg dry weight)
CF = conversion factor (0.001 mg/µg)
DF = dilution factor (unitless) (default value of 1 for saturated sediment)
K_d = soil-water distribution coefficient (L/kg)
θ_w = water-filled porosity (0.615 ml/ml) (Ecology 2017)
ρ_b = dry sediment bulk density (1.02 kg/L) (Ecology 2017)

K_d values were obtained directly from Ecology's "Lower Duwamish Waterway, Preliminary Cleanup Level Workbook" dated December 2017.

MTCA (WAC 173-340-705[6]) specifies that the screening level for a given constituent shall not be set at a value below the natural background concentration or analytical PQL, whichever is higher. Preliminary groundwater SLs were selected based on the lowest of the applicable numerical criteria described above. The SLs were then adjusted as necessary based on background concentrations (arsenic only) and PQLs. The background value for arsenic in groundwater is based on the MTCA Method A groundwater cleanup level, which is identified as the regulatory background concentration of arsenic in Washington state. The PQLs listed in Table 8 were obtained from ARI of Tukwila, Washington and CAS of Longview, Washington, both of which are Washington-certified laboratories. Discussions with these laboratories regarding the analytical requirements for this project indicate that the listed groundwater PQLs in Table 8 are the lowest practicably attainable values using conventional/accepted analytical methods. For those analytes listed in Table 8 with PQLs greater than the lowest applicable protective criteria, the laboratories have determined that PQLs below the protective criteria cannot be practicably achieved.

Groundwater SLs listed in the column titled "Preliminary Screening Level" in Table 8 are the lowest risk-based concentration and have not been adjusted for background or PQLs. The SL for groundwater are presented in the last column of Table 8, after adjustment for PQL.

5.1.3. Soil Screening Levels

Screening levels for soil are presented in Table 9. Soil SLs were not developed for the protection of terrestrial ecological receptors because the Simplified Terrestrial Ecological Evaluation (TEE) conducted for the 7100 Site concluded that land use at the site and surrounding area makes wildlife exposure unlikely and that further evaluation was not required (WAC 173-340-7492). The Ecology TEE forms used to arrive at this conclusion are presented in Appendix F. The soil SLs were selected from the following criteria:

- **Human Direct Contact:** MTCA standard Method B soil cleanup levels protective of human health for unrestricted land use (WAC 173-340-740[3][b]), obtained from Ecology's "CLARC Master Spreadsheet.xlsx" dated August 2015 (Cleanup Levels and Risk Calculations Volume 3.1 [CLARC] database) or calculated using equations in WAC 173-340-740(3)(b)(iii)(B). MTCA Method A soil cleanup levels for unrestricted land use (WAC 173-340-740[2]) obtained from MTCA Table 740-1 are used for analytes without Method B soil cleanup levels (TPH and lead).
- **Groundwater Protection:** Soil criteria protective of groundwater quality (based on the lowest groundwater criteria that are presented in Table 9 and discussed above in Section 5.1.2). These criteria

were only calculated for soil constituents that were detected in groundwater at concentrations greater than groundwater SLs. These soil criteria address the soil to groundwater pathway, and were calculated using the MTCA fixed parameter three-phase partitioning model (WAC 173-340-747[4]). Default assumptions provided in WAC 173-340-747(4)(b) (Equation 747-1 and Equation 747-2) for vadose and saturated zone soils were used in the calculations, and model input parameter values (soil organic carbon-water partitioning coefficient [K_{OC}] and Henry's Law constants) were taken directly from Ecology's CLARC database, with exceptions noted below.

Where K_{OC} and Henry's Law constants were not available in CLARC, they were generally obtained from EPA's EPI Suite, Version 4.11. K_{OC} values for PCBs were obtained from CLARC (total PCBs), EPA's "Technical Background Document for Draft Soil Screening Level Guidance" dated March 1994 (Aroclor 1254), and EPA's "Aquatic Fate Process Data for Organic Priority Pollutants" dated 1982. EPA's 1994 Technical Background Document is a source for K_{OC} values cited in the CLARC database; EPA's 1982 Aquatic Data report is a source for K_{OC} in EPA's 1986 Superfund Public Health Evaluation Manual.

The default organic carbon fraction (f_{OC}) of 0.001 was not used to calculate MTCA Method B soil cleanup levels based on the protection of groundwater. This default value represents a clean, non-organic soil condition, which is not representative of moderately to high organic content in native soil and fill within the saturated zone at the 7100 Site. To account for this, a site-specific f_{oc} of 0.0114 was used. This value is the average f_{oc} from 23 soil samples obtained at the 7100 Site. Soil samples included in the average f_{OC} calculation are those samples with f_{OC} data and with minimal or no evidence of petroleum contamination.

Soil SLs for other exposure pathways were considered but ultimately determined to be not applicable for the 7100 Site. These pathways are described below, along with the rationale for not including these pathways in the development of soil SLs.

- **Terrestrial Ecological Evaluation (TEE):** Ecology conducted a simplified TEE for the Site (see Appendix F). The exposure analysis determined that land use at the 7100 Site and surrounding area makes wildlife exposure unlikely. At this point the simplified TEE process ended. Based on the TEE outcome, soil screening levels based on protection of ecological receptors are not required.
- **Soil Erosion to Sediment:** Screening levels also were not developed for direct soil erosion and transport to sediment at the 7100 Site. Screening levels for this pathway are not considered necessary because any upland remedy will prevent soil erosion and provide for stormwater management.

MTCA (WAC 173-340-705[6]) specifies that the screening level for a given constituent shall not be set at a level lower than the natural background concentration or the PQL, whichever is higher. Soil SLs were selected based on the lowest of the applicable numerical criteria. The SLs were then adjusted upward, as needed, based on background concentrations (metals) and PQLs. The background metals concentrations used are the Puget Sound region 90th percentile values reported by Ecology (1994), except for arsenic; the natural background concentration for arsenic is based on MTCA Table 740-1. The PQLs listed in Table 9 were obtained from ARI and CAS, both of which are Washington-certified laboratories.

Soil SLs listed in the column titled "Preliminary Screening Level" in Table 9 are the lowest risk-based concentration and have not been adjusted for background or PQLs. The SL for vadose and saturated zone soil are presented in the last two columns of Table 9, after adjustment for PQL.

5.2. Contaminants of Concern

Contaminants of concern (COCs) for the 7100 Site were selected following the methodology Ecology uses at other LDW sites. This process was used to eliminate hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The selected COCs are not only representative of those chemicals that pose the greatest risk, but collectively encompass the footprint of other chemicals that are present less frequently or have lower concentrations relative to their screening level.

All RI data were compared to the screening levels described in Section 5.1. Tables G-1 through G-3 in Appendix G present the RI soil data screened against the respective SLs. Tables G-4 through G-6 present the RI groundwater data screened against the respective SLs. Any chemical that exceeds the lowest applicable screening level, regardless of frequency or magnitude, is identified as a contaminant of potential concern (COPC).

COCs were selected from the COPC list and represent those chemicals that exceed their respective SL most frequently (exceedance frequency) and by the greatest amount (exceedance ratio). These chemicals also have the largest spatial footprint of SL exceedances, encompassing the locations where COPCs exceed their SLs. Chemicals were selected as COCs if either of the following criteria were met:

1. The constituent had a SL exceedance frequency of at least 10 percent; or
2. The constituent had a SL exceedance ratio of 2 or more.

Exceedance ratios are derived by dividing the detected concentration by the SL concentration.

COPCs and COCs in Site groundwater and soil are summarized in Tables 10 and 11, respectively. These tables also present statistical information about the occurrence of these chemicals at the Site. The selection of groundwater and soil COCs is discussed below.

5.2.1. Groundwater COCs

Thirty-five constituents were selected as groundwater COCs using the procedure described above (Table 10). The rationale for selecting these COCs is discussed below.

- Total Petroleum Hydrocarbons – Gasoline, diesel, and heavy oil-range hydrocarbons are COCs due to their frequency and magnitude of SL exceedances. Diesel- and heavy oil-range hydrocarbon concentrations are summed and compared to a single SL of 500 ug/L in this RI. Diesel/heavy oil-range hydrocarbons exceed the groundwater SL most frequently, while gasoline-range hydrocarbons exceed the SL by the greatest magnitude.
- Volatile Organic Compounds (VOCs) - Benzene, ethylbenzene, and 1,1,1-trichloroethane are COCs in groundwater. Benzene has the highest exceedance frequency (33 percent) of all VOCs and the highest exceedance ratio of all COCs (2,600). Ethylbenzene and 1,1,1-trichloroethane are infrequently detected above SLs.
- SVOCs – Only one SVOC, bis(2-ethylhexyl)phthalate, meets the criteria for selection as a COC. This chemical qualifies as a COC because it has a maximum exceedance ratio of 4.0, even though it exceeds the SL very infrequently at the Site (exceedance frequency of about 5 percent).

- Carcinogenic PAHs (cPAHs) – Five individual cPAHs are COCs due to their frequency and magnitude of SL exceedances, including benzo(a)anthracene, benzo(a)pyrene, chrysene, benzofluoranthenes, indeno(1,2,3-cd)pyrene. The exceedance frequency and exceedance ratio of these chemicals are relatively similar except for indeno(1,2,3-cd)pyrene, which only marginally qualifies as a COC. The entire group of cPAHs, reflected as a total cPAH TEQ, also qualifies as a COC.
- Non-carcinogenic PAHs – Although acenaphthene and fluorene are COPCs, naphthalene is the only non-carcinogenic compound that meets the selection criteria as a COC. Naphthalene exceeds its SL in 18 percent of the samples, and has a maximum exceedance ratio of 140 times the SL.
- PCBs –Total PCBs and one individual PCB arochlor, arochlor 1254, are groundwater COCs. Total PCBs exceed its SL at a frequency of 53 percent with a maximum exceedance ratio of 440. Arochlor 1254 exceeds its SL at a frequency of 44 percent and has a maximum exceedance ratio of 190.
- Pesticides – Ten pesticides (2,4'- and 4,4'-DDD, 2,4'- and 4,4'-DDE, 2,4'- and 4,4'-DDT, alpha- and gamma-chlordane, dieldrin, and hexachlorobenzene) meet one or both of the criteria for COC selection. The most widespread pesticides are 4,4'-DDD and 4,4'-DDE; they have exceedance frequencies and exceedance ratios substantially higher than the other pesticides (exceedance frequency as high as 42 percent and exceedance ratio as high as 320 times the SL).
- Metals – Based solely on the COC selection criteria, five metals in the dissolved and/or total form qualify as COCs (copper, lead, mercury, nickel and zinc). The dissolved metal COCs only marginally exceed the exceedance ratio criterion (of 2), and one of them marginally exceeds the exceedance frequency crititerion (of 10 percent). All five metals exceed the COC threshold criteria based on total concentrations. Additional discussion about the COC-status of metals is presented in Section 6.0.

The effect of elevated analytical reporting limits on the COC selection process also was evaluated. Aldrin, heptachlor, bis(2-ethylhexyl)phthalate, hexachlorobenzene and endrin are constituents that were detected in at least one sample, but had elevated reporting limits in at least 10 percent of the groundwater samples obtained between 2008 and 2014. However, these constituents were either not detected in soil or had limited detections, and none of the detected concentrations exceeded the SLs. The exception is dieldrin, which had a single exceedance of its SL. Based on this evaluation, the elevated reporting limits do not adversely affect the groundwater characterization or the selection of groundwater COCs at the 7100 Site.

5.2.2. Soil COCs

The process described above also was used to select soil COCs and the results are presented in Table 11. Twenty-eight constituents were selected as soil COCs, as described below.

- Total Petroleum Hydrocarbons – Gasoline and diesel/heavy oil-range hydrocarbons are considered COCs due to the frequency and/or magnitude of SL exceedances. Contrary to groundwater, gasoline-range hydrocarbons are the more prominent petroleum COC in soil.
- Volatile Organic Compounds - Benzene and ethylbenzene are considered COCs in soil. Benzene frequently exceeds its screening level (30 percent) and has a relatively high exceedance ratio (1,000). Ethylbenzene, however, is infrequently detected above its SL (4.5 percent) but has a maximum exceedance ratio of 790.
- SVOCs – Similar to groundwater, only one SVOC marginally qualifies as a COC in soil. N-Nitrosodiphenylamine meets the criteria for inclusion as a COC because of a single occurrence of an

exceedance ratio of 17. This is a different chemical than the SVOC that qualifies as a COC in groundwater (bis(2-ethylhexyl)phthalate).

- Carcinogenic PAHs (cPAHs) – Several cPAHs are considered COCs due to the frequency and magnitude of screening level exceedances, including benzo(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzofluoranthenes, as well as total cPAH TEQ.
- Non-carcinogenic PAHs – Naphthalene is the only non-carcinogenic PAH that qualifies as a COC in soil. Naphthalene exceeds its SL in 38 percent of the samples, and has a maximum exceedance ratio of 77. This is also the only non-carcinogenic compound that is a COC in groundwater.
- PCBs –Total PCBs and two individual PCB arochlors, 1254 and 1260, are considered soil COCs. Total PCBs exceed its SL at a frequency of 71 percent and a maximum exceedance ratio of 1,400, while arochlor 1254 exceeds its SL at a frequency of 66 percent and a maximum exceedance ratio of 370. Arochlor 1260 is a much less prominent COC within the PCB group; it does not meet the exceedance frequency threshold of 10 percent, but it has a maximum exceedance ratio of 18.
- Pesticides – A total of nine pesticies (2,4'- and 4,4'-DDD, 2,4'- and 4,4'-DDE, 2,4'- and 4,4'-DDT, alpha- and gamma-chlordane, and dieldrin are selected as soil COCs. The pesticides 2,4'- and 4,4'-DDD, and 4,4'-DDE are most prominent, exceeding groundwater SLs in over 50 percent of soil samples at exceedance ratios ranging from 540 to 5,000 times the SL.
- Metals – Four metals meet the selection criteria for COCs in soil, including copper, lead, mercury and zinc. Exceedance frequencies range from 19 percent (lead) to 72 percent (mercury). Exceedance ratios range from 2.7 (copper) to 25 (mercury). Additional discussion about the COC-status of metals is presented in Section 6.0.

The effect of elevated analytical reporting limits on the COC selection process also was evaluated. The pesticides 2,4'-DDD, 2,4'-DDE, aldrin, heptachlor, and hexachlorobenzene had elevated reporting limits in at least 10 percent of the soil samples in the RI database. All of the samples with elevated reporting limits of these pesticides, however, also had detected concentrations of the selected COCs above their respective SLs. Therefore, the elevated pesticide reporting limits do not adversely affect the evaluation of nature and extent of contamination in soil at the Site.

6.0 SUMMARY OF NATURE AND EXTENT OF CONTAMINATION

This section summarizes the nature and extent of contaminants in soil, groundwater and stormwater at the Site. The discussion of the nature and extent of contamination focuses on COCs in soil and groundwater (Section 5.0). This discussion and the associated graphics also account for the relatively limited number of COPCs that do not qualify as COCs. Collectively, the COCs encompass the vertical and lateral extent of Site COPCs and provide a basis for developing the CSM.

Tabulated chemical analytical results are presented in Appendix G. Results for soil COCs are summarized in Section 6.1 and presented on Figures 16 through 36. Chemical analytical results for groundwater (including seep sample) COCs are summarized in Section 6.2 and presented on Figures 37 through 40. Chemical analytical results for stormwater are presented in Table G-7 (Appendix G) and summarized in Section 6.3. Electronic copies of laboratory reports for soil, groundwater (including seep) and stormwater samples obtained during the RI are included in Appendix H. Data validation reports are presented in Appendix I.

6.1. Soil

The nature and extent of soil contamination at the Site has been interpreted using available soil data, as discussed in Section 3.5. These data were derived from soil sampling events during the RI field work, as well as previous phases of investigation conducted at the Property. A total of 81 soil samples were collected at depths ranging from near ground surface to approximately 35 feet bgs. Soil analytical results for detected analytes are presented in Tables G-1 through G-3 of Appendix G.

As discussed in Section 5.2, the following constituents were selected as soil COCs for the Site (Table 11):

- Petroleum hydrocarbons (gasoline- and diesel/heavy oil-range);
- VOCs (benzene and ethylbenzene);
- SVOCs (N-nitrosodiphenylamine);
- PAHs (naphthalene, several individual cPAHs and total cPAH TEQ);
- PCBs (aroclors 1254 and 1260, and total PCBs);
- Pesticides (nine individual pesticide compounds); and
- Metals (copper, lead, mercury and zinc).

The following section discusses the nature and extent of these COCs. For chemical groups containing a large number of individual COCs, this discussion and the associated data figures focus on a subset of COCs that pose the greatest risk to human health and the environment based on their exceedance frequency, exceedance ratio and exceedance footprint. This approach accounts for all other COCs and COPCs identified in Table 11. Soil analytical results also are presented on Figures 16 through 36. Some of the figures show analytical results for sediment and soil samples collected by others from the Trotsky Inlet and ICS site, located south of the 7100 Site. These off-Site data are provided to support development of the CSM for the 7100 Site, but are not described in all of the following sections.

6.1.1. Petroleum Hydrocarbons and VOCs

Gasoline- and diesel/heavy oil-range hydrocarbons and benzene are by far the most prominent COCs in this contaminant group based on their frequency and magnitude of SL exceedances, and the spatial footprint of those exceedances. The lateral distribution of petroleum hydrocarbons and benzene in soil is presented on Figures 16 through 19. Figures 20 through 22 show the vertical distribution of petroleum hydrocarbons and benzene in a north-south oriented cross-section. Tabulated soil analytical results for petroleum hydrocarbons and VOCs screened against SLs are presented in Table G-1 of Appendix G.

Ethylbenzene also qualifies as a COC but was only detected at concentrations exceeding the SL in two soil samples. SL exceedances for this COC are shown in the above-referenced figures, but the actual data is not shown. At some locations in the RI where petroleum hydrocarbons are generally referenced, such a reference also includes benzene and ethylbenzene because of its association with gasoline- and diesel-range hydrocarbons.

Petroleum hydrocarbon and benzene SL exceedances are summarized below.

- Gasoline-range hydrocarbon concentrations exceeded the SL in soil samples obtained at exploration locations DP-6, DP-10, and MW-12 at depths ranging between approximately 5 and

15 feet bgs and at exploration locations MW-14, MW-16 and MW-17 at depths ranging between approximately 25 and 30 feet bgs.

- Diesel/heavy oil-range hydrocarbon concentrations exceeded the SL in soil samples obtained at boring locations MW-16, MW-17 and MW-18, at depths ranging from 25 to 27.5 feet bgs.
- Total petroleum hydrocarbon (historical analytical method) concentrations exceeded the SL at location SG-1 at a depth of approximately 3.5 feet bgs and at location SB-5 at a depth of approximately 18 feet bgs. The TPH analytical results for soil samples collected during and immediately after removal of the USTs are presumed to be approximately equivalent to the current diesel-range hydrocarbon analysis results based on review of laboratory chromatograms (D&M 1991a).
- Benzene was detected at concentrations exceeding the SL in 21 soil samples obtained from explorations SG-1, DP-2, DP-4, DP-5, DP-6, DP-10, MW-2, MW-2R, MW-3, MW-12, MW-15, MW-16, MW-18, and MW-19 at depths ranging between approximately 7.5 and 27.5 feet bgs.

The relative extent of petroleum-related contamination is reflected in the frequency of SL exceedances in addition to the data presentations in Figures 16 and 17. Gasoline-range hydrocarbons exceeded the SL in 21 percent of the samples analyzed, diesel/heavy oil-range hydrocarbons in 6.1 percent and benzene in 30 percent. Gasoline-range hydrocarbon and benzene SL exceedances are significantly more widespread.

Petroleum hydrocarbon SL exceedances at depths ranging between about 3.5 and 15 feet bgs in the central portion of the Site are interpreted to be associated with releases from the former Site USTs; these exceedances are spatially limited based on surrounding soil data (Figure 18)[2] and the limited footprint of groundwater exceedances (Section 6.2). Petroleum exceedances in this portion of the Site are likely spatially limited because some of the soil impacts are in the vadose zone, while petroleum releases to the saturated horizon (about 10 feet bgs) attenuate in relatively short distances based on the data (note the data that bounds the SL exceedances in the former UST area in Figure 18).

SL exceedances at depths greater than approximately 20 to 25 feet occur in native soil beneath the fill unit and are interpreted to be unrelated to historic Site activities (described below). These SL exceedances occur over a broader portion of the Site, the adjacent Trotsky Inlet and ICS site (Figure 19). These impacts are more widespread because they reflect petroleum hydrocarbon releases from the ICS site that were distributed in the mudflats that formerly existed beneath the Site upland.

Samples of native deeper soil beneath the Site fill unit have a broader footprint of petroleum hydrocarbon SL exceedances (Figures 20 through 22). In general, the petroleum-related screening level exceedances extend from the ICS site to native sediment and soil beneath the Trotsky Inlet and 7100 Site. In several explorations, petroleum-related contaminant concentrations are substantially greater in deeper (native soil) samples than in shallower (fill) samples (Figures 20 and 21), strongly suggesting that the deeper contamination did not originate from historical activities on the Site.

[2] Soil data beneath the Site is described in terms of depth below the ground surface. However, the figures showing interpolated concentration gradients in soil and sediment beneath the Site, Trotsky Inlet and the ICS site (e.g. Figures 19 and 20) present data for various elevation ranges rather than sample depth ranges. This is necessary to account for the difference in ground surface elevation between the 7100 Site, Trotsky Inlet and ICS site (e.g see topographic variation in Figure 21).

The limited extent of petroleum-related SL exceedances near the former USTs is likely the result of past UST decommissioning activities and natural attenuation processes that have positively affected the petroleum-related contamination over the 25-year period since the USTs were removed. Fate and transport processes are more completely described in Section 7, but in general, there appears to be significant biodegradation of petroleum hydrocarbons as a result of tidal fluctuations rejeuvenating dissolved oxygen in groundwater.

The only other COC in this contaminant group, ethylbenzene, had merely two SL exceedances (MW-17 at 27.5 feet bgs and DP-10 at 12.5 feet bgs). Although the data is not posted in the figures, the ethylbenzene exceedances are indicated by the red triangles in Figures 16 and 17, and are represented in the SL exceedance footprints shown in Figures 18 and 19. This same approach is used in the ensuing figures to assure the full extent of all COCs and COPCs are reflected in the RI graphics.

6.1.2. PAHs and SVOCs

As described in Section 5.2, one non-carcinogenic PAH (naphthalene), several carcinogenic PAHs and total cPAH TEQ qualify as COCs in soil. SVOCs are a relatively insignificant COC at the site in both soil and groundwater; n-nitrosodiphenylamine is the sole SVOC meeting the COC criteria for soil, and its occurrence is relatively insignificant in comparison to the PAHs.

The lateral distribution of PAHs and SVOCs in soil is shown on Figure 23. This figure shows data for the most frequently detected individual cPAH (benzo(a)anthracene), cPAH TEQ and the only non-carcinogenic PAH qualifying as a COC (naphthalene). SL exceedances for other COCs or COPCs in these chemical groups (PAHs and SVOCs) are indicated by triangles in Figure 23. The lateral and/or vertical distribution of cPAHs and naphthalene are shown in Figures 24 through 27. Analytical results for these COCs are presented in Table G-2 of Appendix G.

PAHs were detected in all explorations at the Site except borings SB-4 and SB-5, which were completed during an older (1990) investigation for which the laboratory provided higher reporting limits. The SL exceedances for PAHs are also broadly distributed across the Site. All of the SL exceedances occur in deeper (native soil) samples beneath the fill unit, except for naphthalene exceedances at 12.5 feet bgs at MW-19 and at 15 feet at MW-12) (Figure 23). These naphthalene exceedances may be associated with petroleum-related contamination in the former UST and garage area.

Naphthalene concentrations exceeded the SL in nearly 40 percent of the soil samples at depths ranging between approximately 12.5 and 35 feet bgs (Figure 23). Benzo(a)anthracene concentrations exceeded the SL in 27 percent of the samples at depths ranging between approximately 22.5 and 35 feet bgs. The cPAH TEQ exceeded the SL in only 12 percent of the samples at depths ranging between 22.5 and 27.5 feet bgs in the upland, and one shallow sample (0.5 feet bgs) collected on the bank of the Trotsky Inlet.

Similar to petroleum hydrocarbons, cPAH concentrations in the native soil unit beneath the Site, the Trotsky Inlet and the ICS site are greater than in the fill unit beneath the Site. Figure 24 shows the limited SL exceedances of cPAHs in the upper 20 feet of soil on the 7100 Site. Figure 25 shows a relatively widespread footprint of cPAH exceedances in soil deeper than 20 feet bgs, including portions of the Trotsky Inlet and the ICS site to the south. These deeper cPAH exceedances occur in the upper part of the native soil unit and lower part of the overlying fill unit. The occurrence of cPAH and naphthalene SL exceedances in native soil beneath the 7100 Site is shown in vertical profile in Figures 26 and 27. This data suggests that native soil was impacted by PAHs before fill was placed in the LDW tideflat to produce the present-day 7100 Property.

Similar to petroleum hydrocarbons, PAH concentrations in Site soil are generally low even though they exceed the very low SLs over a relatively broad area. The broad distribution of low concentration PAHs may be partially the result of the age of the contamination and the potential for natural attenuation. PAHs have been shown to degrade naturally under aerobic conditions, but at lower rates due to low solubility and increased toxicity at higher concentrations (Loehr 1992). Naphthalene, while categorized as a PAH, degrades at a higher rate than the cPAHs. The high concentration of dissolved oxygen in groundwater at the Site likely promotes biological degradation of PAHs. Fate and transport processes are more completely described in Section 7.

6.1.3. PCBs

Total PCBs are representative of the spatial footprint and cumulative risk of the individual aroclor COCs (aroclor 1254 and 1260). The lateral distribution of total PCBs is shown in Figures 28 through 30; the vertical profile is shown in Figure 31. Table G-3 of Appendix G presents tabulated soil analytical results for PCBs screened against the SL.

PCBs were detected in soil at concentrations exceeding the SL in all explorations where PCBs were analyzed. The exception to this is soil boring MW-C that was installed near the southeast corner of the 7100 Site by DOF for the ICS site RI (DOF 2016). This boring was completed to install a deep monitoring well. One soil sample collected at 26 feet bgs from the boring contained total PCBs at a concentration slightly less than the SL. On a Site-wide basis, total PCBs were not detected in only four individual soil samples; these samples were collected from depths between 26 and 35 feet bgs in explorations MW-C (2016 DOF boring), MW-15, MW-16 and MW-19. Total PCB concentration exceeded the SL in 71 percent of the samples analyzed.

PCB concentrations generally increase with increasing depth below the ground surface (Figures 29 and 30). Beneath the 7100 Site, PCB SL exceedances are most widespread in the 10- to 20-foot and 20- to 30-foot depth intervals, but concentrations are greater in the deeper interval. The deeper interval is primarily comprised of the native soil unit representative of the pre-fill river mudflat surface.

The highest PCB concentrations are most prevalent in the Trotsky Inlet and on the ICS site, south of the 7100 Site. The depth of elevated PCB concentrations increases in a northerly direction, extending beneath the 7100 Site as shown in Figure 31. Beneath the 7100 Site, PCB concentrations are significantly higher in the deeper (native soil) unit than in the overlying fill unit. However, samples collected from the deepest interval sampled (greater than 30 feet bgs) indicate that PCB concentrations decrease with depth below the interpreted native-fill interface representative of the former river mudflats. The lateral and vertical trend of PCB concentrations suggests that historic releases from the adjacent ICS site impacted LDW tideflat sediment prior to the placement of fill that later became the present-day 7100 Property. Subsequent upward vertical migration of PCBs into the saturated portion of the fill unit explains the lower PCB concentrations in the fill unit, although these concentrations still exceed the very low SL.

6.1.4. Pesticides

Several pesticides meet the selection criteria for COCs in soil as described in Section 5.2. The lateral distribution of SL exceedances for these COCs is shown in Figures 32 through 34. Figure 32 also shows analytical results for two of the most frequently detected pesticides, 4,4'-DDD and 4,4'-DDE. As indicated by the triangles in Figure 32, the lateral footprint of 4,4'-DDD and 4,4'-DDE is very representative of SL exceedances of other COCs and COPCs in this chemical group. The lateral and/or vertical distribution of

4,4'-DDD and 4,4'-DDE are shown in Figures 33 through 36. Analytical results for these COCs are presented in Table G-3 of Appendix G.

Similar to PCBs, pesticides are present in a widespread portion of the Site. 4,4'-DDD and 4,4'-DDE concentrations exceeded the SL in 84 percent and 53 percent of the soil samples tested, respectively. At least one of these COCs exceeded the SL in each exploration in which soil samples were submitted for analysis of pesticides, with the exception of one hand auger shallow soil location along the bank of the Trotsky Inlet (HA-2).

The lateral and vertical distribution of 4,4'-DDD and 4,4'-DDE beneath and adjacent to the 7100 Site is generally similar to PCBs: SL exceedances of these COCs are most widespread in the 10- to 20-foot and 20- to 30-foot depth intervals, but the magnitude of exceedances is greater in the deeper interval (native soil unit) (Figures 33 and 34). The highest pesticide concentrations are most prevalent in the Trotsky Inlet and on the ICS site, south of the 7100 Site. The depth of elevated pesticide concentrations increases in a northerly direction, extending beneath the 7100 Site as shown in Figures 35 and 36. Beneath the 7100 Site, 4,4'-DDD and 4,4'-DDE concentrations are significantly higher in the deeper (native soil) unit than in the overlying fill unit, but similar to PCBs, reduced pesticide concentrations in the deepest samples indicate that the highest concentrations fall within the interval representative of the former river mudflat surface.

Similar to other COCs, the vertical and lateral concentration gradients of pesticides beneath and south of the Site suggest pesticide occurrence is unrelated to Site historical activities.

6.1.5. Metals

Four metals (copper, lead, mercury and zinc) meet the COC selection criteria described in Section 5.2, The lowest SLs used to evaluate these chemicals are based on the protection of groundwater (with adjustments to account for background for some of the metals). However, it is unlikely that these metals are actually groundwater COCs at the 7100 Site, as described in Section 6.2.5. Therefore, these metals are not considered COCs for Site soil. See Section 6.2.5 for further discussion of metals.

6.2. Groundwater

The nature and extent of groundwater contamination at the Site has been interpreted using available groundwater data, as discussed in Section 3.5. This data set was derived from groundwater sampling events conducted during the RI field work (quarterly monitoring events in 2013 and 2014), as well as previous phases of investigation (July 2008 monitoring event) conducted at the Property. Groundwater data collected by others in connection with the RI for the ICS site also is included in this report. This includes data from three monitoring wells (MW-A, MW-B, and MW-C) on the southern part of the 7100 Site, and three wells (DOF-MW6, SA-MW1, and SA-MW2) on the northern part of the ICS Property. Tabulated analytical results are presented in Tables G-4 through G-6 in Appendix G.

As discussed in Section 5.2, the following constituents were selected as groundwater COCs for the 7100 Site (Table 10):

- Petroleum hydrocarbons (gasoline- and diesel/heavy oil-range);
- VOCs (benzene, ethylbenzene and 1,1,1-trichloroethane);
- SVOCs (bis(2-ethylhexyl)phthalate);

- PAHs (naphthalene, several individual cPAHs and total cPAH TEQ);
- PCBs (aroclor 1254 and total PCBs);
- Pesticides (ten individual pesticide compounds); and
- Metals (dissolved and/or total occurrences of copper, lead, mercury, nickel and zinc).

Monitoring wells MW-A through MW-C were constructed with screens set 10 feet deeper than nearby wells because the ICS RI is investigating deeper groundwater conditions in the deeper (native) soil unit. Data obtained from those wells were screened against the groundwater SLs selected for the 7100 Site RI. The party conducting the ICS RI will screen the same data against screening levels developed for their (ICS) RI.

The following sections discuss the nature and extent of individual COCs in groundwater at the Site. Groundwater analytical results are presented on Figures 37 through 40. A broader discussion of contaminant migration pathways between media is presented in Section 7.0. The cumulative distribution of all COCs and COPCs in soil, groundwater and sediment at the Site is discussed later in terms of the CSM (Section 8.0).

6.2.1. Petroleum Hydrocarbons and VOCs

Gasoline- and diesel/heavy-range hydrocarbons were selected as groundwater COCs due to their frequency and magnitude of SL exceedances, and because they are associated with known sources of contamination at the Site (former USTs). Benzene is by far the most significant VOC based on its footprint and magnitude of SL exceedances, and its presumed association with petroleum hydrocarbons. The footprint of gasoline- and diesel/heavy oil-range hydrocarbons and benzene encompass SL exceedances of other COCs in this chemical group (ethylbenzene and 1,1,1-trichloroethane). General reference to petroleum hydrocarbons in this section includes benzene and ethylbenzene due to their association with the types of petroleum hydrocarbons on the Site. The distribution of these COCs in groundwater is presented on Figure 37. Table G-4 in Appendix G presents the tabulated results for RI and pre-RI groundwater samples analyzed for these compounds, screened against respective SLs.

Petroleum-related COCs were detected at concentrations exceeding SLs in 8.1 percent (gasoline-range), 50 percent (diesel/heavy oil-range) and 33 percent (benzene) of the groundwater samples analyzed. Analytical results for these COCs are presented in Figure 37, along with an interpolation of concentration gradients for these compounds. Data from the final RI quarterly sampling event (July 2014) was selected for the interpolation because it is the most recent and extensive groundwater data set available. The interpolated contours (colors) reflect analytical results for the COC with the highest exceedance ratio relative to its respective SL. Based on this data set, petroleum-related COCs exceeded SLs within the vicinity of the former garage and USTs. This generally coincides with the area in which petroleum-related soil contamination is greatest (Figures 17 and 18). There were no SL exceedances in shoreline monitoring wells during the July 2014 sampling event.

The historical footprint of petroleum-related SL exceedances for all groundwater data, regardless of sampling date, also is shown in Figure 37. This data suggests the historical footprint of SL exceedances was somewhat larger than conditions in July 2014. However, concentrations at the perimeter of the expanded footprint infrequently exceeded the SL by marginal amounts (low exceedance ratios) (e.g. see MW-1, MW-10 and MW-14). This data supports the existence of natural attenuation processes.

There were no SL exceedances in nearshore monitoring wells, with two exceptions. Diesel/heavy oil-range hydrocarbon concentrations marginally exceeded the SL during one RI sampling event in MW-10 and a different sampling event in MW-14. There were no SL exceedances of COCs potentially related to petroleum-hydrocarbons in these wells during other sampling events (including TPH, VOCs, SVOCs and PAHs). In addition, there were no SL exceedances of these COCs in any of the other monitoring wells installed near the shoreline as part of the Site RI (MW-8, MW-9, MW-10, MW-11, MW-13 and MW-15).[3] Collectively, this information indicates that petroleum-related contamination detected in the center of the site (former garage and UST area) does not pose a risk to surface water or sediment in the LDW and Trotsky Inlet.

The discussion above excludes analytical results from well MW-A which was installed near the southern Site shoreline by parties conducting the ICS RI. This well is screened in deeper native soil beneath the Site. SL exceedances in this well by petroleum hydrocarbons and other COCs are interpreted to be related to ICS contamination sources.

The petroleum-related impacts described above full encompass the location of SL exceedances by other COCs in these chemical groups (ethylbenzene and 1,1,1-trichloroethane). This is demonstrated by the triangles in Figure 37, which show the SL exceedances of these other COCs were spatially limited to the center part of the Site.

6.2.2. PAHs and SVOCs

As discussed in Section 5.2, PAHs seletected as groundwater COCs include naphthalene, several individual cPAHs and total cPAH TEQ. The single SVOC selected as a COC in groundwater (bis(2-ethylhexyl)phthalate) infrequently exceeds the SL by a limited magnitude. The nature and extent of PAHs and SVOCs in groundwater at the Site are thoroughly represented by occurrences of naphthalene, benzo(a)anthracene and total cPAH TEQ. The interpolated spatial distribution of SL exceedances by these COCs in groundwater is shown in Figure 38. Table G-5 in Appendix G presents the tabulated results for RI and pre-RI groundwater samples analyzed for all detected PAHs and SVOCs, screened against respective SLs.

The PAHs shown in Figure 38 were detected at concentrations exceeding SLs in 18 percent (naphthalene), 15 percent (benzo(a)anthracene), and 13 percent (cPAH TEQ) of the groundwater samples analyzed. Based on the July 2014 data set, there were limited SL exceedances of these COCs in groundwater at the Site. The exceedances were located in the vicinity of the former garage and USTs. In these wells, naphthalene exceeded its SL more frequently and by a greater amount than the cPAHs. Naphthalene was also detected above SLs in some shallow (12.5 to 15 feet bgs) soil samples collected in the former UST area, although most naphthalene (and other PAH) exceedances in this area occur at depths of 20 feet bgs and greater. These deeper exceedances are interpreted to be associated with ICS-related contamination in deeper native soil. There were no SL exceedances of PAHs in the shoreline monitoring wells during any of the four RI sampling events.

The historical footprint of PAH SL exceedances for all groundwater data, regardless of sampling date, also is shown in Figure 38. This data shows a slightly expanded footprint of PAHs south of the former

[3] Collectively, this RI produced approximately 2,632 individual analytical results for 94 chemicals in these shoreline monitoring wells as a result of quarterly sampling. These results were derived from the TPH, VOC, PAH and SVOC analyses. Of these 2,632 analytical results, there were only two SL exceedances (the marginal diesel/heavy oil-range hydrocarbon exceedances described above).

garage/USTs in the central portion of the Site (MW-3 and MW-2R). There were also a few isolated SL exceedances at other locations, such as the single marginal SL exceedance of cPAHs in MW-17 and MW-13. Naphthalene and/or cPAHs also exceeded SLs in MW-A and MW-B, installed as part of the ICS RI. These wells are screened 10 feet deeper than the other 7100 Site monitoring wells, in the deeper (native) soil unit.

SL exceedances of other PAHs or SVOCs not discussed above are encompassed by the exceedance footprints shown in Figure 38, as indicated by the triangle symbols on the figure.

For comparison purposes, cPAH concentrations in monitoring well SA-MW1 on the ICS site are at least one order of magnitude greater than the greatest concentration detected on the 7100 Site (Figure 38).

6.2.3. PCBs

Although aroclor 1254 also is a groundwater COC, the distribution of total PCBs accounts for all SL exceedances of aroclor 1254. The exceedance frequency and exceedance ratio of total PCBs are greater than those of aroclor 1254 alone. The distribution of total PCBs in groundwater is presented on Figure 39. Table G-6 in Appendix G presents the tabulated results for RI and pre-RI groundwater samples analyzed for PCBs, screened against respective SLs.

Total PCBs were detected at concentrations exceeding the SL in 53 percent of the groundwater samples analyzed. Figure 39 shows an interpolation of concentration gradients for PCBs based on the July 2014 sampling event. PCB concentrations exceeded the groundwater SL in a greater portion of the Site than other contaminant groups. Elevated PCB concentrations in July 2014 generally extended from the central portion of the Site to the Trotsky Inlet and the southeastern corner of the Site near the LDW shoreline. The highest PCB concentration detected in groundwater at this time was in sample SEEP-1, located in the western portion of the Trotsky Inlet. This seep is located on the southern shoreline of the Trotsky Inlet. Groundwater discharges at this seep from upland located south of the inlet at low tide. Elevated PCBs at this location indicate a PCB source exists in groundwater south of the Trotsky Inlet. These PCBs likely originate from the ICS Property, where similar PCB concentrations are documented in groundwater (SA-MW-1 and SA-MW-2).

The historical footprint of PCB SL exceedances for all groundwater data, regardless of sampling date, also is shown in Figure 39. This data encompasses a larger area and seems to merge exceedances along the southern and southeastern Site shoreline into a larger, single exceedance footprint. Some of these historical exceedances occurred infrequently (e.g. MW-2R, MW-5 and MW-15).

The more widespread occurrence of PCBs in groundwater compared to the COCs discussed above is generally consistent with the extensive presence of PCBs in deeper soil. Higher concentrations of PCBs in groundwater sometimes, but not always, coincide with higher concentrations in soil. For instance, the highest PCB concentration in groundwater at the Site occurred in MW-17, in the northern portion of the Property. The highest detected concentration of PCBs in Site soil was observed in this same exploration. Similarly, very elevated PCB concentrations were detected in both soil and groundwater samples collected from SA-MW-1 on the ICS site. As discussed in Section 6.1.3, PCBs in native soil and fill beneath the Site appear to be unrelated to Site historical activities. It follows, therefore, that PCBs in groundwater also are not related to Site historical activities.

Groundwater impacts adjacent to the Trotsky Inlet appear to be greater in wells screened deeper (MW-A and MW-B) than those screened shallower (MW-8 through MW-10). The greater groundwater concentrations in the deeper wells is likely because those wells have more screen length positioned deeper into the native soil unit where PCB concentrations are greatest. The soil analytical results for the screened intervals in MW-A and MW-B do not necessarily support this because PCB concentrations in those samples were relatively low; however, soil is a highly variable sample matrix and the broader site-wide data indicates contaminant concentrations are generally greater in the deeper native soil unit.

6.2.4. Pesticides

Of the ten pesticide COCs in groundwater, 4,4'-DDD and 4,4'-DDE exceed their SL much more frequently and by greater magnitudes compared to the other compounds. 4,4'-DDD and 4,4'-DDE have exceedance frequencies ranging between 41 and 42 percent and exceedance ratios ranging between 140 and 320. The distribution of pesticides in groundwater is presented on Figure 40. Table G-6 in Appendix G presents the tabulated results for RI and pre-RI groundwater samples analyzed for pesticides, screened against SLs.

Analytical data for 4,4'-DDD and 4,4'-DDE are presented in Figure 40. This figure also shows an interpolation of concentration gradients for these COCs based on the final RI quarterly sampling event (July 2014). The footprint of 4,4'-DDD and 4,4'-DDE SL exceedances in July 2014 was generally similar to the footprint of PCB exceedances; the pesticide exceedance footprint generally extended from the central portion of the Site to the Trotsky Inlet and the southeastern corner of the Site near the LDW shoreline. Pesticide concentrations in groundwater also were elevated in seep samples at the head of the Trotsky Inlet. The greatest pesticide concentrations in July 2014 were detected in sample SEEP-1, located on the south side of the Trotsky Inlet. As described above for PCBs, at low tide, groundwater discharging at this seep flows from upland property located south of the inlet. Elevated pesticide concentrations at this location indicate a source of pesticides exists in groundwater south of the Trotsky Inlet. Elevated pesticide concentrations were detected beneath the ICS site (SA-MW-1 and SA-MW-2).

The historical footprint of pesticide SL exceedances for all groundwater data, regardless of sampling date, also is shown in Figure 40. This data encompasses a larger area and is generally similar to the historical footprint of PCB SL exceedances (Figure 39). As with other COCs, the historical pesticide SL exceedances in some of these wells were sporadic (e.g. MW-15, MW-5 and MW-10). These wells are located along the northeastern shoreline of the Site (near the LDW) and near the southern shoreline (near Trotsky Inlet). More substantial exceedances (greater than 10 times the SL) were encountered in monitoring wells MW-A and MW-B); these are two of the wells installed for the ICS RI that have deeper well screens. Pesticide concentrations are greatest in these two deeper wells on the south end of the 7100 Site, the south side of the Trotsky Inlet (SEEP-1), and the ICS site (SA-MW-1 and SA-MW-2).

Similar to PCBs, pesticide concentrations appear to be greater in deeper parts of the aquifer beneath the southern portion of the Site, adjacent to the Trotsky Inlet (see Section 6.2.3). The greater groundwater concentrations in the the deeper wells is likely because those wells have more screen length positioned deeper into the native soil unit where pesticide concentrations are greatest.

The footprint of pesticide SL exceedances at the Site is generally similar for groundwater and soil in that both are relatively widespread; however, there does not appear to be a consistent direct correlation. As discussed in Section 6.1.4, pesticides in native soil and fill beneath the Site appear to be unrelated to Site

historical activities. It follows, therefore, that pesticides in groundwater also are not related to Site historical activities.

6.2.5. Metals

6.2.5.1. Dissolved Metals

Dissolved copper, lead and nickel meet the statistical criteria to be considered COCs for the 7100 Site, as described in Section 5.2.1. However, an analysis of the groundwater data indicates that the limited SL exceedances of these dissolved metals, which occur near the shoreline, are sourced by surface water that infiltrates nearshore portions of the Site during tidal flushing. Therefore, dissolved metals are not a COC for Site groundwater. The nature and extent of each of these metals is discussed below.

Dissolved copper exceeds the groundwater SL of 3.1 micrograms per liter (µg/L) in 13 percent of the samples (11 of 82 samples), which marginally exceeds the 10 percent frequency trigger for a COC. The copper exceedances occurred in seep or groundwater samples collected from monitoring wells located adjacent to the Trotsky Inlet or LDW. Copper concentrations did not exceed the SL in any groundwater samples collected from monitoring wells located inland of the shoreline wells. Dissolved copper concentrations in 10 of the 11 SL exceedances were within the range of dissolved copper concentrations observed in surface water samples collected from the LDW during the RI (2, 6, and 7 µg/L observed during three quarterly monitoring events). Only one groundwater sample (MW-11) had a dissolved copper concentration slightly greater than the range of detected LDW surface water concentrations (9 µg/L versus 7 µg/L). These data suggest that dissolved copper exceedances in groundwater at the 7100 Site appear to be the result of surface water intrusion at perimeter sample locations closest to the LDW and Trotsky Inlet, rather than originating from the Site. Therefore, dissolved copper is not considered to be a Site COC.

Dissolved lead only exceeds the groundwater SL of 8.1 µg/L in 3.7 percent of the samples (three of 82 samples); the maximum exceedance ratio for dissolved lead is 2.4, only slightly above the 2.0 exceedance ratio threshold. SL exceedances were detected only at three shoreline sampling locations, MW-A, MW-B and SEEP-1. The highest dissolved lead concentrations were detected in samples collected in November 2015 from MW-A and MW-B. These shoreline wells are screened in deeper native soil beneath the Site. November 2015 was the first time these wells were sampled. Dissolved lead concentrations were less than the SL in these same wells in March 2016. These results suggest that the initial exceedances at new wells MW-A and MW-B may be the result of excessive turbidity in the initial samples collected after well construction. The only other location where dissolved lead was detected at a concentration greater than the SL was SEEP-1, which is located on the opposite shoreline of the Trotsky Inlet. The SL exceedances at MW-A , MW-B, and SEEP-1 do not appear to be originating from sources of lead beneath the Site; therefore, dissolved lead is not considered to be a Site COC.

Dissolved nickel only exceeds the groundwater SL of 8.2 µg/L in 7.4 percent of samples; the maximum exceedance ratio for nickel is 2.2, only slightly higher than the 2.0 exceedance ratio threshold. The exceedance ratio threshold was exceeded in only one groundwater sample collected during the July 2014 sampling event (18 ug/L in MW-9). MW-9 is located adjacent to the Trotsky Inlet and other samples collected from adjacent shoreline monitoring wells in July 2014 also had elevated dissolved nickel concentrations during that monitoring event. Based on this data, it appears that dissolved nickel concentrations are influenced by surface water adjacent to the 7100 Site. There is no evidence suggesting that dissolved nickel in groundwater results from on-site sources of nickel. Dissolved nickel SL exceedances were not observed in groundwater samples collected from locations further from the shoreline. Therefore, dissolved nickel is not considered to be a Site COC.

6.2.5.2. Total Metals

Total copper, lead, nickel and zinc meet the statistical criteria to be considered COCs for the 7100 Site, as described in Section 5.2.1. However, these constituents are not considered to be Site COCs because the SLs used to evaluate them are based on surface water standards that are, in turn, based on dissolved concentrations (not total concentrations). Therefore, the appropriate evaluation of metals in Site groundwater is presented in the discussion above about dissolved metals, and no dissolved metals are considered to be Site COCs.

One metal detected in Site groundwater has a surface water-based SL based on total concentration rather than dissolved concentration – total mercury. Total mercury exceeds the groundwater SL of 0.025 µg/L in 15 percent of the samples, and the maximum exceedance ratio is 40. However, review of the groundwater data strongly suggests the detected concentrations are artifacts of the drilling and sampling process, which produce turbid samples that are not representative of groundwater conditions beneath the Site. For instance, eight monitoring wells were installed at the Site during the summer of 2013 to support this RI (MW-2R and MW-13 thorugh MW-19). The number of total mercury SL exceedances in all of the new wells progressively decreased during four subsequent quarterly sampling events. The total number of exceedances by quarter were: four in August 2013, three in December 2013, two in March 2014 and none in July 2014. During these same sampling events, there were no SL exceedances of total mercury in any of the previously existing monitoring wells which were installed between 1990 and 2008 (MW-1, MW-3, MW-4, MW-8, MW-9, MW-10, MW-11 and MW-12). More broadly, there are no exceedances of the total mercury SL in any monitoring wells installed prior to the RI.

The elevated concentration of suspended solids in groundwater samples from the more recent (RI) wells is clearly demonstrated by the turbidity measurements recorded during sampling (Table 5). The effect of turbidity on total metals concentrations in groundwater samples is not limited to mercury. Collecitvely, these RI results illustrate the difficulty of obtaining representative groundwater samples for purposes of comparing data to SLs on a total metals basis.

6.3. Stormwater and Sediment

Stormwater at the Site was sampled in September 2013 and March 2014 to evaluate the potential for contaminants in stormwater to impact LDW sediment. In addition to the stormwater sampling, a sediment sample was collected near the Site stormwater outfall in September 2013 for chemical analysis. Figure 9 shows the locations where these samples were collected. The stormwater and sediment samples were submitted for analysis of COPCs described in Section 3.4. Stormwater results were compared to established benchmarks set for the Property's stormwater discharge permit. Specific chemical effluent benchmarks for stormwater include:

- Diesel-range hydrocarbons – 10 mg/L
- Total copper – 14 µg/L
- Total zinc – 117 µg/L
- Dissolved lead – 81.6 µg/L

Petroleum hydrocarbons, VOCs, SVOCs, PAHs, pesticides, and metals were detected in the stormwater samples collected from the influent end of the treatment system (SW-IN samples). PCBs were not detected in untreated stormwater collected from the treatment system influent. Chemical analytical results for stormwater are presented in Table G-7 (Appendix G). Samples of treated stormwater collected from the

treatment system effluent (SW-OUT samples) collected at the same time as the influent samples indicated that contaminants either were not detected in system effluent or were detected at concentrations less than the permit benchmarks listed above.

The surface sediment sample collected near the Site stormwater outfall at location SED-OF-1 (Figure 9) was analyzed for Site COPCs. VOCs, SVOCs, PAHs, PCBs, and metals were detected in the sediment sample and were compared with the sediment SLs presented in Appendix E. Table G-8 of Appendix G presents the data for detected COPCs and applicable sediment screening levels. The only analyte that exceeded a sediment SL is total PCBs. The detected SVOCs, PAHs, metals, and individual PCBs were all below respective SLs.

Sample SED-OF-1 was collected from an elevation within the tidal range of LDW surface water. As a result, sediment quality at the sampling location is subject to potential contaminant sources unrelated to the 7100 Property, including the nearby outfall associated with the 1st Avenue South Storm Basin (Figure 2) and any LDW sediment contamination in the Site vicinity. The lack of detected PCBs in the pre-treatment stormwater samples indicates that Site stormwater was not a likely source of the PCBs detected in the sediment sample.

7.0 CONTAMINANT FATE AND TRANSPORT

This section describes the fate and transport of contaminants in soil and groundwater at the 7100 Site. The text is organized according to the following topics:

- Phase distribution of contaminants
- Fate and transport processes affecting Site COCs

7.1. Phase Distribution of Contaminants

Contaminants present at the 7100 Site appear to originate from two different sources: (1) releases of fuel-related contaminants from former USTs; and (2) a broader suite of contaminants in native mud flats that were buried by fill used to construct the upland Property. Contaminants present at the 7100 Site are adsorbed to soil and other solids present in the subsurface and dissolved in groundwater. This distribution of the contaminants is described in the sections below.

7.1.1. Adsorbed Phase (Soil)

For the purposes of this report, adsorption refers to the process of dissolved contaminants partitioning from groundwater and adhering to the surface of soil or sediment particles. In the case of organic compounds such as the Site COCs, the adsorption process involves the uptake of the compound by the organic fraction of the soil or sediment. The distribution coefficient, K_d, of an organic compound is the ratio of the compound's adsorbed-phase concentration in soil (or sediment) to its dissolved-phase concentration in groundwater. The distribution coefficient is directly proportional to the fraction of organic material in the soil (or sediment) and an empirically-based organic carbon-water partitioning coefficient, K_{OC}. The compound-specific K_{OC} values used to estimate distribution coefficients provide a general indication of the tendency of a compound to preferentially partition to soil/sediment (higher K_{OC} values) or to groundwater (lower K_{OC} values). Accordingly, K_{OC} values provide an indication of a compound's relative aqueous-phase mobility; compounds with higher K_{OC} values have a greater tendency to sorb to soil or sediment, and are therefore less mobile in the aqueous-phase than compounds with lower K_{OC} values.

The mass of adsorbed-phase organic contaminants present in soil or sediment that is in equilibrium with groundwater containing dissolved contaminants is highly dependent on the fraction of organic material present in the solid matrix and the type of organics present. At the 7100 Site, both the fill and native units contain a significant fraction of organics. Consequently, contaminants would be expected to sorb to soil more, and partition into groundwater less, at the 7100 Site than at sites that have less organic carbon in soil and sediment.

7.1.2. Aqueous Phase

The transport of aqueous-phase contaminants is affected by several processes, including advection, dispersion, destructive attenuation, adsorption, and volatilization. Advection and dispersion are the primary transport mechanisms for aqueous-phase contaminants in groundwater. Advection transports contaminants via groundwater flow driven by hydraulic (pressure) gradients. Dispersion causes the spreading of aqueous-phase contaminants in groundwater via molecular diffusion, physical deflection of groundwater by solid particles as it flows through interconnected pore spaces, and chemical retardation; the latter is a result of dissolved contaminants in groundwater sorbing to organic matter, as described above.

Destructive attenuation processes affecting aqueous-phase contaminants include biological degradation and abiotic (non-biological) destruction or transformation. Most of the groundwater COCs at the 7100 Site, particularly petroleum hydrocarbon related compounds, can be biologically degraded to varying degrees under favorable aerobic conditions. Groundwater at the 7100 Site appears to be under seasonally fluctuating aerobic conditions. Aerobic conditions were observed during the August 2013 monitoring event, followed by generally reduced dissolved oxygen concentrations observed during subsequent events. Field parameter measurements during groundwater sampling have indicated strongly fluctuating dissolved oxygen concentrations (Table 5), generally ranging from less than 1 mg/L to concentrations greater than 10 mg/L[4]. Likewise, field measurements of redox (+331 to -361 millivolts) fluctuated from oxidizing to reducing conditions, with slightly to moderate reducing conditions being most frequently observed.

Aqueous-phase contaminants in groundwater, if present near the shoreline, experience attenuation as a result of physical (tidal) mixing prior to the point at which groundwater discharges to surface water. The mixing of groundwater and surface water near the shoreline can be a significant component of natural attenuation of contaminants in groundwater prior to discharge to marine sediment and surface water. Tidal influences not only reduce contaminant concentrations as a result of physical mixing, but also enhance oxygen concentrations, which can increase biological and chemical attenuation processes in groundwater near the shoreline. In addition, diurnal tidal fluctuations in the LDW produce hydraulic gradients that are relatively flat or gently slope toward the interior of the Site, reducing groundwater flux to the LDW. Collectively, these groundwater/surface water interactions along the Site boundary produce conditions that promote contaminant attenuation and inhibit contaminant flux.

Aqueous-phase contaminants in groundwater, particularly the COCs potentially associated with the former USTs at the 7100 Site, appear to attenuate significantly within a short distance from the location of the former USTs. The groundwater in the vicinity of the former garage, and specifically the former USTs, continues to have detectable concentrations of gasoline and diesel-range hydrocarbons, benzene, and naphthalene; concentrations of these COCs sometimes exceed SLs (Figures 37 and 38). However, groundwater outside the immediate location of the former garage has significantly reduced concentrations

[4] March 2014 dissolved oxygen measurements appear anomalous and are likely the result of equipment malfunction.

of hydrocarbons. During the 2013/2014 RI quarterly sampling events, the more readily degradable gasoline-range hydrocarbons and benzene were not detected in samples collected from monitoring wells located east and northeast of the former garage (MW-5, MW-14, MW-15 and MW-18). The slower degrading diesel-range hydrocarbons were detected in some of these wells (MW-5, -14 and -18), including some SL exceedances at varying frequencies. Most of the residual fuel-related contaminants in soil and groundwater associated with the former USTs appear to be naturally attenuating to below cleanup levels in groundwater within a short distance (approximately 100 to 150 feet) of the contaminant source.

The groundwater COCs that are not associated with the former USTs or activities of the former warehouse or garage include cPAHs, PCBs, and pesticides. These COCs are considered to be primarily associated with an off-site contaminant source that impacted the native soil unit before the 7100 Site was constructed by placing fill in the tide flat. The presence of cPAHs, PCBs, and pesticides in groundwater appears to be the result of contaminated deeper (native) soil.

7.2. Fate and Transport Processes Affecting COCs

This section describes chemical, physical, and biological processes affecting the fate and transport of the COCs at the 7100 Site. This section primarily discusses the fate and transport of the most prevalent COCs, but is applicable to other COCs and COPCs at the Site. The COCS that are the focus of this discussion conservatively represent the footprint, and magnitude, of risk of all COCs and COPCs at the Site.

7.2.1. Petroleum Hydrocarbons

Petroleum hydrocarbons at the 7100 Site are associated with two separate release mechanisms: (1) releases from former on-site USTs in the vicinity of the former garage; and (2) releases from an off-site source that contaminated the native soil unit beneath the Site before fill placement. Aqueous-phase petroleum hydrocarbons in groundwater can biodegrade under aerobic conditions. As described above in Section 7.1.2, high dissolved oxygen concentrations observed in groundwater at the 7100 Site suggest that conditions in the saturated zone are favorable for continued aerobic biodegradation, thereby restricting contaminant migration and limiting the potential for impacts to off-site receptors.

7.2.2. Polycyclic Aromatic Hydrocarbons

Generally, PAHs are hydrophobic and have low vapor pressures, resulting in limited mass transfer to soil vapor and groundwater. In particular, the higher molecular weight cPAHs exhibit strong hydrophobicity and are expected to partition most mass in the adsorbed phase in soil. This results in limited mobility in groundwater beyond the immediate vicinity of high cPAH concentrations in soil.

Naphthalene is also a prevalent PAH at the Site. It is the lowest molecular weight and most soluble PAH. Naphthalene can be categorized as a SVOC as well as a VOC due to its high volatility relative to other PAHs. Naphthalene, while being a PAH, behaves more like a lighter petroleum hydrocarbon compound, with higher solubility and mobility (lower K_{OC}) than the cPAHs. In addition, naphthalene readily degrades aerobically and would be expected to attenuate as a result of biodegradation at a faster rate than the heavier, more complex cPAHs. Naphthalene has been shown to naturally degrade at rates similar to BETX compounds under suitable natural attenuation conditions (Neuhauser, et. al. 2009). Naphthalene appears to be naturally degrading at the 7100 Site, reducing its concentrations beyond the general area of the former garage.

7.2.3. Pesticides

The pesticide COCs for the 7100 Site behave similar in the environment to the cPAHs described above, with low vapor pressure, low solubility, and high partition coeficients. This results in limited mass transfer from soil to soil vapor and groundwater. The pesticides 4,4'-DDD and 4,4'-DDE have low solubility and high K_{OC} values in the same general range as cPAHs, indicating a high affinity for partitioning to soil. At the relatively low concentrations of pesticides in groundwater at the 7100 Site, the transport processes are driven by the high K_{OC}, which indicates strong hydrophobicity and the tendency to partition most mass to the adsorbed phase in soil. This results in limited mobility in groundwater beyond the immediate vicinity of high pesticide concentrations in soil. Pesticides at the 7100 Site are not expected to degrade biologically at a significant rate.

7.2.4. PCBs

PCBs at the 7100 Site behave similar in the environment to the cPAHs and pesticides described above, with low vapor pressure, low solubility, high partition coeficients, and limited natural degradation. This results in limited mass transfer from soil to soil vapor and groundwater. PCBs have low solubility and high K_{OC} values indicating a high affinity for partitioning to soil. The transport processes for PCBs are driven by the high K_{OC}, which indicates strong hydrophobicity and the tendency to partition most mass to the adsorbed phase in soil. This results in limited mobility in groundwater beyond the immediate vicinity of high PCB concentrations in soil.

8.0 CONCEPTUAL SITE MODEL

A CSM was developed for the 7100 Site in the 2012 RI/FS Work Plan. The CSM summarized potential contaminant sources, release mechanisms, transport processes, and exposure routes by which receptors may be affected by Site contaminants. The 7100 Site CSM has been refined to incorporate the results of additional investigation activities completed during the RI. The refined CSM is discussed in this section, and shown graphically in Figures 41 and 42. Figure 41 shows potential sources of contamination and transport pathways. Figure 42 shows the potential exposure pathways and receptors. This section is organized as follows:

- Section 8.1 – Potential contaminant sources
- Section 8.2 – Nature and extent of contamination
- Section 8.3 – Contaminant transport mechanisms
- Section 8.4 – Potential exposure pathways and receptors
- Section 8.5 – Brief review of cleanup actions to date that addressed certain historical sources and pathways identified in the CSM

8.1. Potential Contaminant Sources

The industrial history of the 7100 1st Avenue Property is relatively short compared to other properties along the LDW waterfront. The location of the Property was a turning basin of the LDW until fill was placed in the tide flat to produce upland upon which the Property was developed in the 1960s (SAIC 2008c). Once constructed, primary historic activities at the Property consisted of material storage, barge loading, and shipping consistent with the mission of current and previous ownership. During the late 1970s, the Property also was used for school bus fueling, maintenance, and parking. These operations included installation and

use of three USTs (gasoline and diesel) and associated dispensing facilities. One gasoline UST was removed in 1984 and investigations were initiated in 1990 to evaluate the condition of the remaining USTs (D&M 1990, 1991b). In 1991, the two remaining USTs were removed. During removal of the USTs, approximately 16,700 cubic yards of soil surrounding the USTs were excavated to facilitate UST removal. The excavated soil was placed back in the excavation as backfill.

Investigations conducted by D&M in 1990 through 1992 included soil and groundwater sampling to evaluate contamination associated with the former USTs. The results of the investigation indicated that groundwater was impacted by petroleum hydrocarbons and benzene but the risk to receptors was minimal and the potential for contaminants to reach the LDW was minimal due to the natural attenuation of contaminants outside the immediate area of the USTs (D&M 1992). This condition remains at the Site today based on recent groundwater data; only one COC (diesel/heavy oil-range hydrocarbons) marginally exceeded the SL in two samples collected from seven shoreline monitoring wells installed for this RI. There were no other SL exceedances in the shoreline monitoring wells installed and sampled during the RI (representing approximately 2,632 analytical results for 94 chemicals tested in the TPH, VOC, PAH and SVOC analyses).

Prior to development of the Property in the 1960s, the adjacent property to the south of the turning basin (south of the present-day Trotsky Inlet) was the site of a drum reconditioning facility that operated under the name of Mitzel & Co., and later, Northwest Cooperage. This business continues to operate today as Industrial Container Services (ICS). Drum refurbishing operations on this property date back as early as the 1930s, including significant refurbishing operations to support World War II. SAIC (2007a) reported that the drums may have contained food products, petroleum products, solvents, resins, paints, adhesives and hazardous wastes. Subsequent testing encountered a broad range of contaminants in various media on and adjacent to the ICS site, including petroleum hydrocarbons, VOCs, SVOCs, PAHs, PCBs, pesticides and metals. Hazardous substances from the drum storage facility were apparently discharged to the tide flat that later became the 7100 Property and Trotsky Inlet. During this time period (prior to the 1960s), contaminants were most likely released to the tide flat from the drum refurbishing facility via stormwater (SAIC 2007a; see Section 4.2.1.1). This contamination is present beneath the present-day 7100 Site in the native soil unit and lower part of the overlying fill unit.

8.2. Nature and Extent of Contamination

8.2.1. Soil Impacts

Soil contamination at the 7100 Site originated from the two primary sources described above: shallower(fill unit) petroleum-related contamination associated with the former on-site USTs, and deeper (primarily native soil unit) contamination associated with historical releases from the drum refurbishing facility located south of the 7100 Site. The latter source includes a broader spectrum of contaminants including all of the soil COCs described in this report: petroleum hydrocarbons and VOCs, PAHs, PCBs and pesticides.

With limited exceptions, petroleum-related contaminants in the fill unit associated with the former USTs are primarily limited to the area surrounding the former garage and USTs, as shown on Figures 16 through 19. SL exceedances of these COCS, however, are sporadic and inconsistent even in the vicinity of the former USTs. This indicates that contaminants have been naturally degrading over time since the source was removed.

All of the soil COC groups are present in the deeper native soil unit. This deeper unit contains petroleum-hydrocarbons, PAHs, PCBs and pesticides at concentrations significantly greater than SLs. These

COCs also are present at some locations in the overlying fill unit, but the general vertical (upward) decrease of concentrations indicates that the source of these COCs in Site fill is the underlying, more heavily contaminated native soil unit. Cross sections and plan view figures for all of the COC groups show that contaminant concentrations are substantially higher at the Trotsky Inlet and ICS site, located south of the 7100 Site. This combination of lateral and vertical concentration gradients suggests that deeper contamination beneath the 7100 Site and adjacent Trotsky Inlet likely originated from historical releases at the nearby drum refurbishing facility (ICS site).

8.2.2. Groundwater Impacts

Similar to soil contaminants, groundwater impacts at the Site are related to either the former on-site USTs or underlying contamination in the native soil unit. Gasoline- and diesel/heavy oil-range hydrocarbons and benzene exceed SLs primarily in a localized footprint near the former USTs. PAHs, particularly naphthalene, also exceed SLs in the vicinity of the former USTs. There have been very few historical SL exceedances of petroleum hydrocarbons and PAHs near the perimeter of the Site, indicating that natural attenuation processes are inhibiting contaminant transport in groundwater. The limited footprint and location of the petroleum-related contamination suggests that the former on-Site USTs are likely the primary source of these groundwater impacts.

Petroleum- and PAH-related contamination associated with the off-Site (ICS) source, however, also likely contributes to groundwater impacts beneath the 7100 Site. For instance, petroleum- and PAH-related contamination in deeper soil in MW-17, which is outside of the UST area, is likely responsible for the groundwater exceedances at this location (Figures 20 and 21). The same situation likely exists for the petroleum- and/or PAH-related SL exceedances in groundwater at the locations of MW-A and MW-B, near the Trotsky Inlet shoreline. The well screens for MW-17, MW-A and MW-B extend into, or very close to, the deeper and more heavily impacted native soil unit.

PCBs and pesticides exceed groundwater SLs in a more widespread area at the 7100 Site. Based on the distribution of these COCs in soil (described above), the source of these COCs in groundwater appears to be the contaminated deeper native soil unit beneath the Site. The highest concentrations of PCBs and pesticides in groundwater have been observed at the seep location on the south side of the Trotsky Inlet (SEEP-1) and beneath the adjacent ICS site further south, further suggesting that the ICS site is the likely source of these COCs.

8.3. Contaminant Transport Mechanisms

The primary contaminant transport mechanism for the 7100 Site is dissolution of adsorbed contaminants and migration away from the source by groundwater advection. Petroleum hydrocarbon-related contamination associated with the former USTs remains relatively close to the location of the former USTs. Natural attenuation processes such as biodegradation and adsorption are likely inhibiting contaminant transport from the UST area.

A secondary transport mechanism involves erosion of bank soil, transporting contaminants from soil to surface water. However, the 7100 Property bank is mostly armored, particularly along the frontage of the LDW where erosion potential is greatest as a result of river flow and wave action from boat traffic.

8.4. Potential Exposure Pathways and Receptors

To be considered complete, a contaminant exposure pathway must have: (1) an identified source of a contaminant; (2) a release/transport mechanism from the source; and (3) contact with a receptor of concern. This section summarizes potentially complete exposure pathways and receptors for the 7100 Site based on the investigation results and the screening levels discussed in Section 5.2.

Potential exposures to contamination associated with historical activities on the 7100 Site are limited to people directly contacting (incidental ingestion and dermal contact) shallow soil in the vicinity of the former USTs. The UST-related groundwater contamination does not pose a risk to humans because Site groundwater is non-potable. In addition, the RI data indicates this contamination does not pose a risk to humans or ecological receptors via exposures to LDW sediment or surface water.

There is also a potential direct contact exposure pathway to deeper contamination associated with historical releases from the ICS site. People on the 7100 Property could potentially be exposed to this contamination at locations where it is shallower than 15 feet bgs, which is the standard point of compliance under MTCA for this exposure pathway. Portions of this contamination that are deeper than 15 feet bgs are not considered to pose a direct contact risk to people under MTCA. In addition, none of the ICS-related contamination in groundwater beneath the 7100 Site poses a risk to human health because Site groundwater is non-potable, as described above.

Some ICS-related groundwater contamination (PCBs and pesticides) appears to extend to the shoreline beneath the southern portion of the 7100 Site (Figures 39 and 40). These contaminants exceed groundwater SLs based on the protection of surface water and/or sediment in monitoring wells located near the shoreline. This suggests that aquatic organisms could potentially be exposed to PCBs and pesticides in surface water and/or sediment adjacent to the Site. Humans and higher trophic level ecological receptors also could potentially be exposed to these contaminants via the food chain.

9.0 CONCLUSIONS AND RECOMMENDATIONS

This section provides the overall conclusions and recommendations regarding the 7100 Site RI, based on the results summarized in the sections above.

9.1. Conclusions

Data collected during this RI and prior studies were used to evaluate whether contamination beneath the 7100 Site might pose an unacceptable risk to human health and the environment. Potential contaminant exposures in the upland were evaluated by comparing the data to SLs protective of unrestricted land uses even though the Site is used for industrial purposes. Upland data also were compared to SLs protective of aquatic land uses in the adjacent LDW. The data screening process identified several chemicals in Site soil and groundwater that are present at concentrations exceeding their respective SLs, including petroleum hydrocarbons, VOCs, SVOCs, PAHs, PCBs, pesticides and metals.

The nature and extent of contamination at the Site can be broadly described in terms of the shallower fill unit and the deeper native soil unit. Petroleum-related contamination associated with the former on-site USTs is present in the fill unit. A broader spectrum of contaminants unrelated to Site activities is present in the underlying native soil unit. This deeper contamination appears to have originated from historical

operations on the ICS property south of the 7100 Site. Contaminant releases from the ICS site apparently impacted the LDW tide flats beneath the 7100 Site before fill was placed to produce the Site upland. Contamination associated with the off-site (ICS) source includes all of the 7100 Site COCs: PCBs, pesticides and PAHs, and to a lesser degree, petroleum hydrocarbons and VOCs.

With few exceptions, the petroleum-related contamination associated with historic Site activities occurs in the area surrounding the former on-Site garage and USTs. COCs associated with this contaminant source include gasoline- and diesel/heavy oil-range hydrocarbons, benzene and naphthalene. SL exceedances of these COCs, however, are sporadic and inconsistent even in the vicinity of the former USTs.

This indicates that contaminants have been naturally degrading since the source was removed. The RI data further indicate that the petroleum-related contamination associated with the former USTs does not pose a risk to receptors in the LDW as a result of the soil to groundwater to surface water/sediment pathway. Other potential exposure to the UST-related contamination are limited to direct contact with petroleum-related soil contamination at depths shallower than the 15 feet bgs standard point of compliance, but there are few instances of exceedance of direct-contact SLs (i.e., 18 mg/kg for benzene [Table 9]) in this depth range. Petroleum-related groundwater contamination in the vicinity of the USTs does not pose a risk to humans because Site groundwater is non-potable. In addition, it does not pose a risk to humans or ecological receptors via exposures to sediment or surface water adjacent to the 7100 Site.

All of the COC groups are present in the deeper native soil unit. This deeper unit contains petroleum-hydrocarbons, PAHs, PCBs and pesticides at concentrations greater than SLs. These COCs also are present at some locations in the overlying fill unit, but the general vertical (upward) decrease in concentrations indicates that the source of these COCs in Site fill is the underlying, more heavily contaminated native soil unit. These COCs also have substantially greater concentrations at the Trotsky Inlet and ICS site, located south of the 7100 Site. This combination of lateral and vertical concentration gradients suggests that deeper contamination beneath the 7100 Site and adjacent Trotsky Inlet likely originated from historical releases at the nearby drum refurbishing facility (ICS site).

Unlike petroleum-related contamination at the Site, PCBs and pesticides exceed groundwater SLs in a more widespread area, including locations near the Site boundary (adjacent to the LDW and Trotsky Inlet shorelines). The highest concentrations of PCBs and pesticides in groundwater have been observed at a groundwater seep on the south side of the Trotsky Inlet and beneath the adjacent ICS site, further suggesting that the ICS site is the likely source of these COCs. The ICS-related contaminants do not pose a risk to humans via consumption as drinking water because Site groundwater is non-potable. However, these contaminants may pose an unacceptable risk to humans or ecological receptors via exposures to LDW surface water or sediment, if impacted by Site groundwater. People also could be exposed to ICS-related contaminants by direct contact with soil at depths shallower than 15 feet bgs.

9.2. Recommendations

The existing data is sufficient to conclude the RI for the 7100 Site, although some relatively minor data gaps exist. These data gaps are described below and can be filled either prior to or at the beginning of a focused feasibility study that will address Site-related contamination. This contamination includes petroleum-related impacts to soil and groundwater in the vicinity of the former on-Site USTs and garage. The following data gaps should be filled to refine understanding of the nature and extent of contamination associated with Site-related activities and obtain data to support the feasibility study:

- The extent of petroleum-related soil impacts north and west of the former UST/garage area, particularly in the 0-10 foot depth interval.
- Current groundwater conditions since the last monitoring event conducted four years ago. Existing monitoring wells would be sampled for this purpose. Data would be obtained to confirm the nature and extent of groundwater impacts, and evaluate the use of monitored natural attenuation as a remedial technology.
- Depending on the groundwater monitoring results described above, the extent of groundwater impacts north and west of the former UST/garage area may require delineation.

In addition to the UST-related data gaps described above, there is limited vadose zone soil data across the Site. A few widely dispersed borings could evaluate vadose zone soil conditions at depths shallower than the zone potentially impacted by underlying ICS-related contamination. The vadose zone soil samples would be analyzed for a broad range of petroleum hydrocarbons, VOCs and SVOCs. This data would evaluate the potential for contamination associated with fill at the Site.

It is anticipated that data gaps associated with the deeper ICS-related contamination, to the extent they exist, will be addressed under the ICS RI/FS process. This process has begun, as the ICS party has collected soil and groundwater samples from the 7100 property for purposes of characterizing ICS-related contamination. It is recommended that the ICS party collect additional data, if needed, before evaluating potential cleanup actions.

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Table 1

Summary of Remedial Investigation Soil Samples

7100 1st Avenue South Site

Seattle, Washington

Sample Location[1]	Date	Total Exploration Depth (feet bgs)	Sample Interval (feet bgs)	Sampling Rationale	Metals[2]	SVOCs[3]	VOCs[4]	Pesticides[5]	PCBs[6]	Petroleum Hydrocarbons[7]			Dioxins/Furans[8]	TOC, Grain Size[9]
										Gasoline - Range	BETX	Diesel/ Heavy Oil - Range		
Hand Auger Explorations														
HA-1	07/10/13	2	0 - 0.5	Hand auger borings were performed on bank above Trotsky Inlet to characterize near-surface soil with potential for transport to the LDW through erosion.	X	X		X	X			X		
HA-2	07/10/13	2	0 - 0.5		X	X		X	X			X		
HA-3	07/10/13	2	0 - 0.5		X	X		X	X			X		
Stormwater Outfall Exploration														
SED-0F-1	09/03/13	60 cm	0 - 10 cm	Surface and shallow subsurface sediment in the vicinity of stormwater outfall was sampled to characterize the potential for stormwater discharge to impact LDW sediments.	X	X	X	X	X	X		X		X
Direct-Push Explorations														
DP-1	07/08/13	20	10 - 11	Direct-push borings were completed in the vicinity of the former underground storage tanks to characterize extent of hydrocarbon-related contaminants in soil.						X	X	X		
			12.5-13.5							X	X	X		
DP-2	07/08/13	20	7.5 - 8.5							X	X	X		
			12.5-13.5							X	X	X		
DP-3	07/08/13	20	12.5-13.5							X	X	X		
DP-4	07/08/13	20	7.5 - 8.5							X	X	X		
			12.5-13.5							X	X	X		
DP-5	07/08/13	20	7.5 - 8.5							X	X	X		
DP-6	07/08/13	20	5 - 6							X	X	X		
			7.5 - 8.5							X	X	X		
			12.5-13.5							X	X	X		
DP-7	07/08/13	20	7.5 - 8.5							X	X	X		
DP-8	07/08/13	20	12.5 - 13.5							X	X	X		
DP-10	07/08/13	20	5 - 6							X	X	X		
			10 - 11							X	X	X		
			12.5-13.5							X	X	X		
			15 - 16							X	X	X		
DP-11	07/08/13	20	12.5 - 13.5							X	X	X		
Hollow Stem Auger Eplorations														
MW-2R	07/11/13	41	10 - 11	Soil exploration and monitoring well MW-2R was completed to replace damaged monitoring well MW-2.	X	X	X	X	X	X		X		X
			32 - 33		X	X	X	X	X	X		X		X

Sample Location[1]	Date	Total Exploration Depth (feet bgs)	Sample Interval (feet bgs)	Sampling Rationale	SVOCs[3]	SVOCs[3]	VOCs[4]	Pesticides[5]	PCBs[6]	Petroleum Hydrocarbons[7]			Dioxins/Furans[8]	TOC, Grain Size[9]
										Gasoline - Range	BTEX	Diesel/ Heavy Oil - Range		
MW-13	07/12/13	38.5	12.5 - 13.5	Soil explorations and monitoring wells MW-13, MW-14, MW-15 were completed to characterize soil at the 7100 1st Avenue South Property limit adjacent to the Lower Duwamish Waterway.	X	X	X	X	X	X		X		X
			25 - 26		X	X	X	X	X	X		X		X
			32.5 - 33.5		X	X	X	X	X	X		X		X
MW-14	07/09/13	36	7.5 - 8.5		X	X	X	X	X	X		X		X
			17.5 - 18.5		X	X	X	X	X	X		X		X
			30 - 31		X	X	X	X	X	X		X		X
MW-15	07/09/13	36	12.5 - 13.5	Soil explorations and monitoring wells MW-13, MW-14, MW-15 were completed to characterize soil at the 7100 1st Avenue South Property limit adjacent to the Lower Duwamish Waterway.	X	X	X	X	X	X		X		X
			22.5 - 23.5		X	X	X	X	X	X		X		X
			35 - 36		X	X	X	X	X	X		X		X
MW-16	07/10/13	36	12.5 - 13.5	Soil exploration and monitoring well MW-16 was completed to further characterize soil in the vicinity of the former underground storage tanks.	X	X	X	X	X	X		X		X
			25 - 26		X	X	X	X	X	X		X		X
			30 - 31		X	X	X	X	X	X		X		X
MW-17	07/12/13	38.5	12.5 - 13.5	Soil exploration and monitoring well MW-17 was completed to characterize soil and groundwater in the northern poriton of the Site.	X	X	X	X	X	X		X		X
			27.5 - 28.5		X	X	X	X	X	X		X		X
			30 - 31		X	X	X	X	X	X		X		X
MW-18	07/11/13	38.5	12.5 - 13.5	Soil explorations and monitoring wells MW-18 and MW-19 were competed to characterize soil in the area of the Site between the former underground storage tanks and Lower Duwamish Waterway.	X	X	X	X	X	X		X		X
			27.5 - 28.5		X	X	X	X	X	X		X		X
			35 - 36		X	X	X	X	X	X		X		X
MW-19	07/10/13	36	12.5 - 13.5		X	X	X	X	X	X		X		X
			20 - 21		X	X	X	X	X	X		X		X
			32.5 - 33.5		X	X	X	X	X	X		X		X

Notes:

[1]Sample locations are shown on Figures 8 and 10.

[2]Metals by EPA Method 6000/7000 series, including arsenic, cadmium, coper, lead, mercury, nickel, silver, and zinc.

[3]Semi-volatile organic compounds (SVOCs) by EPA Method 8270 SIM.

[4]Volatile Organic Compounds (VOCs) by EPA Method 8260.

[5]Polychloriated biphenyls (PCBs) by EPA Method 8280.

[6]Pesticides by EPA Method 8081B

[7]Petroleum hydrocarbons by NWTPH-Dx for diesel and heavy oil range, NWTPH-G for gasoline-range, and/or EPA Method 8021 for benzene, ethylbenzene, toulene and xylene (BETX) compounds.

[8]Dioxins/Furans by EPA Method 8290A

[9]Total Organic Carbon (TOC) by SW-846 Method 9060, and grainsize by Puget Sound Esturay Program methods.

bgs = below ground surface

cm = centimeters

EPA = Environmental Protection Agency

LDW = Lower Duwamish Waterway

UST = underground storage tank

Property = 7100 1st Avenue South, Seattle, Washington

Site = Contaminated media sourcing from he 7100 1st Avenue South Property

Table 2

Summary of Remedial Investigation Groundwater and Stormwater System Samples

7100 1st Avenue South Site
Seattle, Washington

Sample Location[1]	Monitoring Event	Date	Sampling Rationale	Metals[2]	SVOCs[4]	VOCs[5]	PCBs[6]	Pesticides[7]	Petroleum Hydrocarbons[8]		Chloride, TDS[9]
									Gasoline - Range	Diesel/ Heavy Oil - Range	
Groundwater Monitoring Wells											
MW-1	Round 1	8/15/2013	Monitoring well MW-1 was sampled to characterize groundwater in the apparent upgradient direction of the former USTs.	X	X	X	X	X	X	X	X
	Round 2	12/19/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/15/2014		X	X	X	X	X	X	X	X
MW-2R	Round 1	8/20/2013	Monitoring wells MW-2R, MW-3, and MW-4 were sampled to characterize groundwater in the vicinity of, and immediately downgradient from, the location of the former USTs. Well MW-2R is a new well to replace damaged well MW-2.	X	X	X	X	X	X	X	X
	Round 2	12/20/2013		X	X	X	X	X	X	X	X
	Round 3	3/18/2014		X	X	X	X	X	X	X	X
	Round 4	7/17/2014		X	X	X	X	X	X	X	X
MW-3	Round 1	8/16/2013		X	X	X	X	X	X	X	X
	Round 2	12/17/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X
MW-4	Round 1	8/16/2013		X	X	X	X	X	X	X	X
	Round 2	12/18/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X
MW-5	Round 1	8/15/2013	Monitoring well MW-5 was sampled to characterize groundwater downgradient from the location of the former USTs, as well as provide general Property-wide groundwater chemistry.	X	X	X	X	X	X	X	X
	Round 2	12/26/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/17/2014		X	X	X	X	X	X	X	X
MW-8	Round 1	8/14/2013	Monitoring wells MW-8, MW-9, and MW-10 were sampled to characterize groundwater adjacent to the Trotsky inlet, as well as provide general Property-wide groundwater chemistry.	X	X	X	X	X	X	X	X
	Round 2	12/19/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
MW-9	Round 1	8/15/2013		X	X	X	X	X	X	X	X
	Round 2	12/18/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
MW-10	Round 1	8/16/2013		X	X	X	X	X	X	X	X
	Round 2	12/18/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/15/2014		X	X	X	X	X	X	X	X

Sample Location[1]	Monitoring Event	Date	Sampling Rationale	SVOCs[4]	SVOCs[4]	VOCs[5]	PCBs[6]	Pesticides[7]	Petroleum Hydrocarbons[8]		Chloride, TDS[9]
									Gasoline - Range	Diesel/ Heavy Oil - Range	
MW-11	Round 1	8/15/2013	Monitoring well MW-11 was sampled to characterize groundwater adjacent to the Trotsky Inlet as well as general Property-wide groundwater chemistry.	X	X	X	X	X	X	X	X
	Round 2	12/26/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
MW-12	Round 1	8/16/2013	Monitoring well MW-12 was sampled to characterize groundwater in the vicinity of the former USTs.	X	X	X	X	X	X	X	X
	Round 2	12/18/2013		X	X	X	X	X	X	X	X
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4	7/15/2014		X	X	X	X	X	X	X	X
MW-13	Round 1	8/14/2013	Monitoring wells MW-13, MW-14, MW-15 were sampled to characterize groundwater at the Property limit adjacent to the LDW.	X	X	X	X	X	X	X	X
	Round 2	12/17/2013		X	X	X	X	X	X	X	X
	Round 3	3/20/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
MW-14	Round 1	8/19/2013		X	X	X	X	X	X	X	X
	Round 2	12/17/2013		X	X	X	X	X	X	X	X
	Round 3	3/18/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
MW-15	Round 1	8/15/2013		X	X	X	X	X	X	X	X
	Round 2	12/26/2013		X	X	X	X	X	X	X	X
	Round 3	3/20/2014		X	X	X	X	X	X	X	X
	Round 4	7/15/2014		X	X	X	X	X	X	X	X
MW-16	Round 1	8/19/2013	Monitoring well MW-16 was sampled to characterize groundwater in the vicinity of, and immediately downgradient from, the location of the former USTs.	X	X	X	X	X	X	X	X
	Round 2	12/18/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/17/2014		X	X	X	X	X	X	X	X
MW-17	Round 1	8/19/2013	Monitoring well MW-17 was sampled to characterize groundwater in the northern section of the Site, as well as general Property-wide groundwater chemistry .	X	X	X	X	X	X	X	X
	Round 2	12/20/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X
MW-18	Round 1	8/20/2013	Monitoring well MW-18 was sampled to characterize groundwater in the area of the Site between the former USTs and the LDW, as well as general Property-wide groundwater chemistry.	X	X	X	X	X	X	X	X
	Round 2	12/19/2013		X	X	X	X	X	X	X	X
	Round 3	3/18/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X
MW-19	Round 1	8/20/2013	Monitoring well MW-19 was sampled to characterize groundwater in the area of the Site between the former USTs and the LDW, as well as general Property-wide groundwater chemistry.	X	X	X	X	X	X	X	X
	Round 2	12/17/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X

Sample Location[1]	Monitoring Event	Date	Sampling Rationale	SVOCs[4]	SVOCs[4]	VOCs[5]	PCBs[6]	Pesticides[7]	Petroleum Hydrocarbons[8]		Chloride, TDS[9]
									Gasoline - Range	Diesel/ Heavy Oil - Range	
MW-A	Round 1[10]	--	Previouly unidentified monitoring well was sampled to characterize groundwater in the area of the site between the former USTs and the LDW, as well as general Property-wide groundwater chemistry.	--	--	--	--	--	--	--	--
	Round 2[10]	--		--	--	--	--	--	--	--	--
	Round 3	3/19/2014		X	X	X	X	X	X	X	X
	Round 4[11]	--		--	--	--	--	--	--	--	--
Trotsky Inlet Seep Locations											
SP-01	Round 1	9/3/2013	Seep location SP-01 was sampled to characterize shallow groundwater flowing into the Trotsky Inlet at low tide from the north side of the inlet.	X	X	X	X	X	X	X	X
	Round 2[12]	--		--	--	--	--	--	--	--	--
	Round 3	3/20/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
Seep-1	Round 1	9/4/2013	Seep location SEEP-1 was sampled to characterize shallow groundwater flowing into the Trotsky Inlet at low tide from the south side of the inlet.	X	X	X	X	X	X	X	X
	Round 2[12]	--		--	--	--	--	--	--	--	--
	Round 3	3/20/2014		X	X	X	X	X	X	X	X
	Round 4	7/14/2014		X	X	X	X	X	X	X	X
Stormwater System Monitoring Points											
SW-IN	Round 1	9/3/2013	The stormwater treatment system influent and efluent samples were intended to characterize potental contaminants in stormwater water runoff and in stormwater being discharged to the Lower to surface water.	X	X	X	X	X	X	X	
	Round 2[13]	--		--	--	--	--	--	--	--	
	Round 3	3/17/2014		X	X	X	X	X	X	X	
	Round 4[13]	--		--	--	--	--	--	--	--	
SW-EF	Round 1	9/3/2013		X	X	X	X	X	X	X	
	Round 2[13]	--		--	--	--	--	--	--	--	
	Round 3	3/17/2014		X	X	X	X	X	X	X	
	Round 4[13]	--		--	--	--	--	--	--	--	
Lower Duwamish Waterway											
LDW	Round 1	9/3/2013	The LDW was sampled to characterize background conditions within the vicinity of the Site.	X	X	X	X	X	X	X	X
	Round 2	12/17/2013		X	X	X	X	X	X	X	X
	Round 3	3/17/2014		X	X	X	X	X	X	X	X
	Round 4	7/16/2014		X	X	X	X	X	X	X	X

Notes:

[1]Sample locations are shown on Figures 9 and 10.

[2]Metals by EPA Method 200.7/ 200.8, including arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc.

[3]Mercury to be analyzed by EPA Method 1631E

[4]Semivolatile organic compounds (SVOCs) by EPA Method 8270 SIM.

[5]Volatile organic compounds (VOCs) by EPA Method 8260.

[6]Polychlorinated biphenyls (PCBs) by EPA Method 8280.

[7]Pesticides by EPA Method 8081B

[8]Petroleum hydrocarbons by NWTPH-G for gasoline-range and/or NWTPH-Dx for diesel and heavy oil range.

[9]Chloride by EPA 300.0 and total dissolved solids by EPA 160.1.

[10]Monitoring well MW-A was previouly unknown and therefore not sampled.

[11]Obstruction covering the monitoring well at the Property prevented the collection a groundwater sample.

[12]Seep sample was not collected because the day time low tide was above the elevation of the seep loctaion.

[13]Stormwater sample not collected due to insufficent water present in the system.

EPA = Environmental Protection Agency

LDW = Lower Duwamish Waterway

UST = underground storage tank

Property = 7100 1st Avenue South, Seattle, Washington

Site = Contaminated media sourcing from he 7100 1st Avenue South Property

Table 3

Monitoring Well Completion Details

7100 1st Avenue South Site

Seattle, Washington

Monitoring Well[1]	Date Installed	Installed By	Ecology Well ID	Ground Surface Elevation[2] (feet)	Top of Casing Elevation[3] (feet)	Bottom of Casing Elevation (feet)	Total Well Depth (feet bgs)	Casing Diameter (inches)	Screen Interval (feet bgs)	Screen Specifications
MW-1	10/25/90	Dames & Moore	TBD	18.04	17.39	-1.96	20	4	10 to 20	4-inch Schedule 40 PVC 0.010-inch slot
MW-3	10/25/90	Dames & Moore	TBD	18.14	17.29	-1.86	20	4	10 to 20	4-inch Schedule 40 PVC 0.010-inch slot
MW-4	10/26/90	Dames & Moore	TBD	17.66	16.51	-2.34	20	4	10 to 20	4-inch Schedule 40 PVC 0.010-inch slot
MW-5	01/22/91	Dames & Moore	TBD	15.92	15.02	-3.58	19.5	2	10 to 19.5	4-inch Schedule 40 PVC 0.010-inch slot
MW-8	06/18/08	SAIC	TBD	17.33	16.93	-2.67	20	2	10 to 20	2-inch Schedule 40 PVC 0.010-inch slot
MW-9	06/18/08	SAIC	TBD	16.72	16.32	-3.28	20	2	10 to 20	2-inch Schedule 40 PVC 0.010-inch slot
MW-10	06/18/08	SAIC	TBD	17.03	16.73	-2.97	20	2	10 to 20	2-inch Schedule 40 PVC 0.010-inch slot
MW-11	06/18/08	SAIC	TBD	17.89	17.59	-2.11	20	2	10 to 20	2-inch Schedule 40 PVC 0.010-inch slot
MW-12	06/19/08	SAIC	TBD	18.30	17.88	-1.7	20	2	10 to 20	2-inch Schedule 40 PVC 0.010-inch slot
MW-2R	07/11/13	GeoEngineers	BIC 627	17.19	17.37	-4.81	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-13	07/12/13	GeoEngineers	BIC 628	18.00	17.60	-4	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-14	07/09/13	GeoEngineers	BIC 623	16.56	16.16	-5.44	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-15	07/09/13	GeoEngineers	BIC 622	15.94	15.49	-6.06	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot

Monitoring Well[1]	Date Installed	Installed By	Ecology Well ID	Ground Surface Elevation[2] (feet)	Top of Casing Elevation[3] (feet)	Bottom of Casing Elevation (feet)	Total Well Depth (feet bgs)	Casing Diameter (inches)	Screen Interval (feet bgs)	Screen Specifications
MW-16	07/10/13	GeoEngineers	BIC 625	18.24	17.59	-3.76	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-17	07/12/13	GeoEngineers	BIC 638	17.01	16.51	-4.99	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-18	07/11/13	GeoEngineers	BIC 626	17.90	17.60	-4.1	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot
MW-19	07/10/13	GeoEngineers	BIC 624	17.49	16.99	-4.51	22	2	7 to 22	2-inch Schedule 40 PVC 0.010-inch slot

Notes:

[1]Monitoring well locations are shown on Figure 10.

[2]Elevation from July/August 2013 land survey performed by David Evans Associates.

[3]Elevation from the difference in height between the well monument rim and north top of casing.

bgs = below ground surface

PVC = polyvinyl chloride

TBD = to be determined

Monitoring wells were installed using hollow-stem auger (HAS) drilling methods.

All elevations referenced to North American Vertical Datum 1988 (NAVD-88).

Table 4

Summary of Remedial Investigation Groundwater Monitoring Elevation Data

7100 1st Avenue South Site

Seattle, Washington

Monitoring Well[1]	Quarterly Groundwater Monitoring Event	Date Measured	Top of Casing Elevation[2] (feet)	Depth to Water from Top of Casing (feet)	Groundwater Elevation[2] (feet)
MW-1	Round 1	08/15/13	17.39	11.28	6.11
	Round 2	12/19/13		11.28	6.11
	Round 3	03/19/14		10.22	7.17
	Round 4	07/15/14		11.62	5.77
MW-2R	Round 1	08/20/14	17.37	11.16	6.21
	Round 2	12/20/13		--	--
	Round 3	03/18/14		--	--
	Round 4	07/17/14		11.81	5.56
MW-3	Round 1	08/16/13	17.29	11.10	6.19
	Round 2	12/17/13		11.35	5.94
	Round 3	03/19/14		10.18	7.11
	Round 4	07/16/14		11.57	5.72
MW-4	Round 1	08/16/13	16.51	10.15	6.36
	Round 2	12/18/13		10.20	6.31
	Round 3	03/17/14		9.34	7.17
	Round 4	07/16/14		9.98	6.53
MW-5	Round 1	08/15/13	15.02	9.68	5.34
	Round 2	12/26/13		10.09	4.93
	Round 3	03/17/14		9.67	5.35
	Round 4	07/17/14		10.02	5
MW-8	Round 1	08/14/13	16.93	11.36	5.57
	Round 2	12/19/13		10.33	6.6
	Round 3	03/19/14		10.01	6.92
	Round 4	07/14/14		10.92	6.01

Monitoring Well[1]	Quarterly Groundwater Monitoring Event	Date Measured	Top of Casing Elevation[2] (feet)	Depth to Water from Top of Casing (feet)	Groundwater Elevation[2] (feet)
MW-9	Round 1	08/15/13	16.32	10.52	5.8
	Round 2	12/18/13		9.74	6.58
	Round 3	03/19/14		10.45	5.87
	Round 4	07/14/14		10.78	5.54
MW-10	Round 1	08/16/13	16.73	11.32	5.41
	Round 2	12/18/13		11.54	5.19
	Round 3	03/19/14		10.82	5.91
	Round 4	07/15/14		10.11	6.62
MW-11	Round 1	08/15/13	17.59	11.17	6.42
	Round 2	12/26/13		11.17	6.42
	Round 3	03/19/14		10.56	7.03
	Round 4	07/14/14		10.51	7.08
MW-12	Round 1	08/16/13	17.88	12.33	5.55
	Round 2	12/18/13		11.89	5.99
	Round 3	03/19/14		10.26	7.62
	Round 4	07/15/14		12.01	5.87
MW-13	Round 1	08/14/13	17.60	11.42	6.18
	Round 2	12/17/13		11.58	6.02
	Round 3	03/20/14		11.69	5.91
	Round 4	07/14/14		11.61	5.99
MW-14	Round 1	08/19/13	16.16	10.06	6.1
	Round 2	12/17/13		9.54	6.62
	Round 3	03/18/14		9.26	6.9
	Round 4	07/14/14		9.63	6.53
MW-15	Round 1	08/15/13	15.49	8.85	6.64
	Round 2	12/26/13		8.67	6.82
	Round 3	03/20/14		8.91	6.58
	Round 4	07/15/14		8.81	6.68

Monitoring Well[1]	Quarterly Groundwater Monitoring Event	Date Measured	Top of Casing Elevation[2] (feet)	Depth to Water from Top of Casing (feet)	Groundwater Elevation[2] (feet)
MW-16	Round 1	08/19/13	17.59	11.49	6.1
	Round 2	12/18/13		11.78	5.81
	Round 3	03/17/14		10.30	7.29
	Round 4	07/17/14		11.25	6.34
MW-17	Round 1	08/19/13	16.51	10.02	6.49
	Round 2	12/20/13		9.62	6.89
	Round 3	03/17/14		9.23	7.28
	Round 4	07/16/14		9.83	6.68
MW-18	Round 1	08/20/14	17.60	11.12	6.48
	Round 2	12/19/13		11.57	6.03
	Round 3	03/18/14		11.04	6.56
	Round 4	07/16/14		11.15	6.45
MW-19	Round 1	08/20/14	16.99	10.80	6.19
	Round 2	12/17/13		10.77	6.22
	Round 3	03/17/14		10.52	6.47
	Round 4	07/16/14		10.21	6.78
MW-A	Round 1[3]	--	17.1	--	--
	Round 2[3]	--		--	--
	Round 3	03/19/14		10.40	6.7
	Round 4[4]	--		--	--
MW-B	Round 1[3]	--	18.00	--	--
	Round 2[3]	--		--	--
	Round 3	03/19/14		10.40	7.6
	Round 4[4]	--		--	--
MW-C	Round 1[3]	--	17.48	--	--
	Round 2[3]	--		--	--
	Round 3	03/19/14		10.40	7.08
	Round 4[4]	--		--	--

Notes:

[1]Monitoiring well locations are shown on Figure 10.

Monitoring Well[1]	Quarterly Groundwater Monitoring Event	Date Measured	Top of Casing Elevation[2] (feet)	Depth to Water from Top of Casing (feet)	Groundwater Elevation[2] (feet)

[2]Elevation is referenced to North American Vertical Datum 1988 (NAVD-88).

[3]Monitoring well MW-A was previouly unknown and therefore not sampled.

[4]Obstruction covering the monitoring well at the Property prevented the collection a groundwater sample.

TBD = to be determined

-- = not measured

Table 5

Summary of Water Quality Field Measurements and Conventional Analyses

7100 1st Avenue South Site
Seattle, Washington

Sample Location[2]	Monitoring Event	Date	Field Measurements[1]								Laboratory Analysis	
			Acidity (pH)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Total Dissolved Solids (g/L)	Oxidation Reduction Potential (m/V)	Salinity (%)	Chloride[3] (mg/L)	Total Dissolved Solids[4] (mg/L)
Groundwater Monitoring Wells												
MW-1	Round 1	08/15/13	7.03	2.98	0.6	7.40	17.3	1.9	-143	0.1	567	1,450
	Round 2	12/19/13	6.50	0.22	0.0	11.00	14.7	11.0	-111	0.1	462	1,210
	Round 3	03/19/14	7.51	2.80	0.0	4.79	14.4	1.5	-180	0.12	485	1,160
	Round 4	07/15/14	6.49	2.57	0.0	0.33	15.7	1.7	-109	0.14	623	1,430
MW-2R	Round 1	08/20/13	6.20	1.98	122	3.10	15.4	1.3	-67	0.1	42.0	892
	Round 2	12/20/13	6.58	0.16	29.2	2.70	13.2	--	-21	0.1	49.6	857
	Round 3	03/18/14	6.87	1.33	11.,2	3.31	11.3	0.9	-172	0.13	49.5	677
	Round 4	07/17/14	6.43	1.33	0.0	0.63	15.9	0.9	-65.5	0.07	40.3	775
MW-3	Round 1	08/16/13	6.84	1.40	18.2	7.20	18.3	0.9	-139	--	55.1	748
	Round 2	12/17/13	6.54	1.44	0.9	1.61	13.9	0.9	-194	0.07	57.1	735
	Round 3	03/19/14	7.37	1.29	0.0	6.62	14.3	0.8	-184	0.06	56.7	674
	Round 4	07/16/14	6.58	1.09	34.4	0.16	17.1	0.3	-104	0.06	57.6	1,800
MW-4	Round 1	08/16/13	7.02	1.43	9.1	7.50	18.1	0.9	-159	0.1	35.3	1,070
	Round 2	12/18/13	6.55	0.14	0.0	1.60	15.7	0.9	-143	0.1	41.8	815
	Round 3	03/17/14	7.02	1.41	27.3	0.00	13.1	0.9	-187	0.07	46.4	800
	Round 4	07/16/14	6.66	1.27	3.6	0.11	17.8	1.0	-114	0.08	54.3	1,290
MW-5	Round 1	08/15/13	7.10	2.35	23.8	7.30	15.8	1.5	-117	0.1	387	1,320
	Round 2	12/26/13	6.66	2.14	--	0.49	13.0	--	313	--	404	1,190
	Round 3	03/17/14	6.59	2.35	5.4	0.00	13.1	1.5	-142	0.09	523	978
	Round 4	07/17/14	6.50	2.48	15.0	1.17	13.6	1.6	-106.4	0.13	499	1,320

Sample Location[2]	Monitoring Event	Date	Field Measurements[1]								Laboratory Analysis	
			Acidity (pH)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Total Dissolved Solids (g/L)	Oxidation Reduction Potential (m/V)	Salinity (%)	Chloride[3] (mg/L)	Total Dissolved Solids[4] (mg/L)
MW-8	Round 1	08/14/13	7.06	8.71	13.6	6.80	15.4	5.5	-88	0.5	2,490	4,320
	Round 2	12/19/13	6.37	1.32	0.0	1.30	13.9	--	-21	0.8	3,160	5,350
	Round 3	03/19/14	6.91	6.41	6.0	8.94	10.2	4.04	-138	0.12	2,130	3,740
	Round 4	07/14/14	6.63	6.05	0.4	0.20	14.2	4.9	-39	0.42	2,120	3,680
MW-9	Round 1	08/15/13	7.33	26.40	0.7	5.70	17.2	16.0	-333	0.16	8,090	14,000
	Round 2	12/18/13	6.50	14.60	5.2	3.80	13.5	9.4	-361	0.87	4,160	6,980
	Round 3	03/19/14	7.33	1.48	2.4	0.00	10.3	0.9	-106	0.3	333	879
	Round 4	07/14/14	6.55	19.95	0.4	0.15	17.0	15.2	-264.6	0.65	7,110	11,800
MW-10	Round 1	08/16/13	7.05	9.60	-0.8	6.80	15.2	6.0	-111	0.5	2,830	4,950
	Round 2	12/18/13	6.62	0.66	0.0	1.20	14.1	4.1	-176	0.3	1,990	3,550
	Round 3	03/19/14	7.05	3.64	0.0	0.00	11.2	2.3	-130	0.12	898	2,060
	Round 4	07/15/14	6.72	8.80	0.0	0.19	14.7	5.7	-72	0.5	2,430	4,460
MW-11	Round 1	08/15/13	6.93	27.80	3.5	7.80	16.9	17.0	83	0.17	9,340	16,400
	Round 2	12/26/13	7.14	5.01	--	13.41	7.9	--	198	--	1,380	2,620
	Round 3	03/19/14	7.91	1.33	0.0	10.06	8.2	1.1	-45	0.6	431	729
	Round 4	07/14/14	6.41	22.85	0.2	6.28	17.4	14.9	143.2	1.4	7,370	12,500
MW-12	Round 1	08/16/13	6.91	1.27	-0.7	7.00	16.4	0.8	-148	--	73.6	654
	Round 2	12/18/13	6.50	1.15	0.0	2.42	14.0	0.7	-185	0.06	66.2	609
	Round 3	03/19/14	7.50	0.96	0.0	5.41	13.4	0.6	-198	0.05	60.9	477
	Round 4	07/15/14	6.58	1.14	2.8	0.15	16.6	0.7	-93.8	0.06	73.6	604
MW-13	Round 1	08/14/13	6.67	23.80	11.0	6.40	20.1	15.0	26	0.14	8,190	13,800
	Round 2	12/17/13	6.10	6.96	58.9	1.23	11.1	4.1	-83	0.35	1,630	2,960
	Round 3	03/20/14	7.04	2.61	22.0	0.00	7.8	1.6	-21	0.13	698	1,390
	Round 4	07/14/14	6.11	11.68	9.4	0.17	14.0	9.6	--	0.87	5,000	7,560

Sample Location[2]	Monitoring Event	Date	Field Measurements[1]								Laboratory Analysis	
			Acidity (pH)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Total Dissolved Solids (g/L)	Oxidation Reduction Potential (m/V)	Salinity (%)	Chloride[3] (mg/L)	Total Dissolved Solids[4] (mg/L)
MW-14	Round 1	08/19/13	6.63	5.77	0.8	3.78	13.1	3.6	-66	0.3	1,870	3,690
	Round 2	12/17/13	6.17	0.61	20.8	1.40	12.7	3.8	-9	0.3	2,200	3,990
	Round 3	03/18/14	6.98	4.83	4.0	0.00	9.6	3.1	-161	0.13	1,650	2,880
	Round 4	07/14/14	6.74	4.73	1.5	0.44	14.8	3.8	-44.2	0.32	1,870	3,200
MW-15	Round 1	08/15/13	6.98	5.48	12.8	7.00	14.0	3.5	-81	0.3	1,360	2,480
	Round 2	12/26/13	6.42	5.86	--	0.54	12.6	--	331	--	1,730	3,230
	Round 3	03/20/14	6.81	4.11	1.8	0.00	9.4	2.6	-122	0.0	1,290	2,820
	Round 4	07/15/14	6.06	6.49	0.0	0.28	13.6	4.2	-63.9	0.36	1,940	3,560
MW-16	Round 1	08/19/13	6.72	1.86	210	3.62	17.0	1.2	-80	0.1	58.2	1,040
	Round 2	12/18/13	6.45	0.14	2.2	1.20	14.9	0.4	-151	0.1	75.0	887
	Round 3	03/17/14	6.88	0.84	11.4	0.00	11.6	0.5	-156	0.4	55.7	426
	Round 4	07/17/14	6.51	1.30	11.7	0.91	16.0	0.8	-100.9	0.07	84.8	824
MW-17	Round 1	08/19/13	6.65	2.40	99.7	3.41	16.8	1.5	-101	0.1	109	1,600
	Round 2	12/20/13	6.78	0.23	17.7	2.10	13.8	--	-14	0.1	118	1,510
	Round 3	03/17/14	7.28	2.14	52.2	0.00	12.4	1.4	-211	0.11	113	1,480
	Round 4	07/16/14	6.93	2.05	19.6	0.10	18.0	1.5	-131	0.12	116	1,560
MW-18	Round 1	08/20/13	6.43	2.82	36.8	3.09	15.3	1.8	-75	0.1	287	1,350
	Round 2	12/19/13	6.54	0.23	16.0	1.50	14.2	--	-69	0.1	240	1,180
	Round 3	03/18/14	6.95	2.30	8.0	0.17	12.56	1.5	-180	0.12	291	1,290
	Round 4	07/16/14	6.56	2.38	8.0	0.87	17.4	1.5	129.6	0.12	299	1,250
MW-19	Round 1	08/20/13	6.29	2.13	17.8	3.25	17.5	1.4	-59	0.1	38.7	1,020
	Round 2	12/17/13	6.61	1.97	51.8	1.70	14.9	1.3	-251	0.1	41.7	1,010
	Round 3	03/17/14	6.68	1.63	9.5	0.00	14.7	1.1	-146	0.5	44.2	961
	Round 4	07/16/14	6.57	1.77	0.0	0.87	18.3	1.1	-137.5	0.09	47.1	1,040

Sample Location[2]	Monitoring Event	Date	Field Measurements[1]								Laboratory Analysis	
			Acidity (pH)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Total Dissolved Solids (g/L)	Oxidation Reduction Potential (m/V)	Salinity (%)	Chloride[3] (mg/L)	Total Dissolved Solids[4] (mg/L)
Trotsky Inlet Seep Locations												
SEEP-1	Round 1	09/03/13	7.43	22.80	119.0	10.19	19.0	14.1	-21	0.13	8,120	14,100
	Round 2[7]	--	--	--	--	--	--	--	--	--	--	--
	Round 3	03/20/14	7.68	3.04	0.0	9.45	9.4	1.9	45	0.15	930	1,920
	Round 4	07/14/14	6.60	20.88	5.7	1.76	18.6	13.6	92.6	1.3	6,750	10,500
SP-1	Round 1	09/04/13	7.40	21.50	100	17.70	18.5	13.3	-1	0.13	7,240	12,200
	Round 2[7]	--	--	--	--	--	--	--	--	--	--	--
	Round 3	03/20/14	7.65	2.01	6.2	15.98	8.9	1.3	39	0.1	475	912
	Round 4	07/14/14	7.16	22.25	6.1	7.09	19.7	14.5	80.1	1.3	6,880	11,600
Stormwater System Monitoring Points												
SW-Influent	Round 1	09/03/13	7.18	0.90	112.0	9.88	22.9	0.6	34	0.04	99.8	240
	Round 2[8]	--	--	--	--	--	--	--	--	--	--	--
	Round 3	03/17/14	8.69	0.24	57.7	11.11	6.6	0.1	85	0.1	49.4	99.5
	Round 4[8]	--	--	--	--	--	--	--	--	--	--	--
SW-Effluent	Round 1	09/03/13	6.05	0.35	35	0.15	21.6	0.2	126	0.02	70.9	171
	Round 2[8]	--	--	--	--	--	--	--	--	--	--	--
	Round 3	03/17/14	9.75	0.40	9.0	11.07	8.5	0.26	26.0	0.2	98.7	192
	Round 4[8]	--	--	--	--	--	--	--	--	--	--	--
Lower Duwamish Waterway												
LDW	Round 1	09/03/13	6.94	28.50	28.2	11.35	20.4	17.7	120	1.3	10,000	18,900
	Round 2	12/17/13	--	--	--	--	--	--	--	--	--	--
	Round 3	03/17/14	8.10	50.60	52.8	12.84	10.0	1.2	-136	1.2	810	1,520
	Round 4	07/16/14	7.44	26.73	4.3	81.50	18.4	16.7	102	1.5	6,090	17,900

Notes:

[1]Water quality parameters measured using a Horiba U-50 series or YSI Multi-Probe Field Meter with flow through cell.

[2]Monitoiring well locations are shown on Figure 10.

[3]Chloride by EPA Method 300.0.

[4]Total Disolved Solids (TDS) by EPA Method 160.1.

[5]Monitoring well MW-A was previouly unknown and therefore not sampled.

[6]Obstruction covering the monitoring well at the Property prevented the collection a groundwater sample.

[7]Seep sample was not collected because the day time low tide was above the elevation of the seep location.

[8]Stormwater sample not collected due to insufficent water present in the system.

°C = degrees centigrade

EPA = Environmental Protection Agency

g/L = grams per liter

m/V = millivolts

mg/L - miligram per liter

mS/cm = microsiemens per centimeter

NTU = nephelometric turbidity unit

% = percent

-- = not measured

Table 6

Observed Tidal Effects on Groundwater[1]

7100 1st Avenue South Site
Seattle, Washington

Monitoring Well	Distance from Shoreline (feet)[2]	Ground Surface Elevation (feet)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Wellscreen Midpoint Elevation (feet)	Wellscreen Length (feet)	Mean Groundwater Elevation[3] (feet)	Time Lag[4] (hours)	Stage Ratio[4] (%)
Tidally influented Monitoring Wells									
MW-9	30	16.72	10	20	1.72	10	6.29	0.82	86
MW-13	35	18.00	7	22	3.50	15	6.16	0.83	19
MW-12	100	18.13	10	20	3.13	10	6.00	3.1	3.4
MW-16	150	18.24	7	22	3.74	15	6.37	8.4	2.9
Monitoring Wells showing little or no Tidal Influence[5]									
MW-11	330	17.89	10	20	2.89	10	6.62	7.9	3
MW-5	60	15.92	10	19	1.42	9	5.17	Indeterminate	<1

Notes:

[1]The tidal study was performed between August 19 and August 21, 2014.

[2]Distance is from the well to the nearest shoreline area.

[3]Mean groundwater elevation calculated using the Serfes (1991) Method.

[4]Time lag and stage ratio calculated using the Ferris (1951) Method.

[5]There were no discernable tidal effects observed in MW-5. Water levels in MW-11 showed some response to tidal fluctuations though water levels also appeared to be influenced by non-tidal effects; therefore data from MW-11 were not used for the tidal analysis.

bgs = below ground surface

% = percent

Table 7

Estimated Hydraulic Conductivity

7100 1st Avenue South Site

Seattle, Washington

Monitoring Well	Hydraulic Conductivity[1,2] (K, feet/day)	Hydraulic Test
MW-2A	4.90	Slug Test
MW-14	0.97	Slug Test
MW-16	1.10	Slug Test
Bulk Value (Time Lag Method)	0.17	Tidal study
Bulk Value (Stage Ratio Method)	2.9	Tidal study

Notes:

[1]Hydraulic conductivities were calculated for slug tests using Bouwer and Rice (1976).

[2]Hydraulic conductivity values for tidal study were calculated from Ferris (1946) method by converting average diffusivity (T/S) value calculated from tidal response to K values using assumed aquifer thickness of 50 feet.

K = hydraulic conductivity

Table 8

Proposed Groundwater Screening Levels

7100 1st Avenue South Site

Seattle, Washington

Analyte	CAS Number	Concentrations Protective of Marine Surface Water												Concentrations Protective of Sediment[7]					Preliminary Screening Level µg/L	Practical Quantitation Limit[10] µg/L	Groundwater Screening Level µg/L
		Chapter 173-201A WAC Washington State Surface Water Quality Criteria[1]			40 CFR 131.45 Federal Water Quality Criteria for Washington[2]	CWA §304(a) Federal Water Quality Criteria[3]			Ecology Alternative Marine Protection of Aquatic Life Criteria[4] µg/L	MTCA Method B Marine Surface Water Standard Formula Value - Protection of Human Health (Consumption of Aquatic Life)[5,6]				Sediment Screening Level		Equilibrium Distribution/ Partitioning Coefficient[8]		Calculated Groundwater Concentration Protective of Sediment[9]			
		Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L	Protection of Human Health (organisms only) µg/L	Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L		Carcinogen µg/L	Carcinogen Adjusted µg/L	Non-Carcinogen µg/L	Non-Carc. Adjusted µg/L	Value	Units	K_d L/kg	µg/L	µg/L			
		Acute µg/L	Chronic µg/L			Acute µg/L	Chronic µg/L														
Petroleum Hydrocarbons																					
Gasoline-Range TPH w/ Benzene	--	--	--	--	--	--	--	--	--	--	--	8.0E+02	8.0E+02	--	--	--	--	--	8.0E+02	2.5E+02	8.0E+02
Gasoline-Range TPH w/o Benzene	--	--	--	--	--	--	--	--	--	--	--	1.0E+03	1.0E+03	--	--	--	--	--	1.0E+03	2.5E+02	1.0E+03
Diesel-Range TPH	--	--	--	--	--	--	--	--	--	--	--	5.0E+02	5.0E+02	--	--	--	--	--	5.0E+02	2.5E+02	5.0E+02
Heavy Oil-Range TPH	--	--	--	--	--	--	--	--	--	--	--	5.0E+02	5.0E+02	--	--	--	--	--	5.0E+02	4.0E+02	5.0E+02
Diesel plus Heavy Oil-Range TPH	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+02	2.5E+02	5.0E+02
Volatile Organic Compounds (VOCs)																					
1,1,2-Trichloroethane	79-00-5	--	--	1.8E+00	9.0E-01	--	--	8.9E+00	--	7.0E+00	--	6.4E+02	--	--	--	--	--	--	9.0E-01	2.0E-01	9.0E-01
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
1,2-Dichloroethane (EDC)	107-06-2	--	--	1.2E+02	7.3E+01	--	--	6.5E+02	--	1.6E+01	--	3.6E+03	--	--	--	--	--	--	7.3E+01	2.0E-01	7.3E+01
1,3,5-Trimethylbenzene	108-67-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
2-Butanone (MEK)	78-93-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+00	---
2-Hexanone	591-78-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+00	---
Acetone	67-64-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+00	---
Benzene	71-43-2	--	--	1.6E+00	1.6E+00	--	--	1.6E+01	8.0E+01	6.3E+00	--	5.5E+02	--	--	--	--	--	--	1.6E+00	2.0E-01	1.6E+00
Bromomethane	74-83-9	--	--	2.4E+03	2.4E+03	--	--	1.0E+04	--	--	--	2.7E+02	2.7E+02	--	--	--	--	--	2.7E+02	1.0E+00	2.7E+02
Carbon Disulfide	75-15-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Chloroform	67-66-3	--	--	1.2E+03	6.0E+02	--	--	2.0E+03	--	1.5E+01	1.5E+02	1.9E+03	--	--	--	--	--	--	1.5E+02	2.0E-01	1.5E+02
Chloromethane	74-87-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E-01	---
cis-1,2-Dichloroethene	156-59-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Dichlorodifluoromethane (CFC-12)	75-71-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Ethylbenzene	100-41-4	--	--	2.7E+02	3.1E+01	--	--	1.3E+02	--	--	--	1.9E+03	--	--	--	--	--	--	3.1E+01	2.0E-01	3.1E+01
Isopropylbenzene (Cumene)	98-82-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Methyl Iodide (Iodomethane)	74-88-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E+00	---
Methylene Chloride	75-09-2	--	--	2.5E+02	1.0E+02	--	--	1.0E+03	--	1.0E+03	--	4.8E+03	--	--	--	--	--	--	1.0E+02	1.0E+00	1.0E+02
n-Butylbenzene	104-51-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
n-Propylbenzene	103-65-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Sec-Butylbenzene	135-98-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Tert-Butylbenzene	98-06-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Tetrachloroethene	127-18-4	--	--	7.1E+00	2.9E+00	--	--	2.9E+01	--	2.8E+01	--	1.4E+02	--	--	--	--	--	--	2.9E+00	2.0E-01	2.9E+00
Toluene	108-88-3	--	--	4.1E+02	1.3E+02	--	--	5.2E+02	--	--	--	5.4E+03	--	--	--	--	--	--	1.3E+02	2.0E-01	1.3E+02
Trichloroethene	79-01-6	--	--	8.6E-01	7.0E-01	--	--	7.0E+00	1.9E+02	3.5E+00	--	3.3E+01	--	--	--	--	--	--	7.0E-01	2.0E-01	7.0E-01
Xylene, m-	108-38-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Xylene, p-	95-47-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Xylene, o-	106-42-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-01	---
Semivolatile Organic Compounds (SVOCs)												--									
2,4-Dimethylphenol	105-67-9	--	--	9.7E+01	9.7E+01	--	--	3.0E+03	--	--	--	1.5E+02	--	--	--	--	--	--	9.7E+01	1.0E+00	9.7E+01
Benzoic Acid	65-85-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E+01	---
Benzyl Alcohol	100-51-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+00	---
Bis(2-Ethylhexyl) Phthalate	117-81-7	--	--	2.5E-01	4.6E-02	--	--	3.7E-01	3.6E+02	9.9E-01	--	1.1E+02	--	--	--	--	--	--	4.6E-02	1.0E+00	1.0E+00
Butyl benzyl phthalate	85-68-7	--	--	5.8E-01	1.3E-02	--	--	1.0E-01	3.4E+00	2.3E+00	--	3.5E+02	--	--	--	--	--	--	1.3E-02	1.0E+00	1.0E+00
Carbazole_	86-74-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E+00	---
Dibutyl phthalate	84-74-2	--	--	5.1E+02	8.0E+00	--	--	3.0E+01	--	--	--	8.1E+02	--	--	--	--	--	--	8.0E+00	1.0E+00	8.0E+00
Diethyl phthalate	84-66-2	--	--	5.0E+03	2.0E+02	--	--	6.0E+02	--	--	--	7.9E+03	--	--	--	--	--	--	2.0E+02	1.0E+00	2.0E+02
Dimethyl phthalate	131-11-3	--	--	1.3E+05	6.0E+02	--	--	2.0E+03	--	--	--	--	--	--	--	--	--	--	6.0E+02	1.0E+00	6.0E+02
Di-N-Octyl Phthalate	117-84-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E+00	---
Isophorone	78-59-1	--	--	1.1E+02	1.1E+02	--	--	1.8E+03	--	4.3E+02	--	3.3E+04	--	--	--	--	--	--	1.1E+02	1.0E+00	1.1E+02
N-Nitrosodiphenylamine (as diphenylamine)	86-30-6	--	--	6.9E-01	6.9E-01	--	--	6.0E+00	--	2.7E+00	--	--	--	--	--	--	--	--	6.9E-01	1.0E+00	1.0E+00
p-Cresol (4-methylphenol)	106-44-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E+00	---
Pentachlorophenol	87-86-5	1.3E+01	7.9E+00	1.0E-01	2.0E-03	1.3E+01	7.9E+00	4.0E-02	--	4.1E-01	--	3.3E+02	--	--	--	--	--	--	2.0E-03	5.0E+00	5.0E+00
Phenol	108-95-2	--	--	2.0E+05	7.0E+04	--	--	3.0E+05	--	--	--	1.5E+05	--	--	--	--	--	--	7.0E+04	1.0E+00	7.0E+04
Pyridine	110-86-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E+00	---
Polycyclic Aromatic Hydrocarbons (PAHs)																					
1-Methylnaphthalene	90-12-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
2-Methylnaphthalene	91-57-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
Acenaphthene	83-32-9	--	--	1.1E+02	3.0E+01	--	--	9.0E+01	--	--	--	1.8E+02	--	--	--	--	--	--	3.0E+01	1.0E-02	3.0E+01
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
Anthracene	120-12-7	--	--	4.6E+03	1.0E+02	--	--	4.0E+02	--	--	--	7.2E+03	--	--	--	--	--	--	1.0E+02	1.0E-02	1.0E+02
Benzo(a)anthracene	56-55-3	--	--	2.1E-02	1.6E-04	--	--	1.3E-03	1.2E-02	cPAH TEQ	--	--	--	--	--	--	--	--	1.6E-04	1.0E-02	1.0E-02
Benzo(a)pyrene	50-32-8	--	--	2.1E-03	1.6E-05	--	--	1.3E-04	2.2E-02	6.0E-02	--	7.2E+00	--	--	--	--	--	--	1.6E-05	1.0E-02	1.0E-02
Benzo(b)fluoranthene	205-99-2	--	--	2.1E-02	1.6E-04	--	--	1.3E-03	1.7E-02	cPAH TEQ	--	--	--	--	--	--	--	--	1.6E-04	1.0E-02	1.0E-02
Benzo(ghi)perylene	191-24-2	--	--	--	--	--	--	--	--	--	--	--	--	6.7E-01	mg/kg	--	--	--	--	1.0E-02	---
Benzo(k)fluoranthene	207-08-9	--	--	2.1E-01	1.6E-03	--	--	1.3E-02	1.7E-02	cPAH TEQ	--	--	--	--	--	--	--	--	1.6E-03	1.0E-02	1.0E-02
Benzofluoranthenes (Sum)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-02	2.0E-02 [11]
Chrysene	218-01-9	--	--	2.1E+00	1.6E-02	--	--	1.3E-01	7.0E-02	cPAH TEQ	--	--	--	--	--	--	--	--	1.6E-02	1.0E-02	1.6E-02
Dibenzo(a,h)anthracene	53-70-3	--	--	2.1E-03	1.6E-05	--	--	1.3E-04	1.4E-03	cPAH TEQ	--	--	--	--	--	--	--	--	1.6E-05	1.0E-02	1.0E-02
Dibenzofuran	132-64-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
Fluoranthene	206-44-0	--	--	1.6E+01	6.0E+00	--	--	2.0E+01	--	--	--	2.5E+01	--	1.7E+00	mg/kg	9.3E+02	1.8E+00	1.8E+00	1.8E+00	1.0E-02	1.8E+00
Fluorene	86-73-7	--	--	6.1E+02	1.0E+01	--	--	7.0E+01	--	--	--	9.6E+02	--	--	--	--	--	--	1.0E+01	1.0E-02	1.0E+01
Indeno(1,2,3-cd)pyrene	193-39-5	--	--	2.1E-02	1.6E-04	--	--	1.3E-03	2.7E-03	cPAH TEQ	--	--	--	6.0E-01	mg/kg	6.6E+04	9.1E-03	9.1E-03	1.6E-04	1.0E-02	1.0E-02

Analyte	CAS Number	Concentrations Protective of Marine Surface Water												Concentrations Protective of Sediment[7]					Preliminary Screening Level µg/L	Practical Quantitation Limit[10] µg/L	Groundwater Screening Level µg/L
		Chapter 173-201A WAC Washington State Surface Water Quality Criteria[1]			40 CFR 131.45 Federal Water Quality Criteria for Washington[2]	CWA §304(a) Federal Water Quality Criteria[3]			Ecology Alternative Marine Protection of Aquatic Life Criteria[4] µg/L	MTCA Method B Marine Surface Water Standard Formula Value - Protection of Human Health (Consumption of Aquatic Life)[5,6]				Sediment Screening Level		Equilibrium Distribution/ Partitioning Coefficient[8]		Calculated Groundwater Concentration Protective of Sediment[9] µg/L			
		Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L	Protection of Human Health (organisms only) µg/L	Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L		Carcinogen µg/L	Carcinogen Adjusted µg/L	Non-Carcinogen µg/L	Non-Carc. Adjusted µg/L	Value	Units	K_d L/kg	µg/L				
		Acute µg/L	Chronic µg/L			Acute µg/L	Chronic µg/L														
Naphthalene	91-20-3	--	--	--	--	--	--	--	1.4E+00	--	--	1.4E+03	1.4E+03	--	--	--	--	--	1.4E+00	1.0E-02	1.4E+00
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
Pyrene	129-00-0	--	--	4.6E+02	8.0E+00	--	--	3.0E+01	--	--	--	7.2E+02	--	--	--	--	--	--	8.0E+00	1.0E-02	8.0E+00
cPAH TEQ	cPAH TEQ	--	--	2.1E-03	1.6E-05	--	--	1.3E-04	--	6.0E-02	--	7.2E+00	--	9.0E-02	mg/kg	1.8E+04	4.9E-03	4.9E-03	1.6E-05	1.0E-02	1.0E-02
Polychlorinated Biphenyls (PCBs)																					
PCB-aroclor 1242	53469-21-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
PCB-aroclor 1248	12672-29-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
PCB-aroclor 1254	11097-69-1	--	--	--	--	--	--	--	--	2.9E-05	--	4.6E-04	4.6E-04	--	--	--	--	--	4.6E-04	1.0E-02	1.0E-02
PCB-aroclor 1260	11096-82-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-02	---
Total PCBs	1336-36-3	1.0E+01	3.0E-02	1.7E-04	7.0E-06	--	3.0E-02	6.4E-05	--	2.9E-05	--	--	--	4.0E-03	mg/kg	5.9E+03	6.8E-04	6.8E-04	7.0E-06	1.0E-02	1.0E-02
Pesticides																					
2,4'-DDD	53-19-0	1.3E-01	1.0E-03	3.6E-05	7.9E-06	--	--	3.1E-04	--	1.4E-04	--	--	--	--	--	--	--	--	7.9E-06	5.0E-04	5.0E-04
2,4'-DDE	3424-82-6	1.3E-01	1.0E-03	5.1E-05	8.8E-07	--	--	2.2E-04	--	9.8E-05	--	--	--	--	--	--	--	--	8.8E-07	5.0E-04	5.0E-04
2,4'-DDT	789-02-6	1.3E-01	1.0E-03	2.5E-05	1.2E-06	1.3E-01	1.0E-03	2.2E-04	--	9.8E-05	--	6.7E-03	--	--	--	--	--	--	1.2E-06	5.0E-04	5.0E-04
4,4'-DDD	72-54-8	1.3E-01	1.0E-03	3.6E-05	7.9E-06	--	--	1.2E-04	--	1.4E-04	--	--	--	--	--	--	--	--	7.9E-06	5.0E-04	5.0E-04
4,4'-DDE	72-55-9	1.3E-01	1.0E-03	5.1E-05	8.8E-07	--	--	1.8E-05	--	9.8E-05	--	--	--	--	--	--	--	--	8.8E-07	5.0E-04	5.0E-04
4,4'-DDT	50-29-3	1.3E-01	1.0E-03	2.5E-05	1.2E-06	1.3E-01	1.0E-03	3.0E-05	--	9.8E-05	--	6.7E-03	--	--	--	--	--	--	1.2E-06	5.0E-04	5.0E-04
Aldrin	309-00-2	7.1E-01	1.9E-03	5.8E-06	4.1E-08	1.3E+00	--	7.7E-07	--	2.3E-05	--	4.6E-03	--	--	--	--	--	--	4.1E-08	1.0E-03	1.0E-03
Alpha-BHC	319-84-6	--	--	5.6E-04	4.8E-05	--	--	3.9E-04	--	2.2E-03	--	4.4E+01	--	--	--	--	--	--	4.8E-05	1.0E-03	1.0E-03
alpha-Chlordane[12]	56534-02-2	9.0E-02	4.0E-03	9.3E-05	2.2E-05	9.0E-02	4.0E-03	8.1E-04	--	3.6E-04	--	2.5E-02	--	--	--	--	--	--	2.2E-05	5.0E-04	5.0E-04
Beta-BHC	319-85-7	--	--	2.0E-03	1.4E-03	--	--	1.4E-02	--	7.7E-03	--	--	--	--	--	--	--	--	1.4E-03	5.0E-04	1.4E-03
Chlorpyriphos	2921-88-2	1.1E-02	5.6E-03	--	--	1.1E-02	6.0E-03	--	--	--	--	--	--	--	--	--	--	--	5.6E-03	5.0E-04	5.6E-03
Delta-BHC	319-86-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E-04	---
Dieldrin	60-57-1	7.1E-01	1.9E-03	6.1E-06	7.0E-08	7.1E-01	1.9E-03	1.2E-06	--	2.4E-05	--	7.7E-03	--	--	--	--	--	--	7.0E-08	5.0E-03	5.0E-03
Endosulfan II	19670-15-6	3.4E-02	8.7E-03	--	--	--	--	--	--	--	--	1.6E+01	--	--	--	--	--	--	8.7E-03	1.0E-03	8.7E-03
Endosulfan Sulfate	1031-07-8	--	--	1.0E+01	--	--	--	4.0E+01	--	--	--	1.6E+01	--	--	--	--	--	--	1.0E+01	5.0E-04	1.0E+01
Endrin	72-20-8	3.7E-02	2.3E-03	3.5E-02	2.0E-03	3.7E-02	2.3E-03	3.0E-02	--	--	--	5.4E-02	--	--	--	--	--	--	2.0E-03	2.0E-03	2.0E-03
Endrin Ketone	53494-70-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	---
gamma-Chlordane[12]	5566-34-7	9.0E-02	4.0E-03	9.3E-05	2.2E-05	9.0E-02	4.0E-03	8.1E-04	--	3.6E-04	--	2.5E-02	--	--	--	--	--	--	2.2E-05	5.0E-04	5.0E-04
Heptachlor	76-44-8	5.3E-02	3.6E-03	1.0E-05	3.4E-07	5.3E-02	3.6E-03	5.9E-06	--	3.6E-05	--	3.2E-02	--	--	--	--	--	--	3.4E-07	1.0E-03	1.0E-03
Heptachlor Epoxide	1024-57-3	--	--	7.4E-06	2.4E-06	5.3E-02	3.6E-03	3.2E-05	--	1.8E-05	--	8.3E-04	--	--	--	--	--	--	2.4E-06	1.0E-03	1.0E-03
Hexachlorobenzene	118-74-1	--	--	5.2E-05	5.0E-06	--	--	7.9E-05	--	1.3E-04	--	6.6E-02	--	--	--	--	--	--	5.0E-06	1.0E-03	1.0E-03
Isodrin	465-73-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0E-03	---
Lindane (Gamma-BHC)	58-89-9	1.6E-01	--	1.7E+01	4.3E-01	1.6E-01	--	4.4E+00	--	1.3E-02	1.3E-01	1.7E+00	--	--	--	--	--	--	1.3E-01	2.0E-03	1.3E-01
Methoxychlor	72-43-5	--	--	--	--	--	3.0E-02	2.0E-02	--	--	--	2.3E+00	--	--	--	--	--	--	2.0E-02	5.0E-04	2.0E-02
Mirex	2385-85-5	--	--	--	--	--	1.0E-03	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	1.0E-03	1.0E-03
trans-Nonachlor	39765-80-5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0E-04	---
Metals																					
Arsenic	7440-38-2	6.9E+01	3.6E+01	1.0E+01	1.4E-01	6.9E+01	3.6E+01	1.4E-01	--	2.7E-02	--	4.9E+00	--	7.0E+00	mg/kg	3.1E+01	2.2E+02	2.2E+02	1.4E-01	2.0E-01	8.0E+00 [13]
Cadmium	7440-43-9a	4.2E+01	9.3E+00	--	--	3.3E+01	7.9E+00	--	--	--	--	1.1E+01	--	--	--	--	--	--	7.9E+00	1.0E-01	7.9E+00
Chromium III / Total	16065-83-1	--	--	--	--	--	--	--	2.7E+01	--	--	6.7E+04	6.7E+04	--	--	--	--	--	2.7E+01	5.0E-01	2.7E+01
Copper	7440-50-8	4.8E+00	3.1E+00	--	--	4.8E+00	3.1E+00	--	--	--	--	8.0E+02	--	--	--	--	--	--	3.1E+00	5.0E-01	3.1E+00
Lead	7439-92-1	2.1E+02	8.1E+00	--	--	2.1E+02	8.1E+00	--	--	--	--	--	--	--	--	--	--	--	8.1E+00	1.0E-01	8.1E+00
Mercury	7439-97-6	1.8E+00	2.5E-02	1.5E-01	--	1.8E+00	9.4E-01	3.0E-01	--	--	--	--	--	--	--	--	--	--	2.5E-02	1.0E-03	2.5E-02
Nickel	7440-02-0	7.4E+01	8.2E+00	1.9E+02	1.0E+02	7.4E+01	8.2E+00	4.6E+03	--	--	--	3.1E+02	--	--	--	--	--	--	8.2E+00	5.0E-01	8.2E+00
Silver	7440-22-4	1.9E+00	--	--	--	1.9E+00	--	--	--	--	--	7.2E+03	--	--	--	--	--	--	1.9E+00	2.0E-01	1.9E+00
Zinc	7440-66-6	9.0E+01	8.1E+01	2.9E+03	1.0E+03	9.0E+01	8.1E+01	--	--	--	--	--	--	--	--	--	--	--	8.1E+01	4.0E+00	8.1E+01

Notes:

[1] Ambient Water Quality Criteria (AWQC) for protection of aquatic life and human health from Chapter 173-201A WAC (adopted August 1, 2016).

[2] EPA Federally Promulgated Human Health Criteria (incorporated in to Chapter 173-201A WAC; adopted August 1, 2016).

[3] National Recommended Water Quality Criteria (https://www.epa.gov/wqc/national-recommended-water-quality-criteria; accessed March 6, 2018).

[4] Washington State Department of Ecology (Ecology) recommended criteria for the protection of aquatic life for marine surface water. Values from Ecology's "Groundwater cleanup levels for upland sites along the Lower Duwamish Waterway" memorandum dated November 23, 2015; revised March 1, 2016).

[5] "Carc. Adjusted" column is applicable when a state or federal surface water standard is available but is not considered to be "sufficiently protective" under MTCA (that is, the standard is based on a cancer risk greater than 1 x 10^{-5}). In these cases, WAC 173-340-730(5)(b) allows the standard to be adjusted downward to a cancer risk of 1 x 10^{-6}.

[6] Values shown for petroleum hydrocarbons are MTCA Method A groundwater cleanup levels; MTCA Method B surface water standard formula values are not available for petroleum hydrocarbons.

[7] Sediment screening levels, distribution/partitioning coefficients, and calculated groundwater concentrations protective of sediment are shown only for analytes that are contaminants of potential concern (COPCs) in sediment (i.e., analytes detected above sediment screening levels in LDW sediment samples offshore/downgradient of the 7100 1st Ave. S. Site). Sediment samples used for this evaluation are identified in the text.

[8] Values for K_d are from Ecology's Lower Duwamish Waterway, Preliminary Cleanup Level Workbook dated December 2017.

[9] C_{GW} [µg/L] = SL_{sed} [mg/kg] / (0.001 mg/µg * 1 * (K_d [L/kg] + 0.615 ml/ml / 1.02 kg/L)); Equation from Ecology's Lower Duwamish Waterway, Preliminary Cleanup Level Workbook, Supplemental Information dated December 2017.

[10] Listed values are the lowest available practical quantitation limits from Analytical Resources, Inc. of Tukwila, Washington or Columbia Analytical Laboratory of Kelso, Washington.

[11] Benzofluoranthenes (Sum) groundwater screening level is the sum of the groundwater screening levels for benzo(b)fluoranthene and benzo(k)fluoranthene.

[12] Chlordane values used for alpha- and gamma-chlordane.

[13] Arsenic groundwater screening level is based on the natural background arsenic concentration in the Puget Sound Basin (Ecology 2018).

CAS = Chemical Abstract Services
CLARC = Cleanup Levels and Risk Calculations online database (https://fortress.wa.gov/ecy/clarc/Reporting/CLARCReporting.aspx)

cPAH = Carcinogenic polycyclic aromatic hydrocarbon

EPA = Environmental Protection Agency

EPI = EPA Estimation Programs Interface

SL_{sed} = Sediment screening level

C_{GW} = Groundwater concentration protective of sediment

f_{oc} = Fractional organic carbon content

K_d = Soil-water distribution coefficient

K_{oc} = Soil organic carbon-water partitioning coefficient

Analyte	CAS Number	Concentrations Protective of Marine Surface Water												Concentrations Protective of Sediment[7]						Preliminary Screening Level µg/L	Practical Quantitation Limit[10] µg/L	Groundwater Screening Level µg/L
		Chapter 173-201A WAC Washington State Surface Water Quality Criteria[1]			40 CFR 131.45 Federal Water Quality Criteria for Washington[2]	CWA §304(a) Federal Water Quality Criteria[3]			Ecology Alternative Marine Protection of Aquatic Life Criteria[4] µg/L	MTCA Method B Marine Surface Water Standard Formula Value - Protection of Human Health (Consumption of Aquatic Life) [5,6]				Sediment Screening Level		Equilibrium Distribution/ Partitioning Coefficient[8]		Calculated Groundwater Concentration Protective of Sediment[9]			
		Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L	Protection of Human Health (organisms only) µg/L	Protection of Aquatic Life		Protection of Human Health (organisms only) µg/L		Carcinogen µg/L	Carcinogen Adjusted µg/L	Non-Carcinogen µg/L	Non-Carc. Adjusted µg/L	Value	Units	K_d L/kg	µg/L	µg/L			
		Acute µg/L	Chronic µg/L			Acute µg/L	Chronic µg/L															

L/kg = Liters per kilogram

mg/kg = Milligrams per kilogram

mg/kg OC = Milligrams per kilogram normalized to organic carbon

µg/L = Micrograms per liter

µg/mg = Micrograms per milligram

MTCA = Model Toxics Control Act

TEQ = Toxicity equivalency quotient

TPH = Total petroleum hydrocarbons

-- = Not available/not applicable

Shading indicates basis for screening level.

Table 9

Proposed Soil Screening Levels

7100 1st Avenue South Site
Seattle, Washington

Analyte	CAS Number	MTCA Method B Standard Formula Value - Protection of Human Health (Direct Contact Pathway)[1]		Concentrations Protective of Groundwater[2]						Preliminary Screening Level		Background Concentration[6]	Practical Quantitation Limit[7]	Soil Screening Level	
				Equilibrium Distribution/Partitioning Coefficient			Groundwater Screening Level	Calculated Soil Concentration Protective of Groundwater (WAC 173-340-740[1][d], Eq. 747-1/747-2)							
		Carcinogen	Non-Carcinogen	K_{oc}[3]	K_d[4]	H[5]		Unsaturated Soil	Saturated Soil	Unsaturated Soil	Saturated Soil			Unsaturated Soil	Saturated Soil
		mg/kg	mg/kg	L/kg	L/kg	(-)	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Petroleum Hydrocarbons															
Gasoline-Range TPH w/ Benzene	--	3.0E+01		--	--	--	8.0E+02	--	--	3.0E+01	3.0E+01	--	5.0E+00	3.0E+01	3.0E+01
Gasoline-Range TPH w/o Benzene	--	1.0E+02		--	--	--	1.0E+03	--	--	1.0E+02	1.0E+02	--	5.0E+00	1.0E+02	1.0E+02
Diesel-Range TPH	--	2.0E+03		--	--	--	5.0E+02	--	--	2.0E+03	2.0E+03	--	1.0E+01	2.0E+03	2.0E+03
Heavy Oil-Range TPH	--	2.0E+03		--	--	--	5.0E+02	--	--	2.0E+03	2.0E+03	--	1.0E+01	2.0E+03	2.0E+03
Diesel plus Heavy Oil-Range TPH	--	--		--	--	--	5.0E+02	--	--	2.0E+03	2.0E+03	--	1.0E+01	2.0E+03	2.0E+03
Volatile Organic Compounds (VOCs)															
1,1,2-Trichloroethane	79-00-5	1.8E+01	3.2E+02	7.5E+01	8.6E-01	3.7E-02	9.0E-01	1.9E-02	1.0E-03	1.9E-02	1.0E-03	--	1.0E-03	1.9E-02	1.0E-03
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	---	---
1,2-Dichloroethane (EDC)	107-06-2	1.1E+01	4.8E+02	--	--	--	--	--	--	1.1E+01	1.1E+01	--	1.0E-03	1.1E+01	1.1E+01
1,3,5-Trimethylbenzene	108-67-8	--	8.0E+02	--	--	--	--	--	--	8.0E+02	8.0E+02	--	1.0E-03	8.0E+02	8.0E+02
2-Butanone (MEK)	78-93-3	--	4.8E+04	--	--	--	--	--	--	4.8E+04	4.8E+04	--	5.0E-03	4.8E+04	4.8E+04
2-Hexanone	591-78-6	--	--	--	--	--	--	--	--	--	--	--	5.0E-03	---	---
Acetone	67-64-1	--	7.2E+04	--	--	--	--	--	--	7.2E+04	7.2E+04	--	5.0E-03	7.2E+04	7.2E+04
Benzene	71-43-2	1.8E+01	3.2E+02	6.2E+01	7.1E-01	2.3E-01	1.6E+00	3.0E-02	1.6E-03	3.0E-02	1.6E-03	--	1.0E-03	3.0E-02	1.6E-03
Bromomethane	74-83-9	--	1.1E+02	--	--	--	--	--	--	1.1E+02	1.1E+02	--	1.0E-03	1.1E+02	1.1E+02
Carbon Disulfide	75-15-0	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-03	8.0E+03	8.0E+03
Chloroform	67-66-3	3.2E+01	8.0E+02	--	--	--	--	--	--	3.2E+01	3.2E+01	--	1.0E-03	3.2E+01	3.2E+01
Chloromethane	74-87-3	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	---	---
cis-1,2-Dichloroethene	156-59-2	--	1.6E+02	--	--	--	--	--	--	1.6E+02	1.6E+02	--	1.0E-03	1.6E+02	1.6E+02
Dichlorodifluoromethane (CFC-12)	75-71-8	--	1.6E+04	--	--	--	--	--	--	1.6E+04	1.6E+04	--	1.0E-03	1.6E+04	1.6E+04
Ethylbenzene	100-41-4	--	8.0E+03	2.0E+02	2.3E+00	3.2E-01	3.1E+01	1.6E+00	8.1E-02	1.6E+00	8.1E-02	--	1.0E-03	1.6E+00	8.1E-02
Isopropylbenzene (Cumene)	98-82-8	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-03	8.0E+03	8.0E+03
Methyl Iodide (Iodomethane)	74-88-4	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	---	---
Methylene Chloride	75-09-2	5.0E+02	4.8E+02	--	--	--	--	--	--	4.8E+02	4.8E+02	--	2.0E-03	4.8E+02	4.8E+02
n-Butylbenzene	104-51-8	--	4.0E+03	--	--	--	--	--	--	4.0E+03	4.0E+03	--	1.0E-03	4.0E+03	4.0E+03
n-Propylbenzene	103-65-1	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-03	8.0E+03	8.0E+03
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--	1.0E-03	---	---
Sec-Butylbenzene	135-98-8	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-03	8.0E+03	8.0E+03
Tert-Butylbenzene	98-06-6	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-03	8.0E+03	8.0E+03
Tetrachloroethene	127-18-4	4.8E+02	4.8E+02	--	--	--	--	--	--	4.8E+02	4.8E+02	--	1.0E-03	4.8E+02	4.8E+02
Toluene	108-88-3	--	6.4E+03	--	--	--	--	--	--	6.4E+03	6.4E+03	--	1.0E-03	6.4E+03	6.4E+03
Trichloroethene	79-01-6	1.2E+01	4.0E+01	--	--	--	--	--	--	1.2E+01	1.2E+01	--	1.0E-03	1.2E+01	1.2E+01
Xylene, m-	108-38-3	--	1.6E+04	--	--	--	--	--	--	1.6E+04	1.6E+04	--	1.0E-03	1.6E+04	1.6E+04
Xylene, p-	95-47-6	--	1.6E+04	--	--	--	--	--	--	1.6E+04	1.6E+04	--	1.0E-03	1.6E+04	1.6E+04
Xylene, o-	106-42-3	--	1.6E+04	--	--	--	--	--	--	1.6E+04	1.6E+04	--	1.0E-03	1.6E+04	1.6E+04
Semivolatile Organic Compounds (SVOCs)															
2,4-Dimethylphenol	105-67-9	--	1.6E+03	--	--	--	--	--	--	1.6E+03	1.6E+03	--	2.0E-02	1.6E+03	1.6E+03
Benzoic Acid	65-85-0	--	3.2E+05	--	--	--	--	--	--	3.2E+05	3.2E+05	--	2.0E-01	3.2E+05	3.2E+05
Benzyl Alcohol	100-51-6	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	1.0E-01	8.0E+03	8.0E+03
Bis(2-Ethylhexyl) Phthalate	117-81-7	7.1E+01	1.6E+03	1.1E+05	1.3E+03	4.2E-06	1.0E+00	2.5E+01	1.3E+00	2.5E+01	1.3E+00	--	2.0E-02	2.5E+01	1.3E+00
Butyl benzyl phthalate	85-68-7	5.3E+02	1.6E+04	--	--	--	--	--	--	5.3E+02	5.3E+02	--	2.0E-02	5.3E+02	5.3E+02
Carbazole	86-74-8	--	--	--	--	--	--	--	--	--	--	--	2.0E-02	---	---
Dibutyl phthalate	84-74-2	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	2.0E-02	8.0E+03	8.0E+03
Diethyl phthalate	84-66-2	--	6.4E+04	--	--	--	--	--	--	6.4E+04	6.4E+04	--	2.0E-02	6.4E+04	6.4E+04
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	--	--	--	--	--	2.0E-02	---	---
Di-N-Octyl Phthalate	117-84-0	--	8.0E+02	--	--	--	--	--	--	8.0E+02	8.0E+02	--	2.0E-02	8.0E+02	8.0E+02
Isophorone	78-59-1	1.1E+03	1.6E+04	--	--	--	--	--	--	1.1E+03	1.1E+03	--	2.0E-02	1.1E+03	1.1E+03

Analyte	CAS Number	MTCA Method B Standard Formula Value - Protection of Human Health (Direct Contact Pathway)[1]		Concentrations Protective of Groundwater[2]						Preliminary Screening Level		Background Concentration[6]	Practical Quantitation Limit[7]	Soil Screening Level	
				Equilibrium Distribution/Partitioning Coefficient			Groundwater Screening Level	Calculated Soil Concentration Protective of Groundwater (WAC 173-340-740[1][d], Eq. 747-1/747-2)							
		Carcinogen	Non-Carcinogen	K_{oc}[3]	K_d[4]	H[5]		Unsaturated Soil	Saturated Soil	Unsaturated Soil	Saturated Soil			Unsaturated Soil	Saturated Soil
		mg/kg	mg/kg	L/kg	L/kg	(-)	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
N-Nitrosodiphenylamine (as diphenylamine)	86-30-6	2.0E+02	--	1.3E+03	1.5E+01	2.1E-04	1.0E+00	3.0E-01	1.5E-02	3.0E-01	1.5E-02	--	2.0E-02	3.0E-01	2.0E-02
p-Cresol (4-methylphenol)	106-44-5	--	8.0E+03	--	--	--	--	--	--	8.0E+03	8.0E+03	--	2.0E-02	8.0E+03	8.0E+03
Pentachlorophenol	87-86-5	2.5E+00	4.0E+02	--	--	--	--	--	--	2.5E+00	2.5E+00	--	1.0E-01	2.5E+00	2.5E+00
Phenol	108-95-2	--	2.4E+04	--	--	--	--	--	--	2.4E+04	2.4E+04	--	2.0E-02	2.4E+04	2.4E+04
Pyridine	110-86-1	--	8.0E+01	--	--	--	--	--	--	8.0E+01	8.0E+01	--	1.0E-01	8.0E+01	8.0E+01
Polycyclic Aromatic Hydrocarbons (PAHs)															
1-Methylnaphthalene	90-12-0	3.4E+01	5.6E+03	--	--	--	--	--	--	3.4E+01	3.4E+01	--	5.0E-03	3.4E+01	3.4E+01
2-Methylnaphthalene	91-57-6	--	3.2E+02	--	--	--	--	--	--	3.2E+02	3.2E+02	--	5.0E-03	3.2E+02	3.2E+02
Acenaphthene	83-32-9	--	4.8E+03	4.9E+03	5.6E+01	6.4E-03	3.0E+01	3.4E+01	1.7E+00	3.4E+01	1.7E+00	--	5.0E-03	3.4E+01	1.7E+00
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	--	--	5.0E-03	---	---
Anthracene	120-12-7	--	2.4E+04	--	--	--	--	--	--	2.4E+04	2.4E+04	--	2.0E-02	2.4E+04	2.4E+04
Benzo(a)anthracene	56-55-3	cPAH TEQ	--	3.6E+05	4.1E+03	1.4E-04	1.0E-02	8.2E-01	4.1E-02	8.2E-01	4.1E-02	--	5.0E-03	8.2E-01	4.1E-02
Benzo(a)pyrene	50-32-8	cPAH TEQ	--	9.7E+05	1.1E+04	4.6E-05	1.0E-02	2.2E+00	1.1E-01	2.2E+00	1.1E-01	--	5.0E-03	2.2E+00	1.1E-01
Benzo(b)fluoranthene	205-99-2	cPAH TEQ	--	1.2E+06	1.4E+04	4.6E-03	1.0E-02	2.8E+00	1.4E-01	2.8E+00	1.4E-01	--	5.0E-03	2.8E+00	1.4E-01
Benzo(ghi)perylene	191-24-2	--	--	--	--	--	--	--	--	--	--	--	5.0E-03	---	---
Benzo(k)fluoranthene	207-08-9	cPAH TEQ	--	1.2E+06	1.4E+04	3.4E-05	1.0E-02	2.8E+00	1.4E-01	2.8E+00	1.4E-01	--	5.0E-03	2.8E+00	1.4E-01
Benzofluoranthenes (Sum)	--	cPAH TEQ	--	--	--	--	--	--	--	--	--	--	5.0E-03	5.6E+00 [8]	2.8E-01 [8]
Chrysene	218-01-9	cPAH TEQ	--	4.0E+05	4.5E+03	3.9E-03	1.6E-02	1.5E+00	7.3E-02	1.5E+00	7.3E-02	--	5.0E-03	1.5E+00	7.3E-02
Dibenzo(a,h)anthracene	53-70-3	cPAH TEQ	--	--	--	--	--	--	--	--	--	--	5.0E-03	---	---
Dibenzofuran	132-64-9	--	8.0E+01	--	--	--	--	--	--	8.0E+01	8.0E+01	--	2.0E-02	8.0E+01	8.0E+01
Fluoranthene	206-44-0	--	3.2E+03	--	--	--	--	--	--	3.2E+03	3.2E+03	--	2.0E-02	3.2E+03	3.2E+03
Fluorene	86-73-7	--	3.2E+03	7.7E+03	8.8E+01	2.6E-03	1.0E+01	1.8E+01	8.8E-01	1.8E+01	8.8E-01	--	5.0E-03	1.8E+01	8.8E-01
Indeno(1,2,3-cd)pyrene	193-39-5	cPAH TEQ	--	3.5E+06	4.0E+04	6.6E-05	1.0E-02	7.9E+00	4.0E-01	7.9E+00	4.0E-01	--	5.0E-03	7.9E+00	4.0E-01
Naphthalene	91-20-3	--	1.6E+03	1.2E+03	1.4E+01	2.0E-02	1.4E+00	3.9E-01	1.9E-02	3.9E-01	1.9E-02	--	5.0E-03	3.9E-01	1.9E-02
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	--	--	5.0E-03	---	---
Pyrene	129-00-0	--	2.4E+03	--	--	--	--	--	--	2.4E+03	2.4E+03	--	5.0E-03	2.4E+03	2.4E+03
cPAH TEQ	cPAH TEQ	1.9E-01	--	9.7E+05	1.1E+04	4.6E-05	1.0E-02	2.2E+00	1.1E-01	1.9E-01	1.1E-01	--	5.0E-03	1.9E-01	1.1E-01
Polychlorinated Biphenyls (PCBs)															
PCB-aroclor 1242	53469-21-9	--	--	--	--	--	--	--	--	--	--	--	4.0E-03	---	---
PCB-aroclor 1248	12672-29-6	--	--	--	--	--	--	--	--	--	--	--	4.0E-03	---	---
PCB-aroclor 1254	11097-69-1	5.0E-01	1.6E+00	4.3E+05	4.9E+03	1.2E-02	1.0E-02	9.8E-01	4.9E-02	5.0E-01	4.9E-02	--	4.0E-03	5.0E-01	4.9E-02
PCB-aroclor 1260	11096-82-5	5.0E-01	--	--	--	--	--	--	--	5.0E-01	5.0E-01	--	4.0E-03	5.0E-01	5.0E-01
Total PCBs	1336-36-3	5.0E-01	--	3.1E+05	3.5E+03	1.2E-02	1.0E-02	7.0E-01	3.5E-02	5.0E-01	3.5E-02	--	1.0E-02	5.0E-01	3.5E-02
Pesticides															
2,4'-DDD	53-19-0	4.2E+00	--	4.6E+04	5.2E+02	1.6E-04	5.0E-04	5.2E-03	2.6E-04	5.2E-03	2.6E-04	--	1.0E-04	5.2E-03	2.6E-04
2,4'-DDE	3424-82-6	2.9E+00	--	8.6E+04	9.9E+02	8.6E-04	5.0E-04	9.9E-03	4.9E-04	9.9E-03	4.9E-04	--	1.0E-04	9.9E-03	4.9E-04
2,4'-DDT	789-02-6	2.9E+00	4.0E+01	6.8E+05	7.7E+03	3.3E-04	5.0E-04	7.7E-02	3.9E-03	7.7E-02	3.9E-03	--	1.0E-04	7.7E-02	3.9E-03
4,4'-DDD	72-54-8	4.2E+00	--	4.6E+04	5.2E+02	1.6E-04	5.0E-04	5.2E-03	2.6E-04	5.2E-03	2.6E-04	--	1.0E-04	5.2E-03	2.6E-04
4,4'-DDE	72-55-9	2.9E+00	--	8.6E+04	9.9E+02	8.6E-04	5.0E-04	9.9E-03	4.9E-04	9.9E-03	4.9E-04	--	1.0E-04	9.9E-03	4.9E-04
4,4'-DDT	50-29-3	2.9E+00	4.0E+01	6.8E+05	7.7E+03	3.3E-04	5.0E-04	7.7E-02	3.9E-03	7.7E-02	3.9E-03	--	1.0E-04	7.7E-02	3.9E-03
Aldrin	309-00-2	5.9E-02	2.4E+00	--	--	--	--	--	--	5.9E-02	5.9E-02	--	1.0E-04	5.9E-02	5.9E-02
Alpha-BHC	319-84-6	1.6E-01	6.4E+02	1.8E+03	2.0E+01	4.4E-04	1.0E-03	4.1E-04	2.0E-05	4.1E-04	2.0E-05	--	1.0E-04	4.1E-04	1.0E-04
alpha-Chlordane[9]	56534-02-2	2.9E+00	4.0E+01	5.1E+04	5.8E+02	2.0E-03	5.0E-04	5.9E-03	2.9E-04	5.9E-03	2.9E-04	--	1.0E-04	5.9E-03	2.9E-04
Beta-BHC	319-85-7	5.6E-01	--	--	--	--	--	--	--	5.6E-01	5.6E-01	--	1.0E-04	5.6E-01	5.6E-01
Chlorpyriphos	2921-88-2	--	8.0E+01	7.3E+03	8.3E+01	1.0E-04	5.6E-03	9.3E-03	4.7E-04	9.3E-03	4.7E-04	--	1.0E-04	9.3E-03	4.7E-04
Delta-BHC	319-86-8	--	--	--	--	--	--	--	--	--	--	--	1.0E-04	---	---
Dieldrin	60-57-1	6.3E-02	4.0E+00	2.6E+04	2.9E+02	6.2E-04	5.0E-03	2.9E-02	1.5E-03	2.9E-02	1.5E-03	--	2.0E-04	2.9E-02	1.5E-03
Endosulfan II[10]	19670-15-6	--	4.8E+02	--	--	--	--	--	--	4.8E+02	4.8E+02	--	2.0E-04	4.8E+02	4.8E+02
Endosulfan Sulfate[10]	1031-07-8	--	4.8E+02	--	--	--	--	--	--	4.8E+02	4.8E+02	--	1.0E-04	4.8E+02	4.8E+02
Endrin	72-20-8	--	2.4E+01	--	--	--	--	--	--	2.4E+01	2.4E+01	--	2.0E-04	2.4E+01	2.4E+01
Endrin Ketone[11]	53494-70-5	--	2.4E+01	--	--	--	--	--	--	2.4E+01	2.4E+01	--	2.0E-04	2.4E+01	2.4E+01

Analyte	CAS Number	MTCA Method B Standard Formula Value - Protection of Human Health (Direct Contact Pathway)[1]		Concentrations Protective of Groundwater[2]						Preliminary Screening Level		Background Concentration[6]	Practical Quantitation Limit[7]	Soil Screening Level	
				Equilibrium Distribution/Partitioning Coefficient			Groundwater Screening Level	Calculated Soil Concentration Protective of Groundwater (WAC 173-340-740[1][d], Eq. 747-1/747-2)							
		Carcinogen	Non-Carcinogen	K_{oc}[3]	K_d[4]	H[5]		Unsaturated Soil	Saturated Soil	Unsaturated Soil	Saturated Soil			Unsaturated Soil	Saturated Soil
		mg/kg	mg/kg	L/kg	L/kg	(-)	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
gamma-Chlordane[9]	5566-34-7	2.9E+00	4.0E+01	5.1E+04	5.8E+02	2.0E-03	5.0E-04	5.9E-03	2.9E-04	5.9E-03	2.9E-04	--	1.0E-04	5.9E-03	2.9E-04
Heptachlor	76-44-8	2.2E-01	4.0E+01	9.5E+03	1.1E+02	4.5E-02	1.0E-03	2.2E-03	1.1E-04	2.2E-03	1.1E-04	--	1.0E-04	2.2E-03	1.1E-04
Heptachlor Epoxide	1024-57-3	1.1E-01	1.0E+00	8.3E+04	9.5E+02	3.9E-04	1.0E-03	1.9E-02	9.5E-04	1.9E-02	9.5E-04	--	1.0E-04	1.9E-02	9.5E-04
Hexachlorobenzene	118-74-1	6.3E-01	6.4E+01	8.0E+04	9.1E+02	5.4E-02	1.0E-03	--	--	6.3E-01	6.3E-01	--	1.0E-04	6.3E-01	6.3E-01
Isodrin	465-73-6	--	--	--	--	--	--	--	--	--	--	--	1.0E-04	---	---
Lindane (Gamma-BHC)	58-89-9	9.1E-01	2.4E+01	--	--	--	--	--	--	9.1E-01	9.1E-01	--	1.0E-04	9.1E-01	9.1E-01
Methoxychlor	72-43-5	--	4.0E+02	--	--	--	--	--	--	4.0E+02	4.0E+02	--	1.0E-04	4.0E+02	4.0E+02
Mirex	2385-85-5	5.6E-02	1.6E+01	--	--	--	--	--	--	5.6E-02	5.6E-02	--	1.0E-04	5.6E-02	5.6E-02
trans-Nonachlor	39765-80-5	--	--	--	--	--	--	--	--	--	--	--	1.0E-04	---	---
Metals															
Arsenic	7440-38-2	6.7E-01	2.4E+01	--	2.9E+01	0.0E+00	8.0E+00	4.8E+00	2.3E-01	6.7E-01	2.3E-01	2.0E+01	2.0E-01	2.0E+01	2.0E+01
Cadmium	7440-43-9a	--	8.0E+01	--	--	--	--	--	--	8.0E+01	8.0E+01	1.0E+00	1.0E-01	8.0E+01	8.0E+01
Chromium III / Total	16065-83-1	--	1.2E+05	--	--	--	--	--	--	1.2E+05	1.2E+05	4.8E+01	5.0E-01	1.2E+05	1.2E+05
Copper	7440-50-8	--	3.2E+03	--	2.2E+01	0.0E+00	3.1E+00	1.4E+00	6.9E-02	1.4E+00	6.9E-02	3.6E+01	5.0E-01	3.6E+01	3.6E+01
Lead	7439-92-1	2.5E+02		--	1.0E+04	0.0E+00	8.1E+00	1.6E+03	8.1E+01	2.5E+02	8.1E+01	1.7E+01	1.0E-01	2.5E+02	8.1E+01
Mercury	7439-97-6	--	2.4E+01	--	5.2E+01	4.7E-01	2.5E-02	2.6E-02	1.3E-03	2.6E-02	1.3E-03	7.0E-02	2.5E-02	7.0E-02	7.0E-02
Nickel	7440-02-0	--	1.6E+03	--	6.5E+01	0.0E+00	8.2E+00	1.1E+01	5.4E-01	1.1E+01	5.4E-01	4.8E+01	5.0E-01	4.8E+01	4.8E+01
Silver	7440-22-4	--	4.0E+02	--	--	--	--	--	--	4.0E+02	4.0E+02	--	2.0E-01	4.0E+02	4.0E+02
Zinc	7440-66-6	--	2.4E+04	--	6.2E+01	0.0E+00	8.1E+01	1.1E+02	5.0E+00	1.1E+02	5.0E+00	8.5E+01	4.0E+00	1.1E+02	8.5E+01

Notes:

[1] Values shown for petroleum hydrocarbons and lead are MTCA Method A soil cleanup levels; MTCA Method B standard formula values are not available for petroleum hydrocarbons or lead.

[2] Distribution/partitioning coefficients, groundwater screening levels, and calculated soil concentrations protective of groundwater are shown only for analytes that are contaminants of potential concern (COPCs) in groundwater (i.e., analytes detected above groundwater screening levels in groundwater samples collected at the 7100 1st Avenue South Site).

[3] Values for K_{oc} are from Washington State Department of Ecology's (Ecology) "CLARC Master Spreadsheet.xlsx" dated August 2015 if available; if not, values are from EPA's EPI Suite Version 4.11 (November 2012; https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface).

[4] For ionizing and non-ionizing organics, $K_d = K_{oc} \times f_{oc}$ (assumes average fractional organic carbon content of 1.14% in upland soil). Metals K_d values are from Ecology's "CLARC Master Spreadsheet.xlsx" dated August 2015.

[5] Values for the Henry's Law Constant (unitless) are from Ecology's "CLARC Master Spreadsheet.xlsx" dated August 2015 if available; if not, values are from EPA's EPI Suite Version 4.11 (November 2012; https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface).

[6] Metals background values (Puget Sound Region 90th percentile values) are from *Natural Background Soil Metals Concentrations in Washington State* (Ecology Publication #94-115, 1994), except for arsenic. Arsenic value from MTCA Table 740-1 (natural background for soil in Washington).

[7] Listed values are the lowest available practical quantitation limits from Analytical Resources, Inc. of Tukwila, Washington or Columbia Analytical Laboratory of Kelso, Washington.

[8] Benzofluoranthenes (Sum) unsaturated and saturated zone soil screening levels are the sum of the soil screening levels for benzo(b)fluoranthene and benzo(k)fluoranthene.

[9] Chlordane values used for alpha- and gamma-chlordane.

[10] Endosulfan values used for endosulfan II, and endosulfan sulfate.

[11] Endrin values used for endrin ketone.

CAS = Chemical Abstract Services
CLARC = Cleanup Levels and Risk Calculations
cPAH = Carcinogenic polycyclic aromatic hydrocarbon
EPA = Environmental Protection Agency
EPI = EPA Estimation Programs Interface
f_{oc} = Fractional organic carbon content
H = Henry's Law constant (unitless)
K_d = Soil-water distribution coefficient
K_{oc} = Soil organic carbon-water partitioning coefficient
L/kg = liters per kilogram
mg/kg = Milligrams per kilogram
MTCA =Model Toxics Control Act
TEQ = Toxicity equivalency qoutient
TPH = Total petroleum hydrocarbons

µg/L = Micrograms per liter

WAC = Washington Administrative Code
-- = Not available/not applicable
Shading indicates basis for screening level.

Table 10

Identification of Groundwater COPCs and COCs

7100 1st Avenue South Site
Seattle, Washington

Analyte	Screening Level (SL)[1] (µg/L)	Total # Samples	Detection Frequency (%)	Non-detect Results: Frequency of Reporting Limit Exceeding SL (%)	Detected Results: Maximum Concentration (µg/L)	Detected Results: Frequency of SL Exceedances (%)	Detected Results: Maximum Exceedance Ratio	COPC and COC Identification: Meet COPC Identification Criteria?	COPC and COC Identification: Meet COC Identification Criteria?
COC Selection Criteria						>=10	>2x		
Total Petroleum Hydrocarbons									
Gasoline-range hydrocarbons	800	99	31	0	23,000	8.1	29	Yes	Yes
Diesel-range hydrocarbons	500	101	64	0	6,600	30	13	Yes	Yes
Heavy Oil-range Hydrocarbons	500	87	45	1.1	1,700	4.6	3.4	Yes	Yes
Diesel plus Heavy Oil-range Hydrocarbons	500	101	64	0	6,600	50	13	Yes	Yes
Total petroleum hydrocarbons[2]	500	16	25	75	590	12.5	1.2	Yes	Yes
Volatile Organic Compounds (VOCs)									
1,1,1-Trichloroethane	0.9	93	1.1	2.2	3.4	1.1	3.8	Yes	Yes
Benzene	1.6	128	45	2.3	4,200	33	2,600	Yes	Yes
Ethylbenzene	31	128	28	0.8	270	3.1	8.7	Yes	Yes
Semi-Volatile Organic Compounds (SVOCs)									
Bis(2-Ethylhexyl) Phthalate	1	94	14	75	4	5.3	4.0	Yes	Yes
N-Nitrosodiphenylamine	1	94	1.1	0	1.2	1.1	1.2	Yes	No
Carcinogenic PAHs (cPAHs)									
Benzo(a)anthracene	0.01	91	16	14	0.088	15	8.8	Yes	Yes
Benzo(a)pyrene	0.01	91	14	14	0.07	11	7.0	Yes	Yes
Chrysene	0.016	91	19	14	0.14	14	8.8	Yes	Yes
Benzofluoranthenes (Sum)	0.02	91	13	14	0.094	11	4.7	Yes	Yes
Indeno(1,2,3-cd)pyrene	0.01	91	6.6	15	0.022	6.6	2.2	Yes	Yes
Total cPAH TEQ (ND=0.5RL)	0.01	91	19	14	0.093	13	9.3	Yes	Yes
Non-Carcinogenic PAHs									
Acenaphthene	30	94	78	0	44	3.2	1.5	Yes	No
Fluorene	10	94	59	0	18	5.3	1.8	Yes	No
Naphthalene	1.4	93	78	0	200	18	140	Yes	Yes
Polychlorinated Biphenyls (PCBs)									
PCB-aroclor 1254	0.01	94	54	16	1.9	44	190	Yes	Yes
Total PCBs	0.01	94	62	16	4.4	53	440	Yes	Yes
Pesticides									
2,4'-DDD	0.0005	85	41	47	0.052	16	100	Yes	Yes
2,4'-DDE	0.0005	85	21	59	0.0054	8.2	11	Yes	Yes
2,4'-DDT	0.0005	85	4.7	68	0.002	3.5	4.0	Yes	Yes
4,4'-DDD	0.0005	92	59	34	0.16	41	320	Yes	Yes
4,4'-DDE	0.0005	92	73	24	0.072	42	140	Yes	Yes
4,4'-DDT	0.0005	92	16	62	0.09	9.8	180	Yes	Yes
alpha-BHC	0.001	81	7.4	7.4	0.0015	1.2	1.5	Yes	No
alpha-Chlordane (cis)	0.0005	91	25	62	0.00480	11	9.6	Yes	Yes
Chlorpyrifos	0.0056	74	8.1	0	0.0093	1.4	1.7	Yes	No
Dieldrin	0.005	92	8.7	54	0.011	2.2	2.2	Yes	Yes
gamma-Chlordane	0.0005	84	25	56	0.00580	9.5	12	Yes	Yes
Heptachlor	0.001	92	34	14	0.0013	1.1	1.3	Yes	No
Heptachlor Epoxide	0.001	81	9.9	19	0.0013	1.2	1.3	Yes	No
Hexachlorobenzene	0.001	94	4.3	44	0.0021	1.1	2.1	Yes	Yes
Metals									
Arsenic (Dissolved)	8	82	80	0	14.2	2.4	1.8	Yes	No
Copper (Dissolved)	3.1	82	40	7.3	9.0	13	2.9	Yes	Yes
Lead (Dissolved)	8.1	82	27	0	19.2	3.7	2.4	Yes	Yes
Nickel (Dissolved)	8.2	81	93	0	18	7.4	2.2	Yes	Yes
Arsenic (Total)	8	88	78	0	15	5.7	1.9	Yes	No
Chromium (Total)	27.4	88	56	0	30	1.1	1.1	Yes	No
Copper (Total)	3.1	88	66	4.5	48	27	15	Yes	Yes
Lead (Total)	8.1	88	68	0	206	12.5	25	Yes	Yes
Mercury (Total)	0.025	91	97	1.1	0.991	15	40	Yes	Yes
Nickel (Total)	8.2	77	90	0	16.8	10	2.0	Yes	Yes
Zinc (Total)	81	88	59	0	420	6.8	5.2	Yes	Yes
Detected Analytes Not Selected As CPOCs (Detected With No Exceedances)									
Volatile Organic Compounds (VOCs)									
1,2,4-Trimethylbenzene	NE	93	31.2	NE	64.0	NE	NE	No	No
1,2-Dichloroethane	73	93	3.2	0	2.90	0	<1	No	No
1,3,5-Trimethylbenzene	NE	93	15.1	NE	71.0	NE	NE	No	No
1,4-Dichlorobenzene	59.8	93	1.1	0	0.0400	0	<1	No	No
2-Butanone (MEK)	NE	93	2.2	NE	18.0	NE	NE	No	No
Acetone	NE	93	40.9	NE	9.80	NE	NE	No	No
Carbon Disulfide	NE	93	3.2	NE	0.480	NE	NE	No	No
Chloroform	154	93	5.4	0	3.60	0	<1	No	No
Chloromethane	NE	93	11.8	NE	0.550	NE	NE	No	No
cis-1,2-Dichloroethene	NE	93	15.1	NE	0.300	NE	NE	No	No
Isopropylbenzene (Cumene)	NE	93	31.2	NE	33.0	NE	NE	No	No
n-Butylbenzene	NE	93	14	NE	41.0	NE	NE	No	No
n-Propylbenzene	NE	93	28	NE	110	NE	NE	No	No
p-Isopropyltoluene	NE	93	16.1	NE	9.40	NE	NE	No	No
Sec-Butylbenzene	NE	93	18.3	NE	13.0	NE	NE	No	No
Tert-Butylbenzene	NE	93	7.5	NE	0.250	NE	NE	No	No
Toluene	130	128	36.7	0	70.0	0	<1	No	No
Vinyl Chloride	1	93	2.2	0	0.130	0	<1	No	No
Xylene, m-,p-	NE	102	36.3	NE	63.0	NE	NE	No	No
Xylene, o-	NE	102	34.3	NE	4.20	NE	NE	No	No

Analyte	Screening Level (SL)[1] (µg/L)	Total # Samples	Detection Frequency (%)	Non-detect Results: Frequency of Reporting Limit Exceeding SL (%)	Detected Results: Maximum Concentration (µg/L)	Detected Results: Frequency of SL Exceedances (%)	Detected Results: Maximum Exceedance Ratio	COPC and COC Identification: Meet COPC Identification Criteria?	COPC and COC Identification: Meet COC Identification Criteria?
Semi-Volatile Organic Compounds (SVOCs)									
2,4-Dimethylphenol	97	94	1.1	0	0.800	0	<1	No	No
4-methylphenol (p-Cresol)	NE	94	8.5	NE	11.0	NE	NE	No	No
Benzoic Acid	NE	94	2.1	NE	12.0	NE	NE	No	No
Carbazole	NE	83	20.5	NE	19.0	NE	NE	No	No
Dibutyl Phthalate	8	94	1.1	0	0.110	0	<1	No	No
Diethyl Phthalate	200	94	6.4	0	1.40	0	<1	No	No
Isophorone	110	89	1.1	0	0.300	0	<1	No	No
Pentachlorophenol	5	94	1.1	80.9	0.0600	0	<1	No	No
Phenol	70000	94	9.6	0	3.00	0	<1	No	No
Phosphoric Acid Tributyl Ester	NE	55	5.5	NE	7.40	NE	NE	No	No
PAHs									
1-Methylnaphthalene	NE	76	67.1	NE	42.0	NE	NE	No	No
2-Methylnaphthalene	NE	87	57.5	NE	83.0	NE	NE	No	No
Acenaphthylene	NE	94	22.3	NE	0.230	NE	NE	No	No
Anthracene	100	94	31.9	0	0.590	0	<1	No	No
Benzo(g,h,i)perylene	NE	94	10.6	NE	0.0370	NE	NE	No	No
Dibenzofuran	NE	93	38.7	NE	18.0	NE	NE	No	No
Fluoranthene	1.82	94	55.3	0	0.670	0	<1	No	No
Phenanthrene	NE	94	62.8	NE	9.30	NE	NE	No	No
Pyrene	8	94	57.4	0	0.560	0	<1	No	No
Polychlorinated Biphenyls (PCBs)									
PCB-Aroclor 1242	NE	94	2.1	NE	0.110	NE	NE	No	No
PCB-Aroclor 1248	NE	94	31.9	NE	1.40	NE	NE	No	No
PCB-Aroclor 1260	NE	94	36.2	NE	1.10	NE	NE	No	No
Pesticides									
Aldrin	0.001	91	1.1	84.6	0.000670	0	<1	No	No
Beta-BHC	0.0014	81	4.9	6.2	0.000210	0	<1	No	No
Delta-BHC	NE	81	3.7	NE	0.000990	NE	NE	No	No
Endosulfan Sulfate	10	81	7.4	0	0.00110	0	<1	No	No
Endrin	0.002	81	4.9	91.4	0.00120	0	<1	No	No
Endrin Ketone	NE	81	7.4	NE	0.000680	NE	NE	No	No
Isodrin	NE	73	2.7	NE	0.00110	NE	NE	No	No
Lindane (Gamma-BHC)	0.126	92	3.3	0	0.000690	0	<1	No	No
Methoxychlor	0.02	81	6.2	3.7	0.00140	0	<1	No	No
Mirex	0.001	74	29.7	6.8	0.000170	0	<1	No	No
trans-Nonachlor	NE	74	13.5	NE	0.00160	NE	NE	No	No
Metals[1]									
Cadmium (dissolved)	7.9	88	10.2	0	0.600	0	<1	No	No
Cadmium (total)	7.9	79	1.3	0	0.0200	0	<1	No	No
Chromium (total)	27.4	82	31.7	0	8.00	0	<1	No	No
Mercury (dissolved)	0.025	82	96.3	2.4	0.0211	0	<1	No	No
Silver (total)	1.9	88	4.5	8	0.120	0	<1	No	No
Silver (dissolved)	1.9	79	1.3	8.9	0.0100	0	<1	No	No
Zinc (dissolved)	81	82	32.9	0	80.0	0	<1	No	No

Notes:

[1] Surface water criteria used to evaluate groundwater are applicable to dissolved, not total, concentrations.

[2] Includes results of Total Petroleum Hydrocarbons analyses performed by Dames and Moore. Review of chromatographs indicate hydrocarbons are predominantly heavy oil range hydrocarbons, so were included with

cPAH = carcinogenic polycyclic aromatic hydrocarbon

NE = screening level was not established for this analyte (See Table 9)

n/a = not applicable

RL = reporting limit

TEQ = toxicity equivalency concentration

µg/L = micrograms per liter

Frequency of screening level exceedances = (# of samples with constituent detected at a concentration greater than screening level)/(total # of samples analyzed for constituent)

Exceedance ratio (max) = ratio of maximum detected concentration divided by the screening level

Meets selection criteria

Table 11

Identification of Soil COPCs and COCs

7100 1st Avenue South Site
Seattle, Washington

Analyte	Screening Levels		Total # Samples	Detection Frequency (%)	Non-detect Results	Detected Results				COPC and COC Identification	
	Vadose Zone Screening Level (mg/kg)	Saturated Zone Screening Level (mg/kg)			Frequency of Reporting Limit Exceeding SL (%)	Maximum Vadose Zone Concentration (mg/kg)	Maximum Saturated Zone Concentration (mg/kg)	Frequency of SL Exceedances (%)	Maximum Exceedance Ratio	Meet COPC Identification Criteria?	Meet COC Identification Criteria?
COC Selection Criteria								**>=10**	**>2x**		
Total Petroleum Hydrocarbons											
Gasoline-range hydrocarbons	30	30	43	33	0	820	4500	21	150	Yes	Yes
Diesel-range hydrocarbons	2000	2000	49	98	0	380	3000	4.1	1.5	Yes	No
Heavy Oil-range Hydrocarbons	2000	2000	49	100	0	640	4400	6.1	2.2	Yes	Yes
Diesel plus Heavy Oil-range Hydrocarbons	2000	2000	49	100	0	860	6800	6.1	3.4	Yes	Yes
Total petroleum hydrocarbons [1]	2000	2000	29	100	0	2,800	3,600	6.9	1.8	Yes	No
Volatile Organic Compounds (VOCs)											
Benzene	0.03	0.0016	67	39	28	0.11	1.6	30	1,000	Yes	Yes
Ethylbenzene	1.6	0.081	67	16	0	0.73	64	4.5	790	Yes	Yes
Semi-Volatile Organic Compounds (SVOCs)											
Bis(2-Ethylhexyl) Phthalate	25	1.3	32	78	0	0.24	2.5	3.1	1.9	Yes	No
N-Nitrosodiphenylamine	0.3	0.02	32	6.3	31	not detected	0.33	6.3	17	Yes	Yes
Carcinogenic PAHs (cPAHs)											
Benzo(a)anthracene	0.82	0.041	34	91	2.9	0.11	0.46	27	11	Yes	Yes
Benzo(a)pyrene	2.2	0.11	34	91	0	0.18	0.31	8.8	2.8	Yes	Yes
Benzo(b)fluoranthene	2.8	0.14	34	91	0	0.23	0.29	8.8	2.1	Yes	Yes
Benzo(k)fluoranthene	2.8	0.14	34	82	0	0.13	0.16	2.9	1.1	Yes	No
Benzofluoranthenes (Sum)	5.6	0.28	26	96	0	0.45	0.58	12	2.1	Yes	Yes
Chrysene	1.5	0.073	34	94	0	0.28	1.0	24	14	Yes	Yes
Total cPAH TEQ (ND=0.5RL)	0.19	0.11	34	94	0	0.25	0.44	12	4.0	Yes	Yes
Non-Carcinogenic PAHs											
Naphthalene	0.39	0.019	34	94	2.9	0.021	1.5	38	77	Yes	Yes
Polychlorinated Biphenyls (PCBs)											
PCB-aroclor 1254	0.5	0.049	35	89	0	1.0	18	66	370	Yes	Yes
PCB-aroclor 1260	0.5	0.5	35	83	2.9	0.83	8.8	8.6	18	Yes	Yes
Total PCBs	0.5	0.035	35	91	0	1.8	48	71	1,400	Yes	Yes
Pesticides											
2,4'-DDD	0.0052	0.00026	32	72	13	0.00514	1.3	53	5,000	Yes	Yes
2,4'-DDE	0.0098	0.00049	32	41	16	0.00269	0.014	19	29	Yes	Yes
2,4'-DDT	0.078	0.00389	32	28	0	0.000653	0.48	16	120	Yes	Yes
4,4'-DDD	0.0052	0.00026	32	94	0	0.0151	0.796	84	3,100	Yes	Yes
4,4'-DDE	0.0098	0.00049	32	81	9.4	0.04	0.265	53	540	Yes	Yes
4,4'-DDT	0.078	0.0039	32	53	0	0.0021	0.093	13	24	Yes	Yes
alpha-Chlordane (cis)	0.0059	0.00029	26	62	12	0.00195	0.00499	7.7	17	Yes	Yes
Dieldrin	0.03	0.0015	32	13	13	0.000587	0.0577	3.1	38	Yes	Yes
gamma-Chlordane	0.0059	0.00029	26	65	12	0.00286	0.00656	15	23	Yes	Yes
Metals											
Arsenic	20	20	32	100	0	21.2	20.9	6.3	1.1	Yes	No
Copper	36	36	32	100	0	57.7	97.4	47	2.7	Yes	Yes
Lead	250	81	32	100	0	78.9	562	19	6.9	Yes	Yes
Mercury	0.07	0.07	32	97	0	0.69	1.75	72	25	Yes	Yes
Zinc	110	85	32	100	0	187	835	41	9.8	Yes	Yes
Detected Analytes Not Selected As COPCs (Detected With No Exceedances)											
Volatile Organic Compounds (VOCs)											
1,2,4-Trimethylbenzene	NE	NE	29	27.6	NE	0.000700	0.380	NE	NE	No	No
1,2-Dichlorobenzene (o-Dichlorobenzene)	7200	7200	31	3.2	0		0.560	0	<1	No	No
1,3,5-Trimethylbenzene	800	800	29	17.2	0		0.0910	0	<1	No	No
1,3-Dichlorobenzene (m-Dichlorobenzene)	NE	NE	31	3.2	NE		0.000380	NE	NE	No	No
1,4-Dichlorobenzene (p-Dichlorobenzene)	185	185	31	6.5	0		2.30	0	<1	No	No
2-Butanone (MEK)	48000	48000	31	45.2	0	0.0360	0.110	0	<1	No	No
2-Hexanone	NE	NE	31	3.2	NE		0.00980	NE	NE	No	No
Acetone	72000	72000	31	77.4	0	0.300	0.710	0	<1	No	No
Bromomethane	112	112	31	12.9	0		0.00370	0	<1	No	No
Carbon Disulfide	8000	8000	31	83.9	0	0.00540	0.0200	0	<1	No	No
Chloromethane	NE	NE	31	6.5	NE		0.0220	NE	NE	No	No
Dichlorodifluoromethane (CFC-12)	16000	16000	29	6.9	0		0.0550	0	<1	No	No
Isopropylbenzene (Cumene)	8000	8000	29	27.6	0	0.00180	1.20	0	<1	No	No
Methyl Iodide (Iodomethane)	NE	NE	23	17.4	NE		0.820	NE	NE	No	No
Methylene Chloride	480	480	31	51.6	0	0.110	0.110	0	<1	No	No
n-Butylbenzene	4000	4000	29	20.7	0		1.70	0	<1	No	No
n-Propylbenzene	8000	8000	29	27.6	0	0.00210	2.50	0	<1	No	No
p-Isopropyltoluene	NE	NE	29	10.3	NE		0.00260	NE	NE	No	No
Sec-Butylbenzene	8000	8000	29	24.1	0		1.70	0	<1	No	No
Tetrachloroethene	476	476	31	3.2	0		0.0160	0	<1	No	No
Toluene	6400	6400	67	29.9	0	0.210	0.180	0	<1	No	No
Trichloroethene	12	12	31	3.2	0		0.00520	0	<1	No	No
Xylene, m-,p-	16000	16000	67	26.9	0	0.680	3.00	0	<1	No	No
Xylene, o-	16000	16000	67	17.9	0	0.210	0.0850	0	<1	No	No
SVOCs											
Benzoic Acid	320000	320000	32	25	0		0.460	0	<1	No	No
Benzyl Alcohol	8000	8000	32	34.4	0	0.0450	0.240	0	<1	No	No
Butyl benzyl phthalate	526	526	32	9.4	0	0.0180	0.420	0	<1	No	No
Carbazole	NE	NE	26	23.1	NE	0.0200	0.260	NE	NE	No	No
Dibutyl phthalate	8000	8000	32	9.4	0	0.00940	0.220	0	<1	No	No
Diethyl phthalate	64000	64000	32	12.5	0	0.0550	0.0720	0	<1	No	No
Dimethyl phthalate	NE	NE	32	3.1	NE		0.0200	NE	NE	No	No
Di-N-Octyl Phthalate	800	800	32	15.6	0	0.0170	0.200	0	<1	No	No
p-Cresol (4-methylphenol)	8000	8000	32	34.4	0		0.0640	0	<1	No	No
Pentachlorophenol	2.5	2.5	32	3.1	0		0.0510	0	<1	No	No
Phenol	24000	24000	32	40.6	0	0.0210	0.0950	0	<1	No	No
Pyridine	80	80	26	15.4	0		0.110	0	<1	No	No
PAHs											
1-Methylnaphthalene	34.5	34.5	26	100	0	0.0120	0.440	0	<1	No	No
2-Methylnaphthalene	320	320	34	94.1	0	0.0110	2.20	0	<1	No	No
Acenaphthene	33.6	1.68	34	79.4	0	0.0110	0.820	0	<1	No	No
Acenaphthylene	NE	NE	34	44.1	NE	0.0180	0.0360	NE	NE	No	No
Anthracene	24000	24000	34	88.2	0	0.0320	0.870	0	<1	No	No
Benzo(ghi)perylene	NE	NE	32	84.4	NE	0.100	0.210	NE	NE	No	No
Dibenzo(a,h)anthracene	NE	NE	34	32.4	NE	0.0270	0.0630	NE	NE	No	No
Dibenzofuran	80	80	34	88.2	0	0.00720	0.410	0	<1	No	No
Fluoranthene	3200	3200	34	97.1	0	0.150	1.40	0	<1	No	No
Fluorene	17.6	0.881	34	88.2	0	0.00760	0.410	0	<1	No	No
Indeno(1,2,3-cd)pyrene	7.91	0.396	34	76.5	0	0.0930	0.130	0	<1	No	No
Phenanthrene	NE	NE	34	97.1	NE	0.0550	1.20	NE	NE	No	No
Pyrene	2400	2400	34	97.1	0	0.190	1.60	0	<1	No	No
Polychlorinated Biphenyls (PCBs)											
PCB-aroclor 1248	NE	NE	35	42.9	NE	0.27	21	NE	NE	No	No
Pesticides											
cis-Nonachlor	NE	NE	26	15.4	NE	0.000345	0.000148	NE	NE	No	No
Endosulfan II	480	480	26	11.5	0	0.00298	0.0123	0	<1	No	No
Hexachlorobenzene	0.625	0.625	64	12.5	10.9	0.000154	0.000300	0	<1	No	No
Lindane (Gamma-BHC)	0.909	0.909	32	3.1	0		0.0000780	0	<1	No	No
Methoxychlor	400	400	26	7.7	0	0.000189	0.00143	0	<1	No	No
trans-Nonachlor	NE	NE	26	26.9	NE	0.00126	0.00157	NE	NE	No	No

Analyte	Screening Levels		Total # Samples	Detection Frequency (%)	Non-detect Results	Detected Results				COPC and COC Identification	
	Vadose Zone Screening Level (mg/kg)	Saturated Zone Screening Level (mg/kg)			Frequency of Reporting Limit Exceeding SL (%)	Maximum Vadose Zone Concentration (mg/kg)	Maximum Saturated Zone Concentration (mg/kg)	Frequency of SL Exceedances (%)	Maximum Exceedance Ratio	Meet COPC Identification Criteria?	Meet COC Identification Criteria?
Metals											
Cadmium	80	80	32	100	No ND Samples	0.600	2.80	0	<1	No	No
Chromium	120000	120000	32	100	No ND Samples	30.6	70.1	0	<1	No	No
Nickel	48	48	26	100	No ND Samples	26.6	30.3	0	<1	No	No
Silver	400	400	32	40.6	0		0.800	0	<1	No	No

Notes:

[1] Includes results of Total Petroleum Hydrocarbons analyses performed by Dames and Moore. Review of chromatographs indicate hydrocarbons are predominantly heavy oil range hydrocarbons, so were included with recent heavy oil range results.

cPAH = carcinogenic polycyclic aromatic hydrocarbon

mg/kg = milligram per kilogram

n/a = not applicable

RL = reporting limit

TEQ = toxicity equivalency concentration

NE = screening level was not established for this analyte (See Table 9)

Frequency of screening level exceedances = (# of samples with constituent detected at a concentration greater than screening level)/(total # of samples analyzed for constituent)

Exceedance ratio (max) = ratio of maximum detected concentration divided by screening level

Meets selection criteria