WORK PLAN

South State Street Manufactured Gas Plant
Remedial Investigation/Feasibility Study

Prepared for

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ACRONYMS AND ABBREVIATIONS

AET	Apparent Effects Threshold
ARI	Analytical Resources, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BAP	benzo(a)pyrene
bgs	below ground surface
BNA	Base Neutral Acid
BNRC	Burlington Northern Railroad Company
BNSF	Burlington Northern Santa Fe Railway Corporation
BSL	bioaccumulation screening level
BT	biological trigger
BTEX	benzene, toluene, ethylbenzene, xylenes
BTX	benzene, toluene, xylenes
CAP	cleanup action plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Bellingham
CLARC	Cleanup Levels and Risk Calculations
Cm	centimeter
CMA	combined mortality and abnormality
COC	Constituents of Concern
COPCs	constituents of potential concern
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CSL	cleanup screening level
CSM	conceptual site model
CWG	carburetted water gas
DMMP	Dredged Material Management Program
DNAPL	dense non-aqueous phase liquid
DQOs	data quality objectives
Dx	Diesel-range and Oil-range organic hydrocarbons

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
ELLW	extreme low or low water
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ESA	environmental site assessment
FCR	field change record
GRO	gas-range hydrocarbons
HASP	Health and Safety Plan
Herrenkohl	Herrenkohl Consulting LLC
JARPA	Joint Aquatic Resources Permit Application
LAET	lowest apparent effect threshold
2LAET	second lowest apparent effect threshold
Landau Associates	Landau Associates, Inc.
MADEP	Massachusetts Department of Environmental Protection
MCLs	maximum contaminant levels
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
mg/kg OC	milligrams per kilogram normalized to organic carbon
mg/L	milligrams per liter
MGP	manufactured gas plant
MIG	mean individual growth rates
MLLW	mean lower low water
MTBE	methyl tert-butyl ether
MTCA	Model Toxics Control Act
NAD	North American Datum
NAPL	nonaqueous phase liquid
NAVD	North American Vertical Datum
NWTPH	Northwest Total Petroleum Hydrocarbons
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons-Diesel, -Oil
NWTPH-GRO	Northwest Total Petroleum Hydrocarbons-Gasoline
OHWM	Ordinary High Water Mark

ORP	oxidation reduction potential
PAHs	Polycyclic aromatic hydrocarbons
Park	Boulevard Park
PCBs	polychlorinated biphenyls
PLP	potentially responsible party
PSE	Puget Sound Energy
PSEP	Puget Sound Estuary Program
PVOCs	petroleum volatile organic compounds
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RAOs	remedial action objectives
RI/FS	remedial investigation and feasibility study
SAP	sampling and analysis plan
SHA	site hazard assessment
SIM	Selective Ion Monitoring
SL	screening level
SMS	Washington State Sediment Management Standards
SOPs	standard operating procedures
SOW	Statement of Work
SQS	sediment quality standard
SSSMGP	South State Street Manufactured Gas Plant
SVOCs	semivolatile organic compounds
TEFs	total equivalency factors
TEQ	toxicity equivalency quotient
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSCA	Toxics Substance Control Act
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
VPH	volatile petroleum hydrocarbons
VOCs	volatile organic compounds

WAC	Washington Administrative Code
WAD	weak acid dissociable
WARM	Washington Ranking Method
WDNR	Washington State Department of Natural Resources
WDFW	Washington State Department of Fish and Wildlife
WISHA	Washington Industrial Safety and Health Act
WQC	water quality criteria

CERTIFICATION

I, Mark J. Herrenkohl, a licensed engineering geologist in the State of Washington, certify that I have reviewed the geosciences portions of this document.

Signature and Stamp of Geologist:

Engineering Geologist
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Mark J. Herrenkohl

Mark J Herrenkohl

Name: Mark J. Herrenkohl Date: August 6, 2010

I, Stacy Lane, a licensed hydrogeologist in the State of Washington, certify that I have reviewed the geosciences and hydrogeology portions of this document.

Signature and Stamp of Geologist:

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Name: Stacy Lane Date: 8/6/2010

1 INTRODUCTION

This document is the Work Plan for the remedial investigation and feasibility study (RI/FS) of the South State Street Manufactured Gas Plant (SSSMGP) Site located in Bellingham, Washington (Figure 1). This Work Plan provides information on existing data for the SSSMGP Site and the sampling strategy and design to meet the data needs for completing the RI/FS. This Work Plan also describes the project management strategy for implementing and reporting RI/FS activities for the Site, including project team responsibilities and schedule. Sampling and laboratory methodology and quality assurance/quality control (QA/QC) procedures for the RI/FS are detailed in the sampling and analysis plan (SAP provided in Appendix B) and quality assurance project plan (QAPP provided in Appendix C), respectively.

Herrenkohl Consulting LLC and Landau Associates Inc. are conducting this work under Reid Middleton's contract (No. 2008-011C) with the City of Bellingham, Parks and Recreation Department (City), and Puget Sound Energy (PSE) with direction from the Washington State Department of Ecology (Ecology) Toxics Cleanup Program. This Work Plan has been prepared in accordance with an Agreed Order and Statement of Work (SOW) negotiated between the City, PSE, and Ecology and signed April 30, 2010 (Document No. 7655; Ecology 2010a) and was developed to meet the requirements of an RI/FS as defined by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (WAC 173-340-350).

Several documents are cited repeatedly and accompany this Work Plan as appendices. Altogether, these documents are referred to as the work plans for the SSSMGP Site RI/FS:

- ***Sampling and Analysis Plan*** (Appendix B) for the RI/FS of the SSSMGP Site, Bellingham, Washington. The SAP describes the procedures for conducting field activities and presents the proposed laboratory analyses for samples collected in the field.
- ***Quality Assurance Project Plan*** (Appendix C) for the RI/FS of the SSSMGP Site, Bellingham, Washington. The QAPP describes analytical method reporting limit goals, field and laboratory quality assurance/quality control (QA/QC) requirements and reporting requirements for the RI/FS for the Site.
- ***Project Health and Safety Plan*** (Appendix D) for the RI/FS of the SSSMGP Site, Bellingham, Washington. The HASP has been prepared in accordance with Washington Administrative Code (WAC) 173-340-810, applicable Washington Industrial Safety and Health Act (WISHA) regulations, and project requirements. It addresses those activities associated with work to be performed at the Site. The project HASP is not reviewed by Ecology.

1.1 PROJECT DESCRIPTION AND BACKGROUND

The SSSMGP Site is located in Bellingham, Washington in the general vicinity of Bayview Drive and South State Street (Figure 1). The Site is situated on the northern portion of a City-managed park, Boulevard Park, and includes nearshore uplands and adjacent aquatic lands located in Bellingham Bay. The preliminary Site boundary is shown on Figure 1. Uplands include the upper and a portion of the lower public park areas, which were first developed into a park by the City from the late 1970s to the mid 1980's. Also included within the preliminary Site boundary are approximately 2 acres of aquatic lands adjacent to and outside of the Inner Harbor line and managed by the Washington State Department of Natural Resources (WDNR). The Site is also intersected by active railroad tracks owned and managed by Burlington Northern Santa Fe Railway (BNSF).

From approximately 1890 to the late 1940's, a coal gasification plant operated on the upper portion of the Site. The facility manufactured gas from coal, supplying residents and local businesses of Bellingham with gas for heating, cooking, and lighting. The gas plant consisted of above-ground gas holder tanks, fuel oil tanks, a retort and purifying facility, a coal shed and a coke shed used for storage. Of the original gas plant structures, a concrete aboveground gas holder tank, a small brick utility building, remnants of concrete foundations and underground piping remain in the upper Site area. The coal gasification plant was originally operated by the Bellingham Bay Gas Company, a predecessor of PSE. Cascade Natural Gas and Bellingham Gas Company, a predecessor of Cascade Natural Gas, also owned and/or operated the property for some time beginning in the late 1940s. Eventually, residential developers purchased the property in the 1960s. In 1975, the City acquired ownership of the majority of the gas plant property from a private owner and Burlington Northern Railroad Company (BNRC) (Griffin 2007). Boulevard Park was dedicated by the City for public use in June 1980.

Between 1984 and 2009, a number of investigations [U.S. Environmental Protection Agency (EPA) 1984, E&E 1991, Erickson and Cubbage 1998, Norton and Summers 1998, Integral 2007, Herrenkohl and Landau Associates 2009] found elevated concentrations of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) (benzene, toluene, and xylene) in surface water, soil, and/or sediment. In 1991, Ecology conducted a Site Hazard Assessment (SHA) and placed the Site (then referred to as the Boulevard Park Site) on the Hazardous Sites List. The Site's hazard ranking, an estimation of the potential threat to human health and/or the environment relative to other Washington State sites assessed at that time, was determined to be a 1, where 1 represents the highest relative risk and 5 the lowest.

In January 2004, the Boulevard Park Site was excluded by EPA from the "eligible response site" list under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) because of its preliminary hazard ranking score in their database (EPA 2004). Ecology concurred with EPA's decision, taking over jurisdiction of the Site (Ecology 2004a).

On August 12, 2005, Ecology notified the City of potential liability for the Site and designated the City as a "Potential Liable Party" (PLP) under MTCA (Chapter 173-340 WAC) (Ecology 2005). Without admitting any liability, the City, accepted its PLP status in an August 22, 2005 response letter (City of Bellingham 2005). On March 31, 2008, the City made a formal request to Ecology to initiate negotiations for an Agreed Order to complete an RI/FS for the Site (City of Bellingham 2008). In that letter to Ecology, the City also asked Ecology to designate PSE, and BNSF as additional PLPs for the Boulevard Park Site. On December 31, 2008, Ecology notified PSE of potential liability for the Site and designated PSE as a PLP (Ecology 2008d). Without admitting any liability, PSE accepted its PLP status in a January 7, 2009 response letter (PSE 2009). After public notice and opportunity to comment, an Agreed Order for completing an RI/FS was signed between the City, PSE, and Ecology on April 30, 2010 (Document No. 7655). Under the terms of the Agreed Order, the City and PSE will conduct an RI/FS at the Site, with Ecology oversight.

1.2 REGULATORY FRAMEWORK

The RI/FS for the SSSMGP Site will be conducted under MTCA (WAC 173-340), which addresses identification and cleanup of contamination in soil, surface water, and groundwater. For contamination in sediments, MTCA refers to the Sediment Management Standards (SMS) (WAC 173-204), which includes standards for marine sediments.

Additional regulations that may be applicable or relevant and appropriate requirements (ARARs) include the following:

- Federal Clean Water Act and National Toxics Rule [40 Code of Federal Regulations (CFR) 131], which provide water quality criteria (WQC) for protection of human health and aquatic organisms
- Water Quality Standards for Surface Water of the State of Washington (WAC 173-201A), which also provides WQC for protection of aquatic organisms
- Federal Safe Drinking Water Act (40 CFR 141), which provides maximum contaminant levels (MCLs) for protection of drinking water
- Washington State Department of Health rules for Public Water Supplies (WAC 246-290-310), which also provides MCLs
- Shoreline Management Act (RCW 90.58; WAC 173-14), which establishes requirements for substantial development in waters of the State of Washington
- Dredge and fill requirements under 33 CFR Part 320-330 and Washington State Hydraulics Projects Approval (RCW 77.55; WAC 220-110)
- Endangered Species Act (16 USC 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402) because listed species are documented in Bellingham Bay (e.g., Bull Trout, Puget Sound Chinook).

The Federal and State MCLs are listed as ARARs pending further investigation, which might conclude that hydrologic connections with Bellingham Bay render the groundwater unsuitable for drinking. Additional regulatory values used for screening data are presented in Section 3. Additional potential ARARs may be considered in the RI/FS report.

MTCA addresses sites with contaminated soil, groundwater, or surface water in Washington State. The regulation establishes a process for managing contaminated sites, from the discovery phase through cleanup. The RI/FS, for which this Work Plan is designed, generates the data and evaluations necessary for Ecology to select a cleanup action alternative for the Site. Following public review of the RI/FS, Ecology's selected cleanup action will be described in a cleanup action plan (CAP). The cleanup action must comply with several requirements, including protection of human health and the environment, compliance with cleanup standards and ARARs, and provisions for compliance monitoring. Following public review of the CAP, the cleanup will move into the implementation phase which includes design, construction, operation, and monitoring of cleanup activities. At the SSSMGP Site, park enhancement activities (e.g., shoreline restoration and construction of an over-water walkway may be performed in conjunction with the cleanup activities.

The SMS establish standards for the quality of surface sediments, apply those standards as the basis for management and reduction of pollutant discharges, and provide a management and decision process for the cleanup of contaminated sediments. Part V of the SMS, Sediment Cleanup Standards, establishes procedures and criteria to identify, prioritize, and clean up, if necessary, contaminated sediment areas.

1.3 RI/FS OBJECTIVES

This section of the Work Plan presents major project objectives for the RI/FS. The RI/FS is intended to provide sufficient data, analysis, and evaluations to enable Ecology to select a cleanup action alternative for the Site. Objectives include the following:

- Obtain data of sufficient quality and quantity to describe the physical setting and physical properties of the site;
- Determine the nature and extent of contamination at the site;
- Characterize the fate and transport of identified contaminants, including how contaminants migrate between media;
- Use the information collected to assess potential human health and ecological health concerns under current planned land uses;
- Develop and evaluate a range of cleanup action alternatives to address potential human health and ecological health concerns;
- Identify a preferred cleanup action alternative; and
- Report the methods and findings of the RI/FS to Ecology and the local Community.

Details on specific data quality objectives (DQOs) for the RI/FS of the Site are presented in the accompanying QAPP (Appendix C).

1.4 WORK PLAN ORGANIZATION

The remaining sections of this Work Plan include the following sections and four appendices:

- **Section 2: Site History and Operations.** Describes the approximate locations of relevant historical activities within the Site boundaries.

- **Section 3: Review of Existing Data.** Provides information on existing data for the Site beginning with a summary of previous investigations, followed by a description of Site features and an evaluation of useable chemical and biological data, property ownership, and cultural resources for the Site.

- **Section 4: Preliminary Conceptual Site Model.** Presents a preliminary understanding of Site conditions including potential sources and constituents of potential concern (COPCs), transport pathways and mechanisms, and exposure pathways for potential human and ecological receptors.

- **Section 5: Data Gaps.** Describes the data gaps in completing the RI/FS for the Site.

- **Section 6: Site Investigation Approach.** Presents the sampling and testing rationale and design to complete the Site RI/FS investigation.

- **Section 7: Project Management Strategy.** Describes the project tasks and subtasks for the RI/FS and the proposed schedule to complete these tasks. It also identifies the organizations and key individuals that will oversee and implement the RI/FS, along with their respective responsibilities.

- **Section 8: References.** Provides full citations for all references cited in the Work Plan.

- **Appendix A: Historical Data Tables and Figures.** A summary of useable chemical, biological, and physical data collected from previous investigations of the Site with comparisons to preliminary screening criteria.

- **Appendix B: Sampling and Analysis Plan.** Provides specific guidance for field methodology and quality assurance procedures.

- **Appendix C: Quality Assurance Project Plan.** Describes laboratory methodology and QA/QC procedures that will be used to complete the RI/FS for the Site

- **Appendix D: Health and Safety Plan.** Provides information on the procedures to ensure the health and safety of personnel and the environment during the field investigation for the Site. The project HASP is not reviewed by Ecology.

2 SITE HISTORY AND OPERATIONS

Site history and operation information was obtained from aerial photographs, the Sanborn Fire Insurance Atlas for the Bellingham area (from 1890 to 1950); property maps (from the 1920's to 1940's); review of local historical reports (Griffin 2007, Herrenkohl and Landau Associates 2009); and personal communication with City and PSE personnel and representatives. Based on these sources of information, the approximate locations of relevant historical features within the Site boundaries are shown on Figure 2. The following sections provide currently available additional information on the Site history and a description of manufactured gas plant (MGP) operations in general. This description may be modified as more information is obtained.

2.1 MANUFACTURED GAS PLANT

On December 18, 1890, the Bellingham Bay Gas Company began operation of a gas works facility in what is now upper Boulevard Park (Griffin 2007 and references therein). The facility was constructed to provide gas from coal to local residents and businesses and initially included a coal house or bunker, retorts, purifier, barrel sheds, and two gas holders (1891 and 1904 Sanborn Fire Insurance maps). However, as the demand for gas increased, the facility expanded to include additional gas holders (1913, 1930, and 1950 Sanborn maps). One of the larger gas holders (gas holder #2) and the electrical/generator building remains on the Site today (Figure 2). The ownership of the gas plant facility changed a number of times between the early 1900's and mid 1950's including Whatcom County Railway and Light Company in approximately 1904, and then Whatcom Fairhaven Gas Company, Puget Sound Traction & Light & Power Company, Puget Sound Power & Light, Bellingham Gas Company, and finally Cascade Natural Gas Corporation (Griffin 2007 and personal communication with Tim Wahl). Gas production and storage occurred from 1890 until about 1956. Before 1890, there was a lumber mill and railroads operating on portions of the Site (refer to Sections 2.2 and 2.3).

2.1.1 Gas Production Methods

There were two main gas production processes used at gas works facilities like the former facility at the Site (Griffin 2007, Sanborn Fire Insurance Atlas). The older and simpler process was coal carbonization. In this process, coal was heated in closed retorts or ovens where the coal was kept from burning by limiting its contact with outside air. Volatile constituents of the coal would be driven off as a gas, which was collected, cooled, and purified prior to being piped into gas holders for use. The solid portion of the coal would become a black, granular material called coke which may have been sold as a by-product of the gas operations for home or commercial use [Gas Research Institute (GRI) 1996, Griffin 2007].

The other main process to produce gas was the carburetted water gas (CWG) process, which produced a gas mixture that burned hotter and brighter than the coal carbonization process. In this process, coal or coke was heated in a closed vessel or retort into which steam was injected. A chemical reaction took place which produced a flammable gas mixture of methane and carbon monoxide. Petroleum products were then sprayed into the hot gas mixture, creating another chemical reaction in which petroleum constituents were "cracked" to form methane, which increased the heating and lighting value of the gas (GRI 1996).

2.1.2 Wastes/By-Products

Some manufactured gas plants have been known to create a number of different by-products and wastes, such as coal tar. A list of typical manufactured gas plant by-products and wastes is provided in Table 1. Coal tar, which is a dense oily liquid, could be separated from the gas throughout production, storage, and distribution and this material could be collected at various points in the process. It was reported in a site status review report (E&E 1999) that the MGP produced on average 39,000 gallons of coal tar per year.

Other byproducts have included purifier wastes, which were created as the purifying material became saturated with impurities. Purifier wastes are comprised of either lime or wood chips (treated with iron oxides) that were used to remove cyanide and sulfur from the coal gas.

Another byproduct, coke, was also a valuable industrial commodity. At the SSSMGP, coke may have been temporarily stored in a shed or house until sale or used as feedstock in the CWG process. Coke sheds were identified at the Site on 1912, 1913, and 1930 Sanborn maps (refer to Figure 2).

Table 1. Process Residuals/By-Products from Manufactured Gas Plants [GRI 1996; New York State Department of Environmental Conservation (NYSDEC) 2009]

Coal Gas Process Residual	**Coal Carbonization**	**Carburetted Water Gas**
Coal Tar	X	X
Oil Tar	--	X
Tar/Oil/Water Emission	--	X
Tar Decanter Sludge	X	--
Ammonia Saturator Sludge	X	--
Acid/Caustic Hydrocarbon Treatment Sludge	X	--
Wastewater Treatment Sludge	X	X
Coke	X	--
Ash	X	X
Spent Oxide/Lime	X	X
Sulfur Scrubber Blowdowns	X	X
Ammonia Sulfate	X	--

A list of typical MGP components and the use of the components are summarized below in Table 2 (from Hatheway 2009) and shown on Figure 2.

Table 2. Typical MGP Components

Component Observed Onsite	MGP Use	Possible Site Location
Transportation Spur	Delivery of coal and oil products; exit point for saleable residuals (e.g., coal tar and coke)	Railroad lines (existing and historical spur) between upper and lower line; coal and tank cars were observed parked below the Site (photographs)
Coal Shed or Yard	Storage area which kept coal dry for optimal use in firing boilers or as retort feedstock	Located adjacent to Front Street (now South State Street) (Sanborn and property maps)
Coke Shed or Yard	Storage area for by-product coke from coal-gas plants	Located between retorts and gas holder tank #2 (1912 and 1913 Sanborn maps)
Retort House	Coal-gas retorts housed internally in benches; groups of benches known as stacks	Located on southern portion of Site, northeast of Spinnaker Condominiums (Sanborn, property, and aerial maps)
Electrical/ Generator House	Location of generator sets for carburetted water gas process	Located adjacent to Front Street (now South State Street). Building remains today.
Condenser House	Building or addition immediately adjacent to retort house or generator house	Between coal shed and purifier, adjacent to retorts (Sanborn maps, property maps, and aerial photos)
Purifiers (Purifier Boxes)	Gas was passed through “boxes” containing layers of lime, wood chips, iron-impregnated wood chips, oxide of iron (particles) and/or strips of iron as various forms of sorbants, often in conjunction with each other	Located adjacent to retorts and condenser house. Lime house shown on 1891 Sanborn map. Oxide bin adjacent to condenser house on 1920’s property map.
Gas Holders (Gasometers)	Generally predicated on the largest holder being equivalent to one day’s make and storage.	Gas holders (the two largest with capacities ranging from 40,000 to 150,000 cubic feet) identified from property and Sanborn maps. The foundation/base of one of the largest (50-ft diameter and 40,000 cubic ft capacity) still remains on Site today.
Tar Extractor,	Aboveground and subsurface tanks, right-circular cylinders and	Photographs and property maps from the 1920’s and

Table 2. Typical MGP Components		
Component Observed Onsite	**MGP Use**	**Possible Site Location**
Separator, Wells	rectangular or square-sided; brick, masonry or concrete or composite separates tar from passing gas	1930's show three tar wells and an extractor near the edge of slope overlooking railroad. The largest tar well, approximately 12 ft in diameter, was located closest to the slope. Also, tar extractor/separator shown on 1950 Sanborn map adjacent to purifying room.
Oil/Fuel Storage Tanks (aboveground and underground)	Illuminating or enriching oil for non-coal-gas production (carburetted water gas)	Oil/fuel tanks are shown on aerial photographs, property and Sanborn maps. One oil storage tank is shown in front of a machine shop (west of the purifying building) on a 1920's property map. On the same map, three reserve fuel tanks are shown adjacent to the south (southwestern) property line.
Piping and drains (aboveground and underground)	Transport gas and fuel to and from gas holders, discharge of waste/byproducts	8-inch and 10-inch pipes observed on circa 1920's property map from condenser/purifying buildings to distribution between gas holders. A drain is also shown on this map running from gas holders to an open ditch located at bottom of slope.

2.1.3 Propane-Air Gas Manufacturing Process

In the late 1940's, the MGP was converted to a propane-air gas manufacturing process (Robinson 2010). Liquid propane tanks (2) were observed on a 1950 aerial photograph. In this process, liquid propane is air-heated into gas which is then held in gas holders for distribution. There are no documented wastes or by-products from this process (Hatheway 2009, personal communication with Allen Hatheway).

2.2 LUMBER MILL

The portion of the SSSMGP Site located in what is now the lower Boulevard Park was originally developed as a lumber mill by Edward Eldridge and Erastus Bartlett in 1884 (Griffin 2007) (Figure 2). The mill changed ownership several times through its history, but operated over most of its time as either the Bellingham Mill Company or the E.K. Wood Lumber Mill. The mill was located almost exclusively on a large wood dock/wharf supported by wood pilings that extended for approximately 1,200 ft along the shoreline and 400 ft out into Bellingham Bay (1904 Sanborn map). The majority of logs were floated or rafted to the mill by way of Bellingham Bay and surrounding tributaries. The wood was then milled and sent to world markets on three to five mast sailing schooners. A 1913 Sanborn map shows an oil house and a steam-generating house at the lumber mill. These features were likely used to power the equipment of the mill. The mill was closed after a fire burned it to the ground on September 30, 1925; the fire was believed to have been started by a hot box or gear box of a machine axle (Griffin 2007). Only hundreds of wood pilings remained along the waterfront after the fire. The mill was not rebuilt.

Over the next 50 years, most of the remaining pier and pilings were cut to the mudline or removed and the area was filled from local sources (e.g., demolition materials from the Fairhaven Hotel, wood debris from the mill) and developed into the lower park area it is today (Griffin 2007).

2.3 RAILROAD

The mainline of the coastal railroad passes along the historic headland and through the Site separating the upper and lower park areas and open water aquatic lands (Figure 2). The active rail line is currently owned and operated by BNSF, but this rail line began operation as the Fairhaven & Northern Railway in 1890. Additional railways historically crossed the Site adjacent to the current rail line. These rail operations included the Bellingham Bay & Eastern (BB&E)/Northern Pacific track connecting with Lake Whatcom and the Highway 9 corridor (originally transporting coal, logs, lumber, and passengers) and now serving as the South Bay Trail (a portion of which is located within the preliminary Site boundary); the Northern Pacific/Chicago Milwaukee log dump spur, a spur off of the main Northern Pacific line to State Street; and the State Street railway. Rail-carried timber was milled at E.K. Wood, which operated on the lower portion of the Site (refer to Section 2.2). Rail-carried coal was exported across the Northern Pacific line and imported for use by the coal gas plant (Griffin 2007, personal communication with Tim Wahl). Tanker and coal rail cars were observed servicing the gas plant in photographs from circa 1920 and 1930.

Previous reports by Ecology document oily material observed in a ditch adjacent to the railroad mainline (E&E 1991). The oil material was reportedly observed north of the preliminary Site boundary. Analytical results from this study confirmed the presence of contaminants (e.g., benzene, naphthalene) in soil and water within the railroad ditch at concentrations exceeding MTCA soil cleanup levels. There is some uncertainty of the source of this contamination.

2.4 STORMWATER AND INDUSTRIAL DISCHARGES

There are two known stormwater outfalls that are located on the northeastern shoreline of the Site (refer to Figure 2). One 18-inch corrugated metal outfall discharges untreated stormwater collected from South State Street and the surrounding South Hill Neighborhood (an approximate 122 acre area) into Bellingham Bay (personal communication with Bill Reilly). The other smaller 8-inch PVC pipe discharges stormwater collected from three catch basins in the Boulevard Park parking lot and lower park area.

2.5 BOULEVARD PARK REDEVELOPMENT

In 1975, the City acquired most of the gas plant property from a private owner and the BNRC for use as a park (Griffin 2007). In early 1979, the City Parks and Recreation Department began development of the upper and lower park areas including construction of trails, parking lots, restrooms, and a picnic shelter. The redevelopment of the Site also included placement of fill with grading, landscaping, shoreline improvements (e.g., erosion control), and pumping the remaining oil/water mixture from two gas holder tanks located in the upper park area. The oil/water mixture from an older, larger tank (gas holder #3) with only a partial foundation was pumped into the existing gas holder tank (gas holder #2) before removal from the Site for disposal (City of Bellingham 1979a). The City also hired a geotechnical engineering firm to complete a soil and foundation investigation in support of park development (Rittenhouse-Zeman 1979). Ten test pits and five borings were drilled in support of this investigation and included information on subsurface soil conditions such as thickness and type of fill materials and depth to bedrock (Figure 3). Although no chemical testing was performed, soil in three test pits (TP-3, TP-5, TP-10) and two borings (B-2, B-5) were described as saturated in oil with strong diesel odor. Information from this study was used in designing a picnic shelter, restroom facility, pedestrian bridge, and parking areas.

By November 1979, approximately two-thirds to three-quarters of the coal tar/water mixture had reportedly been pumped from the gas holder tank (gas holder #2) and transported to Albany, Oregon for disposal (Elmendorf, B. and J. Ivory, 2008, personal communication). City personnel were unable to remove all of the coal tar because of unknown difficulties in accessing the bottom of the tank. The City filled the tank with sand and gravel and placed an asphalt cover over it before constructing a picnic shelter in early 1980. Also in early 1980, the City began work on the pedestrian bridge over the railroad trestle and renovation of the Pottery Studio (present day Woods Coffee Shop) (City of Bellingham 1979b). Boulevard Park was dedicated by the City in June 1980.

In January 1983, the landscape around the existing gas holder tank (gas holder #2) was modified by planting trees around the outside to prevent persons from climbing the gas holder tank. City officials were concerned that coal tar residue remained on the outside of the tank and was observed (both visually and olfactory) in some surrounding soil (City of Bellingham 1983). Byron Elmendorf, Parks Director at that time, contacted EPA officials in early 1984 and requested they conduct an investigation of the soil in the park. While waiting for a response from EPA, the City collected representative soil samples near the tank and submitted the samples to Ecology for analysis of PAHs (Ecology 1984). In a letter dated April 25, 1984, Ecology concluded the concentration of PAHs in these samples were not designated Extremely Hazardous Waste [<1 percent (%) concentration] based on their evaluation of the State's Dangerous Waste Regulations (WAC 173-303). Soil and contaminated water removed from the surrounding area of the tank (a volume filling five 55-gallon drums) was later transported by a City contractor to a landfill for proper disposal (Uniform Hazardous Waste Manifest 1993).

On May 17 and 18, 1984, EPA collected soil samples (from 0 to 0.5 ft and 0 to 3 ft) at various locations in the upper and lower Boulevard Park areas (mostly in the upper park area). Their report was published on July 5, 1984 and the results are discussed further in Section 3.1.2. Park officials roped off areas shown to be of concern based on EPA's investigation including the slope between the upper and lower park areas which was covered with blackberries. In addition, the City posted warning signs in the upper park area (City of Bellingham 1984a, b). On November 19, 1984, the U.S. Department of Health and Human Services of the Centers for Disease Control provided the results of their review of EPA's study. They concluded the available data did not indicate a significant health risk to users of the park but recommended restrictions to public access in the upper park (e.g., a fence around the existing gas holder tank), continued surveillance for new areas of contamination, and assessment of the potential impact on adjacent waters and marine life by PAHs. This information was likely conveyed to Ecology, which conducted a SHA a few years later and in 1991, placed the Site on the Washington State Hazardous Site list (refer to Section 3).

In the fall of 1984, the wharf along the northwest shoreline was refurbished with new decking and support stingers from a 3-ft high concrete retaining wall. Soon after, a public access pier was constructed that adjoined the wharf

The next significant development for the northern portion of the park (within the Site boundaries) was the construction of a park shelter referred to as the "Porch" in 2009. The shelter is an approximately 30-ft by 30-ft wood structure built on a concrete foundation and used for musical concerts and plays during the warmer months of the year. Additional improvements are planned for the portion of the lower park within the preliminary Site boundary including shoreline restoration and the construction of an overwater walkway from Boulevard Park to the former Cornwall Avenue Landfill. These improvements are currently in the engineering and design phase.

2.6 OTHER CLEANUP SITES

There are three MTCA cleanup sites under investigation near the SSSMGP Site including the Whatcom Waterway, Cornwall Avenue Landfill, and R.G. Haley sites. The Whatcom Waterway site overlaps with the sediments portion of the SSSMGP Site. The primary COC at the Whatcom Waterway site is mercury in sediments. A consent decree has been signed for this site and the Port of Bellingham (Port), with Ecology oversight, is in the early stages of designing the remedial cleanup. The cleanup includes monitoring of sediments within the SSSMGP Site.

Along the shoreline of Bellingham Bay and approximately one-half mile to the northeast of the Site are the Cornwall Avenue Landfill and R.G. Haley cleanup sites. The Port is under an Agreed Order with Ecology to complete an RI/FS for the Cornwall Avenue Landfill site. The most recent Ecology review draft of the RI/FS was completed in July 2009. The City is currently negotiating an Agreed Order with Ecology to complete an RI/FS for the R.G Haley site. A draft RI/FS was completed by a previous owner in September 2007. Contamination at these two sites consists primarily of municipal solid waste refuse, wood debris and wood treatment chemicals associated with former operations at the R.G. Haley site.

3 REVIEW OF EXISTING DATA

The following section provides information on existing data for the SSSMGP Site beginning with a summary of previous investigations, followed by a description of physical features (e.g., existing structures, topography, geology, hydrogeology), an evaluation of useable chemical and biological data with comparison to screening level (SL) criteria, and a review of habitat characteristics, property ownership, and cultural resources for the Site.

3.1 SUMMARY OF PREVIOUS INVESTIGATIONS

Environmental and geotechnical investigations have been previously conducted at the SSSMGP Site and adjacent properties. These investigations contain information on sediment, surface water, groundwater, and soil quality; the results of which were used in the evaluation of data gaps for the RI (refer to Section 5). A brief summary of data obtained from the previous investigations is provided below. A vicinity map with previous exploration locations is shown on Figure 3. Relevant historical data for the Site are summarized in tables presented in Appendix A.

Historical data that were evaluated for possible inclusion in this RI/FS Work Plan originated from the following investigations:

- Soil and Foundation Investigation – Rittenhouse-Zeman 1979 (for City)
- Boulevard Park Site Assessment – EPA 1984a
- Site Hazard Assessment for Boulevard Park – E & E 1991 (for Ecology)
- Whatcom Waterway RI/FS – Anchor and Hart Crowser 1996/1998 (for Port)
- Chemical Evaluation of Intertidal Sediments at Boulevard Park – Norton and Summers 1998 (for Ecology).
- Boulevard Park Preliminary Groundwater Assessment – Erickson and Cubbage 1998 (for Ecology).
- Letter Report for Focused Site Characterization, Pavilion Donation Project, Boulevard Park – Integral 2007 (for City)
- Feasibility Report, Boulevard Park Shoreline and Overwater Walkways – Reid Middleton 2009 (for City)
- Sediment Site Characterization Evaluation of Bellingham Bay Creosote Piling and Structure Removal, Cornwall Avenue Landfill Mapping, Boulevard Park Overwater Walkway Feasibility, and Dioxin Background Sampling and Analysis – Hart Crowser 2009 (for Ecology).
- Geotechnical Exploration Study, Boulevard Park Overwater Walkway Project – GeoEngineers 2009 (for City)

This section briefly summarizes the activities conducted, the types of chemical and physical data collected, and observations made during each of these investigations. The usability of the chemical data for the RI/FS was evaluated based the following considerations:

- ***Data Sources***—Evaluate the type and age of data collected (screening data, fixed laboratory data, etc.) and whether QA/QC samples are available for the data to provide data quality information.
- ***Analytical Methods and Detection Limits***—Evaluate methods for appropriateness and sensitivity and determine if detection limits are low enough for comparison to MTCA and SMS.
- ***Data Quality Indicators***—Review laboratory validation reports for data quality issues.
- ***Consistency of Data Collection Methods***—Evaluate sample collection methods for appropriateness for the chemical, media, and analysis; review field notes to assess quality of sample collection; and determine if differences in sample collection exist between different sampling events and investigations.

3.1.1 Rittenhouse-Zeman 1979 Soil Investigation

Rittenhouse-Zeman, on behalf of the City, conducted a soil and foundation investigation in support of the development of Boulevard Park in early 1979. The investigation consisted of excavating 10 test pits (TP-1 through TP-10) and drilling five soil borings (B-1 through B-5) to depths ranging from 1.2 ft and 12 ft below ground surface (bgs). Soil was described in field logs for each location, but no physical or chemical testing was conducted. Subsurface soil conditions observed in the study were considered for designing various new facilities at the park including a picnic shelter, restroom facility, pedestrian bridge, and parking areas. The soil logs also included visual and olfactory observations of potential contamination. Station locations are shown on Figure 3.

3.1.2 EPA 1984 Site Assessment

In May 1984, the EPA completed a preliminary environmental site assessment (ESA) of soil in the vicinity of the Site. The evaluation was conducted in response to observations made by City personnel during the development of the park in the late 1970’s and early 1980’s (personal communication with Byron Elmendorf and John Ivary and various City records/archives). Twenty-two surface soil (0 to 6 in) and 19 subsurface soil (3 ft depth) samples were collected in the lower and upper upland portions of Boulevard Park (EPA 1984a). Each soil sample was analyzed for PAHs using unspecified screening analytical methods. The results were not included in the project database because the data are over 25 years old and original laboratory data certificates are not available for review. The data were used to help in the selection of additional soil and groundwater station locations in support of completing the Site RI/FS (refer to Section 6).

3.1.3 Ecology 1991 Site Hazard Assessment

Ecology and Environmental Inc. (E&E), on behalf of Ecology, conducted a hazard assessment of the Site area to evaluate the potential environmental and public health hazards and to determine the ranking of the Site using the Washington Ranking Method (WARM). Four surface [(0 to 10 centimeters (cm)] sediment samples, three subsurface (1 to 2 ft) sediment samples, and one surface water sample were collected in the vicinity of the public dock and pocket beach on the northern end of Boulevard Park as part of a site hazard assessment (E&E 1991) (Figure 3). Five surface soil samples (unknown depth) were also collected in the upper park area of the Site. Additional soil and surface water samples were collected within and adjacent to a ditch between the upper park and the BNSF railroad tracks located along the shoreline. VOCs and semivolatile organic compounds (SVOCs) were analyzed for each media. The data are included in the project database and used in evaluating data gaps and additional sampling in support of the RI/FS.

3.1.4 Whatcom Waterway RI/FS (1996/1998)

Georgia Pacific Corporation conducted a RI/FS on the Whatcom Waterway site in 1996 and 1998 (Anchor and Hart Crowser 2000). Two surface sediment grab samples (0 to 9 cm) were collected in the vicinity of the public dock at Boulevard Park in support of this study (Figure 3). Sediment samples collected from stations AN-SS-301 and -304 were analyzed for total organic carbon (TOC), metals, grain size, and SVOCs. These data were carried forward for use in the Site RI/FS and included in the project database.

3.1.5 Ecology 1998 Intertidal Sediment Investigation

Ecology conducted a sediment investigation at Boulevard Park to assess whether or not a sediment station cluster of potential concern was present, as described in Ecology’s SMS (173-204-510). Six surface sediment samples (locations BLVD1 through BLVD6) were collected from a depth of 0 to 10 cm for chemical analysis (Norton and Summers 1998) (Figure 3). All samples were analyzed for conventionals (e.g., TOC), metals, and SVOCs using Puget Sound Estuary Program (PSEP)-recommended methods. These data were carried forward for use in the Site RI/FS and included in the project database.

3.1.6 Ecology 1998 Preliminary Groundwater Assessment

A qualitative groundwater assessment was also conducted by Ecology in the upland portions of the Site to assess whether contaminants could migrate via groundwater to Bellingham Bay (Erickson and Cubbage 1998). Nine test holes (TH-1 through TH-9) were drilled to depths ranging from 1 to 15 ft to determine depth to groundwater and bedrock and physical soil characteristics (Figure 3). No analytical data were collected but information gathered was considered in evaluating data gaps and additional sampling in support of the RI/FS.

3.1.7 City of Bellingham 2007 Soil Investigation

Two soil borings (COB-BLVD-01 and -02) were advanced within the footprint of a proposed park shelter planned for construction in the lower section of the Site (Figure 3) (Integral 2007). Selected soil samples were collected from the borings and analyzed for metals, total petroleum hydrocarbons (TPH), and SVOCs. These data were carried forward for use in the Site RI/FS and included in the project database.

3.1.8 City of Bellingham 2009 Feasibility Study, Overwater Walkway

In 2008-2009, Reid Middleton, under contract with the City, conducted a feasibility study of the Boulevard Park shoreline and proposed overwater walkways. The purpose of the feasibility study was to assess alternatives and evaluate the issues involved in the proposed construction of a new overwater walkway from Boulevard Park to the Cornwall Avenue Landfill, and associated improvements to the existing Pattle Point overwater trail and the park shoreline area. The study included:

- Structural integrity inspection of the Pattle Trestle (Echelon Engineering 2008)
- Eelgrass survey of the shoreline (Grette 2008 & 2009)
- Biological evaluation of the proposed trestle renovation (Grette 2009)
- Shoreline assessment of for potential shoreline improvements (Reid Middleton 2008)
- Preliminary geotechnical evaluation of the proposed Boulevard Park shoreline and overwater walkway work (GeoEngineers 2009)
- Archeological assessment of the area (Wessen & Wahl 2009)
- Focused ESA report (Herrenkohl and Landau Associates 2009).

The focused ESA was intended to define the characteristics and extent of contamination in the soil and sediments along the proposed overwater walkway and within the shoreline redevelopment area. In support of this evaluation, 9 surface sediment samples and 9 sediment vibracores were collected within the proposed alignment of the overwater walkway. Five of these locations are near or within the preliminary SSSMGP Site boundaries (Figure 3). Selected sediment samples were analyzed for conventionals (e.g., TOC), TPH, SVOCs, metals, chlorinated pesticides/PCBs, and physical characteristics (e.g., grain size). These data were carried forward for use in the Site RI/FS and included in the project database.

3.1.9 Ecology 2009 Sediment Site Characterization Study of Bellingham Bay

Ecology conducted sediment site characterizations in support of several cleanup and restoration projects in Bellingham Bay (Hart Crowser 2009). Two surface sediment grab sample (0 to 12 cm) were collected in the vicinity of the pocket beach and preliminary SSSMGP site boundary (Figure 3). The sediment samples collected from stations BBP-SS-02 and BBP-SS-03 were analyzed for TOC, ammonia, total sulfides, grain size, metals, TPH, SVOCs, and dioxins/furans.

Sediment from BBP-SS-02 was also tested for specific gravity and bioassays. These data were carried forward for use in the Site RI/FS and included in the project database.

3.1.10 City of Bellingham 2009 Geotechnical Study, Overwater Walkway

In 2009, GeoEngineers conducted a geotechnical investigation for the City in support of the design for the proposed overwater walkway. Six sediment borings were drilled along the proposed alignment of the overwater walkway ranging in depth from 45 to 102.5 ft below mudline. The borings were used to characterize the geology of the subsurface and to develop a generalized cross-section of the subsurface. Sediments were described on field logs for each location, but there was no chemical testing conducted on the sediments. Station locations are shown on Figure 3. These data were carried forward for use in the Site RI/FS and included in the project database.

3.2 PHYSICAL FEATURES

This section describes the physical characteristics of the Site and surrounding areas including Site structures, topography, bathymetry, geology, hydrogeology, and sediment and water dynamics. These Site features are important in the context of understanding the preliminary conceptual site model discussed in the next section of the report.

3.2.1 Site Structures

The SSSMGP Site has a number of structures within its boundaries including a former public pier, wharf structure and retaining wall, covered stage, restroom, pedestrian bridge, gas holder tank, and small brick building (Figure 2). The public pier is located in the north end of the study area and consists of a short (~100 ft) wharf that parallels the shoreline and a small (~50 ft) pier that extends into the bay. The pier is constructed with wood planks over stringers and pilings and is currently closed to the public due to structural problems and safety issues. A park shelter is located on the eastern end of the grassy field in the lower portion of the park. The shelter was constructed in 2009 and consists of a raised concrete-formed stage, with a mural wall and an inverted roof. A restroom facility is also located in the northern portion of the lower park. It was constructed during the development of the park in 1979 and is approximately 700 ft^2. A pedestrian bridge connects the upper park with the lower park over the active railroad tracks and is located in the center and on the western edge of the SSSMGP Site. The bridge was also built during the development of the park and is approximately three stories high and spans the width of the railroad right-of-way. In the upper park area, there is a historical gas holder tank and concrete foundations, which are remnants of the manufactured gas plant. The tank is approximately 50 ft in diameter and 20 ft high. The tank is currently surrounded by Cyprus trees and English ivy, blending in with the park setting. The top of the tank has been capped with asphalt with a sheltered picnic area and the concrete stairs around the side the tank appear to have become covered with soil. A small brick building currently used for park storage is located on the southern boundary of the park and borders South State Street. This small building is approximately one story high and 425 ft^2, and reportedly may have been used as an electric/generator building during the operation of the gas plant (refer to Section 2.1).

3.2.2 Topography and Bathymetry

The topography and bathymetry of the SSSMGP Site area has a stepped plateau form. The area has two main plateaus or flat areas and three sloped surfaces (Figures 3 and 4). The east side of the study area, next to South State Street, is approximately 80 ft above sea level and is the highest elevation on the Site. As one moves west from South State Street, a narrow slope drops approximately 15 to 20 ft, then the land flattens out and forms the first plateau, which is also the location of the upper portion of the park and the previous MGP location. The upper portion of the park and South State Street have been modified by human development, which likely included cutting into the sandstone bedrock to develop the road and enhance the gas plant's operating room and structures. Additionally, during construction of the park, an unknown amount of fill was placed on the upper plateau to cover impacted soil, old concrete foundations, and create a friendlier park environment. West of the first plateau is another slope drop of approximately 35 ft after, which point the land flattens out again and forms another plateau. Railroad tracks are located at the base of the slope and create a small rise of less the 5 ft within the second plateau. The second plateau is the location of the lower portion of Boulevard Park as well as the location of the historic lumber mill. Filling the tidal flats with local materials created the lower portion of the park. The topography and bathymetry of the west end of the Site is split nearly down the middle with the southern half of the area dominated by the flat lower portion of the upland park and the northern half of the area dominated by the aquatic land portion of the Site. The marine zone continues to slope beneath the surface of the bay and drops to depths of approximately -20 ft MLLW (refer to Figures 3 and 4).

3.2.3 Geology

This section describes both the regional and Site geology. Regional geologic information was obtained from the Geologic Map of Western Whatcom County, Washington (USGS 1976) and the draft RI/FS for the former Cornwall Avenue Landfill (Landau Associates 2007). Site geologic conditions are based on information provided during the previous investigations described in Section 3.1.

3.2.3.1 Regional Geology

Geologic units presented in this section are discussed from deepest to shallowest. Bedrock within the vicinity of the Site consists of predominately sandstone with occasional interbedded shale and siltstone of the Chuckanut Formation. This geologic unit is thought to have originated as alluvial flood plain deposits during the Paleocene epoch over 60 million years ago. Overlying the Chuckanut Formation is glacial marine drift. These sediments were deposited as rising sea levels floated and melted Pleistocene glacial ice. The glaciomarine drift consists of unsorted, unstratified silt and clay with varying amounts of sand, gravel, cobbles, and occasional boulders. The glacial marine drift is typically overlain by fine-grained sediments deposited in Bellingham Bay by the Nooksack River. Boring logs from the former Cornwall Avenue Landfill site indicate that the Nooksack deposits generally consist of green-gray silt, or green-gray silty clay and sandy silt (Landau Associates 2007).

3.2.3.2 Site Geology

In general, the geology of the lower upland portion of the Site consists of mostly fill material, a thin layer of beach deposits, and bedrock (Figure 4). The fill material consists of sand and silt with occasional clay and gravel. The fill material contains varying amounts of wood debris (chips, bark, logs, etc). Bricks and other miscellaneous debris were also observed in the fill material at some locations. The thickness of the fill material is approximately 23 ft in the center of this area of the Site but decreases to about 10 ft farther east. A 2 ft thick beach deposit consisting of silty, clayey, fine to medium sand with shell fragments was encountered below the fill material at borings (COB-BLVD-01, -02), located in the center of the lower portion of the Site. Bedrock was encountered immediately beneath the fill material and beach deposits.

The soil in the upper portion of the Site consists of a fill material, primarily a sandy silt and silty sand. The fill material contains varying amounts of wood and other debris such as brick fragments, coal fragments, and clinkers. Bedrock is encountered immediately beneath the fill. The depth to bedrock ranges from 1.0 ft to 20 ft bgs. The deepest depth to bedrock was encountered in the southwest section of the upper portion of the Site near the footbridge. Bedrock is exposed along portions of the slope separating the upper and lower portions of the Site and along the slope separating the upper portion of the Site and South State Street.

3.2.4 Hydrogeology

Hydrogeologic conditions at the Site were evaluated using geologic data from previous investigations (Rittenhouse-Zeman 1979, Erickson and Cubbage 1998, Integral 2007). Soil boring logs and test pit information, indicate two principal hydrostratigraphic units beneath the Site (Figure 4). The uppermost unit consists of fill material made up of silts and sands in both the upper and lower portions of the Site. Groundwater was encountered in this unit at some locations. The second unit is bedrock that consists of the sandstone of the Chuckanut Formation. Regionally, the unit acts as an aquitard but could act as an aquifer in some areas where it is highly fractured. For the purposes of this RI, the Chuckanut Formation is assumed to act as an aquitard at the Site.

In the upper portion of the Site, the surface of the Chuckanut Formation appears to be sloping toward the shoreline (Figure 4). With the Chuckanut Formation acting as an aquitard, the sloping surface, appears to result in a thin, perched groundwater zone in the overlying soil/fill material. During the groundwater assessment conducted in April 1994 (Erickson and Cubbage 1998), groundwater was not encountered in many of the test holes drilled in the upper portion of the Site. At locations where groundwater was encountered, the thickness of groundwater saturated soil was only 2 to 3 ft.

In the lower portion of the Site, depth to bedrock is much deeper and the saturated zone in the overlying soil/fill material appears to be much thicker (Figure 4). During previous investigations

(Rittenhouse-Zeman 1979, Integral 2007), groundwater was encountered between 6 and 10 ft bgs. Some tidal influence on groundwater in this portion of the Site is expected; however, no tidal studies have been conducted to date. At the Cornwall Landfill site, located less than one-half mile north of the Site, the tidal influence on groundwater was estimated to extend about 100 ft inland from the shoreline (Landau Associates 2007).

3.2.5 Sediment and Water Dynamics

The sediment and water dynamics in the vicinity of the SSSMGP Site are driven by a complex interplay of forces including deep water ocean currents, tides, river discharges, and wind. The Site is located on the boundary of what has been called the upper Bellingham Bay area and the Inner Harbor. The currents in this area are generally powered by a fairly steady deep water current (>20 m) that brings Pacific Ocean water from Rosario Strait in through the south end of Bellingham Bay and westward. The westward moving deep current eventually encounters the powerful discharge of the Nooksack River located in the northwest corner of the bay and mixing ensues [U.S. Army Corps of Engineers (USACE) 1977]. The currents on the surface of the bay are highly influenced by the discharge rates of the Nooksack River and the wind (Colyer 1998 and Shea et. al. 1981). The primary surface currents of the bay are clockwise in nature, but counter-clockwise rotations can occur depending on the wind direction. Several studies have suggested that an eddy may form north of the Site to the mouth of the Whatcom Waterway (Collias et al. 1966, USACE 1977, Coyler 1998). This eddy generally functions in a clockwise rotation and its location is dependent on the tide level as well as the discharge rates of the Nooksack River and Whatcom Creek (Coyler 1998). As a result of this eddy, surface water at the Site is generally flowing in a southwestern direction and a depositional environment is created along its shoreline. The longshore drift near the Site can vary with the wind and does not have a dominate direction (Ecology 2010b).

The mean tidal range in Bellingham Bay is 5.2 ft with a typical diurnal range of about 8.6 ft; however, tidal elevations can be increased by storm surges and tsunamis (RETEC 2006). The salinity of the surface water in the vicinity of the Site can range from 10 to 25 parts per thousand (ppt) with salinity of the deeper waters ranging from 26 to 30 ppt. Salinity can be lowered by large flooding events in the Nooksack River and Whatcom Creek, as well as higher salinities during the incoming tides (Coyler 1998). The water temperatures of the bay vary with depth and seasonal air temperature, but can range from 8 to 13 degrees Celsius (Colyer 1998). The total suspended solids (TSS) near the Site was measured by Coyler (1998) and reported to have 3 to 25 milligrams per liter (mg/L) surface water concentrations and a 1 to 32 mg/L deep water concentration, with an average of 10 mg/L across the water column.

There is no sedimentation rate information for sediments within the preliminary Site boundary but sedimentation rates have been evaluated for other parts of Bellingham Bay as part of the Whatcom Waterway Site RI/FS (RETEC 2006 and references therein). Data collected in support of the RI/FS indicates much of the inner Bellingham Bay area, including the area between Boulevard Park and Cornwall Avenue Landfill, is depositional with the Nooksack River as a primary sediment source. Sedimentation rates were calculated for the Whatcom Waterway Site using four estimation methods including the onset of Cs-137 activity, peak of Cs-137 activity, Pb-210 decay, and peak mercury concentration (RETEC 2006). The average net sedimentation rate calculated for inner Bellingham Bay was 1.6 cm/yr (range from approximately 1.5 to 1.8 cm/yr). A similar sedimentation rate is expected for aquatic lands within the preliminary Site boundary.

3.3 SOIL AND SURFACE WATER CHEMICAL DATA

Soil and surface water chemistry data are summarized in this section with comparison, as appropriate, to preliminary SL criteria. No chemical data are available for groundwater at the Site.

Preliminary Site soil SLs were developed for those constituents detected in soil samples collected during previous investigations. The SLs were developed to be protective of humans, groundwater (as marine surface water), and terrestrial ecological receptors. The soil SLs protective of human health were developed using applicable human health risk assessment procedures specified in WAC 173-340-708. These procedures include development of SLs based on the reasonable maximum exposure to occur at the Site. Ecology has determined that residential land use is generally the site use requiring the most protective SLs and that exposure to hazardous substances under residential land use conditions represents the reasonable maximum exposure scenario. The Site is currently used as a park; therefore, soil SLs protective of human health were developed based on the requirements under WAC 173-340-740 for unrestricted (residential) land use. Under WAC 173-340-740, Method B soil cleanup levels must be as stringent as:

- Concentrations established under applicable state and federal laws
- Concentrations protective of direct human contact with soil
- Concentrations protective of groundwater.

These criteria were considered during development of the soil SLs.

Except for naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, standard MTCA Method B soil SLs protective of direct human contact were determined in accordance with WAC 173-340-740(3) using Ecology's Cleanup Levels and Risk Calculations (CLARC) database. The MTCA Method A soil cleanup levels for unrestricted site use were used to address naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene in soil. The SL for benzo(a)pyrene (BAP) is used for the sum of carcinogenic PAHs (cPAHs). A toxicity equivalency quotient (TEQ) for total cPAHs is calculated from the toxicity equivalency factors (TEFs) for cPAHs in accordance with WAC 173-340-708(8)(e).

Soil SLs protective of groundwater were determined using the fixed parameter three-phase partitioning model in accordance with WAC 173-340-747(4). Because groundwater is not a current or likely future source of drinking water and because it discharges to marine surface water, as described in Section 4.4, groundwater SLs were developed based on marine surface water cleanup levels protective of human health and aquatic organisms in accordance with WAC 173-340-730.

Soil SLs protective of terrestrial ecological receptors were developed using the ecological indicator soil concentrations for protection of terrestrial plants and animals listed in MTCA Table 749-3.

To develop a single soil SL for each constituent, the lowest protective criterion was selected as the cleanup level. For metals, if the selected criterion was below the natural background level, the SL was adjusted upward to the background concentration in accordance with WAC 173-340-740(5)(c). The preliminary soil SLs are shown in Table A-1 in Appendix A.

Six soil explorations were conducted previously in the lower portion of the Site. These include two test pits and four soil borings. Soil samples for laboratory analysis were collected from only two of the soil borings (COB-BLVD-01 and -02; Integral 2007). As shown in Table A-2, metals (lead, mercury, and zinc), PAHs, and diesel-range and motor oil-range petroleum hydrocarbons exceed preliminary SLs at these locations. Visual and olfactory evidence of contamination was also reported at depth in these soil borings and at soil boring B-2, and test pits TP-3 and TP-10 (Rittenhouse-Zeman 1979).

Two shallow test pits, five shallow test holes, and one soil boring were previously completed in the upper portion of the Site. The logs for these samples are available but no samples were collected for laboratory analysis. Olfactory evidence of contamination was reported in soil boring B-5 (Rittenhouse-Zeman 1979). Five surface soil samples (SS-2 through SS-6) were also collected in the upper portion of the Site and analyzed for SVOCs and VOCs (E&E 1991). The depth of these samples and logs for these samples are not available. The analytical results indicate that cPAHs were present in samples SS-4, SS-5, and SS-6 at concentrations exceeding SLs. The SLs and analytical results for these samples are summarized in Tables A-1 and A-2.

Only one surface water (or stormwater) sample was collected previously for the Site (E&E 1991). The sample (SW-01) was collected from a stormwater outfall that discharges into Bellingham Bay and located within the preliminary boundary of the SSSMGP Site (Figure 3). Only VOCs were tested on the surface water sample[1] and one compound, Freon, was detected at a concentration of 0.3 µg/L. This concentration is below the MTCA SL for this compound.

3.4 SEDIMENT CHEMICAL AND BIOLOGICAL DATA

Sediment chemistry and biological testing data are summarized in the following sections with comparison, as appropriate, to SL criteria and biological effects endpoints, respectively (Figure 3 and figures from Herrenkohl and Landau Associates 2009 presented in Appendix A).

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[1] E&E's report states that SVOCs were previously tested on surface water from this location, but results were unavailable.

3.4.1 Sediment Chemistry

Available onsite historical chemical data for sediments described in Section 3.1 were compared to SL criteria (refer to Tables A-3 and A-4 in Appendix A). There are no human health sediment benchmarks, but there are ecological sediment benchmarks[2]. Screening benchmarks for sediment were obtained from the Marine SMS, WAC 173-204 (Ecology 1995, 2008a) and the Apparent Effects Threshold (AET) values (PSEP 1998). Sediment results for non-ionizable chemicals (e.g., PAHs) were organic carbon-normalized when TOC concentrations were between 0.5% to 3.5% per current Ecology guidance (personal communication with Dr. Peter Adolphson of Ecology). Results of the sediment chemical analysis of organic carbon-normalized data were compared to SMS marine criteria, including sediment quality standards (SQS) and cleanup screening levels (CSLs) as described in WAC 173-204-320. Samples with TOC concentrations outside the 0.5% to 3.5% range were compared to AET values including Lowest Apparent Effects Threshold (LAET) and Second Lowest Apparent Effects Threshold (2LAET) in accordance with SMS protocols.

The marine SQS and LAET numerical chemical concentration criteria define the degree of sediment quality that is expected to cause no adverse effects to biological resources in Puget Sound marine sediments. The CSL and 2LAET represent concentrations above which adverse biological effects may, under certain conditions, be considered significant. The SLs were prioritized such that the minimum value of the screening values was used as the SL.

There are no criteria for TPH in the SMS. The lowest available SL in MTCA is the ecological indicator soil concentration [200 milligrams per kilogram (mg/kg)] for protection of terrestrial plants and animals (MTCA 173-340-900, Table 749-3). Based on discussions with Ecology, a lower SL of 50 mg/kg for TPH should be used for sediments. This lower SL is based on best professional judgment and TPH and PAH comparisons from other sites in Puget Sound (Integral 2008, Herrenkohl and Landau Associates 2009).

Data from a total of 18 Site surface sediment samples (0 to 9 cm, 0 to 10 cm, and 0 to 12 cm) were available for comparison to SLs; these data were generated from several of the historical investigations discussed in Section 3.1 (Figure 3 and Appendix A). Selected samples were analyzed for VOCs, SVOCs, TPH, and conventional parameters (e.g., TOC). Dioxins and furans were also analyzed and detected in two surface samples (BBP-SS-02 and BBP-SS-03) collected in support of Ecology's Bellingham Pile Study (Hart Crowser 2009). Site surface samples had 145 analytes with detected concentrations exceeding SLs (Table A-3, Appendix A). SL exceedances were found for the following analyte classes (number of individual analytes indicated in parentheses): SVOCs (143) and metals (mercury = 2). Most of the SVOC exceedances (137) were for PAHs, with most exceeding the higher 2LAET or CSL SL. There were more SL exceedances in surface sediments collected from investigations in 1991 and 1998 when compared with the more recent studies from 2008 and 2009. Lower levels of chemicals in surface sediments observed in 2008 and 2009 can be explained by recent sediment deposition in this portion of Bellingham Bay (Retec 2006, Herrenkohl and Landau Associates 2009). Over

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[2] Human health benchmarks are based upon accumulation of all exposure pathways and the affected populations, but not upon strict direct numerical criteria.

time, cleaner sediments from the Nooksack River and local creeks may have mixed with and covered the impacted sediments.

Subsurface sediment samples were collected from eight locations within or adjacent to the SSSMGP Site (Figure 3 and Appendix A). Sediments were collected from depths of 2 ft to 14 ft below mudline and selected samples analyzed for metals, SVOCs, TPH, and conventional parameters. Subsurface sediment samples had 109 analytes with detected concentrations exceeding SLs (Table A-4, Appendix A). SL exceedances were determined for SVOCs (107) and metals (mercury = 2). PAHs had the most SL exceedances (106) with most above the higher threshold of 2LAET[3]. Subsurface sediments near the Site have SL exceedances to at least 6 ft below mudline based on sample results for BLVD-SC-01, -02, and -04. From the current dataset, the extent of SL exceedances in subsurface sediments appears to be contiguous between the pocket beach and east side of the pier (Figure 3 and figures from Herrenkohl and Landau Associates 2009 in Appendix A).

3.4.2 Sediment Bioassays

Several surface sediment samples previously collected within the Site were tested for bioassays including AN-SS-301 and AN-SS-304 (Anchor and Hart Crowser 2000 and references therein), BBP-SS-02 (Hart Crowser 2009), and BLVD-SS-01 (Herrenkohl and Landau Associates 2009) (refer to Figure 3). Screening benchmarks for sediment bioassay tests were obtained from the SMS (WAC 173-204, Ecology 1995, 2008a). Sediment bioassays are the definitive tool for evaluation of ecological risk in marine systems. The following marine bioassay tests were conducted on previous surface samples:

- Acute Amphipod (*Eohaustorius estuarius*) 10-day mortality test (Ecology 2008a)
- Acute Larval (*Mytilus galloprovincialis*) development test (Ecology 2008a)
- Chronic Juvenile Polychaete (*Neanthes arenaceodentata*) 20-day mortality and growth test (Ecology 2008a).

Under the SMS program, a sediment treatment fails SQS if mean amphipod mortality is statistically significantly higher than that of the reference treatment, and mean mortality in the test sediment is greater than 25%. Treatments fail the CSL if the test treatment mortality is both statistically significantly different and 30% greater than the reference sediment. Percent mortality for all samples was not significantly greater than the associated reference samples and mean mortality for test sediment samples was less than the 25% and 30% criteria. Therefore, all test sediments for amphipod mortality passed both SQS and the one-test criterion for CSL.

For the larval test, a sediment test fails SQS criteria if the number of normal larvae in the test treatment is significantly different than that of the reference and the combined mortality and abnormality (CMA) in the test treatment is greater than 15% of the CMA in the reference. Treatments fail CSL criteria if the CMA is greater than 30% of the response observed in the

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[3] All subsurface sediment samples analyzed either contained TOC content greater than 3.5% or TOC was not reported. Consequently, results for non-ionizable chemicals were compared to the AET values.

reference. There were no significant decreases in normal development for any of the samples compared to their corresponding reference samples. Statistically significant decreases in normal development were observed in test and reference sediment samples relative to seawater controls. Relative to their respective reference treatments, normal development in each of the larval test treatments met the numeric threshold for both SQS and CSL criteria; thus, passing the overall criteria.

Suitability determinations for the juvenile polychaete test were based on mean individual growth rates (MIG). A test treatment will fail SQS criteria if MIG is statistically lower in the test treatment, relative to the reference, and MIG in the test treatment is 70% less than the reference treatment. The treatments will fail CSL criteria if MIG is significantly lower than the reference treatment and is 50% less than the reference treatment. The MIG in BLVD-SS-01 was significantly lower than its corresponding reference sediment, although it did not fail the mean growth thresholds of less than 70% or 50% reference mean growth. It was noted that the MIG in BLVD-SS-01 was also significantly lower than the control (Herrenkohl and Landau Associates 2009). All test sediments passed both SQS and the one-test criterion for CSL.

3.4.3 Wood Debris

Wood debris (e.g., chips, bark) was observed in many of the sediment samples collected in the vicinity of the preliminary site boundary. In the sediment cores, wood debris or highly organic sediments ranged from approximately 4 ft to 9 ft thick (BLVD-SC-05). The wood debris was covered with a thin layer (6-inches to 1 ft) of fine grained or sandy sediment in several of the cores. Surface sediment (0 to 12 cm) collected at station BBP-SS-03 was almost entirely composed of wood chips (Hart Crowser 2009). The likely source(s) of the wood debris was activities associated with the E.K. Wood sawmill and extensive rafting of logs in this portion of Bellingham Bay (refer to Section 2.2).

3.5 HABITAT CHARACTERISTICS

The SSSMGP Site area consists of three distinct habitat communities, each with a unique set of characteristics, as well as plant and animal species. The three habitat communities are the subtidal, intertidal, and the marine riparian zones.

The subtidal zone extends from extreme low or low water (ELLW) to approximately 100 meters water depth [Washington State Department of Fish and Wildlife (WDFW) 2010]. Subtidal areas within the Site consist of rocky substrate, fine sediment substrate, wood waste, fill material, and native vegetation such as eelgrass and macroalgae. A number of federally listed threatened and endangered species potentially may utilize the study area. These include Pacific salmonids and trout [Chinook (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*)], and marbled murrelet (*Brachyramphus marmoratus*) (Grette & Associates 2009). In addition, a number of WDFW priority habitat species have been identified as potentially utilizing Bellingham Bay including surf smelt, Pacific sand lance, Pacific salmonids and trout (Coho, Chum, Chinook, Pink, Sockeye, and Cutthroat), a number of groundfish (e.g., starry flounder), a variety of clams, geoduck, oysters, various shrimp, crabs, a variety of small and large marine invertebrates, and a variety of marine mammals (harbor seal, sea lions, Orca whale, gray whale, and harbor porpoise) (WDFW 2010, RETEC 2006).

The intertidal zone extends from the Ordinary High Water Mark (OHWM) to the ELLW (WDFW 2010). Intertidal areas within the Site consist of rocky substrate, sand and gravel beaches, armored shoreline, historical piers and pilings, and native vegetation such as eelgrass and emergent vegetation. Similar to the subtidal zone, the intertidal zone potentially may include the federally listed Pacific salmonids and trout species, as well as the seabird marbled murrelet (Grette & Associates 2009). A number of WDFW priority habitat species may be found utilizing the intertidal habitat within the study area including various marine invertebrates, shrimp, clams, oysters, crabs, groundfish, surf smelt, Pacific sand lance, Pacific salmonids and trout, seabirds and waterfowl (e.g., widgeon, scoter, golden eye glaucous-winged gulls and pigeon guillemots), bald eagles, and peregrine falcon (WDFW 2010, RETEC 2006).

The marine riparian zone extends inland from the OHWM to that portion of the terrestrial landscape that is influenced by, or that directly influences, the aquatic ecosystem (WDFW 2010). The marine riparian zone within the study area consists of the developed landscape of Boulevard Park (lawns, buildings, trails, and parking lots), the railroad right-of-way, armored shorelines, residential buildings and apartments, and a small forested slope area. The forested slope area consists of a mixed deciduous and conifer forest with an under story of shrubs and herbaceous plant species. The plant species include, but are not limited to, red alder (*Alnus rubra*), western hemlock (*Tsuga heterophylla*), big leaf maple (*Acer macrophyllum*), Douglas fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea stichensis*), shore pine (*Pinas contorta*), salmonberry (*Rubus spectabilis*), oceanspray (*Holodiscus discolor*), Himalayan blackberry (*Rubus armeniacus*), and English Ivy (*Hedera helix*). A number of WDFW priority habitat species may utilize the Site marine riparian zone and include a variety of birds and waterfowl, similar to those found in the intertidal zone.

3.6 PROPERTY OWNERSHIP, USE, AND ZONING

Current property owners and zoning within the SSMGP Site area are shown on Figure 5. The entire Site is zoned for public land use – Boulevard Park. There are three property owners including the City, BNSF, and the State. The upper and slope areas of the Site are owned by the City. The inner harbor line delineates the property boundary between BNSF and State lands, managed by WDNR. WDNR and the City are currently negotiating a lease for continued use of the property in the lower park area and aquatic lands between the north end of Boulevard Park and the historical Cornwall Avenue landfill to the north. A proposed future improvement of the park and adjacent aquatic lands is an overwater walkway connecting Boulevard Park with the former Cornwall Avenue landfill. The project is currently in the engineering and design phase including obtaining required permits.

Current uses in the aquatic land area of the Site include transit and transient moorage use by recreational vessels (e.g., kayak use of the pocket beach). Some tribal, recreational, and commercial fishing and shellfish activities may also occur seasonally. Deepwater navigation is restricted in this area due to the proximity of natural shallow-water obstructions (e.g., Starr

Rock), and by the lack of adjacent upland navigation support facilities (RETEC 2006). No changes to these existing uses are anticipated.

Drinking water for the Site is currently supplied by the City of Bellingham. Site groundwater is not considered to be a suitable source of drinking water due to its proximity to marine surface water and its limited productivity as a domestic water supply. This assumption will be verified during the RI by analyzing some or all of the groundwater samples for total dissolved solids (TDS). In accordance with WAC 173-340-720(2)(b), groundwater containing TDS at concentrations greater than 10,000 mg/L shall not be classified as potable. However, even with TDS results below 10,000 mg/L, Site groundwater would not be considered a reasonable source of drinking water due to likely saltwater intrusion from marine surface water and the availability of a municipal water supply.

3.7 CULTURAL RESOURCES

Archaeological surveys were conducted for portions of Boulevard Park by Wessen and Wahl (2009) and Wessen & Associates (2010). The 2009 assessment of archaeological potential focused on the southern end of the park where improvements to the existing Pattle Point Trestle walkway are proposed by the City. The 2010 cultural resource evaluation was completed for the lower southern portion of the park and surrounding areas in support of the engineering design for shoreline improvements and construction of an overwater walkway between Boulevard Park and the former Cornwall Avenue landfill. Both studies consisted primarily of a literature review, but neither included the upper portion of the SSSMGP Site. The 2010 study by Wessen & Associates also included a pedestrian reconnaissance of the lower portion of the park, noting areas where prehistoric or historic cultural resources could be present.

Both studies included examining relevant archaeological, ethnohistorical, and historical reports to understand the cultural history of the project areas and facilitate identification of potential culturally sensitive areas.

According to both reports, there were no indications of the presence of prehistoric or early historic archaeological deposits or features within the project area, including the lower portion of the SSSMGP Site. It was reported that these areas have been disturbed by a variety of both natural and historic cultural affects (e.g., railroad activities) and the latter may have impacted any archaeological resources.

Although the possibility of encountering cultural artifacts is unlikely, procedures for the identification of prehistoric archeological deposits during sampling activities are presented in the SAP (Section 2.7).

4 PRELIMINARY CONCEPTUAL SITE MODEL

During this phase of the RI/FS, the conceptual site model (CSM) presents a preliminary understanding of Site conditions. The preliminary CSM was developed from the information presented in Section 3 and general knowledge of Site conditions and contaminant transport behavior. Development of a CSM early in the RI/FS process helps identify data gaps and guide collection of data appropriate for assessing risks and remedial actions. The CSM will be refined throughout the project as additional data are collected and Site conditions are better understood. The CSM, illustrated on Figure 6 and discussed in the following sections, includes potential sources and constituents of potential concern (COPCs), transport pathways or mechanisms, and potential exposure pathways for human and ecological receptors.

4.1 SOURCES AND CONSTITUENTS OF POTENTIAL CONCERN

The historical operation of the MGP may be a source of COPCs at the Site. The by-products resulting from the manufacture of coal gas contain a number of different chemical constituents that may be a cause for potential concern to human health and the environment. Based on previous investigations of this Site (Rittenhouse-Zeman 1979, EPA 1984a, Ecology 1991, 1998a, b, Integral 2007, Herrenkohl and Landau Associates 2009) and the COPCs identified in the Management of Manufactured Gas Plant Sites (GRI 1996), these constituents include the following:

- PAHs
- Petroleum hydrocarbons
- VOCs; typically, the VOCs of concern at MGPs are BTEX (benzene, toluene, ethylbenzene, and xylenes) and trimethylbenzenes, collectively referred to as petroleum volatile organic compounds (PVOCs)
- Phenols
- Complexed cyanide compounds
- Metals including antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

A summary of the COPCs for the Site are listed in Table 3.

Table 3. Possible Coal Gas Process Residuals and COPCs (from GRI 1996).

Possible Coal Gas Process Residual	Constituents of Potential Concern
Coal tar/oil tar Tar/oil/water emulsion Tar decanter sludge Coke	PAHs, BTEX, and phenols
Wastewater treatment sludge	PAHs, BTEX, phenols, nitrogen, sulfur, and metals
Spent purifier (oxide/lime) and scrubber wastes Ash	Nitrogen, sulfur, and inorganic compounds (most commonly cyanide)
Oil/fuel tanks	Petroleum hydrocarbons, PAHs, and BTEX

Former coal tar or tar/oil/water emulsions could be present in two forms of a non-aqueous phase liquid (NAPL). A dense NAPL (DNAPL) includes a non-aqueous phase or immiscible liquid that remains as a separate phase or layer and has a specific gravity greater than water. DNAPL has the potential to migrate on top of or along a confining unit or is immobilized as a residual. DNAPLs may flow down the slope of the aquifer bottom in directions that are not the same as the direction of groundwater movement, along preferential transport pathways (e.g., depressions or channels in underlying bedrock). Light NAPL (LNAPL) includes a non-aqueous phase or immiscible liquid that remains as a separate phase or layer and has a specific gravity less than water. Because LNAPLs are less dense than water, they tend to float on top of the water table and are also commonly referred to as a floating product. Typically, LNAPLs are expected to move through the subsurface in the same direction as groundwater moves. DNAPL and LNAPL may exist at the Site, may contain COPCs, and may interact with all media at the Site.

Non-MGP activities on and near the site may be the source of additional COPCs. Other potential sources of contamination to the Site include operations associated with the lumber mill (or various fill materials used to develop the lower park), railroad activities, and stormwater discharges from urban runoff. After the lumber mill closed due to fire, a large area of the shoreline was filled with various construction and wood waste materials. The fill materials could be a source of heavy metals, petroleum hydrocarbons, PAHs, and phenols to soil in the lower Site area and sediments nearshore.

Activities associated with the existing BNSF railroad tracks and the historical railroad tracks that bisect the Site could be a source of petroleum hydrocarbons, including PAHs, to all media in the vicinity of the tracks. Oily products (e.g., creosote) have been reportedly used to treat the wood in the ties and to control vegetation along the tracks.

Outfalls convey nonpoint source runoff from the parking lot in the lower park and from South State Street and the surrounding neighborhood to Bellingham Bay. The outfalls could be a source of petroleum hydrocarbons, PAHs and metals from vehicular activities and general urban runoff.

Former pulp and paper operations associated with the Whatcom Waterway Site is the likely source of mercury and dioxins/furans in sediments of Site aquatic lands.

4.2 POTENTIAL MEDIA OF CONCERN AND MIGRATION PATHWAYS

An overview of the media of concern, potential pathways and receptors is provided on Figure 6.

Infiltration from rainfall could cause contaminants in surface soil to leach to subsurface soil and eventually to groundwater. Shallow groundwater discharges into Bellingham Bay. The groundwater in the lower portion of the Site is also likely hydraulically connected to Bellingham Bay. Contaminants in groundwater or migration of NAPL could eventually reach surface water and sediments in the bay.

Soil contaminants could be carried in surface runoff (e.g., sheet flow) to surface water and discharge to the bay. Some of the contaminants in surface water could bind or adsorb to bottom sediments in the bay. Other surface water contaminants could be carried to the shoreline and the surface water and sediments of the bay.

Soil in areas not covered by vegetation could become airborne and transported by wind. If gasoline-range petroleum hydrocarbons (e.g., BTEX) are present in Site media from historical operations, some volatilization could occur. The other contaminants of interest (e.g., PAHs, metals) are not especially volatile, so volatilization is not likely to be an important transport pathway for them.

Contaminants in surface and subsurface soil could be taken up by plants and soil-dwelling invertebrates. Contaminants in surface water and sediments of the bay could be ingested by benthic organisms (animals and plants living in the sediments). Benthic organisms (infauna and epifauna) could then be ingested by higher animals (e.g., fish, birds, mammals).

4.3 POTENTIAL RECEPTOR POPULATIONS AND EXPOSURE PATHWAYS

Potential human receptors include the following (refer to Figure 6):

- Recreational park users
- Recreational and Tribal fishers
- Maintenance and construction workers, working at the Site
- Residents near the Site

- Workers at other work sites near the Site.

Potential ecological receptors include the following:

- Terrestrial and aquatic plants
- Soil-dwelling invertebrates (e.g., worms)
- Terrestrial animals (e.g., birds, mammals, amphibians, and reptiles)
- Benthic invertebrates (e.g., polychaetes worms)
- Aquatic animals (e.g., shellfish, fish, birds, mammals).

Park users, maintenance and construction workers, and terrestrial animals could be exposed to contaminants in surface soil by direct contact (unintentional ingestion and absorption across the skin) with the soil or by inhalation of airborne particulates. Residents, workers, and terrestrial animals near the Site could inhale dust blown out of the Site. Terrestrial animals could take up contaminants from surface and shallow subsurface soil and consume contaminated plants or soil-dwelling invertebrates while foraging for food at the Site. Park users could be exposed to contaminants by ingesting local plants (e.g., berries).

If Site development or maintenance activities uncovered subsurface soil, Park users, workers, and terrestrial animals could be exposed to the subsurface soil through direct contact or inhalation. Some subsurface soil could become available for windblown transport to residents, workers, and terrestrial animals near the Site.

Ecological terrestrial receptors could be exposed directly to groundwater, because groundwater may be within the active zone for plant roots and burrowing animals (typically 6 ft). Aquatic ecological receptors could be exposed directly to groundwater if groundwater intrudes or “daylights” in the bioactive zone (upper 10 to 20 cm) of the sediments.

Pending future Site investigations, the groundwater will be evaluated to determine its potability. As discussed in Section 4.2, groundwater contaminants could be transported from upgradient sources to Bellingham Bay.

Park users could be exposed to contaminants in surface water and sediments through direct contact while recreationally using the shoreline and beach. Park maintenance workers are likely to have some contact with the beach and shoreline areas of the Site when removing garbage and repairing shoreline structures (e.g., bulkhead, pier). Construction workers could come into direct contact with surface water and sediments in support of shoreline development activities.

If groundwater or surface water contaminants reach Bellingham Bay, humans could be exposed through direct contact with water and sediments while collecting shellfish or wading recreationally and through ingestion of shellfish and fish caught locally.

Terrestrial animals could be exposed to surface water and sediments through direct contact while foraging for prey and through unintentionally drinking the water. Terrestrial animals could also be exposed by eating contaminated prey along the shore.

Birds or aquatic animals preying on shellfish and fish in the bay could also be exposed through direct contact with the surface water and the sediments and through ingestion of the shellfish and fish.

5 DATA GAPS

Data gaps can include the following issues:

- Poor data quality
- Inappropriate analytes
- Lack of data for an area or at depth (spatial)
- Lack of current data (temporal).

In Section 3, the quality of data collected previously within the project area was evaluated. Because of age, data quality problems, or both, the project team will not use any of the chemical data collected prior to 1991. Data from the EPA 1984 study has been excluded from the project database. Most historical samples have been analyzed for the contaminants of interest (TPH, PAHs, phenols, metals). The discussion of data gaps for this RI/FS will focus on spatial and temporal issues, based on the review of available data and locations of Site concentrations that exceed preliminary SL's. The following subsections provide more details on data gaps for each medium at the Site.

5.1 SOIL

The discussion of data gaps in this section covers the upland areas within or adjacent to the Site boundaries. Twenty-one explorations have been completed within the Site boundaries during previous investigations (refer to Section 3.1 and Figure 3). The information collected by Integral (2007) from soil borings located in the lower area is the most recent subsurface soil information available for the Site. The need for additional soil investigation is evaluated by area below and is based on availability of existing data for soil characterization in and adjacent to potential source areas, exceedances of available data to the SLs described in Section 3.3, and the spatial distribution of existing data.

5.1.1 Lower Portion of Site

Six explorations were previously conducted in the lower portion of the Site. These include two test pits to 10 ft bgs and 4 soil borings, which were drilled to depths ranging between 10 and approximately 25 ft bgs. Soil samples for laboratory analysis were collected from two soil borings (COB-BLVD-01 and -02). As shown in Table A-2 (Appendix A), metals (lead, mercury, and zinc); PAHs; and diesel-range and motor oil-range petroleum hydrocarbons exceed preliminary SLs at this location. Visual and olfactory evidence of contamination was also found in soil borings COB-BLVD-01 and -02 at depth as well as in soil in the two test pits. Additional explorations and sample analysis for the COPCs identified in Section 4.1 are required to better evaluate the extent of contamination found at each of these locations and to evaluate whether additional areas of contamination are present near potential source areas (e.g., near the former railroad that was used by the MGP) in the lower portion of the Site.

5.1.2 Upper Portion of Site

Two shallow test pits (TP1 and TP2) and one soil boring (B-5) were previously completed in the upper portion of the Site in 1979. The logs for these samples are available but samples were not collected for laboratory analysis (refer to Section 3.1). However, olfactory evidence of contamination was reported in soil boring B-5. Five surface soil samples (SS2 through SS6) were also collected previously (1991) in the upper area of the Site. The depth and logs for these surface soil samples are not available. A comparison of the analytical results to SLs indicates that PAHs in samples SS4, SS5, and SS6 were detected at concentrations exceeding the preliminary SLs (see Table A-2). Additional data are needed to further evaluate soil quality in the upper portion of the property as follows:

- Soil samples should be collected and analyzed for COPCs where contamination was previously observed but samples were not collected and analyzed.
- Previous chemical analysis of samples only included SVOCs and VOCs. Soil samples need to be collected and analyzed for other COPCs such as metals and cyanide.
- No soil samples were collected near the electrical/generator house where there may have been transformers. Transformers have historically contained PCBs and potential leaks could be a potential source of PCBs in surrounding soil.
- Further investigation of the soil quality within and near the footprints of the existing and former MGP structures (e.g., gas holder, retort house, purifier boxes, and coal sheds) is needed, as well as in the areas where fuel tanks and waste piles were previously located.
- Further investigation should also be conducted to identify areas where spills, leaks, or onsite disposal of MGP by-products may have occurred, if at all.

5.2 GROUNDWATER

No information has been collected to date that can be used quantitatively to evaluate groundwater quality at the Site. Furthermore, information regarding hydrogeologic conditions at the Site is limited to the 1994 groundwater assessment conducted by Ecology (Erickson & Cubbage 1998). The groundwater assessment included an evaluation of depth to groundwater in the upper portion of the Site to qualitatively determine groundwater flow in this area. Nine test holes were drilled to depths ranging from 1 to 15 ft bgs (refer to Section 3.1 and Figure 3). Ecology concluded that groundwater saturated zones are thin and discontinuous due to the shallow depth to bedrock and that the topography of the bedrock surface is the predominate control on the occurrence and movement of groundwater in this upper park area. Test pits and boring logs from earlier and subsequent investigations provide snapshot information on the depth to groundwater in the lower portion of the Site. Due to the limited information for groundwater at the Site, further investigation of the groundwater in both the upper and lower portions of the Site is needed. To better evaluate groundwater flow direction and the seasonal and tidal effects on groundwater at the Site, permanent monitoring wells need to be installed and depth to groundwater at the wells measured. A tidal study will also be needed to evaluate tidal influence on groundwater flow and quality in the lower portion of the Site.

5.3 SURFACE WATER

Except for sheet flow of surface water during storm events, the only source of surface water to the Site is two outfalls discharging stormwater into Bellingham Bay. The source of the stormwater is from South State Street and portions of the South Hill neighborhood (SW-01) and the parking lot in the lower park area (SW-02). Data gaps for surface water (and stormwater) are primarily temporal. Contaminant concentrations in stormwater discharging from local roads are expected to vary over time because of variable inputs from the discharges. Additional stormwater sampling is warranted to provide current data, focusing on discharge areas and identification of other sources to sediments at the Site.

5.4 SEDIMENT

Sediment data gaps are both spatial and temporal. Sediment concentrations are expected to vary to some extent over time because of sedimentation and interactions with marine surface water, so older data may not be entirely representative of current sediment conditions. Surface and subsurface sediment sampling was recently conducted adjacent to the dock and pocket beach located in the aquatic lands portion of the Site. Historical sediment data exceed SMS numeric criteria; however, bioassay tests for surface sediment samples passed SMS criteria. These spatial issues are important for understanding sediment conditions within the Site boundaries.

A round of sediment sampling, at both surface and depth, is warranted to provide additional data, focusing on understanding the spatial extent of sediment impacts within the Site area. Samples collected should be tested for metals (including mercury), TPH, SVOCs (including PAHs, phenols), conventional parameters (e.g., TOC), and bioassays (as necessary) for comparison to SLs. These are COPCs based on historical uses of the Site (e.g., coal gasification plant). Additional geotechnical data for sediments may also be required to support the FS and engineering and remedial design for potential cleanup.

5.5 SOIL AND/OR GROUNDWATER VAPOR

The COPCs for the Site include volatile petroleum hydrocarbon carbons (e.g., BETX and trimethylbenzenes), which, if present in soil and/or groundwater at sufficient quantity, may also be present in a vapor phase within the soil column. Vapor phase contaminants can migrate and pose risk to humans if present in indoor air. Although no buildings are present within the preliminary Site boundary where people work or reside, a residential building is located adjacent to the Site. As a result, the soil to vapor and/or groundwater to vapor pathway will be evaluated if evidence of potential contamination is observed during field activities (e.g., field screening, preliminary testing results).

5.6 CULTURAL RESOURCES

Cultural resources have recently been evaluated in the lower portion of the Site in support of the feasibility study for shoreline improvements and construction of the overwater walkway (Wessen & Wahl 2009, Wessen & Associates 2010). However, there is no information available for the upper portion of the Site. Since most of the Site has been disturbed over the past 100 or more years from construction and operation activities associated with the MGP, railroad, lumber mill, and park, prehistoric archeological deposits are unlikely to be found. There may be some historical significance with the remaining MGP features (i.e., gas holder and electrical/generator building) in the upper portion of the Site. If remediation is required for the Site that alters these structures, then a cultural resource evaluation may be required to determine the historic significance of the structures.

Although the possibility of encountering cultural artifacts is unlikely, procedures for the identification of prehistoric archeological deposits during sampling activities are presented in the SAP (Section 2.7).

6 SITE INVESTIGATION APPROACH

This section presents the sampling and testing approach to complete the SSSMGP Site RI/FS field investigation. This approach is based on an understanding of historical Site use and data and best professional judgment. Specific issues related to sampling methods and sample handling procedures are addressed in the accompanying SAP (Appendix B). Laboratory methodology and QA/QC procedures are presented in the accompanying QAPP (Appendix C).

Visual, sheen, and/or headspace screening will be conducted in the field on all soil and sediment samples collected during this investigation. Visual screening will consist of inspecting the soil/sediment for the presence of stains indicative of residual petroleum hydrocarbons and coal tar. Sheen testing will involve immersion of a portion of the soil/sediment sample in water and observing the water surface for signs of petroleum sheen. Headspace screening will involve the semi-quantitative measurement of total volatile compounds in the air above the sample material using either a flame ionization detector (FID) or a photo ionization detector (PID). This field screening approach will assist in selecting samples for laboratory analysis and provide real-time information on whether the proposed sampling program should be expanded to include the collection of additional samples at depth and/or at surrounding locations to further evaluate the nature and extent of contamination at the Site.

Metals will be analyzed in all selected soil, surface water, groundwater, and sediment samples because several metals are associated with by-products from the coal gas purifying process. Mercury is also a COC at the Whatcom Waterway site, which extends and overlaps with the aquatic lands portion of the SSSMGP Site. Cyanide will be analyzed in selected soil and groundwater samples in the upper and lower Site areas because it may also be associated with by-products in the purifying process. PCBs will be analyzed only in soil samples collected from inside and immediately surrounding the existing electrical/generator building, because this is the only area where PCBs may be present based on historical operations. Results from the headspace screening in the field may be followed by the laboratory analysis of soil and sediment samples for VOCs (e.g., BTEX) if it is deemed warranted. The actual number of samples selected for VOC analysis will be determined in the field.

SVOCs have commonly exceeded their SLs in soil and sediment samples from previous investigations. The SVOCs of primary concern are PAHs (components of coal tar, petroleum, and creosote) and phenols (by-product of coal gasification process). PAHs will be analyzed in all selected soil and sediment samples because cPAHs are an important COPC at the Site for determining risk to humans and the environment. A minimum of 20% of the selected soil samples will be analyzed for the complete suite of SVOCs and petroleum hydrocarbons to also evaluate the presence of phenols and fuel oils, other potential by-products and feedstock from the MGP process. A minimum of 20% of the selected sediment samples will also be analyzed for SVOCs.

There are two different laboratory methods of analysis for petroleum hydrocarbons. The NWTPH method provides one result with broad coverage of both aliphatic and aromatic gas-range organic components (NWTPH-GRO) and diesel-range/residual-range organic components

(NWTPH-Dx). The petroleum mixture can also be fractionated into smaller carbon chain ranges, treating aliphatics and aromatics separately, to provide more comprehensive information on the composition of the mixture (e.g., comparing to standards for coal tar/creosote). Fractionation data are necessary to calculate site-specific petroleum cleanup levels, rather than relying on default cleanup levels for petroleum mixtures. GRO mixtures can be fractionated using the volatile petroleum hydrocarbons (VPH) analysis. Dx mixtures can be fractionated using the extractable petroleum hydrocarbons (EPH) analysis.

Selected soil samples will be analyzed initially using the NWTPH method, requesting the GRO analysis or the Dx analysis, or both, depending on historical practices in the area and field screening results. Only those soil samples that yield detected GRO/Dx results above the SL (100/200 mg/kg[4]) will be considered for fractionation analyses. In some cases, not all of the samples with GRO/Dx results above the SLs will be submitted for fractionation. Best professional judgment will be used based on the number of samples with GRO/Dx results above the SLs in an area and an understanding of historical practices.

Because of the limited number of surface water and groundwater samples proposed, all of the samples will be analyzed for NWTPH-GRO, -Dx, SVOCs and VOCs.

Background or reference samples will be collected for groundwater and sediments planned for sampling at the SSSMGP Site. The background location for groundwater will be a well installed to the north of the preliminary Site boundary, but within Boulevard Park (Figure 7). The reference location(s) for sediments is in Samish Bay, located approximately 30 miles south of the project Site. More than one reference sediment sample may be required to match varied physical characteristics (e.g., grain size) of the Site sediment samples.

6.1 SOIL INVESTIGATION

This section describes the rationale, sampling strategy, and analytical strategy for the soil investigation portion of the RI. Additional sample locations beyond the scope described in this Work Plan will be evaluated following receipt of soil and groundwater analytical results.

Soil samples will be collected using direct-push probe techniques[5] and other tools such as hand augers or other hand implements. Sample collection methods are described in detail in the SAP provided in Appendix B of this Work Plan.

6.1.1 Rationale

The purpose of the soil investigation is to determine the lateral and vertical extent of contaminants in Site soil in areas where previous investigations have identified potential impacts to the subsurface either through laboratory analysis or by visual and olfactory observations and

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[4] The MTCA Ecology Indicators for Soil Biota of 100 mg/kg (GRO) and 200 mg/kg (Dx) are the proposed SLs for NWTPH in soil at the Site.

[5] If a direct-push probe rig cannot obtain samples from depth due to debris or other obstructions, a limited access auger rig will be used in its place.

to identify if other areas of soil contamination exist. The soil investigation will, therefore, include sampling soil at locations north, south, east, and west of previous sampling locations, as applicable, and collecting soil samples within areas not previously sampled, but where previous Site uses may have adversely impacted soil. Potential source areas are described in Sections 2 and 4.

6.1.2 Sampling Strategy

The sampling strategy for the soil investigation consists of selecting sampling locations for lateral soil quality characterization throughout the Site and selecting depth intervals to adequately characterize the vertical extent of soil contamination, if any. Because there is a possibility for residual MGP wastes to be present as DNAPL, which may migrate to a confining layer such as the sandstone bedrock located below Site soil, each soil boring will extend to bedrock to the extent practical. The soil strategies for the upper and lower portions of the Site are slightly different based on historical uses of the two areas and because of the differences in depth to bedrock. Soil sampling along the slope separating the upper and lower portion of the Site also requires a slightly different strategy. The sampling strategy for each area is discussed in the following subsections.

6.1.2.1 Lower Portion of Site

This section describes the lateral and vertical soil sampling strategy for the lower portion of the Site.

Sampling Locations

As described in Section 2, most of the lower portion of the Site was not used by the MGP. Only the area adjacent to the former railroad, which is currently a packed gravel pedestrian and bicycle pathway (South Bay Trail), was used by the MGP. However, contaminants from the upper portion of the Site potentially could have migrated to the lower portion of the Site via groundwater or along the surface of the bedrock as a viscous fluid or DNAPL. During previous investigations, soil saturated with oil and exhibiting a diesel odor was observed in three locations in the lower portion of the Site: test pits TP-3 and TP-10 and soil boring B-2 (refer to Figure 3). Also, in 2007, analytical results for soil boring COB-BLVD-02 reported elevated concentrations of diesel-range and motor oil-range petroleum hydrocarbons and SVOCs at depth (greater than 20 ft bgs). To determine the extent of the contamination in the lower portion of the Site, soil samples will be collected at 17 locations as follows (Figure 7 and Table 4):

- Two of the locations will be adjacent to test pits TP-3 and TP-10 where evidence of contamination was previously detected (none of the proposed locations are immediately adjacent to soil boring B-2 because it was located within the footprint of the existing restroom facility).
- Two locations will be west and east of TP-10 along the preliminary southern Site boundary to evaluate the extent of contamination previously observed at TP-10.

- One location will be in the expected downgradient groundwater flow direction from exploration TP-3. A monitoring well (MGP-MW-09) is also proposed for installation at this location, as described in Section 6.2.
- Four of the locations will be distributed around soil boring COB-BLVD-02 to determine the lateral extent of contamination identified at this location. One boring location will be converted to a groundwater monitoring well (MGP-MW-11). The southern and eastern locations will also be used to evaluate the extent of contamination observed at explorations TP-10 and B2, respectively.
- Six of the sampling locations will be at the base of the slope separating the upper and lower portions of the Site. Three of these will be located near the paved pathway that was formerly the railroad spur used by the MGP. The three along the paved pathway and the one station near historical sampling location B-1 will also be converted to groundwater monitoring wells (MGP-MW-06, -07, 08, -10).
- The remaining two soil boring locations are associated with monitoring wells proposed for the lower Site area (MGP-MW-13, -14), as described in Section 6.2.

Proposed soil sampling locations within the lower portion of the Site are shown on Figure 7.

Sample Depth Interval

Based on logs for test pits and soil borings from previous investigations, depth to bedrock in the lower portion of the Site ranges from 10 to 25 ft bgs. Subsequently, the number of soil samples and the depth intervals identified for sample collection will largely be dependant on the depth to bedrock at each proposed soil sampling location. However, in general, the following sampling strategy will be used to characterize the subsurface soil vertically in the lower portion of the Site:

- At locations where no evidence of contamination is observed based on field screening (visual, odor, and/or PID measurements), three soil samples will be collected for analysis. Sample depth intervals will include a discrete 3-in to 6-in sample in the upper 2 ft of soil to evaluate the potential current threat to human health from contaminant concentrations in surface soils. A second sample will be collected from a 1-ft depth interval between 2 and 6 ft bgs to evaluate contaminant concentrations (such as metals that cannot be screened for in the field) above the MTCA conditional point-of-compliance for terrestrial ecological receptors (6 ft bgs). A third sample will be collected from a 1-ft depth interval between 10 to 15 bgs to characterize soil above the MTCA human health point-of-compliance (15 ft bgs).
- At locations where evidence of contamination is observed based on field screening, one soil sample will be collected and analyzed from the zone of contamination and another soil sample will be collected from a depth interval below the zone of contamination (based on screening evidence) to define the vertical extent of contamination. The soil samples may be in addition to the discrete soil sample collected within the upper 2 ft of soil, but may replace the soil samples to be collected at other depth intervals as described previously for those explorations where no evidence of contamination is observed.

6.1.2.2 Upper Portion of Site

This section describes the lateral and vertical soil sampling strategies for the upper portion of the Site.

Sampling Locations

Twenty-nine soil sampling locations are proposed for the upper portion of the Site (Figure 7 and Table 5). The locations were selected based on the location of former MGP structures and operations and subsurface soil conditions observed during previous investigations. Locations outside the footprint of former MGP structures are included to determine whether the possibility of spills, leaks, or onsite disposal practices may have impacted the Site. The rationale for each sampling location is described below.

- Seven of the soil sampling locations will be located within the footprint of three former gas holder tanks. Two of the locations are within the footprint of the holder tank that still remains onsite.
- One soil boring will be located between two of the gas holder tanks where tank valves were formerly located, which is also near the location where water has been observed to be leaking from the existing tank wall and where English Ivy climbing the wall is observed to be distressed or dying. A groundwater monitoring well (MGP-MW-03) is also planned to be installed at this location, as described in Section 6.2.
- One soil boring will be located adjacent to the previous 1979 soil boring location B-5, where soil saturated with oil and a diesel odor were reported at depths between 10 and 20 ft bgs. This area was also the likely location of a tar/water separator tank shown on previous property maps of the site. A groundwater monitoring well (MGP-MW-05) is also planned to be installed at this location, as described in Section 6.2.
- Two soil borings will be located within or near the footprint of former fuel oil tanks and tar wells. These tanks/wells were located south and north of the existing foot bridge as shown on Figures 2 and 7.
- Five soil sampling stations will be located within the footprint of the former processing facility (retort house, purifier boxes, 1891 gas holder, and coal sheds).
- Four of the soil sampling locations are planned for the former electrical/generator building still present on the Site. Soil samples will be collected at two locations inside the generator house and from two locations immediately adjacent to the generator house. One of the exterior sampling locations will be located near the entrance to the house.
- Two soil boring locations are associated with monitoring wells proposed for the upper Site area (identified as MGP-MW-2 and MGP-MW-4 on Figure 7). One of these locations will be downgradient of former fuel oil tanks and the other location will be located along the preliminary northern Site boundary.
- The remaining seven proposed soil sampling locations are dispersed throughout the upper portion of the Site to identify any undocumented spill, leak, or disposal areas, if any exist.

One of these locations is positioned near a historical drain from the gas holder tanks (Figure 7).

Sample Depth Intervals

Based on test pit and soil boring logs from previous investigations, depth to bedrock in the upper portion of the Site ranges from 1.0 ft to greater than 12.0 ft bgs. Consequently, the number of soil samples and the depth intervals identified for sample collection will be dependent on the depth to bedrock at each proposed soil sampling location. However, in general, the following soil sampling strategy will be followed for the upper portion of the Site:

- At locations where no evidence of contamination is observed based on field screening (visual, odor, or PID measurements), three soil samples will be collected for analysis. Sample depth intervals will include a discrete 3-in to 6-in sample in the upper 2 ft of soil to evaluate the potential current threat to human health from contaminant concentrations in surface soils. A second sample will be collected from a 1-ft depth interval between 2 and 6 ft bgs to evaluate contaminant concentrations (such as metals that cannot be screened for in the field) above the MTCA conditional point-of-compliance for terrestrial ecological receptors (6 ft bgs). A third sample will be collected from a 1-ft depth interval between 10 to 15 bgs, if obtainable, to characterize soil above the MTCA human health point-of-compliance (15 ft bgs). Where depth to bedrock is 10 ft or less, the number of samples collected will be reduced as appropriate.

- At locations where evidence of contamination is observed based on field screening, one soil sample will be collected from the zone of contamination and another soil sample will be collected from a depth interval below the zone of contamination (based on field screening information) to define the vertical extent of contamination. The soil samples may be in addition to the discrete soil sample collected within the upper 2 ft of soil, but may replace the soil samples to be collected at other depth intervals, as described previously for those explorations where no evidence of contamination is observed.

6.1.2.3 Slope Area

This section describes the lateral and vertical soil sampling strategies for the slope separating the upper and lower portions of the Site.

Sampling Locations

Eight soil sampling locations are proposed for the slope separating the upper and lower portions of the Site[6]. As shown on Figure 7 and in Table 4, the sampling locations will be spaced at equal distances along the east-west axis of the slope near the lower portion of the slope and approximately mid way up the slope. Sample collection near the top of the slope is not practical

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[6] Additional slope locations on either side of the walkway (from upper to lower park) may be sampled pending access to this area.

due to exposure of bedrock and accessibility. A visual survey of slope conditions will be conducted in advance of sampling to identify any areas exhibiting indications of potential contamination (e.g., soil staining, distressed vegetation, seeps), and sampling locations may be modified based on the results of the survey.

Sample Depth Intervals

Depth to bedrock is expected to be 1 ft or less along the slope; therefore, one depth interval will be collected at each location. This depth interval will extend from the soil surface to bedrock.

6.1.3 Analytical Strategy

As described earlier, the COPCs for MGP sites can consist of PAHs, phenols, VOCs (typically BTEX and trimethylbenzenes), complex cyanide compounds, and metals. Additional COPCs may also include diesel-range, oil-range, and gasoline-range petroleum hydrocarbons when fuel products were used at the Site. Also, PCBs potentially may be associated with transformers or other electrical equipment formerly used at the electrical/generator building. The analytical strategy for the SSSMGP soil investigation is outlined in the following bullets (also refer to Tables 4 and 5); specific analytical methods and QA/QC requirements are described in the QAPP (Appendix C):

- Metals. Because the potential for metals to be present and soil cannot be screened in the field, each selected soil sample will be analyzed for metals.
- PCBs. Only soil samples collected inside and adjacent to the electrical/generator building will be analyzed for PCBs.
- Cyanide. Because cyanide may be associated with by-products in the purifying process, soil samples collected within the footprint of the former purifying facility and adjacent to the facility will be analyzed for cyanide. Additional samples from the lower and upper portions of the Site and the slope area will also be analyzed for cyanide (locations and sample depths to-be-determined in the field). The samples will be analyzed for both total and weak acid dissociable (WAD) cyanide because human health criteria for cyanide are often expressed as total cyanide (although the drinking water MCL is expressed as free cyanide); whereas ecological criteria are expressed as WAD cyanide.
- PAHs and Phenols. All selected soil samples will be analyzed for PAHs. Additionally, at least 20% of the samples will be analyzed for the full SVOC list to evaluate the presence of phenols.
- Diesel and Motor oil-range Petroleum Hydrocarbons (NWTPH-Dx). These compounds will be analyzed in those samples collected in the areas of the former fuel tanks and where field observations (visual and olfactory) indicate the potential presence of these compounds. However, at least 20% of the soil samples collected will be analyzed for petroleum hydrocarbons.
- VOCs and GRO petroleum hydrocarbons will be analyzed in those samples where these compounds may be present based on field observations (visual, olfactory, and PID

measurements) and in those samples collected at and adjacent to the former fuel tanks. However, because BTEX and trimethylbenzenes are compounds commonly associated with MGP sites, at least 20% of the soil samples selected for analysis will be submitted for VOC analysis.

Physical testing (index parameters) will also be analyzed for selected subsurface soil samples (locations and sample depths to-be-determined in the field). Soil samples will be collected from selected well borings for mechanical grain size analysis to assist is estimating aquifer hydraulic conductivity. In addition, a representative sample from all depths will be archived for possible future analysis.

6.2 GROUNDWATER INVESTIGATION

This section describes the rationale, sampling, and analytical strategy for the groundwater investigation portion of the RI. Included in the sampling strategy section are proposed plans for determining groundwater flow direction and tidal influence on groundwater flow at the Site.

6.2.1 Rationale

As described in Section 4.2, migration of COPCs may occur via groundwater either as NAPL or in a dissolved phase. Therefore, to evaluate whether or not contaminants are migrating from the upland portion of the Site to sediments and possibly surface water, groundwater quality must be determined at and downgradient of the potential source area(s).

6.2.2 Sampling Strategy

The sampling strategy for the groundwater investigation consists of installing permanent groundwater monitoring wells so that groundwater quality may be monitored during seasonal water level fluctuations. Groundwater monitoring well construction and installation are described in detail in the SAP provided in Appendix B. This section focuses on the location of the groundwater monitoring wells, monitoring frequency, and data to be collected to determine groundwater flow direction and tidal influence. Because the hydrogeologic conditions are likely different for the upper and lower portions of the Site, the groundwater monitoring strategy for each area are described separately.

6.2.2.1 Sampling Locations

The groundwater monitoring investigation for the upper and lower portions of the Site are described separately below, and are presented on Figure 7 and in Table 6.

Lower Portion of Site

Nine groundwater monitoring wells are proposed for the lower portion of the Site as follows:

- Two wells will be located along the preliminary southern Site boundary. One of these wells, identified as MGP-MW-12 on Figure 7, is located adjacent to test pit TP-10 where evidence of contamination was previously detected. The other well, identified as MGP-MW-10 on Figure 7, is located near the base of the slope separating the upper and lower portions of the Site. The BNSF railroad restricts placement of the well farther east toward the slope. This well will be used to help determine if COPCs observed in explorations located due east on the upper portion of the Site have migrated to the lower portion of the Site.
- Three wells (MGP-MW-06, -07, and -08) will be located at the base of the slope separating the upper and lower portions of the Site. Groundwater quality at these wells will help determine whether COPCs from the upper portion and/or along the slope have migrated to groundwater in the lower portion of the Site. These wells will also assist with identifying groundwater quality at the potential point-of-compliance. In accordance with WAC 173-340-720(8)(d)(i), a property abutting surface water may have a conditional point-of-compliance that is located within the surface water as close as technically possible to the point where groundwater flows into the surface water. The locations of the three wells, as shown on Figure 7, are as close to the shoreline as practical because the BNSF railroad right of way restricts placement of the wells farther west.
- The remaining four wells, identified as MGP-MW-09, -11, -13, and -14 on Figure 7, will be located near the shoreline to evaluate groundwater at the potential conditional point-of-compliance. The wells are also located in the likely downgradient groundwater flow direction of previous explorations where evidence of contamination was observed (i.e., explorations TP-3, TP-10, and B-2) and where contaminant concentrations in soil exceed soil SLs (borings COB-BLVD-01 and -02).

If groundwater conditions along the shoreline in the lower park area indicate the potential for impacts to groundwater downgradient (i.e., intertidal zone), then temporary well points may be installed at representative locations within the intertidal zone. If well points are required, sample methods will be documented in an addendum to the SAP.

Upper Portion of the Site

Five groundwater monitoring wells are proposed for the upper portion of the Site. The locations of the wells are described below; however, it should be noted that, because depth to bedrock may be highly variable and very shallow at some locations, well installation may not be feasible or locations may need to be modified in the field. Well installation is discussed further in the upland SAP (Appendix B). Proposed groundwater sampling locations in the upper portion of the Site are described below:

- One of the proposed monitoring wells (MGP-MW-05 shown on Figure 7) will be located where evidence of contamination was previously observed (exploration B-5), near the historical location of a tar/water separator. Depth to bedrock at this location was reported to be 21 ft bgs, therefore, installation of a well at this location may be technically feasible.

- One monitoring well, identified as well MGP-MW-04, will be located near the slope separating the upper and lower portions of the Site and is also located in the potential downgradient groundwater flow direction of a former oil storage tank area. The location of this well may be moved closer to the former oil storage tank area if evidence of contamination is observed at that location during the soil investigation and no evidence of contamination is observed at the proposed location MGP-MW-05.
- One monitoring well (MGP-MW-03) will be located between two of the gas holder tanks (#2 and #3) where tank valves, pipes, and drains were formerly present, which is also near the location where water has been observed to be leaking from an existing tank drain. The English Ivy climbing the wall near this drain has been observed to be distressed or dying.
- Two monitoring wells (MGP-MW-01 and -02) will be located outside known activities of MGP operations (Figure 7). MGP-MW-02 will be located near the preliminary northern Site boundary and MGP-MW-01 will be approximately 100 ft north of the Site. Samples collected at these locations will assist in determining the extent of groundwater contamination due to MGP operations and provide information on background groundwater quality. The offsite location is adjacent to a previous exploration where depth to bedrock was greater than 15 ft; therefore, installation of a well at this location is feasible.

Additional groundwater grab samples may be collected if evidence of contamination is observed during the soil investigation.

6.2.2.2 Sample Frequency and Timing

Groundwater samples will be collected from the monitoring wells once during the dry season (July through October) and once during the rainy season (November to June). During each event, groundwater samples will be collected from monitoring wells located in the lower portion of the Site during a low tide so that only freshwater is sampled.

6.2.2.3 Groundwater Flow Monitoring

To determine groundwater flow direction, depth to groundwater will be measured from a surveyed reference point on the well casing and the depths converted to elevations for each groundwater monitoring event. Elevations will be plotted on a map and contoured. Additionally, to evaluate the tidal influence on groundwater flow, transducers will be placed in three of the nine monitoring wells located in the lower portion of the Site (possibly MW-07, -11, and -12). Water level fluctuation will be logged on a continuous basis for 48 hours. The tidal study will be timed during a higher high tide and a lower low tide, if possible. Detailed procedures for monitoring groundwater flow and tidal influence are provided in the SAP (Appendix B).

6.2.3 Analytical Strategy

As described previously, the COPCs for the Site may include PAHs, phenols, VOCs (typically BTEX and trimethylbenzenes), complex cyanide compound, and metals. Additional COPCs may also include diesel-range, oil-range, and gasoline-range petroleum hydrocarbons when fuel was used at the Site. Also, PCBs may be associated with transformers formerly used at the electrical/generator house. The analytical strategy for the SSSMGP groundwater investigation is outlined below (also refer to Table 6); specific analytical methods and QA/QC requirements are described in the QAPP (Appendix C):

- Metals. Each groundwater sample will be analyzed for both total and dissolved metals. Most groundwater quality criteria are based on total metals; however, total metals analyses may be biased high due to metals adsorbed to particulates if the groundwater has any turbidity. The dissolved metals analysis provides better quantification of metals in groundwater.
- Cyanide. Each groundwater sample will be analyzed for cyanide during the first groundwater monitoring event. Analysis for cyanide during the second groundwater monitoring event will be determined based on the results for the first samples. The samples will be analyzed for both total and WAD cyanide because criteria for cyanide are often expressed as total cyanide or WAD cyanide (although the drinking water MCL is expressed as free cyanide).
- PAHs and Phenols. Because these constituents are often associated with MGPs, each groundwater sample will be analyzed for SVOCs.
- VOCs. Because VOCs are very soluble in water, each groundwater sample will be analyzed for these compounds.
- Petroleum Hydrocarbons. Each groundwater sample will be analyzed for GRO and Dx petroleum hydrocarbons.
- TDS. Groundwater samples in the lower portion of the Site will be analyzed for TDS during the first groundwater monitoring event to evaluate the suitability of groundwater in this portion of the Site as a potable water source.
- PCBs. PCBs are not very soluble in water and, therefore, analysis of groundwater samples for PCBs is not currently planned. The need for analysis of groundwater samples for PCBs will be further evaluated based on the soil PCB analytical results.

Field parameters (pH, temperature, and conductivity) will be measured at each sampling location during sample collection. Dissolved oxygen and oxidation reduction potential (ORP) will also be measured at each sampling location and ferrous iron will be measured using a field test kit. The latter parameters will be used to evaluate groundwater reducing conditions.

6.3 SURFACE WATER INVESTIGATION

6.3.1 Rationale

The primary goal of surface water sampling is to provide current chemical data on potential sources to local surface water and sediments in the vicinity of the Site. Sampling will focus on the wet season and a storm event during the dry season, since surface water contamination is more likely to be encountered during these times.

6.3.2 Sampling Strategy

Two rounds of surface water samples will be collected from two stormwater outfalls (MGP-SW-01 and -02), once during the wet season and once during a storm event in the dry season (Figure 8). The dry season sample will be collected between July and October. The wet season sample will be collected between November and June. Water samples will be collected using either a portable peristaltic pump equipped with Teflon-lined tubing or direct filling of sample bottles [refer to SAP (Appendix B) for more details].

6.3.3 Analytical Strategy

Surface water samples collected from the stormwater outfalls will be analyzed for hardness, total suspended solids (TSS), TOC, metals (including calcium and magnesium), NWTPH-GRO/Dx, and SVOCs (refer to Table 7).

6.4 SEDIMENT INVESTIGATION

6.4.1 Rationale

The primary goal of sediment sampling is to define the lateral and vertical extent of COPCs detected during previous investigations (e.g., Herrenkohl and Landau Associates 2009), including the identification of SMS cleanup boundaries, if any. The sampling pattern will focus on bounding impacted areas identified in previous investigations.

6.4.2 Sampling Strategy

Surface sediment samples (0-12 cm[7]) will be collected from the following six Site locations and reference location(s) (Figure 8):

- MGP-SS-01
- MGP-SS-02
- MGP-SS-04

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[7] The 12 cm depth is considered the biological active zone in sediments of Bellingham Bay (RETEC 2006).

- MGP-SS-06
- MGP-SS-08
- MGP-SS-12
- Reference location(s) planned for Samish Bay.

Enough sediment volume will be collected for both chemistry and bioassay testing (refer to Section 6.4.3). These sample locations will assist in defining the boundaries of COPCs in surface sediment at the Site.

After surface samples have been collected, sediment borings will be collected at 12 stations (MGP-SC-01 to MGP-SC-12), spaced approximately 75 ft apart, using either a track-mounted, hollow-stem auger drill rig accessed from shore or a hollow-stem auger drill rig mounted on a barge or other overwater platform (Figure 8). Stations MG-SC-01, -02, and -03 may be accessed from shore depending on the tides.

Sediment borings will be used to investigate the depth and width of COPCs in sediment located in this portion of the Site. Sediment samples will be collected at 2-ft intervals to a depth of 25 ft or refusal.

6.4.3 Analytical Strategy

Surface sediment samples will be analyzed using a tiered approach. First, each sediment sample will be analyzed for the following (refer to Table 8):

- Conventional parameters including ammonia, total sulfides, TOC, and grain size
- SMS metals including arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc
- SVOCs.

Based on the chemical results of the surface sediment samples, toxicity testing will be performed at those locations where concentrations exceed SQS SLs. The proposed tests are:

- Acute Amphipod (*Eohaustorius estuarius*) 10-day mortality test (Ecology 2008a)
- Acute Larval (*Mytilus galloprovincialis*) development test (Ecology 2008a)
- Chronic Juvenile Polychaete (*Neanthes arenaceodentata*) 20-day mortality and growth test (Ecology 2008a).

Sediment for toxicity testing may be stored in the dark for a maximum of up to 8 weeks. Sample bottles will be stored either with no headspace or headspace purged with nitrogen gas [refer to SAP (Appendix B) for more details].

Selected subsurface sediment samples from each boring will be analyzed for the following:

- TOC and grain size
- SMS metals including arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc
- PAHs.

Additionally, at least 20% of the samples will be analyzed for the full SVOC list to evaluate the presence of phenols.

Four samples from each sediment boring will be analyzed from the list above (refer to Table 8). Physical testing (index parameters) will also be analyzed for selected subsurface sediment samples (locations and sample depths to-be-determined in the field). In addition, a representative sample from all depths will be archived for possible future analysis.

6.5 SOIL VAPOR INVESTIGATION

6.5.1 Rationale

The primary goal of the soil vapor investigation will be to evaluate the potential risks of volatile COPCs in indoor air to human health.

6.5.2 Sampling Strategy

Soil vapor samples will be collected from up to six locations where evidence of contamination in subsurface soils and groundwater is observed during implementation of field activities. The samples will be collected from boreholes advanced using a direct push probe and will be collected following the soil investigation. Station locations with the most evidence of contamination identified during the soil investigation will be selected for collection of soil vapor samples. Selection will be coordinated with Ecology project representatives. At least one of the locations will include the area in the upper portion of the Site near the adjacent Spinnaker Reach Condominiums. The soil vapor samples will be collected by advancing the probe rod to the target depth (approximately 5 ft bgs) and inserting dedicated polyethylene vapor sampling tubing and an adapter into the rod bore and connected to a peristaltic pump at the surface. A surface seal of hydrated bentonite will be placed around the top of the drill rods at the soil surface to prevent intrusion of atmospheric air. Vapor samples will be collected from the tubing into a Summa canister using a peristaltic pump and the Summa canisters will then be submitted to a laboratory for analysis. Detailed sample collection procedures are provided in the SAP (Appendix B).

6.5.3 Analytical Strategy

Soil vapor samples will be analyzed using EPA Method TO-15 for the following analytes: methyl tert-butyl ether (MTBE); BTEX; naphthalene; 1,3-butadiene; 1,2-dichloroethane; 1,2-dibromoethane; 1,3,5-trimethylbenzene; 1,2,4-trimethylbenzene; and total TPH.

Samples will also be analyzed using an appropriate version of the combined TO-15/APH method so that comparison to reporting limits can be achieved. The APH Method is a modified version of the Massachusetts Department of Environmental Protection (MADEP) air sampling analysis method for air (volatile) petroleum hydrocarbon constituents. This sampling method will be used to analyze the samples for: C5-C8 aliphatic hydrocarbons; C9-C12 aliphatic hydrocarbons; and C9-C10 aromatic hydrocarbons.

6.6 PERMIT REQUIREMENTS

A preliminary list of potential permits or approvals that may be required for sampling activities, include the following:

- **WDNR Access Agreement –** Since much of the lower park area and sediments are managed by the State, an access agreement is required before the start of sampling activities. An application for authorization to use state-owned aquatic lands was submitted to WDNR on March 31, 2010. An access agreement was signed by the City and WDNR on June 23, 2010.
- **USACE Permit for Sampling –** The U.S. Army Corps of Engineers has recently required a Nationwide 6 permit for conducting subsurface sediment and geotechnical investigations in Bellingham Bay (Anchor 2008). A Joint Aquatic Resources Permit Application (JARPA) was submitted to state and federal agencies on March 31, 2010. A Nationwide Permit 6 for survey activities was issued by the USACE on April 19, 2010.
- **Hydraulic Project Approval for Sampling –** WDFW will likely require an HPA for proposed sediment sampling activities. A JARPA was submitted to state and federal agencies on March 31, 2010. An HPA was issued by WDFW on June 4, 2010.
- **BNSF Access Permit –** A portion of the Site is owned and managed by BNSF and they require an environmental access permit before initiation of sampling activities. An application for the environmental access permit was submitted to BNSF representatives on April 12, 2010. An access permit was issued by BNSF on July 26, 2010.

Table 4. Proposed Soil Sampling and Analysis for the Lower Portion and Slope Areas of Site

Location Description	Number of Explorations	Sample Depth Interval[1] (ft bgs)	Metals[2]	Dx[3]	PAHs[4]	VOCs and GRO[5]	Cyanide[6]	Physical Testing[7]
Adjacent to test pits TP-3 and TP-10	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
East and West of TP-10	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Downgradient of TP-3	1	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
North, south, east, and west of COB-BLVD-02	4	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Base of slope separating upper and lower portions of Site	6	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Proposed monitoring well locations	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Slope locations[8]	8	0 to 1	✓	*	✓	**	TBD	TBD
Total Exploration/ Maximum Samples Per Analysis	25		59	Minimum of 11	59	Minimum of 11	TBD	TBD

✓ Indicates samples will be analyzed.

TBD – To-be-determined in the field.

*Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for NWTPH-Dx (~11 samples)

**Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for VOCs and gasoline-range petroleum hydrocarbons (~11 samples).

[1] The first sample will be a discrete 3-in to 6-in sample from the upper 2 ft of soil (0 to 2 ft bgs), the second sample will be a 1-ft composite collected between 4 and 6 ft bgs, and the third sample will be a 1-ft composite collected between 10 and 15 ft bgs. Only the upper 2 ft of soil will be collected from locations proposed for the slope area.

[2] Metals include antimony, arsenic, cadmium, barium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7471)

[3] Diesel-range and motor oil-range petroleum hydrocarbons will be analyzed by Ecology method NWTPH-Dx. Selected samples may also be analyzed for EPH.

[4] PAHs will be analyzed using EPA Method 8270D SIM. A minimum of 20% of the samples will be analyzed for the full SVOC list (~11 samples).

[5] VOCs will be analyzed using EPA Method 8260B and gasoline-range petroleum hydrocarbons will be analyzed by Ecology Method NWTPH-Gx. Selected samples may also be analyzed for VPH.

[6] Both total and WAD cyanide will be analyzed (EPA Method 335.4 and Standard Method 4500CNI). Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[7] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 14 samples for grain size and 7 samples for the other tests) will be determined in the field.

[8] Additional slope locations on either side of the walkway (from upper to lower park) may be sampled pending access to this area.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, PAHs, SVOCs, and cyanide). No field blank samples will be collected for this study [refer to SAP (Appendix B)]. Archive samples will be collected and preserved (frozen) for all sample depths for possible future analysis.

Table 5. Proposed Soil Sampling and Analysis for Upper Portion of Site

Location Description	Number of Explorations	Sample Depth Interval[1] (ft bgs)	Metals[2]	Dx[3]	PAHs[4]	VOCs and GRO[5]	Cyanide[6]	PCBs[7]	Physical Testing[8]
Footprints of former gas holder tanks	7	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Valve house between former tanks	1	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Adjacent to previous exploration B-5 and tar/water separator	1	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Footprints of former fuel/oil tanks	2	0 to 2 4 to 6 10 to 15	✓	✓	✓	**			TBD
Footprint of former processing facility	5	0 to 2 4 to 6 10 to 15	✓	*	✓	**	✓		TBD
Electrical/Generator House	4	0 to 2	✓	*	✓	**		✓	TBD
Proposed Additional Monitoring Well Locations MW-02, -04	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Miscellaneous Areas for Confirmation	7	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Total Explorations/ Maximum Samples per Analyses	29		79	Minimum of 16	79	Minimum of 16	Minimum of 16	4	TBD

✓ Indicates samples will be analyzed.

TBD – To-be-determined in the field.

* Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for NWTPH-Dx (~16 samples).

******Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for VOCs and gasoline-range petroleum hydrocarbons (~16 samples).

[1] The first sample will be a discrete 3-in to 6-in sample from the upper 2 ft of soil (0 to 2 ft bgs); the second sample will be a 1-ft composite collected between 4 and 6 ft bgs; and the third sample will be a 1-ft composite collected between 10 and 15 ft bgs. Only the upper 2 ft of soil will be collected from locations in and adjacent to the electrical/generator building.

[2] Metals include antimony, arsenic, barium, cadmium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7471).

[3] Diesel-range, and motor oil-range petroleum hydrocarbons will be analyzed by Ecology method NWTPH-Dx. Selected samples may also be analyzed for EPH.

[4] PAHs will be analyzed using EPA Method 8270D SIM. A minimum of 20% of the samples will be analyzed for the full SVOC list (~16 samples).

[5] VOCs will be analyzed using EPA Method 8260B and gasoline-range petroleum hydrocarbons will be analyzed by Ecology Method NWTPH-Gx. Selected samples may also be analyzed for VPH.

[6] Both total and WAD cyanide will be analyzed (EPA Method 335.4 and Standard Method 4500CNI). Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[7] PCBs will be analyzed using EPA Method 8082.

[8] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 14 samples for grain size and 8 samples for the other tests) will be determined in the field.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, SVOCs, cyanide, and PCBs). No field blank samples will be collected for this study [refer to SAP (Appendix B)]. Archive samples will be collected for all sample depths for possible future analysis.

Table 6. Proposed Groundwater Sampling and Analysis

Monitoring Well Identification	Easting (ft)	Northing (ft)	Metals and TDS[1]	NWTPH-GRO/Dx[2]	SVOCs[3]	VOCs[4]	Cyanide[5]
MGP-MW-1	1238438.74	636593.70	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-2	1238353.70	636507.56	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-3	1238285.94	636418.57	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-4	1238147.59	636344.81	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-5	1238101.13	636292.36	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-6	1238283.52	636543.76	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-7	1238220.61	636492.01	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-8	1238164.74	636448.51	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-9[6]	1238053.20	636473.55	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-10	1238000.98	636344.04	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-11	1238009.61	636520.39	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-12	1237908.82	636413.20	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-13	1237939.21	636581.07	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-14	1237836.01	636509.83	✓✓	✓✓	✓✓	✓✓	✓
Total Samples			28	28	28	28	14

✓ Indicates analysis will be conducted during the first groundwater monitoring event only.
✓✓ Indicates analysis will be conducted during both groundwater monitoring events.
-- Included in final Work Plan.

[1] Samples will be analyzed for TDS using EPA Method 160.1 and both total and dissolved metals and will include antimony, arsenic, barium, cadmium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7470).

[2] Petroleum hydrocarbons will include gasoline-range, diesel-range, and motor oil-range petroleum hydrocarbons by Ecology methods NWTPH-GRO and NWTPH-Dx.

[3] SVOCs will be analyzed using EPA Method 8270D SIM.

[4] VOCs will be analyzed using EPA Method 8260B.

[5] Both total and WAD cyanide will be analyzed during the first groundwater monitoring event using EPA Method 335.4 and Standard Method 4500CNI. Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[6] MGP-WM-9 may be moved closer to the BNSF railroad pending direct-push drilling results.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, SVOCs and conventionals only). No field blank samples will be collected for this study [refer to SAP (Appendix B)]. Archive samples will be collected for all sample depths for possible future analysis.

Table 7. Proposed Surface Water Sampling Locations and Testing

Station	Easting (ft)	Northing (ft)	Metals[1]	NWTPH-GRO/Dx[2]	SVOCs[3]	Conv. Testing[4]
MGP-SW-01	1238229.47	636604.97	✓✓	✓✓	✓✓	✓✓
MGP-SW-02	1238049.34	636548.45	✓✓	✓✓	✓✓	✓✓

-- Included in final Work Plan.
✓✓ Indicates analysis will be conducted during both surface water monitoring events.

[1] Metals analysis will include arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc (SMS Metals) and calcium and magnesium (EPA Methods 200.8/6010B/7470).

[2] NWTPH-Gx and -Dx analysis (Ecology 1997) will include gasoline-range, diesel-range, and motor oil-range petroleum hydrocarbons.

[3] SVOCs will be analyzed by EPA Method SW8270 low levels for comparison to SLs.

[4] Conventional testing includes TOC (EPA Method 415.1), TSS (EPA Method 160.2), and Hardness (SM 2340B).

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event. No field blank samples will be collected for this study [refer to SAP (Appendix B)].

Table 8. Proposed Sediment Sampling Locations and Testing

Station	Easting (ft)	Northing (ft)	Depth (bgs)	Metals[1]	PAHs/ SVOCs[2]	Conv. Testing[3]	Physical Testing[4]	Bioassays[5]
Surface Sediment Samples			(cm)					
MGP-SS-01	1238114.82	636505.18	0 to 12	✓	SVOCs	✓*		
MGP-SS-02	1238155.51	636563.61	0 to 12	✓	SVOCs	✓*		
MGP-SS-04	1238059.96	636544.08	0 to 12	✓	SVOCs	✓*		
MGP-SS-06	1238145.49	636649.76	0 to 12	✓	SVOCs	✓*		
MGP-SS-08	1238056.15	636652.15	0 to 12	✓	SVOCs	✓*		
MGP-SS-12	1237928.71	636656.54	0 to 12	✓	SVOCs	✓*		
Reference	--	--	0 to 12			✓*		
Sediment Boring Samples[6]			(ft)					
MGP-SB-01	1238114.82	636505.18	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-02	1238155.51	636563.61	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-03	1238209.31	636628.65	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-04	1238059.96	636544.08	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-05	1238102.55	636596.07	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-06	1238145.49	636649.76	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-07	1238013.26	636593.45	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-08	1238056.15	636652.15	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-09	1238101.92	636714.54	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-10	1237992.83	636651.05	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-11	1238036.37	636727.08	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-12	1237928.71	636656.54	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
Total Samples				**54**	**54**	**55**	**15**	**TBD[7]**

Table 8. Proposed Sediment Sampling Locations and Testing (cont.)

Notes:

[1] Metals analysis will include arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc (SMS Metals).

[2] PAHs and SVOCs will be analyzed by EPA Method SW8270 SIM or low levels. SVOCs will be analyzed for all site surface samples. PAHs will be analyzed for selected subsurface samples with 20% of those samples analyzed for complete suite of SVOCs (~11 subsurface sediment samples).

[3] Conventional testing includes: Total organic carbon will be analyzed by EPA Method SW9060 modified for sediment analysis. Samples (✓*) planned for bioassay testing will also be analyzed for total solids (PSEP 1986), ammonia (Plumb 1981/EPA Method 350.1), total sulfides (PSEP 1986/EPA Method 9030), and grain size (ASTM 422-63 w/hydrometer).

[4] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 15 samples) will be determined in the field.

[5] Bioassay testing will include the 10-day Amphipod, Larvae, and 20-day Polychaete (species to-be-determined).

[6] Selection of sediment samples for analysis may change during the field.

[7] TBD- MGP-SS-01, -02, -04, -06, -08, -12 will be chemically analyzed first and compared to SQS numeric criteria. The need for bioassay testing will be determined in consultation with Ecology.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, SVOCs, and conventionals only). No field blank samples will be collected for this study [refer to SAP (Appendix B)]. Archive samples will be collected for all sample depths for possible future analysis (e.g., dioxins/furans).

7 PROJECT MANAGEMENT STRATEGY

The RI/FS must examine current and future risks to workers, the general public, and the environment. A brief description of each of the proposed tasks under this Work Plan, followed by the proposed project team and schedule to complete these tasks, is provided below.

7.1 RI/FS TASKS

The following task and subtask descriptions are planned for the Site RI/FS. These tasks are required by the Agreed Order and SOW negotiated between the City, PSE, and Ecology and signed on April 30, 2010.

7.1.1 Task 1 – Project Planning and Management

Activities under this task include administration and management of the project, including establishment and maintenance of necessary files and records required under the Agreed Order with Ecology; performance of administration functions; support of activities necessary to perform the project in accordance with this Work Plan and all required statutes, circulars, terms & conditions; and attendance at necessary project meetings. City and PSE staff will submit bi-monthly and final reports; manage the consultant contract; and coordinate with Ecology, stakeholders, the public, and with other City departments. City and PSE staff will also provide outreach to area stakeholders in coordination with Ecology as outlined in the Public Participation Plan (Exhibit C to the Agreed Order). As per the Agreed Order, Ecology maintains the responsibility for public participation at the Site.

The project management approach will ensure timely submission of high-quality documents by adhering to the schedule discussed in Section 7.4 and by using rigorous document quality control procedures. Regular contacts within the project team will ensure that the schedule is maintained and that, if unforeseen conditions necessitate changes to the schedule, the project team is apprised so they can respond accordingly. The draft RI/FS document will undergo internal quality control review by the consultant as well as public and stakeholder review. Responses to public and stakeholder comments will be provided in a responsiveness summary to be included in a stand-alone document. A responsiveness summary is a summary of oral and/or written public comments received by Ecology during a comment period on key documents, and Ecology's responses to those comments.

The following two key subtasks will be completed as part of this task:

Subtask 1a – Project Management. The consultant project manager will support the City and PSE project managers in completing project progress reports and other administrative functions required under the Agreed Order.

Subtask 1b – Public Participation. Ecology issues planning documents and investigation reports which will be made available to the public for review and comment. The draft Agreed

Order and draft public participation plan were made available for public review and comment from February 5 to March 8, 2010 (Ecology 2010c). When the RI/FS are complete, Ecology will distribute a fact sheet summarizing the draft RI/FS report and announcing a public meeting and comment period. Ecology, the City and PSE will present the draft RI/FS report during the public information meeting (refer to Section 7.4). A draft RI/FS report will be presented at the public information meeting. The draft document will be made available for public review and comment prior to and after the meeting for one month. The meeting and public comment period will be conducted in a manner to encourage substantive discussion and meaningful public input. Verbal and written comments on the documents will be accepted from the public, and Ecology will respond. In the event that significant changes are made to either document as a result of the public comments, Ecology could reissue the draft document for another round of review and comments prior to finalization

7.1.2 Task 2 – Work Plan

This document fulfills the requirements under Task 2, including information on existing data for the SSSMGP Site and the sampling strategy and design to meet the data needs for completing the RI/FS. The Work Plan also describes the project management strategy for implementing and reporting on RI/FS activities for the Site, including the schedule, project team and responsibilities, and reporting requirements.

7.1.3 Task 3 – Project Plans

The project plans (SAP, QAPP, and HASP) presented in the appendices of this Work Plan fulfills the requirements of Task 3. Details of these plans are presented in the accompanying appendices and consistent with requirements in the Agreed Order. It should be noted that Ecology does not approve the HASP.

7.1.4 Task 4 – Remedial Investigation

The City and PSE will conduct an RI to delineate the area requiring cleanup and to identify sources that may need to be eliminated or reduced as part of the cleanup. Key components of the RI are as follows:

- Determination of nature and extent of contamination exceeding MTCA and the SMS standards
- Assessment of potential human health and ecological health concerns
- Characterization of natural resources
- Evaluation of source control and recontamination.

Three key subtasks will be completed under this task:

Subtask 4a – Field Work. This subtask encompasses all the labor, equipment, and supplies to complete all field work in support of the RI (and FS). Field work for the Site will include sampling groundwater, soil, surface water, and sediments. A detailed description of the field tasks is presented in Section 6 of this Work Plan with field procedures presented in the SAP (Appendix B). Workers in the field will follow health and safety procedures documented in the project HASP (Appendix D).

Subtask 4b – Testing. This subtask includes chemical, conventional, biological, and physical testing of samples collected in support of the RI (and FS). A detailed description of the analytical strategy is presented in Section 6 of this Work Plan with laboratory methodology and QA/QC procedures presented in the project QAPP (Appendix C).

Subtask 4c – RI Report. The RI report is outlined in Section 7.2. The RI report will include a risk evaluation for upland and aquatic areas of the site in accordance with procedures in MTCA (WAC 173-340) and SMS (WAC 173-204). The risk evaluation will include the refinement of the preliminary conceptual site models presented in Section 4 by incorporating additional information for characterizing site-specific exposure pathways.

Upland Risk Evaluation – Human health and ecological risk evaluations will be conducted in accordance with procedures in WAC 173-340-708 and WAC 173-340-7490, respectively. The risk evaluations will include development of screening levels for indicator hazardous substances for each media of concern and a comparison of the RI analytical results to these screening levels. The screening levels will be based on the reasonable maximum exposures expected to occur at the Site under current and potential future site conditions.

Aquatic Risk Evaluation – The aquatic risk evaluation for the site will be conducted in accordance with SMS as required under MTCA. The principal receptors and exposure pathways that may be evaluated in the RI include (from RETEC 2006):

Receptor	Exposure Pathway	Protective Screening Level
Benthic Organisms	Toxic effects to organisms in site surface sediments (0-12 cm)	SMS chemical and biological criteria
Human and Ecological Health	Chemical exposure through consumption of site seafood	Bioaccumulation triggers (e.g., Dredged Material Management Program) and/or bioaccumulation screening levels, adjusted for site-specific exposures, calculated from available paired fish/shellfish and sediment data from Bellingham Bay and other embayment's in Puget Sound (RSET 2006 and updates)

Site-specific bioaccumulation data will only be collected if, following the screening approach described above, "there is a reason to believe chemicals present in project or site sediments may be contributing to levels in invertebrate or fish tissues that could be harmful to aquatic life, aquatic-dependent wildlife, or humans eating fish and shellfish" (RSET 2006).

7.1.5 Task 5 – Feasibility Study

The purpose of the FS is to develop and evaluate cleanup action alternatives for the Site. The FS report is outlined in Section 7.2 and will include the following components:

- Determination of cleanup standards and applicable laws
- Development of remedial action objectives
- Identification and screening of remediation technologies
- Comparative evaluation of cleanup alternatives
- Identification of a preferred cleanup alternative.

The following sections provide additional discussion of details for each of the above bullets.

7.1.5.1 Determination of Cleanup Standards and Applicable Laws

The RI process will determine if results for each media (e.g., soils) exceed preliminary cleanup levels and, if so, identify the locations of the exceedances. Based on any exceedances and the established points-of-compliance, the FS will identify the areas that require remedial action.

In accordance with MTCA, all cleanup actions must comply with applicable state and federal laws (WAC 173-340-710(1)). MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as ARARs (refer to Section 1.2). The starting point for evaluating ARARs is the MTCA cleanup levels and regulations that address implementation of a cleanup under MTCA (Chapter 173.105D RCW; Chapter 173-340 WAC). The FS may identify additional ARARs if a cleanup action is needed. In addition, the FS will identify likely permits required for implementation of the cleanup action.

7.1.5.2 Development of Remedial Action Objectives

The remedial action objectives (RAOs) identify the goals that must be achieved by a cleanup alternative in order to achieve cleanup standards and provide adequate protection of human health and environment. The RAOs must address all affected media and a cleanup alternative must achieve all RAOs to be considered a viable cleanup action. RAOs will be developed for portions of the Site requiring remedial action.

The RAOs will be action-specific and/or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve a specific chemical criterion. Media-specific RAOs are based on the cleanup levels. The RAOs will specify the COCs, the potential exposure pathways and receptors, and acceptable contaminant levels or range of levels for each exposure pathway, as appropriate.

The extent to which each alternative meets the RAOs will be determined by applying the specific evaluation criteria identified in the MTCA and SMS regulations.

7.1.5.3 Identification and Screening of Remediation Technologies

Cleanup alternatives will be developed for portions of the Site that require cleanup action. Initially, general remediation technologies will be identified for the purpose of meeting RAOs. General remediation technologies consist of specific remedial action technologies and process options. General remediation technologies will be considered and evaluated based on the properties of identified contaminant(s) and may include institutional controls, containment or other engineering controls, removal, in situ treatment, and natural attenuation.

Specific remedial action technologies are the engineering components of a general remediation technology and process options are those specific processes within each specific technology. Cleanup alternatives will be developed from the general and specific remedial technologies and process options consistent with Ecology's expectations identified in WAC 173-340-370 using best professional judgment and guidance documents as appropriate [e.g., Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA 1988)].

During the development of cleanup alternatives, both the current and planned future land use will be considered.

7.1.5.4 Comparative Evaluation of Cleanup Alternatives

MTCA requires that cleanup alternatives be compared to a number of criteria as set forth in WAC 173-340-360 to evaluate the adequacy of each alternative in achieving the intent of the regulations, and as a basis for comparing the relative merits of the developed cleanup alternatives. Consistent with MTCA, the alternatives will be evaluated with respect to compliance with threshold requirements, permanence, restoration timeframe, and public concerns, and the results of the evaluation will be documented in the FS.

7.1.5.5 Identification of Preferred Cleanup Alternative

This section of the FS will recommend a cleanup alternative based on the results of the comparative evaluation. The recommended alternative will meet the minimum requirements for cleanup actions: protect human health and the environment, comply with cleanup standards, comply with applicable state and federal laws, provide for compliance monitoring, use permanent solutions to the extent practicable, provide for a reasonable timeframe, and consider public concerns.

7.2 RI/FS REPORT PREPARATION

A draft RI document will be prepared upon completion of the field investigation (refer to project schedule in Section 7.4). After an initial review by Ecology, the RI will be combined with the draft FS (also reviewed by Ecology) into a draft final RI/FS document for stakeholder and public review before the completion of the final RI/FS. A draft outline for the RI/FS document is presented below (from Ecology 2008c).

Section 1.0	**Introduction** (includes Site description and background, document organization)
Section 2.0	**Project Background** (includes Site history, objectives of the RI/FS, and relationship to other documents)
Section 3.0	**Summary of Field Activities** (short narrative of investigation activities in support of the RI/FS with reference to appendix for more details)
Section 4.0	**Environmental Setting** (includes physical conditions, geology, hydrogeology, natural resources, historical and cultural resources, and land and navigation uses as applicable)
Section 5.0	**Site Screening Levels** (includes exposure pathways and receptors, and SLs by media)
Section 6.0	**Nature and Extent of Contamination** (includes nature and extent of COCs by media)
Section 7.0	**Risk Assessment** (human health and/or ecological may be required – refer to Section 7.1.4 for additional details)
Section 8.0	**Contaminant Fate and Transport** (source control, attenuation/transport processes)
Section 9.0	**Conceptual Site Model** (includes contaminants and sources, nature and extent of contamination, fate and transport processes, exposure pathways and receptors, and RI conclusions)
Section 10.0	**Cleanup Requirements** (includes Site cleanup levels, remedial action objectives, and potentially applicable laws)
Section 11.0	**Screening of Remedial Technologies** (description of technologies that were reviewed as part of the development of cleanup action alternatives)
Section 12.0	**Description of Remedial Alternatives** (description of cleanup action alternatives for both upland and sediment portions of the Site)
Section 13.0	**Detailed Evaluation of Remedial Alternatives** (includes MTCA and SMS evaluation criteria, evaluation of alternatives, and MTCA disproportionate cost analysis)
Section 14.0	**Summary and Conclusions** (includes description of the preferred alternative, basis for alternative identification, and implementation of Site cleanup)
Section 15.0	**References**

Tables

Figures

Appendices.

In addition to a written RI/FS report, all chemical, biological, and physical data will be submitted to Ecology in electronic Environmental Information Management (EIM) format.

7.3 PROJECT TEAM AND RESPONSIBILITIES

The SSSMGP Site RI/FS will be implemented by the City's Parks & Recreation Department and PSE. Figure 9 shows the team and organization for the RI/FS; the roles of the team members are discussed below.

City of Bellingham, Park & Recreation Department. The Parks & Recreation Department will be responsible for overall project management for the City. Gina Austin, Project Engineer, is the designated City project manager and will coordinate all activities with the PSE project manager. Ms. Austin will be responsible for contracting with and directly supervising the environmental consultant(s) that will conduct the field, lab, analysis, and reporting tasks for the assessment. She will direct the consultant on a day-to-day basis and provide primary review of all reports and other work products. Ms. Austin will also coordinate with PSE and Ecology through the Agreed Order for the assessment and cleanup of the Site.

Puget Sound Energy, Environmental Services Department. John Rork, Manager of the Environmental Services Department, is the designated PSE project manager and will coordinate all activities with the City and Ecology project coordinators.

Washington State Department of Ecology. The City, PSE, and Ecology through its Toxics Cleanup Program, have entered into an Agreed Order to complete the RI/FS of the SSSMGP Site. Mary O'Herron is the designated project manager for Ecology and will be responsible for overseeing implementation of the Agreed Order, including the development of the RI/FS. Ecology will provide technical review of the Work Plan and reports and, through periodic meetings, provide input on the significance of results and modifications to the RI/FS program. Ecology scientists will also provide technical input into the project design, Work Plan, data interpretation, and reporting. Ecology will make the final determination regarding the satisfaction of all requirements called for in the Agreed Order.

Property Owners and Stakeholders. Residents of the South Hill neighborhood; the Port of Bellingham; public agency partners of the WDNR, BNSF, Washington State Department of Health, and Whatcom County Health Department; and the general public will be apprised of the progress made by the City and PSE on the RI/FS of the Site. Planning documents and investigation reports will be made available to the public and to all other stakeholders for review and comment. Public information meetings will be scheduled after the draft final RI/FS document is complete. At the discretion of the parties, additional meetings may occur earlier in the project (i.e., meeting with Spinnaker Condominium Association)

Herrenkohl Consulting LLC and Landau Associates Inc. Herrenkohl Consulting and Landau Associates were selected by the City and PSE to conduct the RI/FS for the Site and are responsible for writing the Work Plan and implementing the field program, including field sampling, laboratory analysis, data analysis, and reporting.

Mark Herrenkohl, a Licensed Engineering Geologist in Washington State, will be the project manager for the Site RI/FS. He will be responsible for implementing and executing the technical, QA, and administrative aspects of the investigation, including the overall management of the project team. Mr. Herrenkohl is accountable for ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including this Work Plan with its accompanying SAP, QAPP, and HASP. He will communicate all technical, QA, and administrative matters to the City and PSE project managers. He will ensure that any deviations from the approved Work Plan are documented in field change record (FCR) forms, communicated to the City and PSE, and approved before implementation. Mr. Herrenkohl will ensure the quality and timeliness of project documents.

The overall management of the project-specific QA activities is the responsibility of the QA manager, Ms. Stacy Lane of Landau Associates. Ms. Lane, or her designee, is responsible for implementation of Site-specific QA activities, including field and laboratory quality control. In addition, the QA manager or her designee will coordinate with the project manager and other project staff, as applicable, during the reduction, review, and reporting of analytical data.

The project Health and Safety Officer, Dylan Frazer, is responsible for the implementation of the Site-specific HASP. Mr. Frazer, also a cross-trained field manager, will advise the project staff on health and safety issues, conduct health and safety training sessions, and monitor the effectiveness of the health and safety program conducted in the field.

The field operations managers, Mark Herrenkohl and Dylan Frazer, will be responsible for managing and supervising the field investigation program and providing consultation and decision-making on day-to-day issues relating to the sampling activities. The field managers will monitor the sampling to ensure that operations are consistent with plans and procedures and that the data acquired meet the analytical and data quality needs. When necessary, the field managers will document any deviations from the plans and procedures for approval. The field operations manager will be assisted in the field by technical personnel to be determined.

The project engineers, Mr. Dave Pischer, P.E., and Mr. Larry Beard, P.E., will assist the project manager with the FS activities of the project, including an evaluation of remediation alternatives for the Site. Mr. Beard will also provide overall QA/QC for the project.

The services of several subcontractors (e.g., drilling contractor, land surveyors, laboratory services) will be necessary for the performance of the field investigation and implementation of project objectives. The project manager, with assistance from the field manager, as necessary and appropriate, will be the primary liaison between Herrenkohl Consulting/Landau Associates, the City and PSE Project Managers, and each of the subcontractors. Subcontractors are responsible for performing work according to the requirements in this Work Plan and accompanying SAP, QAPP, and HASP. Analytical Resources Inc. of Tukwila, Washington will perform the chemical and physical analyses of water, soil, and sediment samples collected for this project. Northwest Aquatic Sciences of Newport, Oregon will analyze the bioassay samples. The drilling contractor will be Cascade Drilling of Woodinville, Washington. Surveying required on the Site will be accomplished by Larry Steele and Associates. The project manager for each subcontractor will be responsible for coordination with the overall consultant project manager Mr. Herrenkohl, SAP implementation, and analytical data quality.

7.4 PROJECT SCHEDULE

The schedule for all tasks described in Section 7.1, including major milestones, is summarized in Table 9. The project milestones are linked to the project objectives and measures of success as described below. As previously stated, the City, PSE, and Ecology entered into an Agreed Order on April 30, 2010, which represents the first major milestone for the project (Task 1b). A basic schedule for the project is outlined in the Agreed Order Exhibit B (SOW) and includes the following:

RI/FS Actions	Completion Time
Draft RI/FS Work Plan, SAP, QAPP, and HASP	90 calendar days from effective date of Agreed Order
Final Work Plan, SAP, QAPP, and HASP	30 calendar days from receipt of Ecology comments on the Draft RI/FS Work Plan, SAP, and QAPP
Completion of RI work and submittal of RI data	360 calendar days from Ecology approval of Final RI/FS Work Plan, SAP, and QAPP
Draft RI/FS Report	180 calendar days from completion of RI work and submittal of RI data
Draft RI/FS Report for public review incorporating Ecology's comments	90 calendar days from receipt of Ecology's comments on the Draft RI/FS report
Final RI/FS Report incorporating public comments, as Ecology determines necessary	30 calendar days from the close of public comment period if Ecology determines no changes are necessary; 60 calendar days in the event Ecology determines changes are necessary

The project managers (for the City, PSE, and Ecology) will be responsible for overseeing implementation of the Agreed Order, including the development of the RI/FS.

Once the Agreed Order was signed by the City and PSE and a public participation plan was drafted by Ecology, a review of existing studies was initiated to identify data gaps. This information shaped the development of this project Work Plan and SAP (Tasks 2 and 3). The completion of the draft Work Plan and accompanying SAP and QAPP for Ecology review and comment represent the second major milestone for the project. The completion of the final Work Plan, with its accompanying SAP and QAPP, after incorporation of Ecology comments, represents the third major milestone for the project. Ecology approval of the final Work Plan, SAP, and QAPP represents the fourth major milestone for the project.

The RI/FS report (Tasks 4 and 5) will be produced following completion of the sampling and testing outlined in the SAP and QAPP and any amendments, including the receipt and review of the analytical results. The completion of the investigation work and submittal of testing results to Ecology represents the fifth project milestone. The RI/FS report will include the critical environmental evaluation (including evaluation of cleanup levels) for project decision-making and selection of a preferred cleanup action for the Site. The draft RI/FS report represents the sixth major milestone in the project. Ecology will review and provide comments on the draft RI/FS report. Once changes have been made in response to comments by Ecology, a draft RI/FS report for public review will be made available, marking the seventh project milestone. There will be a public comment period and information meeting coordinated with Ecology to present the results of the RI/FS. Verbal and written comments on the documents by the public will be accepted and responses will be incorporated into the final RI/FS report. The final RI/FS represents the eighth major milestone in the project. The final RI/FS is tentatively scheduled for completion in the winter 2011.

Table 9. Estimated Project Schedule.

RI/FS Task	Estimated Completion Date	Milestone
Agreed Order Signed	April 30, 2010	◆
Issue Draft Work Plan, SAP, and QAPP with accompanying HASP	May 2010	◆
Issue Final Work Plan, SAP, and QAPP with accompanying HASP	August 2010	◆
Ecology Approval of Final Work Plan, SAP, and QAPP with accompanying HASP	August 2010	◆
Sampling and Testing	February 2011	
Submittal of Validated RI Data	March 2011	◆
Draft RI/FS Report	Summer 2011	◆
Draft RI/FS Report for Public Review	Fall 2011	◆
Public Comments and Information Meeting	Fall 2011	
Final RI/FS Report	Winter 2011	◆

8 REFERENCES

Anchor and Hart Crowser. 2000. Remedial Investigation and Feasibility Study for the Whatcom Waterway Site. Prepared for Georgia Pacific Corporation.

Anchor. 2008. Joint Aquatic Resources Permit Application, Whatcom Waterway Geotechnical Investigation. Prepared by Anchor Environmental LLC, Bellingham, WA. July 21, 2008.

Bellingham, City of. 1979a. Park and Recreation Advisory Board Meeting Minutes. March 7, 1979.

Bellingham, City of. 1979b. Park and Recreation Advisory Board Meeting Minutes. June 6, 1979.

Bellingham, City of. 1983. Park and Recreation Advisory Board Meeting Minutes. January 1983.

Bellingham, City of. 1984a. Memorandum on Boulevard Park from Byron Elmendorf, Parks and Recreation Director to Bellingham City Council and Bellingham Parks and Recreation Advisory Board. April 25, 1984.

Bellingham, City of. 1984b. Memorandum on Boulevard Park from Byron Elmendorf, Parks and Recreation Director to Bellingham Parks and Recreation Advisory Board. July 26, 1984.

Bellingham, City of. 2005. Letter Request for Agreed Order Negotiations and Response to PLP Notification, Boulevard Park (Facility Site #2865), Bellingham, Washington. Letter to Lucy McInerney, Site Manager and Kristy Carevich, Assistant Attorney General, Washington State Department of Ecology, Bellevue, Washington. Letter prepared by Mark Asmundson, Mayor, Bellingham, Washington. Dated August 22, 2005.

Bellingham, City of. 2008. Letter Request for Agreed Order Negotiations, Boulevard Park Area (Facility Site #2865), Bellingham, Washington. Letter to Lucy McInerney of the Washington State Department of Ecology, Bellevue, Washington. Letter prepared by Amy Kraham, City Assistant Attorney. Dated March 31, 2008.

Bellingham, City of. 2008. Aerial photographs of Boulevard Park and surrounding areas (dates include 1943, 1947, 1950, 1955, 1963, 1974, 1975, 1976, 1988, 1997, 2008).

CDC. 1984. Letter from Georgi Jones, Chief, Superfund Implementation Group, U.S. Public Health Service, Centers for Disease Control to Joel Mulder, Public Health Advisor, U.S. Environmental Protection Agency, Region IX and X. November 19, 1984.

Collias, E.E., C.A. Barnes, C.B. Murty, and D.V. Hansen. 1966. An Oceanographic survey of Bellingham – Samish Bay system. Volume II: Analysis of data. University of Washington Department of Oceanography Special Report No. 32. 142 pp.

Colyer, Troy. 1998. Current Patterns and Suspended Sediment Transport through the Inner Harbor of Bellingham Bay. Masters Thesis, Western Washington University.

Echelon Engineering, Inc. 2008. Inspection & Assessment of Pattle Point Trestle Boulevard Park, Bellingham, WA. Prepared for the City of Bellingham, WA. Prepared by Echelon Engineering, Inc. of Lynnwood, WA. January 2008.

Ecology. 1984. Letter from John Conroy, Supervisor, Hazardous Waste Specialist with the Washington State Department of Ecology to John Ivary, City of Bellingham Parks and Recreation Department. April 25, 1984.

Ecology. 1995. Sediment Management Standards. Chapter 173-204 WAC. Washington State Department of Ecology. Olympia, WA. Last updated December 29, 1995.

Ecology. 1997. Analytical methods for petroleum hydrocarbons. ECY 97-602. Washington State Department of Ecology Toxics Cleanup Program and The Ecology Environmental Laboratory, Olympia, WA.

Ecology. 2004a. Eligible Response Sites List - Site Exclusions. Letter written to Sylvia Kawabata, Manager of Site Assessment and Cleanup Unit, U.S. Environmental Protection Agency, Region 10, Seattle, WA. From Michael Spencer, Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA. From Dated February 19, 2004.

Ecology. 2004b. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, Publication No. 04-03-030. Prepared by the Washington State Department of Ecology, Olympia, WA. July 2004.

Ecology. 2005. Notice of Potential Liability for the Release of Hazardous Substances under the Model Toxics Control Act, Boulevard Park (Facility Site #2865), Bellingham, Washington. Letter to Mark Asmundson, Mayor, Bellingham, Washington. Letter from Lucy McInerney, Site Manager, Washington State Department of Ecology, Bellevue, Washington. Dated August 12, 2005.

Ecology. 2007. Model Toxics Control Act cleanup regulation. Chapter 173-340 WAC. Amended October 12, 2007. Publication No. 94-06. Washington State Department of Ecology, Toxics Cleanup Program, Olympia, WA.

Ecology. 2008a. Sediment Sampling and Analysis Plan Appendix. Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Prepared by the Washington State Department of Ecology, Olympia, WA. Ecology Publication No. 03-09-043, Last updated February 2008.

Ecology. 2008b. Cleanup Action Plan, Whatcom Waterway Site, Bellingham, WA. Prepared by the Washington State Department of Ecology.

Ecology. 2008c. Annotated Outline for RI/FS Documents. Prepared by the Washington State Department of Ecology. Distributed to Mark Herrenkohl of Herrenkohl Consulting LLC by Lucy McInerney, Toxics Cleanup Program.

Ecology. 2008d. Notice of Potential Liability for the Release of Hazardous Substances under the Model Toxics Control Act, Boulevard Park (Facility Site #2865), Bellingham, Washington. Letter to Steve Secrist, Deputy General Council, Puget Sound Energy, Bellevue, WA. Letter from Mary O'Herron, Site Manager, Washington State Department of Ecology, Bellingham, Washington. Dated December 30, 2008.

Ecology. 2009. Remedial Action Grant for Boulevard Park RI/FS. Washington State Department of Ecology. Effective date January 1, 2009.

Ecology. 2010a. Agreed Order for RI/FS, South State Street Manufactured Gas Plant Site. Washington State Department of Ecology, Puget Sound Energy, and the City of Bellingham. Document No. 7655. April 30, 2010.

Ecology. 2010b. On-line, Washington State Coastal Atlas. Washington State Department of Ecology.

Ecology. 2010c. Public Participation Plan, South State Street Manufactured Gas Plant Site Remedial Investigation/Feasibility Study. Prepared by the Washington State Department of Ecology, Bellingham, WA. February 2010.

E&E 1991. Site Hazard Assessment for Boulevard Park, Bellingham, WA. Prepared by Ecology & Environment, Seattle, WA for Washington State Dept. of Ecology.

E&E 1999. Memorandum, Site Status Review Report for Boulevard Park, Bellingham, WA. Prepared by Deena De Palma of Ecology & Environment, Dallas, TX. Prepared for John Meyer, U.S. Environmental Protection Agency, Region 10, Seattle, WA. Dated August 26, 1999.

Erickson, D. and J. Cubbage. 1998. Boulevard Park Preliminary Groundwater Assessment: Results of Soil Borings Collected April 26-27, 1994. Prepared by WA State Dept. of Ecology.

GeoEngineers. 2009. Memorandum to Louis Klusmeyer, PE, re: Boulevard Park Overwater Walkway Project – Geotechnical Exploration Summary. J. Gordon, PE, and Aaron McCain, PE, GeoEngineers, Bellingham, WA. December 8.

GRI. 1996. Management of Manufactured Gas Plant Sites – Two Volume Practical Reference Guide. Ed. Hayes, et al.

Global Geophysics. 2008. Report for Marine Seismic Refraction Survey North of Boulevard Park, Bellingham, WA. Prepared for Landau Associates Inc. of Edmonds, WA. Prepared by Global Geophysics of Monroe, WA. May 27, 2008.

Grette Associates LLC. 2008. Eelgrass Dive Survey, Bellingham, WA. Prepared for Reid Middleton Inc. of Everett, WA. Prepared by Grette Associates LLC of Wenatchee, WA. July 14, 2008.

Grette Associates LLC. 2009. Eelgrass Habitat Survey, Bellingham, WA. Prepared for Reid Middleton Inc. of Everett, WA. Prepared by Grette Associates LLC of Wenatchee, WA. May 7, 2008. (Revised February 15, 2009).

Griffin. Brian L. 2007. Boulevard Park & Taylor Avenue Dock, on the Old Bellingham Waterfront. Knox Cellars Publishing Company, Bellingham, Washington. 224 pages.

Hart Crowser. 2009. Sediment Site Characterization Evaluation of Bellingham Bay Creosote Piling and Structure Removal, Cornwall Avenue Landfill Mapping, Boulevard Park Overwater Walkway Feasibility, and Dioxin Background Sampling and Analysis. Prepared for the Washington Department of Ecology, Bellevue, WA. Prepared by Hart Crowser Inc., Seattle, WA. June 26, 2009

Hatheway, Allen W. 2009. The Former Manufactured Gas Plants Web Pages, <http://www.hatheway.net/>.

Herrenkohl and Landau Associates. 2009. Focused Environmental Site Assessment, Boulevard Park Shoreline Development and Overwater Walkway, Bellingham, Washington. Prepared for the City of Bellingham, Parks & Recreation Department, Bellingham, Washington. Prepared by Herrenkohl Consulting LLC of Bellingham, Washington and Landau Associates Inc., of Edmonds, Washington in association with Reid Middleton of Everett, Washington. April 17, 2009.

Integral. 2007. Letter Report for Focused Site Characterization, Pavilion Donation Project, Boulevard Park, Bellingham WA. Prepared for the City of Bellingham, Parks and Recreation Dept., Bellingham, WA. Prepared by Integral Consulting Inc., Bellingham, WA. March 5, 2007.

Integral. 2008. Draft Final Remedial Investigation, Little Squalicum Park, Bellingham, Washington. Prepared for the City of Bellingham, Parks and Recreation Dept., Bellingham, WA. Prepared by Integral Consulting Inc., Bellingham, WA. December 19, 2008.

Landau Associates. 2007. Ecology Review Draft, Cornwall Avenue Landfill Remedial Investigation/Feasibility Study, Bellingham, WA. Prepared for the Port of Bellingham by Landau Associates, Inc. of Edmonds, WA. November 21, 2007.

NYSDEC. 2009. General Information About MGPs Web Pages. New York State Department of Environmental Conservation.
http://www.dec.state.ny.us/website/der/mgp/mgp_faq.html#produce>.

NYSDEC. 2010. On-line. New York's Approach to the Remediation of Former Manufactured Gas Plants. New York State Department of Environmental Conservation http://www.dec.ny.gov/chemical/8430.html.

Norton, D. and J. Summers. 1998. Chemical Evaluation of Intertidal Sediments at Boulevard Park, Bellingham, WA. Prepared by WA State Dept. of Ecology. April 1998.

Personal Communication between Mark Herrenkohl of Herrenkohl Consulting LLC and Dr. Peter Adolphson of the Washington State Department of Ecology. Email communication on January 20, 2009.

Personal Communication between Mark Herrenkohl of Herrenkohl Consulting LLC and Byron Elmendorf and John Ivory (previous Parks Director and Site Supervisor for the City of Bellingham, respectively). Telephone calls on February 12, 2008.

Personal Communication between Mark Herrenkohl of Herrenkohl Consulting LLC and Tim Wahl, City of Bellingham Parks and Recreation Department. Several telephone calls in 2009.

Personal Communication between Mark Herrenkohl of Herrenkohl Consulting LLC and John Ivory (previous Site Supervisor for the City of Bellingham). Site Visit on February 18, 2010.

Personal Communication between Mark Herrenkohl of Herrenkohl Consulting LLC and Bill Reilly, City of Bellingham Public Works Department. Telephone call on March 10, 2010.

Personal Communication between Jeff Ninnemann of Herrenkohl Consulting LLC and Dr. Allen Hatheway, Sole-Practice Consultant Specializing in Site and Waste Characterization and Remedial Engineering of Former Manufactured Gas Plants and other Coal-Tar Sites, <http://www.hatheway.net/> Email on April 13, 2010.

Plumb, R.H., Jr. 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE/81-1. U.S. Environmental Protection Agency and U.S. Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

PSEP. 1986. Puget Sound Estuary Program: Recommended protocols for measuring conventional sediment variables in Puget Sound. Final report. Prepared for U.S. EPA, Region 10, Office of Puget Sound, Seattle, WA and the U.S. Army Corps of Engineers, Seattle District, Seattle, WA. Tetra Tech, Inc., Bellevue, WA.

PSEP. 1998. Puget Sound Estuary Program: Sediment Quality Values Refinement, Volume I, 1988 Update and Evaluation of Puget Sound AET. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington. September 1988.

PSEP. 1995. Puget Sound Estuary Program: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington. Revised July 1995.

PSEP. 1997a. Puget Sound Estuary Program: Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Final report. Prepared for U.S. EPA, Region 10, Seattle WA and Puget Sound Water Quality Action Team, Olympia, WA. King County Water Pollution Control Division Environmental Laboratory, Seattle, WA.

PSEP. 1997b. Puget Sound Estuary Program: Recommended guidelines for measuring metals in Puget Sound sediment and tissue samples. Final Report. Prepared for U.S. EPA, Region 10, Seattle WA and Puget Sound Water Quality Action Team, Olympia, WA. King County Water Pollution Control Division Environmental Laboratory, Seattle, WA.

PSEP. 1997c. Puget Sound Estuary Program: Recommended guidelines for measuring organic compounds in Puget Sound sediment and tissue samples. Final report. Prepared for U.S. EPA, Region 10, Seattle WA and Puget Sound Water Quality Action Team, Olympia, WA. King County Water Pollution Control Division Environmental Laboratory, Seattle, WA.

PSEP. 1998. Puget Sound Estuary Program: Recommended Guidelines for Station Positioning in Puget Sound. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

Puget Sound Energy. 2009. Response to PLP Notification, Boulevard Park (Facility Site 2865), Bellingham, Washington. Letter to Mary O'Herron, Site Manager, Department of Ecology, Bellingham, Washington. Letter prepared by Steve Secrist, Deputy General Counsel, Director of Environmental Policy and Sustainability. Dated January 7, 2009.

Reid Middleton Inc. 2008. Boulevard Park Shoreline Assessment, Bellingham, WA. Prepared for the City of Bellingham, WA. Prepared by Reid Middleton Inc. of Everett, WA. April 2008.

Reid Middleton. 2009. Feasibility Report. Boulevard Park Shoreline and Overwater Walkway, Bellingham, WA. Prepared for the City of Bellingham, Parks & Recreation Department, Bellingham, WA. Prepared by Reid Middleton, Everett, WA.

RSET. 2006. Northwest Regional Sediment Evaluation Framework for the Pacific Northwest. Interim Final. September 2006.

RETEC. 2006. Supplementary Remedial Investigation and Feasibility Study, Volume 1 Remedial Investigation, Whatcom Waterway Site, Bellingham, Washington. Prepared for the Port of Bellingham. Prepared by RETEC Group, Inc., Seattle, Washington. October 10, 2006.

Rittenhouse-Zeman. 1979. Soils and Foundation Investigation, Boulevard Park, Bellingham, Washington. Rittenhouse-Zeman and Assoc. Inc. February 7.

Robinson, Alison Jones. 2010. Cascade Comments Regarding Draft Work Plan Outlines. Email Prepared for John Houlihan, Houlihan Law PLLC, Seattle, WA. Prepared by Alison Jones Robinson of Tupper Mack Brower PLLC, Seattle, WA. March 29, 2010.

Sanborn Fire Insurance Maps for Bellingham from 1891, 1904, 1913, 1950.

Shea, G.B., C.C. Ebbsmeyer, Q.J. Stober, K. Pazera, J.M. Cox, S. Hemingway, J.M. Helseth, and L.R. Hinchey. 1981. History and effects of pulpmill effluent discharges, Bellingham WA. Nortwest Environmental Consultants. Seattle, Washington. 491 pp.

Uniform Hazardous Waste Manifest. 1993. Soil and Water Removed from Boulevard Park, Bellingham, WA. Manifest No. 10099. Prepared by Envirotech Systems, Inc., Seattle, WA. Prepard for the City of Bellingham, WA. October 21, 1993.

USACE. 1977. A current study of Bellingham Bay. U.S. Army Corps of Engineers. Seattle District, Seattle, WA. 27pp.

USEPA. 1984a. Boulevard Park Site Assessment. Prepared by the U.S. Environmental Protection Agency, Region 10, Seattle, WA.

USEPA. 1984b. Preliminary Assessment of Boulevard Park. Letter from Dave Buecker, RPM to John Osburn, RPO, U.S. Environmental Protection Agency, Region 10, Seattle, WA. Dated July 17, 1984.

USEPA. 1990. Guidance on remedial actions for Superfund sites with PCB contamination. Superfund Management Review: Recommendation 23. OSWER Directive No. 9355.4-01. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA-540/R-99-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA. 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. 540-R-01-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA. 2004. State Input Pursuant to 42 U.S.C. SS 9601(41)(C)(i)(II) into Region 10's Preliminary Determination of those Sites Excluded from Definition of "Eligible Response Site" due to Preliminary Hazard Ranking System (HRS) Score. Letter written to Tim Nord, Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA. From Sylvia Kawabata, Manager of Site Assessment and Cleanup Unit, U.S. Environmental Protection Agency, Region 10, Seattle, WA. Dated January 23, 2004.

USEPA. 2010a. National ambient water quality criteria. Accessed March 2010 at http://www.epa.gov/waterscience/criteria/wqcriteria.html. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2010b. Maximum contaminant levels. Accessed March 2010 at http://www.epa.gov/safewater/mcl.html#mclsUH. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2010c. SW-846 On-line, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. U.S. Environmental Protection Agency. Accessed March 2010 at http://www.epa.gov/epaoswer/hazwaste/test/main.htm.

Wahl, Tim. 2010. Coincidence of the BB&E Railroad Coal Bunker Structure and the Greenways III Over-Water Walkway at “Mamosee” or “Bunker Bight”, Bellingham Bay, Bellingham, WA. Prepared by Tim Wahl, City of Bellingham, Parks & Recreation Department. January 7, 2010.

Washington State Regional Archives: James Copher. Bellingham, Washington. Center for Pacific Nortwest Studies: Ruth Steele. Western Washington University, Bellingham, Washington.

WDOH. 2004. Public water supplies. WAC 246-290-310. Accessed August 2006 at http://apps.leg.wa.gov/WAC/default.aspx?cite=246-290-310. Washington Department of Health, Olympia, WA.

WDFW. 2010. On-line, Washington State Priority Habitats and Species (PHS) List. Washington State Department of Fish and Wildlife. http://wdfw.wa.gov/hab/phslist.htm.

Wessen & Wahl. 2009. Pattle Point Trestle Archeological Potential Assessment, Boulevard Park, Bellingham, WA. Prepared by Wessen & Wahl of Seattle, WA. July 2009.

Wessen & Associates. 2010. Draft Report – An Archaelogical Survey of the Boulevard/Cornwall Overwater Pedestrian Walkway Project Area, Bellingham, WA. Prepared by BergerABAM, Seattle, WA. Prepared by Wessen & Associates, Inc., Seattle, WA. January 2010.

APPENDIX A

HISTORICAL DATA TABLES AND FIGURES

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SCREENING LEVEL COMPARISONS

APPENDIX A-1

HISTORICAL DATA TABLES AND FIGURES

APPENDIX A-2

SCREENING LEVEL COMPARISONS

APPENDIX B

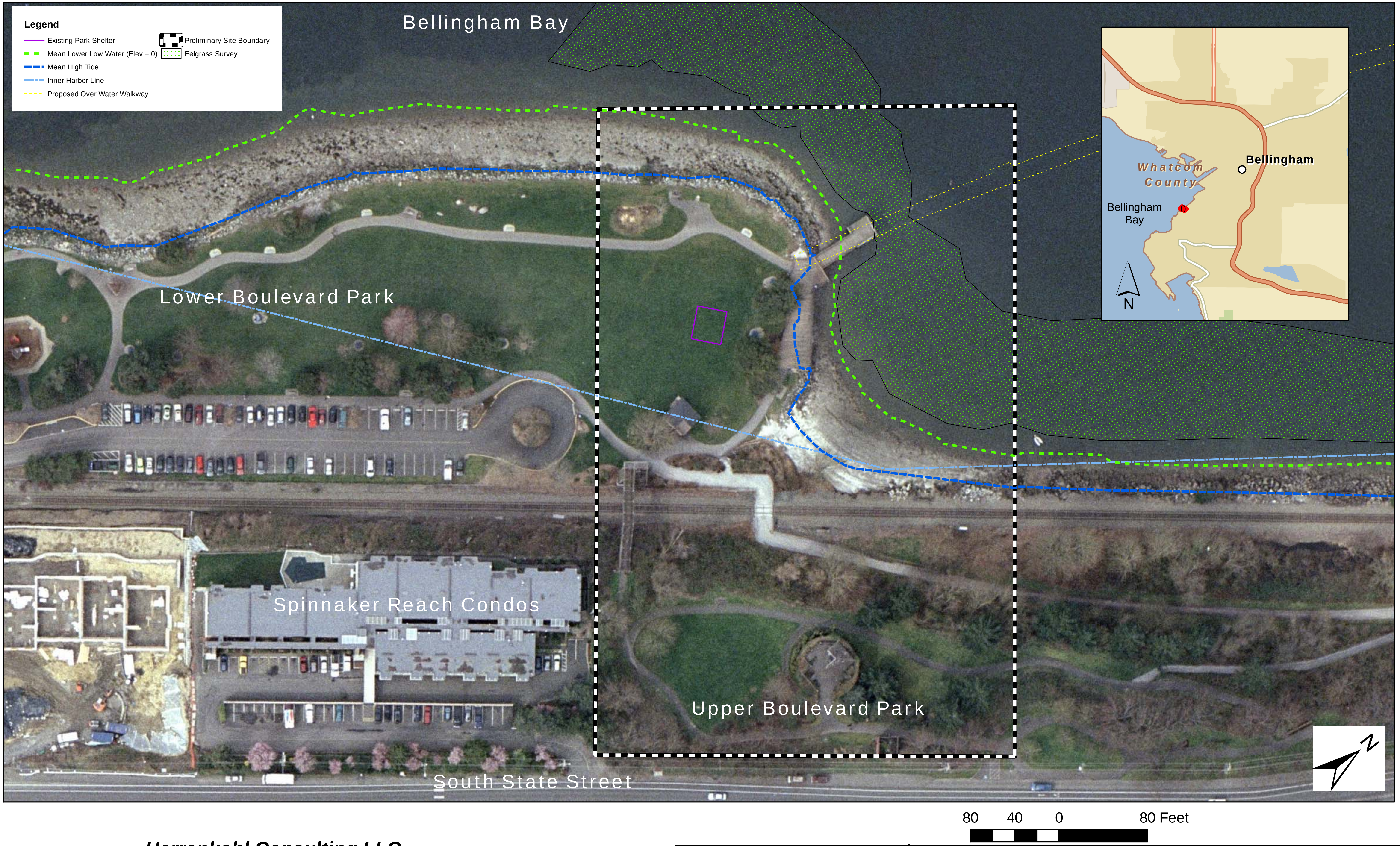
SAMPLING AND ANALYSIS PLAN

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

APPENDIX D

HEALTH AND SAFETY PLAN



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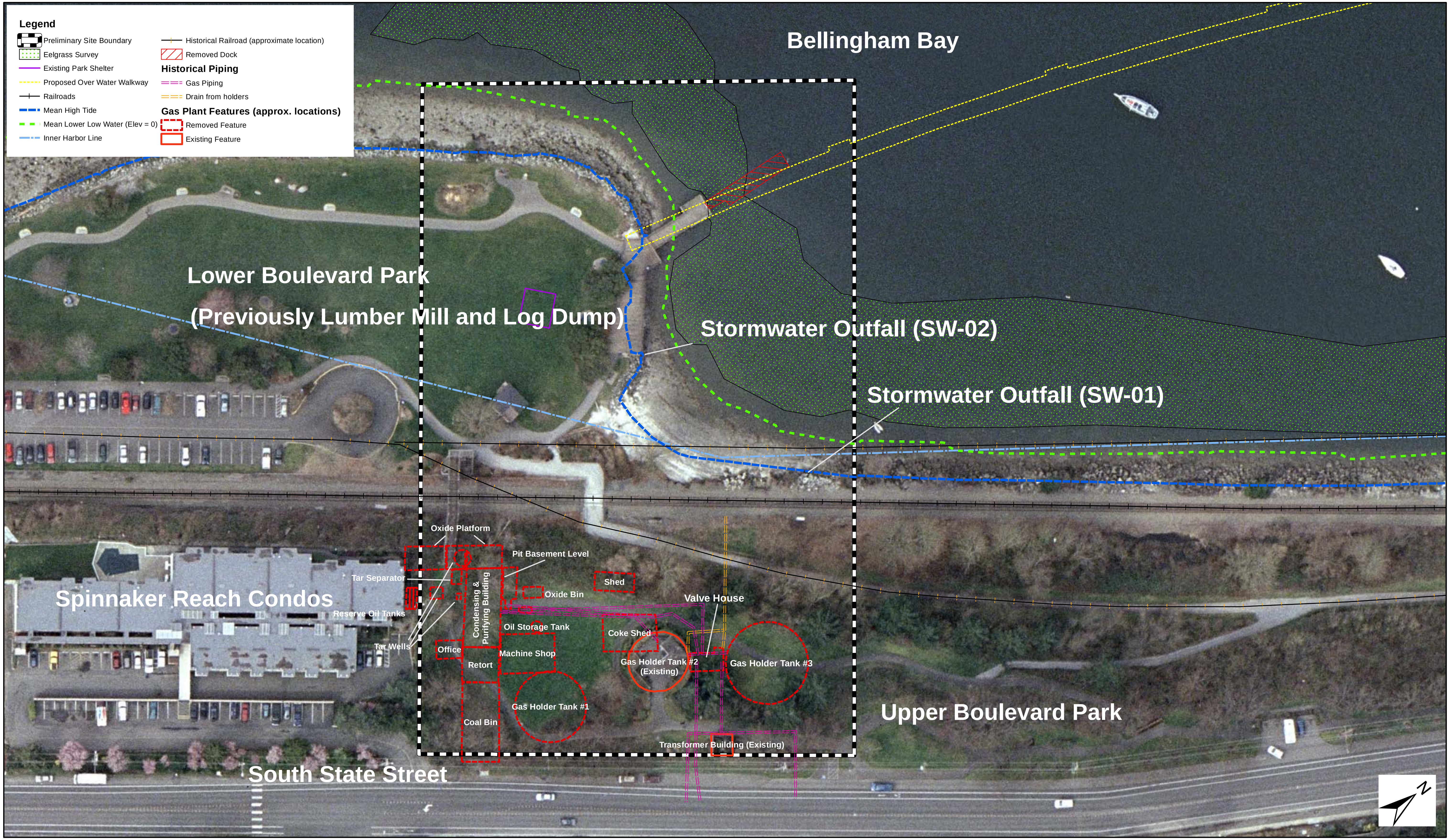
Data Sources:
Air Photo - City of Bellingham, Taken March 22, 2008
Proposed Over Water Walkway - BergerABAM, 2010
Other site features - Steele and Assoc, 2010

Elevation Datum info: For COB contours - Sea Level using the COB Datum; For bathymetric contours, Mean Lower Low Water.

South State Street
Manufactured Gas Plant
RI/FS
Bellingham, WA

Site and Vicinity Map

Figure
1



80 40 0 80 Feet

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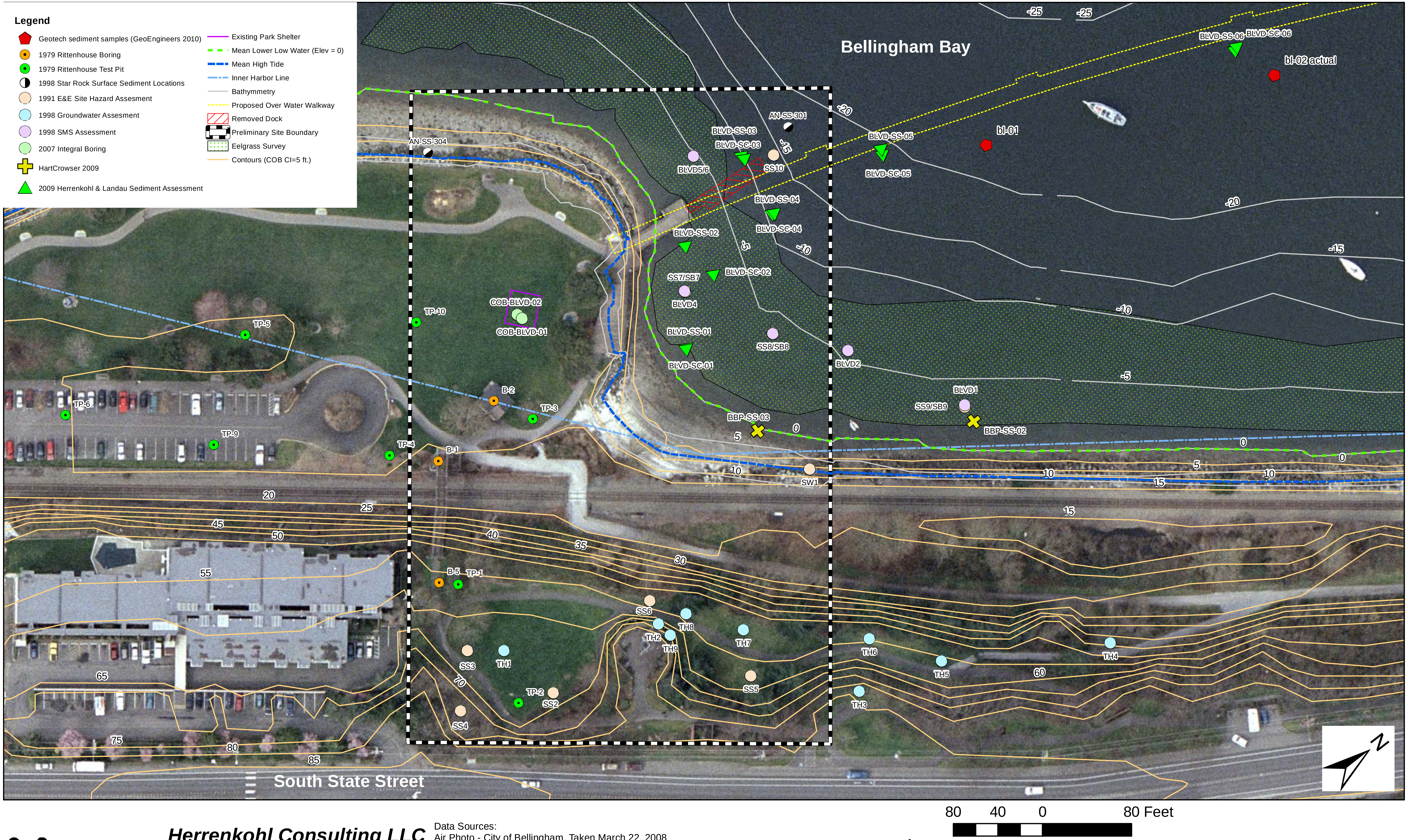
Elevation Datum info: For COB contours - Sea Level using the COB Datum;
For bathymetric contours, Mean Lower Low Water.

Data Sources:
Air Photo - City of Bellingham, Taken March 22, 2008
Proposed Over Water Walkway - BergerABAM, 2010
Historical Railroad - Location Estimated from air photo
Other site features - Steele and Assoc, 2010
Historical Structures - Digitized from property Map,
Gas Plant, Bellingham WA, Puget Sound Power &
Light Company, dated 1922 and revised 1945.

South State Street
Manufactured Gas Plant
RI/FS
Bellingham, WA

Historical Features Map

Figure
2



Herrenkohl Consulting LLC

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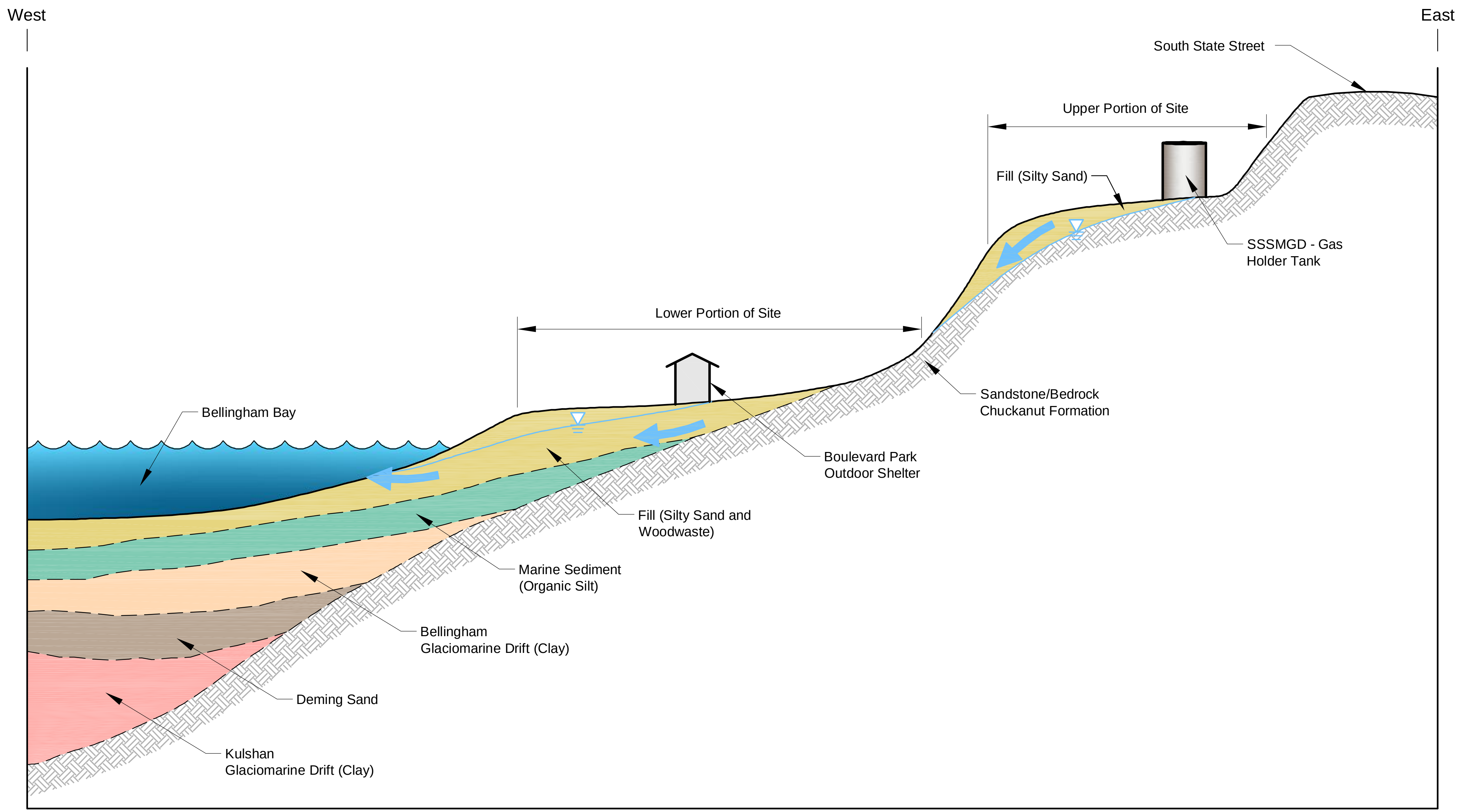
Data Sources:
Air Photo - City of Bellingham, Taken March 22, 2008
Contours - COB
Bathymetry - Larry Steele and Assoc, 2010
Proposed Over Water Walkway - BergerABAM, 2010
Other site features - Steele and Assoc, 2010

Elevation Datum info: For COB contours - Sea Level using the COB Datum; For bathymetric contours, Mean Lower Low Water.

South State Street Manufactured Gas Plant RI/FS Bellingham, WA	**Historical Sampling Locations**	Figure 3



Not To Scale

Legend

▽ Groundwater Table

← Groundwater Flow

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

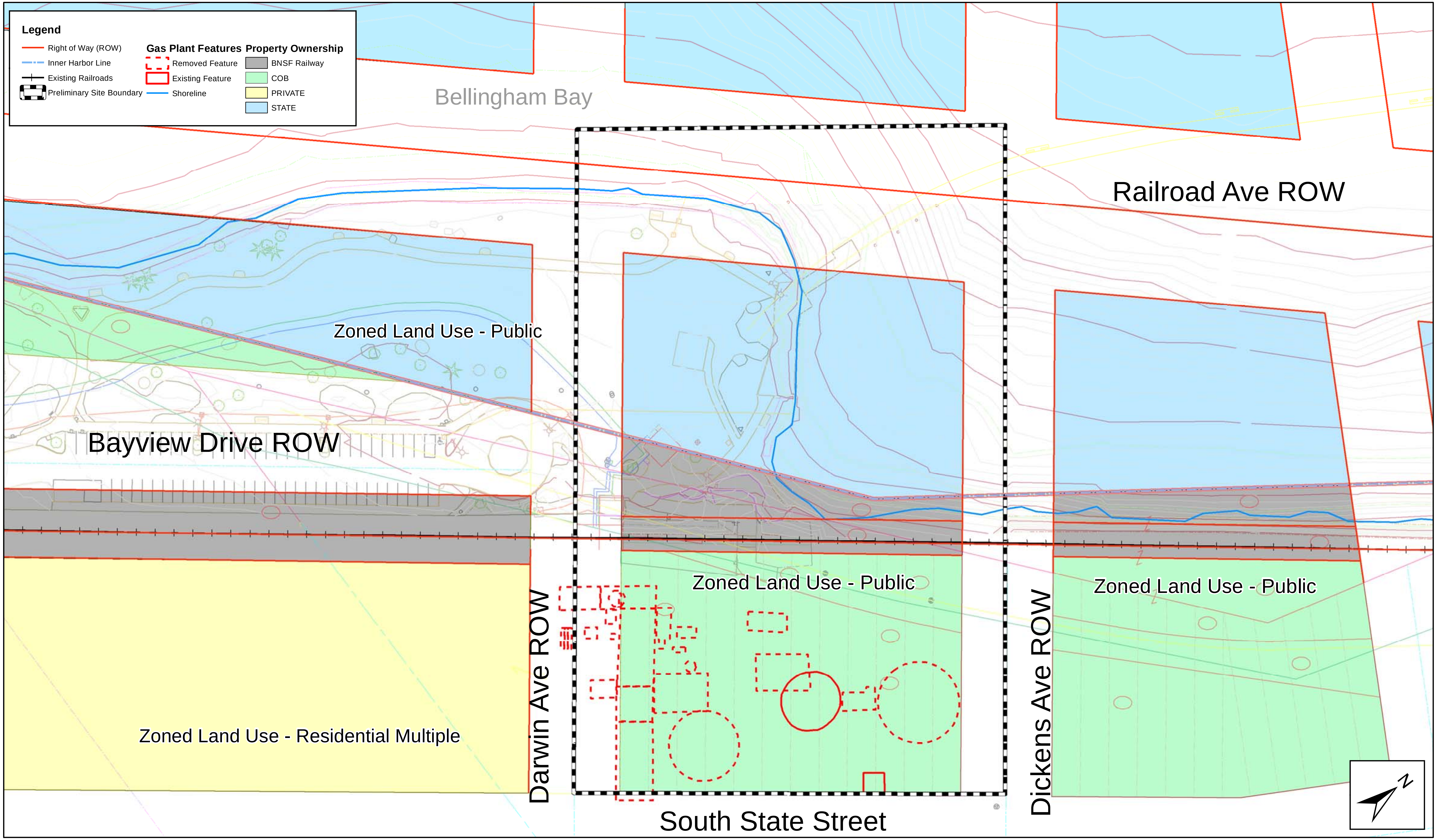
South State Street Manufactured Gas Plant RI/FS Bellingham, Washington

Conceptual Cross Section

Figure 4

LANDAU ASSOCIATES

South State Street Manufactured Gas Plant | V:\053\010\040\042\Updates 2010-3-31\Figure 4.dwg (A) "Figure 4" 7/26/2010



80 40 0 80 Feet

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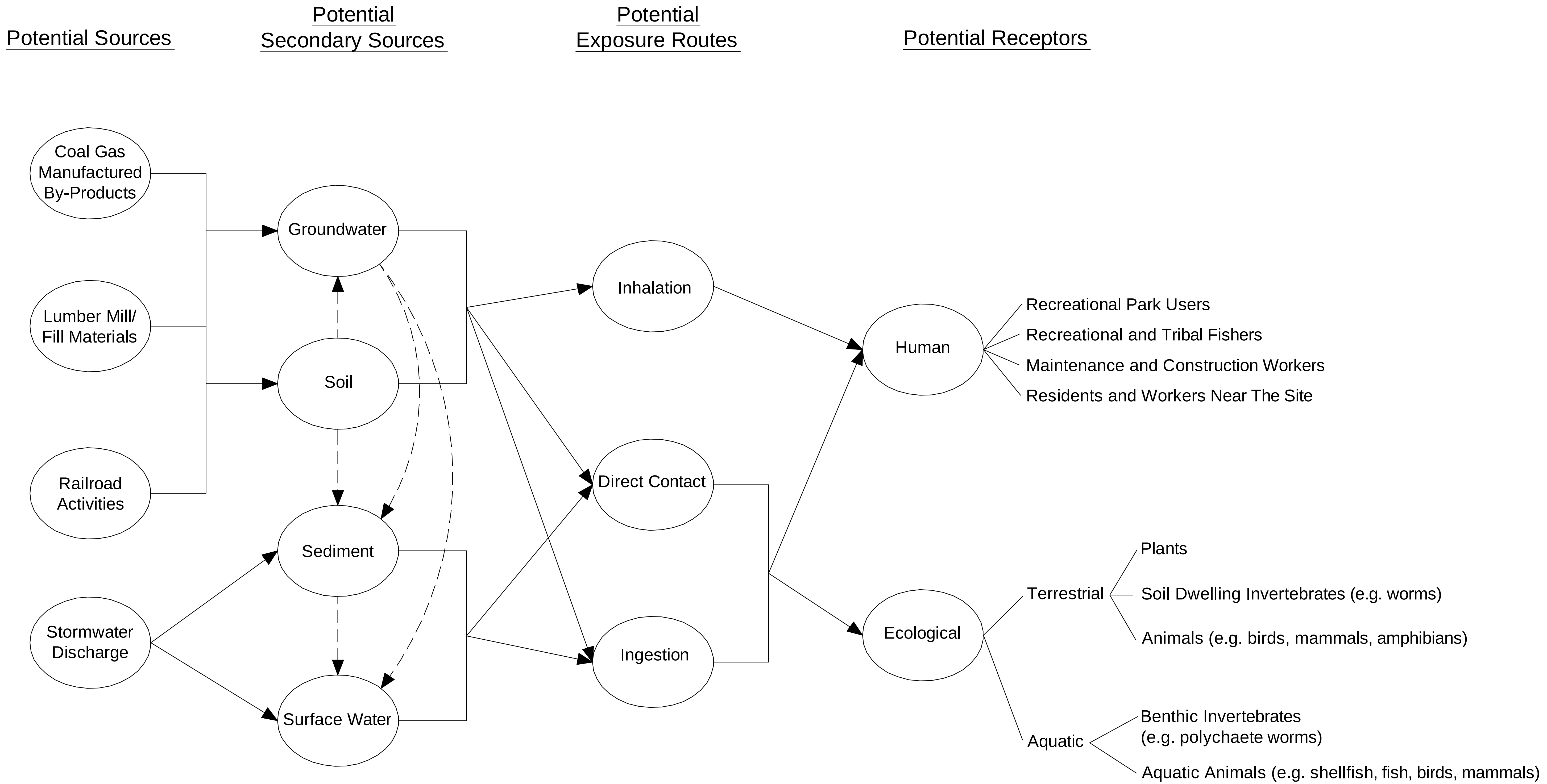
Data Sources:
Ownership and site features - Steele and Assoc, 2010
Historical Structures - Digitized from property Map, Gas Plant, Bellingham WA, Puget Sound Power & Light Company, dated 1922 and revised 1945.

South State Street Manufactured Gas Plant RI/FS Bellingham, WA	**Property Ownership and Zoning**	Figure 5



LANDAU ASSOCIATES, INC. | V:\053\101\040\042\Updates 2010-3-31\Figs 6_9.dwg (A) "Figure 6" 7/26/2010

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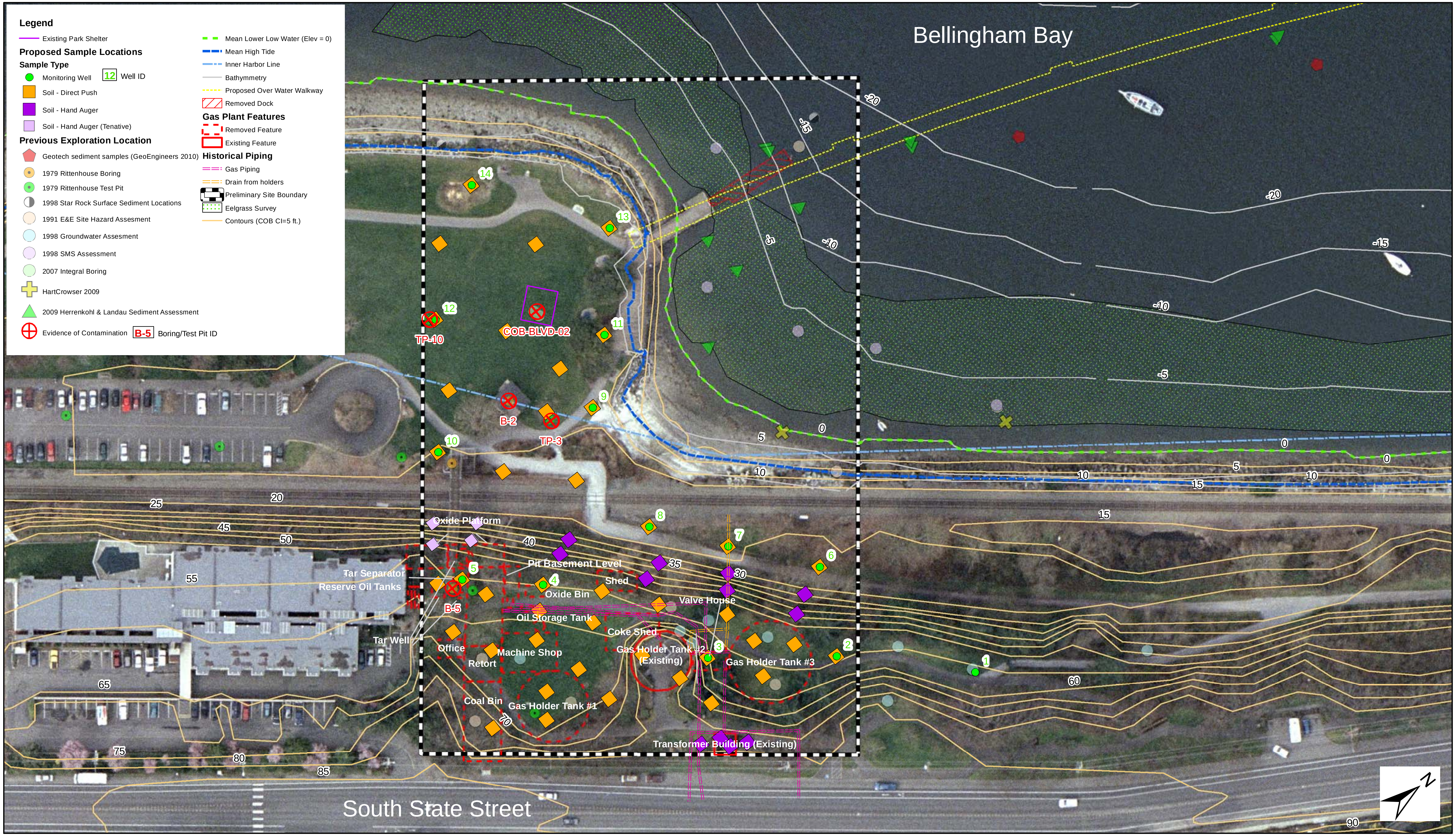
South State Street
Manufactured Gas Plant
RI/FS
Bellingham, Washington

Conceptual Site Model

Figure
6



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Elevation Datum info: For COB contours - Sea Level using the COB Datum;
For bathymetric contours, Mean Lower Low Water.

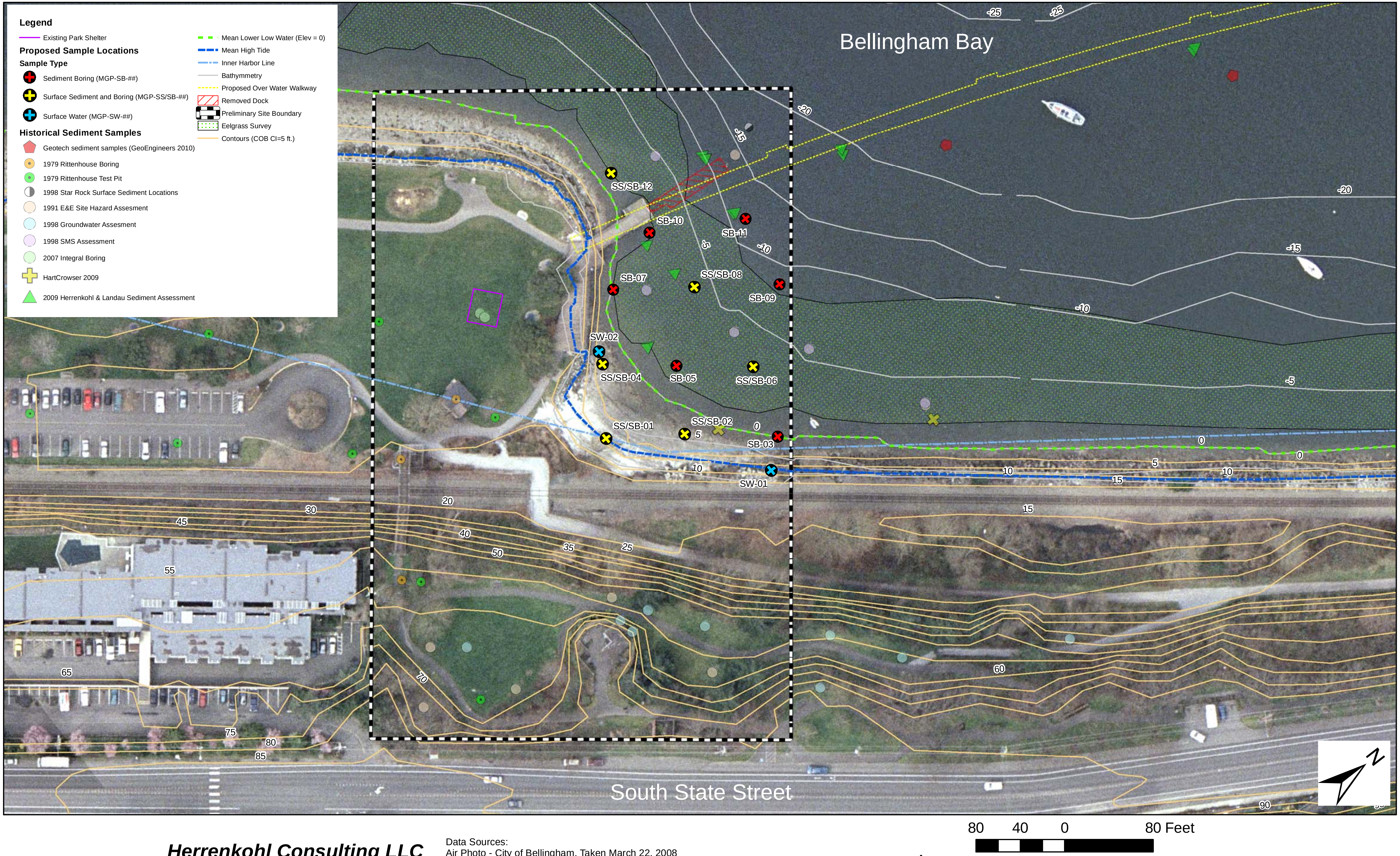
Data Sources:
Air Photo - City of Bellingham, Taken March 22, 2008
Contours - COB
Bathymetry - Larry Steele and Assoc, 2010
Proposed Over Water Walkway - BergerABAM, 2010
Other site features - Steele and Assoc, 2010
Historical Structures - Digitized from property Map,
Gas Plant, Bellingham WA, Puget Sound Power &
Light Company, dated 1922 and revised 1945.

80 40 0 80 Feet

South State Street
Manufactured Gas Plant
RI/FS
Bellingham, WA

Proposed Soil and Groundwater Sampling Locations

Figure
7



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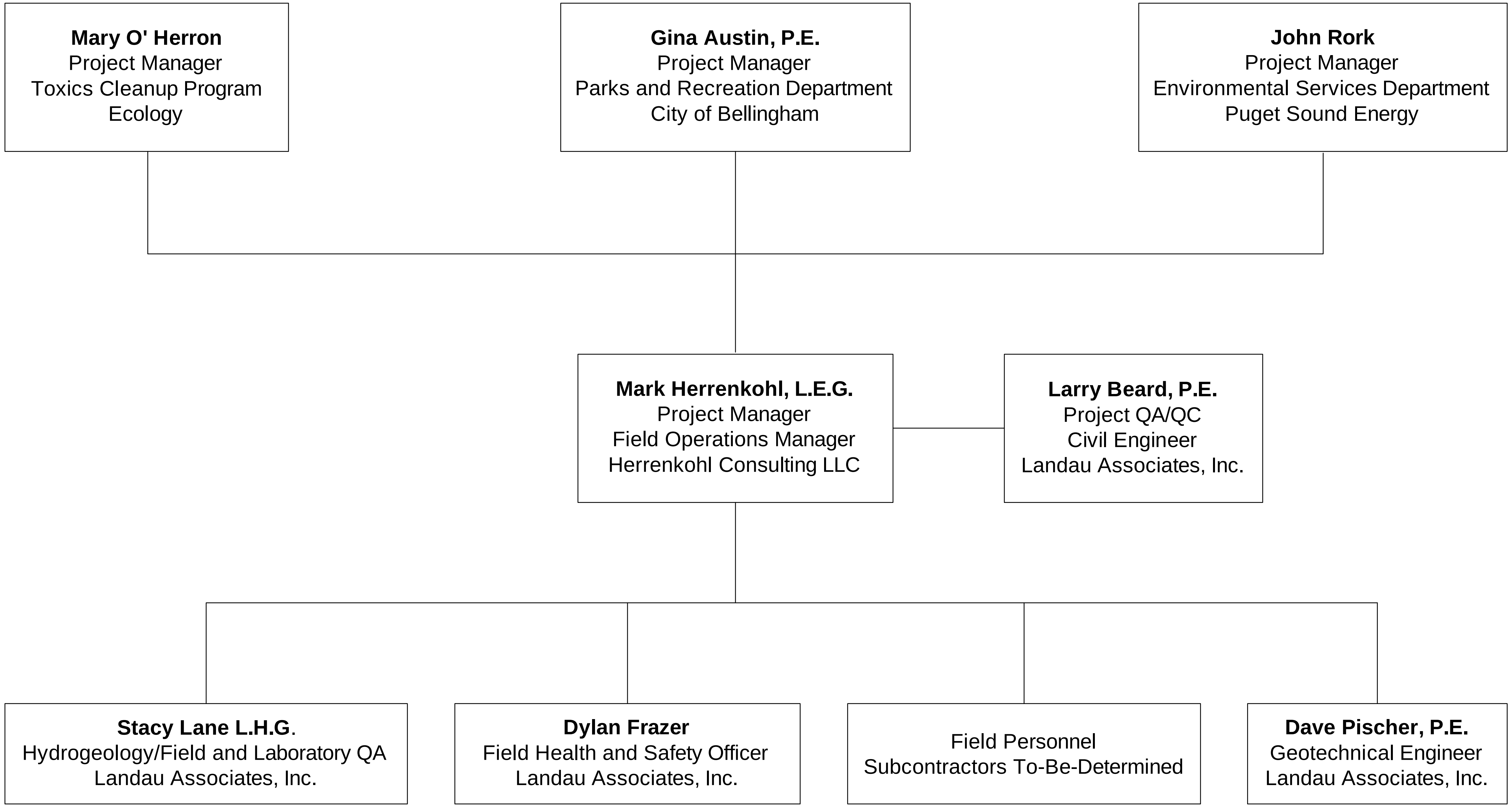
Data Sources:
Air Photo - City of Bellingham, Taken March 22, 2008
Contours - COB
Bathymetry - Larry Steele and Assoc, 2010
Proposed Over Water Walkway - BergerABAM, 2010
Other site features - Steele and Assoc, 2010

Elevation Datum info: For COB contours - Sea Level using the COB Datum; For bathymetric contours, Mean Lower Low Water.

South State Street Manufactured Gas Plant RI/FS Bellingham, WA	**Proposed Sediment and Surface Water Sampling Locations**	Figure 8



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Subcontractors To-Be-Determined

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LANDAU ASSOCIATES, INC. | V:\053\010\040\042\Updates 2010-3-31\Figs 6_9.dwg (A) "Figure 9" 4/26/2010

LANDAU ASSOCIATES

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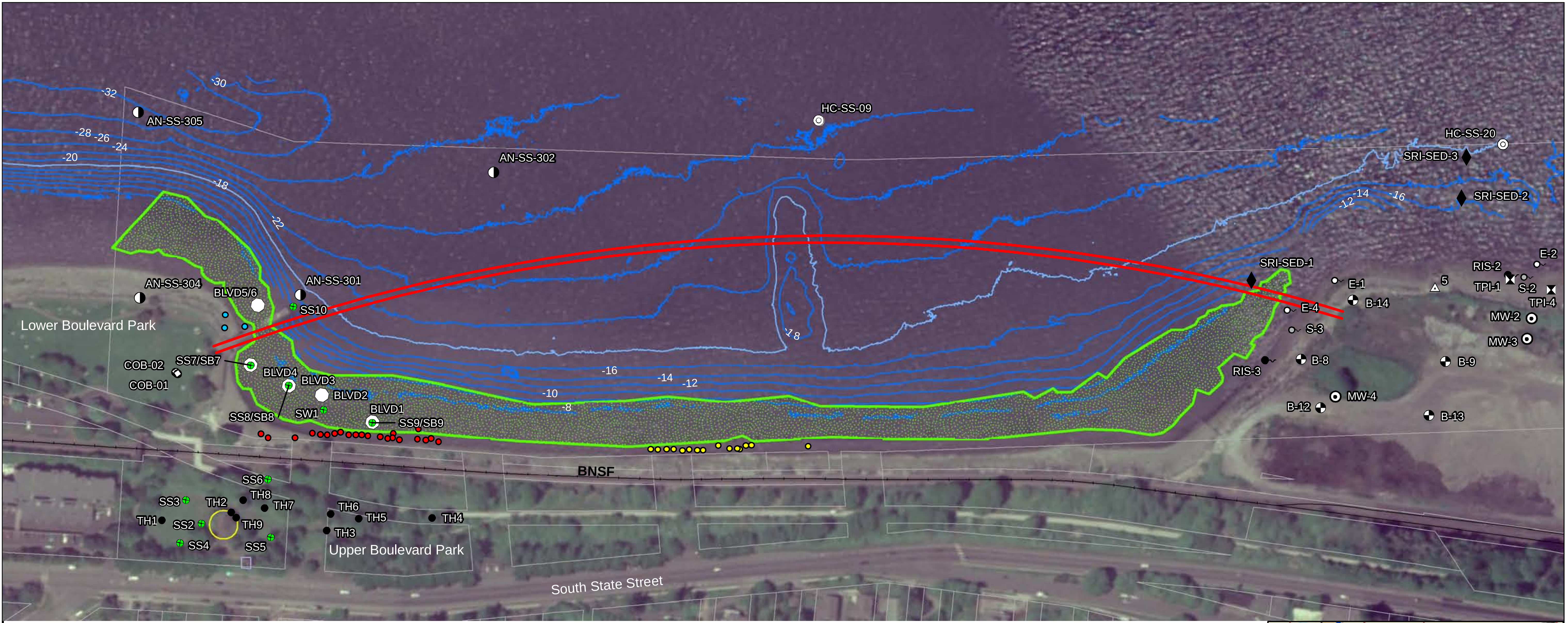
South State Street
Manufactured Gas Plant
RI/FS
Bellingham, Washington

Project Organization Chart

Figure
9



Legend

Historic Boulevard Park Sample Locations

SS1	⊗	1991 E&E Site Hazard Assesment
TH1	●	1998 Groundwater Assesment
BLVD1	○	1998 SMS Assessment
COB-01	◘	2007 Integral Boring
AN-SS-301	◐	Starr Rock Surface Sediment Sample Location (1998)

Historic Cornwall Avenue Landfill Sample Locations

△	Approximate Location of Dames and Moore Boring (1960)
●~	Approximate Location of Expanded Site Investigation Seep/Sediment Sampling (1996) and Focused RI Seep Sampling (1998)
⧗	Approximate Location of Expanded Site Investigation Test Pit (1996)
○~	Approximate Location of Initial Site Investigation Seep/Sediment Sampling (1992)
⊙	Approximate Location of Monitoring Well Focused RI (1998) and of Monitoring Well Supplemental RI (2002)
⊕	Approximate Location of Purnell & Associates Boring (1985)
◆	Approximate Location of Supplemental RI Sediment Sample (2002)
●~	Approximate Location of Supplemental RI Seep Sample (2002)
◎	Approximate Location of Whatcom Waterway RI Sediment Samples (1996)

Other Map Features

●	Boulevard Park Dock Pilings (Lisa Kaufman, DNR 2008)
●	Boulevard Park North Pilings (Lisa Kaufman, DNR 2008)
●	Boulevard Park Beach Pilings (Lisa Kaufman, DNR 2008)
—	Proposed Walkway Alignment (Walker Macy)
—	Bathymetry (Golder 2008)
▨	Eelgrass Survey (Grette Associates)
—+—	Railroad (City of Bellingham)
☐	Parcels (City of Bellingham)
☐	Former Gas Facility Features
☐	Existing Gas Holder Tank
☐	Existing Transformer Building

0 200 400

Scale in Feet, NAD 83

Data Source: City of Bellingham; WA Department of Natural Resources; Reid Middleton; Walker Macy, Grette Associates, Golder

Y:\Projects\053101\Mapdocs\Focused Environmental Site Assesment\Figure1-1_HistoricalSamplingFESA.mxd 3/26/2009

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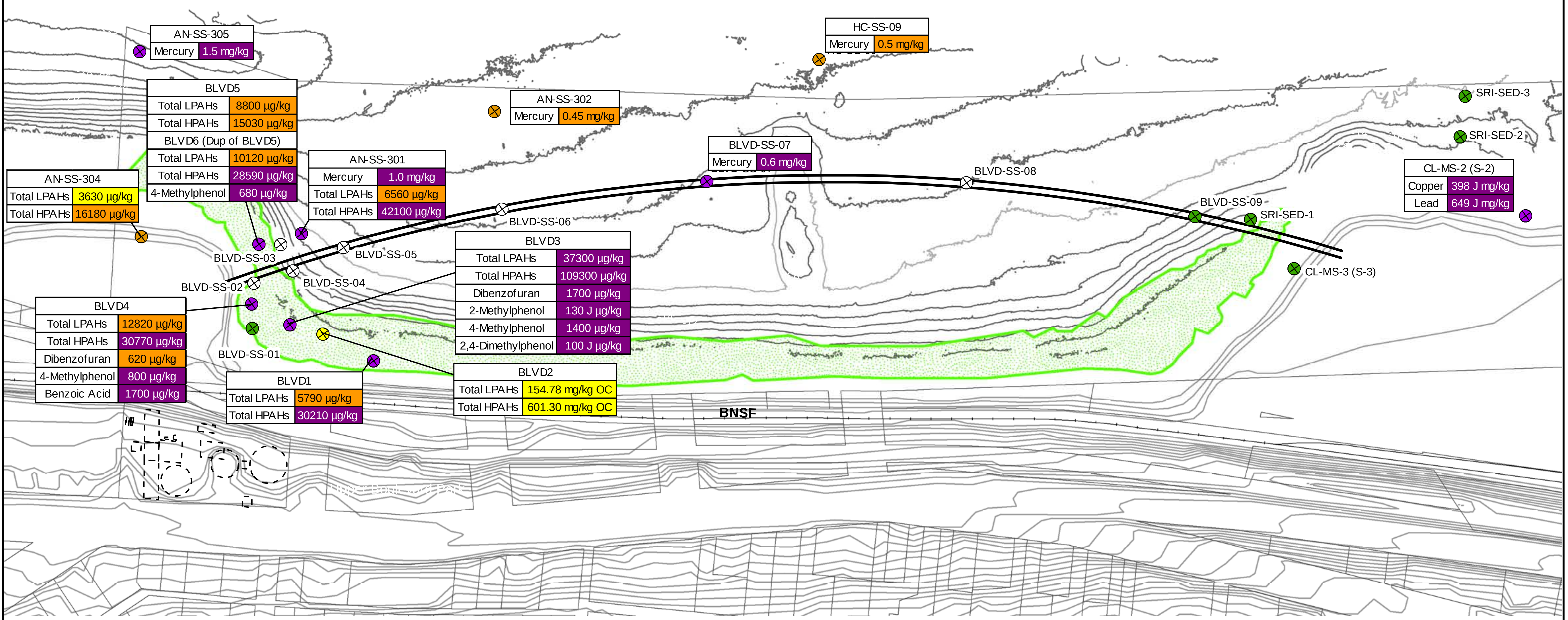
Boulevard Park
Bellingham, Washington

Historical Sampling Locations, Focused Environmental Site Assessment

Figure
1-1



Legend

- ⊕ Sampling Locations Exceeding 2LAET/CSL Screening Levels
- ⊕ Sampling Locations Exceeding LAET/SQS Screening Levels
- ⊕ Sampling Locations with No Screening Level Exceedances
- ⊕ Sampling Location where Total LPAH or HPAH do not Exceed Screening Levels, but Individual PAH Compounds Exceed the Screening Levels
- ⊕ Sampling Location Not Tested for SMS Organic Chemicals
- Proposed Walkway Alignment (Walker Macy)
- Bathymetry (Golder 2008)
- ▨ Eelgrass Survey (Grette Associates)
- Railroad (City of Bellingham)
- Historic Manufactured Gas Plant Features
- ☐ Parcels (City of Bellingham)

N

0 200 400

Scale in Feet, NAD 83

Note

1. For complete analytical results please refer to Tables A-1 and 4-1.

Data Source: City of Bellingham; Reid Middleton; Walker Macy; Grette Associates; Golder

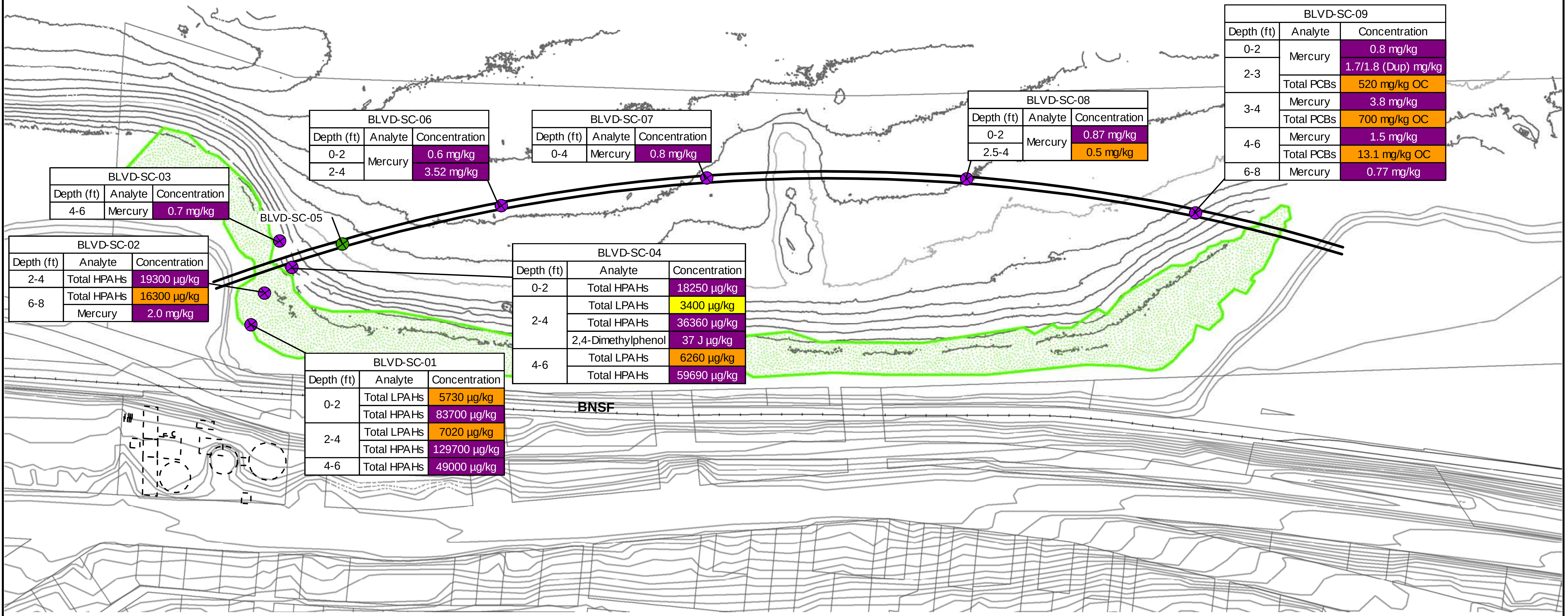
Landau Associates

Boulevard Park
Bellingham, Washington

Distribution of SMS Chemical Exceedances in Surface Sediments, Focused Environmental Site Assessment, Boulevard Park

Figure
4-2

Y:\Projects\053101\Mapdocs\Focused Environmental Site Assessment\Figure4-2_DistributionOfSMSExceedancesSurface.mxd 3/4/2009



BLVD-SC-09		
Depth (ft)	Analyte	Concentration
0-2	Mercury	0.8 mg/kg
2-3		1.7/1.8 (Dup) mg/kg
	Total PCBs	520 mg/kg OC
3-4	Mercury	3.8 mg/kg
	Total PCBs	700 mg/kg OC
4-6	Mercury	1.5 mg/kg
	Total PCBs	13.1 mg/kg OC
6-8	Mercury	0.77 mg/kg

BLVD-SC-08		
Depth (ft)	Analyte	Concentration
0-2	Mercury	0.87 mg/kg
2.5-4		0.5 mg/kg

BLVD-SC-07		
Depth (ft)	Analyte	Concentration
0-4	Mercury	0.8 mg/kg

BLVD-SC-06		
Depth (ft)	Analyte	Concentration
0-2	Mercury	0.6 mg/kg
2-4		3.52 mg/kg

BLVD-SC-03		
Depth (ft)	Analyte	Concentration
4-6	Mercury	0.7 mg/kg

BLVD-SC-02		
Depth (ft)	Analyte	Concentration
2-4	Total HPAHs	19300 µg/kg
6-8	Total HPAHs	16300 µg/kg
	Mercury	2.0 mg/kg

BLVD-SC-04		
Depth (ft)	Analyte	Concentration
0-2	Total HPAHs	18250 µg/kg
2-4	Total LPAHs	3400 µg/kg
	Total HPAHs	36360 µg/kg
	2,4-Dimethylphenol	37 J µg/kg
4-6	Total LPAHs	6260 µg/kg
	Total HPAHs	59690 µg/kg

BLVD-SC-01		
Depth (ft)	Analyte	Concentration
0-2	Total LPAHs	5730 µg/kg
	Total HPAHs	83700 µg/kg
2-4	Total LPAHs	7020 µg/kg
	Total HPAHs	129700 µg/kg
4-6	Total HPAHs	49000 µg/kg

Legend

- ⊕ Sampling Locations Exceeding 2LAET/CSL Screening Levels
- ⊕ Sampling Locations Exceeding LAET/SQS Screening Levels
- ⊕ Sampling Locations where Total LPAH or HPAH do not Exceed Screening Levels, but Individual PAH Compounds Exceed the Screening Levels
- ⊕ Sampling Locations with No Screening Level Exceedances
- — Proposed Walkway Alignment (Walker Macy)
- — Bathymetry (Golder 2008)
- ▨ Eelgrass Survey (Grette Associates)
- -+- Railroad (City of Bellingham)
- ⬚ Historic Manufactured Gas Plant Features
- ☐ Parcels (City of Bellingham)

N

0 200 400
Scale in Feet, NAD 83

Note
1. For complete analytical results please refer to Table 4-2.

Data Source: City of Bellingham; Reid Middleton; Walker Macy; Grette Associates; Golder

Boulevard Park
Bellingham, Washington

Distribution of SMS Chemical Exceedances in Subsurface Sediments, Focused Environmental Site Assessment, Boulevard Park

Figure
4-3

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Y:\Projects\053101\Mapdocs\Focused Environmental Site Assesment\Figure4-3_DistributionOfSubsurfaceSMSExceedances.mxd 3/4/2009

Table 4-1. Summary of Surface Sediment Conventional and Chemistry Results

Sample Station					**BLVD-SS-01**	**BLVD-SS-02**	**BLVD-SS-03**	**BLVD-SS-04**	**BLVD-SS-05**	**BLVD-SS-06**	**BLVD-SS-10**	**BLVD-SS-07**	**BLVD-SS-08**	**BLVD-SS-09**
Sampling Depth (cm)					0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12
Sampling Date	**AETs**		**SMS**		9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008
	LAET	2LAET	SQS	CSL							Dup of BLVD-SS-06			
Conventionals in %														
Total Solids					54.1	40.2	23.6	26.8	28.2	35.7	35.2	37.8	36.9	37.2
Total Organic Carbon					2.94	3.25	9 *	12.2 *	4.87 *	2.33	2.45	2.09	3.27	3.26
Gravel					0.4					0	0	2.3	0	2.2
Sand					76.9					2.5	1.9	3.3	0.9	14.5
Fines					22.5					97.5	98.1	94.5	99.1	83.1
Conventionals in mg/kg														
N-Ammonia					11.4	17.1	27.5	17	22.7	23	21.9	22.5	16.3	13.5
Sulfide					441	1740	1270	749	2710	1510	2000	2180 J	1750	543
TPH in mg/kg														
Diesel-Range Hydrocarbons					29	31	31	26	31	14 U	15 U	13 U	13 U	14 U
Motor Oil-Range Hydrocarbons					72	66	70	43	54	28 U	29 U	26 U	26 U	28 U
Metals in mg/kg														
Arsenic	57	93	57	93	9 U	10 U	20 U	20 U	20 U	10 U	10 U	10	10 U	20
Cadmium	5.1	6.7	5.1	6.7	0.6	0.8	1.2	1.2	1.1	0.9	0.9	0.9	0.7	1.1
Chromium	260	270	260	270	31.6	35	43	43	68	76	76	81	71	70
Copper	390	390	390	390	32.5	46.4	45.9	40.6	53.4	54.6	56.5	55.6	53.8	66.3
Lead	450	530	450	530	32	34	24	21	15	13	13	16	13	27
Mercury	0.41	0.59	0.41	0.59	0.1	0.1	0.3	0.4	0.2	0.2	0.2	**0.6**	0.3	0.4
Nickel	140	140			30	37	60	57	98	111	111	115	107	97
Silver	6.1	6.1	6.1	6.1	0.5 U	0.7 U	1 U	1 U	1 U	0.8 U	0.8 U	0.8 U	0.8 U	0.7 U
Zinc	410	960	410	960	85	93	142	85	112	112	113	119	106	124
PCBs	**ug/kg**		**mg/kg OC**											
Aroclor 1016														0.61 U
Aroclor 1221														0.61 U
Aroclor 1232														0.61 U
Aroclor 1242														0.61 U
Aroclor 1248														0.61 U
Aroclor 1254														0.61 U
Aroclor 1260														0.61 U
Aroclor 1262														0.61 U
Aroclor 1268														0.61 U
Total PCBs	130	1000	12	65										0.61 U
PAHs	**ug/kg**		**mg/kg OC**											
Naphthalene	2100	2400	99	170	1.53 T									
Acenaphthylene	1300	1300	66	66	3.40									
Acenaphthene	500	730	16	57	2.01 U									
Fluorene	540	1000	23	79	2.11									
Phenanthrene	1500	5400	100	480	30.61									
Anthracene	960	4400	220	1200	5.78									
2-Methylnaphthalene	670	1400	38	64	2.01 U									
1-Methylnaphthalene					2.01 U									
Total LPAHs	5200	13000	370	780	43.44									
Fluoranthene	1700	2500	160	1200	57.82									
Pyrene	2600	3300	1000	1400	44.22									

Table 4-1. Summary of Surface Sediment Conventional and Chemistry Results

Sample Station					**BLVD-SS-01**	**BLVD-SS-02**	**BLVD-SS-03**	**BLVD-SS-04**	**BLVD-SS-05**	**BLVD-SS-06**	**BLVD-SS-10**	**BLVD-SS-07**	**BLVD-SS-08**	**BLVD-SS-09**
Sampling Depth (cm)					0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12	0-12
Sampling Date	**AETs**		**SMS**		9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008	9/19/2008
	LAET	2LAET	SQS	CSL							Dup of BLVD-SS-06			
Benzo(a)anthracene	1300	1600	110	270	20.41									
Chrysene	1400	2800	110	460	23.81									
Benzo(b)fluoranthene					19.73									
Benzo(k)fluoranthene					19.39									
Total Benzofluoranthenes	3200	3600	230	450	39.12									
Benzo(a)pyrene	1600	3000	99	210	23.81									
Indeno(1,2,3-cd)pyrene	600	690	34	88	8.50									
Dibenz(a,h)anthracene	230	540	12	33	2.41									
Benzo(g,h,i)perylene	670	720	31	78	7.82									
Total HPAHs	12000	17000	960	5300	227.93									
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**											
1,2-Dichlorobenzene	35	50	2.3	2.3	*2.01 U*									
1,3-Dichlorobenzene	170	170			2.01 U									
1,4-Dichlorobenzene	110	120	3.1	9	2.01 U									
1,2,4-Trichlorobenzene	31	51	0.81	1.8	*2.01 U*									
Hexachlorobenzene	22	70	0.38	2.3	*2.01 U*									
Phthalate Esters	**ug/kg**		**mg/kg OC**											
Dimethylphthalate	71	160	53	53	2.01 U									
Diethylphthalate	200	200	61	110	2.01 U									
Di-n-Butylphthalate	1400	1400	220	1700	2.01 U									
Butylbenzylphthalate	63	900	4.9	64	2.01 U									
bis(2-Ethylhexyl)phthalate	1300	1900	47	78	1.67 T									
Di-n-Octyl phthalate	6200	6200	58	4500	2.01 U									
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**											
Dibenzofuran	540	700	15	58	1.05 T									
Hexachlorobutadiene	11	120	3.9	6.2	*2.01 U*									
N-Nitrosodiphenylamine	28	40	11	11	*2.01 U*									
Hexachloroethane					2.01 U									
Ionizable Organic Compounds in ug/kg														
Phenol	420	1200	420	1200	94									
2-Methylphenol	63	63	63	63	59 U									
4-Methylphenol	670	670	670	670	60									
2,4-Dimethylphenol	29	29	29	29	*59 U*									
Pentachlorophenol	360	690	360	690	300 U									
Benzyl Alcohol	57	73	57	73	*59 U*									
Benzoic Acid	650	650	650	650	590 U									

NOTES:

***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalization. AETs are used for comparison.

U = Not detected at the reporting limit indicated.

J = Estimated value.

T = Value is between the MRL and MDL.

Blank indicates no AET/SMS criteria established or sample not analyzed for specific analyte.

Italics indicate reporting limit is above AET/SMS criteria.

Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL criteria.

Double-lined boxed value exceeds BSL for mercury.

Table 4-1. Summary of Surface Sediment Conventional and Chemistry Result

Sample Station					**Samish Bay Ref 2**	**Samish Bay Ref 3**
Sampling Depth (cm)					0-12	0-12
Sampling Date	**AETs**		**SMS**		9/30/2008	9/30/2008
	LAET	2LAET	SQS	CSL		
Conventionals in %						
Total Solids					35	71.2
Total Organic Carbon					2.14	1.02
Gravel					0	0
Sand					3.2	88.2
Fines					96.8	11.8
Conventionals in mg/kg						
N-Ammonia					17.4	15.8
Sulfide					202	54.4
TPH in mg/kg						
Diesel-Range Hydrocarbons						
Motor Oil-Range Hydrocarbons						
Metals in mg/kg						
Arsenic	57	93	57	93		
Cadmium	5.1	6.7	5.1	6.7		
Chromium	260	270	260	270		
Copper	390	390	390	390		
Lead	450	530	450	530		
Mercury	0.41	0.59	0.41	0.59		
Nickel	140	140				
Silver	6.1	6.1	6.1	6.1		
Zinc	410	960	410	960		
PCBs	**ug/kg**		**mg/kg OC**			
Aroclor 1016						
Aroclor 1221						
Aroclor 1232						
Aroclor 1242						
Aroclor 1248						
Aroclor 1254						
Aroclor 1260						
Aroclor 1262						
Aroclor 1268						
Total PCBs	130	1000	12	65		
PAHs	**ug/kg**		**mg/kg OC**			
Naphthalene	2100	2400	99	170		
Acenaphthylene	1300	1300	66	66		
Acenaphthene	500	730	16	57		
Fluorene	540	1000	23	79		
Phenanthrene	1500	5400	100	480		
Anthracene	960	4400	220	1200		
2-Methylnaphthalene	670	1400	38	64		
1-Methylnaphthalene						
Total LPAHs	5200	13000	370	780		
Fluoranthene	1700	2500	160	1200		
Pyrene	2600	3300	1000	1400		

Table 4-1. Summary of Surface Sediment Conventional and Chemistry Result

Sample Station	AETs		SMS		**Samish Bay Ref 2**	**Samish Bay Ref 3**
Sampling Depth (cm)					0-12	0-12
Sampling Date					9/30/2008	9/30/2008
	LAET	2LAET	SQS	CSL		
Benzo(a)anthracene	1300	1600	110	270		
Chrysene	1400	2800	110	460		
Benzo(b)fluoranthene						
Benzo(k)fluoranthene						
Total Benzofluoranthenes	3200	3600	230	450		
Benzo(a)pyrene	1600	3000	99	210		
Indeno(1,2,3-cd)pyrene	600	690	34	88		
Dibenz(a,h)anthracene	230	540	12	33		
Benzo(g,h,i)perylene	670	720	31	78		
Total HPAHs	12000	17000	960	5300		
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**			
1,2-Dichlorobenzene	35	50	2.3	2.3		
1,3-Dichlorobenzene	170	170				
1,4-Dichlorobenzene	110	120	3.1	9		
1,2,4-Trichlorobenzene	31	51	0.81	1.8		
Hexachlorobenzene	22	70	0.38	2.3		
Phthalate Esters	**ug/kg**		**mg/kg OC**			
Dimethylphthalate	71	160	53	53		
Diethylphthalate	200	200	61	110		
Di-n-Butylphthalate	1400	1400	220	1700		
Butylbenzylphthalate	63	900	4.9	64		
bis(2-Ethylhexyl)phthalate	1300	1900	47	78		
Di-n-Octyl phthalate	6200	6200	58	4500		
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**			
Dibenzofuran	540	700	15	58		
Hexachlorobutadiene	11	120	3.9	6.2		
N-Nitrosodiphenylamine	28	40	11	11		
Hexachloroethane						
Ionizable Organic Compounds in ug/kg						
Phenol	420	1200	420	1200		
2-Methylphenol	63	63	63	63		
4-Methylphenol	670	670	670	670		
2,4-Dimethylphenol	29	29	29	29		
Pentachlorophenol	360	690	360	690		
Benzyl Alcohol	57	73	57	73		
Benzoic Acid	650	650	650	650		

NOTES:

***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalizatio

U = Not detected at the reporting limit indicated.

J = Estimated value.

T = Value is between the MRL and MDL.

Blank indicates no AET/SMS criteria established or sample not analyzed for s

Italics indicate reporting limit is above AET/SMS criteria.

Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL cri

Double-lined boxed value exceeds BSL for mercury.

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station	AETs		SMS		**BLVD-SC-01**	**BLVD-SC-01**	**BLVD-SC-01**	**BLVD-SC-02**	**BLVD-SC-02**	**BLVD-SC-03**	**BLVD-SC-03**	**BLVD-SC-04**	**BLVD-SC-04**
Sample Depth (ft)					0-2	2-4	4-6	2-4	6-8	4-6	6-8	0-2	2-4
Sampling Date					9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL									
Conventionals in %													
Total Solids					40.7	38.5	52.3	20.9	44.8			21.5	32.3
Total Organic Carbon					11.8 *	10.2 *	7.63 *	23.9 *	5.98 *			17.7 *	6.88 *
Gravel													
Sand													
Fines													
TPH in mg/kg													
Diesel-Range Hydrocarbons					130	290	87	72	80	74	52	130	
Motor Oil-Range Hydrocarbons					190	330	140	140	130	92	65	210	
Metals in mg/kg													
Arsenic	57	93	57	93	10 U	10 U	10 U	20 U	10 U	10 U	10 U	20 U	
Cadmium	5.1	6.7	5.1	6.7	0.9	0.8	0.6	1.2	1.2	1.1	1.3	1.1	
Chromium	260	270	260	270	41	40	32	34	73	57	69	44	
Copper	390	390	390	390	50.3	39.5	36.5	36.3	57.8	54.4	57.1	66.3	
Lead	450	530	450	530	48	52	36	44	65	43	78	25	
Mercury	0.41	0.59	0.41	0.59	0.3 J	0.4	0.2	0.3	**2.0**	**0.7**	0.4	0.2	
Silver	6.1	6.1	6.1	6.1	0.8 U	0.8 U	0.6 U	1 U	0.7 U	0.8 U	0.8 U	1 U	
Zinc	410	960	410	960	110	102	96	86	135	95	340	88	
PCBs	**ug/kg**		**mg/kg OC**										
Aroclor 1016													
Aroclor 1221													
Aroclor 1232													
Aroclor 1242													
Aroclor 1248													
Aroclor 1254													
Aroclor 1260													
Aroclor 1262													
Aroclor 1268													
Total PCBs	130	1000	12	65									
PAHs	**ug/kg**		**mg/kg OC**										
Naphthalene	2100	2400	99	170	380	540	240	160	110			150	250
Acenaphthylene	1300	1300	66	66	1200	**2100**	820	550	560			420	840
Acenaphthene	500	730	16	57	140	240	93	69	60			66	210
Fluorene	540	1000	23	79	310	440	170	99	54			100	320
Phenanthrene	1500	5400	100	480	2400	2200	1000	670	370			330	380
Anthracene	960	4400	220	1200	1300	1500	660	480	260			580	1400
2-Methylnaphthalene	670	1400	38	64	220	330	150	50	37 T			76	98
1-Methylnaphthalene					130	170	83	44 T	32 T			68	110
Total LPAHs	5200	13000	370	780	5730	7020	2983	2028	1414			1646	3400
Fluoranthene	1700	2500	160	1200	**14000**	**18000**	**7800**	**2700**	2000			**4100**	**8700**
Pyrene	2600	3300	1000	1400	**14000**	**19000**	**7100**	2500	2000			2300	**6000**
Benzo(a)anthracene	1300	1600	110	270	**10000**	**15000**	**4600**	**2000**	**1700**			**1600**	**3400**
Chrysene	1400	2800	110	460	**11000**	**16000**	**4600**	2400	1800			2300	**3900**
Benzo(b)fluoranthene					8500	13000	5500	2400	2000			1800	2600
Benzo(k)fluoranthene					7500	12000	4000	2000	1800			1800	4300
Total Benzofluoranthenes	3200	3600	230	450	**16000**	**25000**	**9500**	**4400**	**3800**			**3600**	**6900**
Benzo(a)pyrene	1600	3000	99	210	**12000**	**19000**	**8000**	2500	2300			2700	**4500**
Indeno(1,2,3-cd)pyrene	600	690	34	88	**3100**	**12000**	**3400**	**1200**	**1200**			**730**	**1100**
Dibenz(a,h)anthracene	230	540	12	33	**1000**	**1600**	**1000**	400	400			260	460
Benzo(g,h,i)perylene	670	720	31	78	**2600**	**4100**	**3000**	**1200**	**1100**			660	**1400**
Total HPAHs	12000	17000	960	5300	**83700**	**129700**	**49000**	**19300**	16300			**18250**	**36360**

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station					**BLVD-SC-01**	**BLVD-SC-01**	**BLVD-SC-01**	**BLVD-SC-02**	**BLVD-SC-02**	**BLVD-SC-03**	**BLVD-SC-03**	**BLVD-SC-04**	**BLVD-SC-04**
Sample Depth (ft)					0-2	2-4	4-6	2-4	6-8	4-6	6-8	0-2	2-4
Sampling Date	**AETs**		**SMS**		9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL									
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**										
1,2-Dichlorobenzene	35	50	2.3	2.3	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	*40 U*
1,3-Dichlorobenzene	170	170			60 U	59 U	59 U	46 U	39 U			60 U	40 U
1,4-Dichlorobenzene	110	120	3.1	9	60 U	59 U	59 U	46 U	39 U			60 U	40 U
1,2,4-Trichlorobenzene	31	51	0.81	1.8	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	*40 U*
Hexachlorobenzene	22	70	0.38	2.3	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	*40 U*
Phthalate Esters	**ug/kg**		**mg/kg OC**										
Dimethylphthalate	71	160	53	53	60 U	59 U	59 U	46 U	39 U			60 U	40 U
Diethylphthalate	200	200	61	110	60 U	59 U	59 U	46 U	39 U			60 U	40 U
Di-n-Butylphthalate	1400	1400	220	1700	60 U	59 U	59 U	46 U	39 U			60 U	40 U
Butylbenzylphthalate	63	900	4.9	64	60 U	59 U	59 U	46 U	39 U			60 U	40 U
bis(2-Ethylhexyl)phthalate	1300	1900	47	78	100	590 U	84	48	55			99 U	130
Di-n-Octyl phthalate	6200	6200	58	4500	60 U	59 U	59 U	46 U	39 U			60 U	40 U
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**										
Dibenzofuran	540	700	15	58	100	120	46 T	68	53			39 T	120
Hexachlorobutadiene	11	120	3.9	6.2	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	*40 U*
N-Nitrosodiphenylamine	28	40	11	11	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	*40 U*
Hexachloroethane					60 U	59 U	59 U	46 U	39 U			60 U	40 U
Ionizable Organic Compounds in ug/kg													
Phenol	420	1200	420	1200	120	87	100	52	30 T			240	47
2-Methylphenol	63	63	63	63	60 U	59 U	59 U	46 U	39 U			60 U	40 U
4-Methylphenol	670	670	670	670	60 U	59 U	59 U	34 T	47			60 U	67
2,4-Dimethylphenol	29	29	29	29	*60 U*	*59 U*	*59 U*	*46 U*	*39 U*			*60 U*	**37** T
Pentachlorophenol	360	690	360	690	300 U	300 U	300 U	230 U	200 U			300 U	200 U
Benzyl Alcohol	57	73	57	73	*60 U*	*59 U*	*59 U*	46 U	39 U			*60 U*	40 U
Benzoic Acid	650	650	650	650	600 U	590 U	590 UJ	460 U	390 UJ			600 U	400 U

NOTES:
***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalization. AETs are used for comparison.
U = Not detected at the reporting limit indicated.
J = Estimated value.
T = Value is between the MRL and MDL.
Blank indicates no AET/SMS criteria established or sample not analyzed for specific analyte.
Italics indicate reporting limit is above AET/SMS criteria.
Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL criteria.
Double-lined boxed value exceeds BSL for mercury.

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station					**BLVD-SC-04**	**BLVD-SC-04**	**BLVD-SC-05**	**BLVD-SC-05**	**BLVD-SC-05**	**BLVD-SC-05**	**BLVD-SC-05**	**BLVD-SC-06**	**BLVD-SC-06**
Sample Depth (ft)					4-6	8-10	6-8	8-9.5	9.5-10	10.5-12	13.5-14	0-2	2-4
Sampling Date	**AETs**		**SMS**		9/23/08	9/23/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08
	LAET	2LAET	SQS	CSL									
Conventionals in %													
Total Solids					31.2								
Total Organic Carbon					8.83 *****								
Gravel						2.0			0.2	0.1	15.6		
Sand						19.3			52.3	76.9	67.1		
Fines						78.8			47.3	22.9	17.4		
TPH in mg/kg													
Diesel-Range Hydrocarbons						60	79	12		6.8 U		16	29
Motor Oil-Range Hydrocarbons						84	99	20		14 U		26	41
Metals in mg/kg													
Arsenic	57	93	57	93		10 U	10 U	10		7		10	10 U
Cadmium	5.1	6.7	5.1	6.7		1.7	1.6	1.1		0.8		0.9	1.2
Chromium	260	270	260	270		53	59	45.1		16.3		89	83
Copper	390	390	390	390		61.1	56.3	32.2		9.4		59	54.8
Lead	450	530	450	530		49	30	8		3 U		19	29
Mercury	0.41	0.59	0.41	0.59		0.36	0.35	0.1		0.05 U		**0.6**	**3.52**
Silver	6.1	6.1	6.1	6.1		0.8 U	0.7 U	0.5 U		0.4 U		0.8 U	0.7 U
Zinc	410	960	410	960		109	109	67		27		121	123
PCBs	**ug/kg**		**mg/kg OC**										
Aroclor 1016													
Aroclor 1221													
Aroclor 1232													
Aroclor 1242													
Aroclor 1248													
Aroclor 1254													
Aroclor 1260													
Aroclor 1262													
Aroclor 1268													
Total PCBs	130	1000	12	65									
PAHs	**ug/kg**		**mg/kg OC**										
Naphthalene	2100	2400	99	170	440								
Acenaphthylene	1300	1300	66	66	**1500**								
Acenaphthene	500	730	16	57	300								
Fluorene	540	1000	23	79	220								
Phenanthrene	1500	5400	100	480	1500								
Anthracene	960	4400	220	1200	2300								
2-Methylnaphthalene	670	1400	38	64	160								
1-Methylnaphthalene					150								
Total LPAHs	5200	13000	370	780	6260								
Fluoranthene	1700	2500	160	1200	**14000**								
Pyrene	2600	3300	1000	1400	**12000**								
Benzo(a)anthracene	1300	1600	110	270	**6200**								
Chrysene	1400	2800	110	460	**5800**								
Benzo(b)fluoranthene					4900								
Benzo(k)fluoranthene					5600								
Total Benzofluoranthenes	3200	3600	230	450	**10500**								
Benzo(a)pyrene	1600	3000	99	210	**6800**								
Indeno(1,2,3-cd)pyrene	600	690	34	88	**2000**								
Dibenz(a,h)anthracene	230	540	12	33	**590**								
Benzo(g,h,i)perylene	670	720	31	78	**1800**								
Total HPAHs	12000	17000	960	5300	**59690**								

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station	AETs		SMS		BLVD-SC-04	BLVD-SC-04	BLVD-SC-05	BLVD-SC-05	BLVD-SC-05	BLVD-SC-05	BLVD-SC-05	BLVD-SC-06	BLVD-SC-06
Sample Depth (ft)					4-6	8-10	6-8	8-9.5	9.5-10	10.5-12	13.5-14	0-2	2-4
Sampling Date					9/23/08	9/23/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08	9/22/08
	LAET	2LAET	SQS	CSL									
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**										
1,2-Dichlorobenzene	35	50	2.3	2.3	*120 U*								
1,3-Dichlorobenzene	170	170			120 U								
1,4-Dichlorobenzene	110	120	3.1	9	*120 U*								
1,2,4-Trichlorobenzene	31	51	0.81	1.8	*120 U*								
Hexachlorobenzene	22	70	0.38	2.3	*120 U*								
Phthalate Esters	**ug/kg**		**mg/kg OC**										
Dimethylphthalate	71	160	53	53	*120 U*								
Diethylphthalate	200	200	61	110	120 U								
Di-n-Butylphthalate	1400	1400	220	1700	120 U								
Butylbenzylphthalate	63	900	4.9	64	*120 U*								
bis(2-Ethylhexyl)phthalate	1300	1900	47	78	120 U								
Di-n-Octyl phthalate	6200	6200	58	4500	120 U								
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**										
Dibenzofuran	540	700	15	58	180								
Hexachlorobutadiene	11	120	3.9	6.2	*120 U*								
N-Nitrosodiphenylamine	28	40	11	11	*120 U*								
Hexachloroethane					120 U								
Ionizable Organic Compounds in ug/kg													
Phenol	420	1200	420	1200	120 U								
2-Methylphenol	63	63	63	63	*120 U*								
4-Methylphenol	670	670	670	670	120 U								
2,4-Dimethylphenol	29	29	29	29	*120 U*								
Pentachlorophenol	360	690	360	690	*600 U*								
Benzyl Alcohol	57	73	57	73	*120 U*								
Benzoic Acid	650	650	650	650	*1200 U*								

NOTES:
***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalization. AE
U = Not detected at the reporting limit indicated.
J = Estimated value.
T = Value is between the MRL and MDL.
Blank indicates no AET/SMS criteria established or sample not analyzed for specific
Italics indicate reporting limit is above AET/SMS criteria.
Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL criteria.
Double-lined boxed value exceeds BSL for mercury.

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station					BLVD-SC-06	BLVD-SC-06	BLVD-SC-06	BLVD-SC-07	BLVD-SC-08	BLVD-SC-08	BLVD-SC-08	BLVD-SC-08	BLVD-SC-09
Sample Depth (ft)					4-6	6-8	12-14	0-4	0-2	2.5-4	4-6	8.5-10	0-2
Sampling Date	**AETs**		**SMS**		9/22/08	9/22/08	9/22/08	9/24/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL									
Conventionals in %													
Total Solids													
Total Organic Carbon													
Gravel						3.8	0			1.1		3.4	
Sand						15.0	3.1			10.1		2.3	
Fines						81.1	96.8			88.7		94.1	
TPH in mg/kg													
Diesel-Range Hydrocarbons					28			37	14	41	43		45
Motor Oil-Range Hydrocarbons					31			67	23 U	73	61		110
Metals in mg/kg													
Arsenic	57	93	57	93	10 U			10 U	10	10 U	10 U		10
Cadmium	5.1	6.7	5.1	6.7	1.3			1.1	0.9	1.3	1.3		1.2
Chromium	260	270	260	270	70			76	83	53	56		74
Copper	390	390	390	390	58			61.7	62	55.4	50.1		74.4
Lead	450	530	450	530	22			24	22	19	17		52
Mercury	0.41	0.59	0.41	0.59	0.2			**0.8**	**0.87**	0.5	0.35		**0.8**
Silver	6.1	6.1	6.1	6.1	0.7 U			0.8 U	0.7 U	0.7 U	0.7 U		0.8 U
Zinc	410	960	410	960	111			127	126	98	99		148
PCBs	**ug/kg**		**mg/kg OC**										
Aroclor 1016													20 U
Aroclor 1221													20 U
Aroclor 1232													20 U
Aroclor 1242													20 U
Aroclor 1248													55
Aroclor 1254													49
Aroclor 1260													20 U
Aroclor 1262													20 U
Aroclor 1268													20 U
Total PCBs	130	1000	12	65									104
PAHs	**ug/kg**		**mg/kg OC**										
Naphthalene	2100	2400	99	170									
Acenaphthylene	1300	1300	66	66									
Acenaphthene	500	730	16	57									
Fluorene	540	1000	23	79									
Phenanthrene	1500	5400	100	480									
Anthracene	960	4400	220	1200									
2-Methylnaphthalene	670	1400	38	64									
1-Methylnaphthalene													
Total LPAHs	5200	13000	370	780									
Fluoranthene	1700	2500	160	1200									
Pyrene	2600	3300	1000	1400									
Benzo(a)anthracene	1300	1600	110	270									
Chrysene	1400	2800	110	460									
Benzo(b)fluoranthene													
Benzo(k)fluoranthene													
Total Benzofluoranthenes	3200	3600	230	450									
Benzo(a)pyrene	1600	3000	99	210									
Indeno(1,2,3-cd)pyrene	600	690	34	88									
Dibenz(a,h)anthracene	230	540	12	33									
Benzo(g,h,i)perylene	670	720	31	78									
Total HPAHs	12000	17000	960	5300									

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station					**BLVD-SC-06**	**BLVD-SC-06**	**BLVD-SC-06**	**BLVD-SC-07**	**BLVD-SC-08**	**BLVD-SC-08**	**BLVD-SC-08**	**BLVD-SC-08**	**BLVD-SC-09**
Sample Depth (ft)					4-6	6-8	12-14	0-4	0-2	2.5-4	4-6	8.5-10	0-2
Sampling Date	**AETs**		**SMS**		9/22/08	9/22/08	9/22/08	9/24/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL									
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**										
1,2-Dichlorobenzene	35	50	2.3	2.3									
1,3-Dichlorobenzene	170	170											
1,4-Dichlorobenzene	110	120	3.1	9									
1,2,4-Trichlorobenzene	31	51	0.81	1.8									
Hexachlorobenzene	22	70	0.38	2.3									
Phthalate Esters	**ug/kg**		**mg/kg OC**										
Dimethylphthalate	71	160	53	53									
Diethylphthalate	200	200	61	110									
Di-n-Butylphthalate	1400	1400	220	1700									
Butylbenzylphthalate	63	900	4.9	64									
bis(2-Ethylhexyl)phthalate	1300	1900	47	78									
Di-n-Octyl phthalate	6200	6200	58	4500									
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**										
Dibenzofuran	540	700	15	58									
Hexachlorobutadiene	11	120	3.9	6.2									
N-Nitrosodiphenylamine	28	40	11	11									
Hexachloroethane													
Ionizable Organic Compounds in ug/kg													
Phenol	420	1200	420	1200									
2-Methylphenol	63	63	63	63									
4-Methylphenol	670	670	670	670									
2,4-Dimethylphenol	29	29	29	29									
Pentachlorophenol	360	690	360	690									
Benzyl Alcohol	57	73	57	73									
Benzoic Acid	650	650	650	650									

NOTES:

***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalization. AE

U = Not detected at the reporting limit indicated.

J = Estimated value.

T = Value is between the MRL and MDL.

Blank indicates no AET/SMS criteria established or sample not analyzed for specific

Italics indicate reporting limit is above AET/SMS criteria.

Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL criteria.

Double-lined boxed value exceeds BSL for mercury.

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station					BLVD-SC-09	BLVD-SC-11	BLVD-SC-09	BLVD-SC-09	BLVD-SC-09	BLVD-SC-09
Sample Depth (ft)					2-3	2-3	3-4	4-6	6-8	8.5-9.7
Sampling Date	**AETs**		**SMS**		9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL		Dup of BLVD-SC-09-2-3'				
Conventionals in %										
Total Solids					31.1	34	25.5	34.5	44.2	
Total Organic Carbon					13.2 *	7.59 *	8.99 *	3.13	5.28 *	
Gravel										
Sand										
Fines										
TPH in mg/kg										
Diesel-Range Hydrocarbons					80	130	110	210	60	
Motor Oil-Range Hydrocarbons					270	480	210	640	170	
Metals in mg/kg										
Arsenic	57	93	57	93	20 U	20 U	10	10 U	10 U	
Cadmium	5.1	6.7	5.1	6.7	1.8	2.0	2.6	2.5	1.7	
Chromium	260	270	260	270	86	86	110	89	65	
Copper	390	390	390	390	121	119	126	94.8	71.3	
Lead	450	530	450	530	143	124	142	120	42	
Mercury	0.41	0.59	0.41	0.59	**1.7**	**1.8**	**3.8**	**1.5**	**0.77**	0.4 J
Silver	6.1	6.1	6.1	6.1	1 U	1 U	0.9	1.5	0.6 U	
Zinc	410	960	410	960	280	270	328	353	151	
PCBs	**ug/kg**		**mg/kg OC**							
Aroclor 1016					59 U		98 U	3.13 U	20 U	
Aroclor 1221					59 U		98 U	3.13 U	20 U	
Aroclor 1232					59 U		98 U	9.58 U	58 U	
Aroclor 1242					59 U		98 U	8.63	44	
Aroclor 1248					250		290	3.13 U	20 U	
Aroclor 1254					270		410	4.47	40 P	
Aroclor 1260					59 U		98 U	3.13 U	20 U	
Aroclor 1262					59 U		98 U	3.13 U	20 U	
Aroclor 1268					59 U		98 U	3.13 U	20 U	
Total PCBs	130	1000	12	65	520		700	13.1	84	
PAHs	**ug/kg**		**mg/kg OC**							
Naphthalene	2100	2400	99	170	24	17 T	20 U	0.80	11 T	
Acenaphthylene	1300	1300	66	66	22	17 T	20 U	0.64 U	20 U	
Acenaphthene	500	730	16	57	20 U	20 U	20 U	0.45 T	20 U	
Fluorene	540	1000	23	79	14 T	16 T	20 U	0.58 T	20 U	
Phenanthrene	1500	5400	100	480	83	80	42	2.94	30	
Anthracene	960	4400	220	1200	55	49	17 T	1.09	11 T	
2-Methylnaphthalene	670	1400	38	64	15 T	9.9 T	20 U	0.58 T	20 U	
1-Methylnaphthalene					20 U	20 U	20 U	0.42 T	20 U	
Total LPAHs	5200	13000	370	780	198	179	59	5.85	52	
Fluoranthene	1700	2500	160	1200	280	210	110	6.71	72	
Pyrene	2600	3300	1000	1400	210	160	84	2.49	54 U	
Benzo(a)anthracene	1300	1600	110	270	77	99	44 U	0.89 U	31 U	
Chrysene	1400	2800	110	460	260	280	84	3.51	46 U	
Benzo(b)fluoranthene					140	110	43	2.17	28	
Benzo(k)fluoranthene					160	120	60	2.17	28	
Total Benzofluoranthenes	3200	3600	230	450	300	230	103	4.34	56	
Benzo(a)pyrene	1600	3000	99	210	160	120	66	2.68	41 U	
Indeno(1,2,3-cd)pyrene	600	690	34	88	56	44	22	1.88 U	14 T	
Dibenz(a,h)anthracene	230	540	12	33	16 T	13 T	20 U	1.88 U	20 U	
Benzo(g,h,i)perylene	670	720	31	78	50	40	20	1.82 T	14 T	
Total HPAHs	12000	17000	960	5300	1409	1196	489	21.55	156	

Table 4-2 - Summary of Subsurface Sediment Conventional and Chemistry Results

Sample Station	AETs		SMS		BLVD-SC-09	BLVD-SC-11	BLVD-SC-09	BLVD-SC-09	BLVD-SC-09	BLVD-SC-09
Sample Depth (ft)					2-3	2-3	3-4	4-6	6-8	8.5-9.7
Sampling Date					9/23/08	9/23/08	9/23/08	9/23/08	9/23/08	9/23/08
	LAET	2LAET	SQS	CSL		Dup of BLVD-SC-09-2-3'				
Chlorinated Benzenes	**ug/kg**		**mg/kg OC**							
1,2-Dichlorobenzene	35	50	2.3	2.3	20 U	20 U	20 U	0.64 U	20 U	
1,3-Dichlorobenzene	170	170			20 U	20 U	20 U	0.64 U	20 U	
1,4-Dichlorobenzene	110	120	3.1	9	12 T	20 U	20 U	0.64 U	20 U	
1,2,4-Trichlorobenzene	31	51	0.81	1.8	20 U	20 U	20 U	0.64 U	20 U	
Hexachlorobenzene	22	70	0.38	2.3	20 U	20 U	20 U	0.64 U	20 U	
Phthalate Esters	**ug/kg**		**mg/kg OC**							
Dimethylphthalate	71	160	53	53	28	16 T	12 T	1.41	20 U	
Diethylphthalate	200	200	61	110	20 U	20 U	20 U	0.64 U	20 U	
Di-n-Butylphthalate	1400	1400	220	1700	73	24	23	0.64 U	260	
Butylbenzylphthalate	63	900	4.9	64	20 U	20 U	20 U	0.64 U	20 U	
bis(2-Ethylhexyl)phthalate	1300	1900	47	78	260	300	100	16.93	13 T	
Di-n-Octyl phthalate	6200	6200	58	4500	20 U	20 U	20 U	1.88 U	20 U	
Miscellaneous Compounds	**ug/kg**		**mg/kg OC**							
Dibenzofuran	540	700	15	58	20 U	20 U	20 U	0.35 T	20 U	
Hexachlorobutadiene	11	120	3.9	6.2	*20 U*	*20 U*	*20 U*	0.64 U	*20 U*	
N-Nitrosodiphenylamine	28	40	11	11	20 U	20 U	20 U	0.64 U	20 U	
Hexachloroethane					20 U	20 U	20 U	0.64 U	20 U	
Ionizable Organic Compounds in ug/kg										
Phenol	420	1200	420	1200	280	69	20 U	74	22	
2-Methylphenol	63	63	63	63	20 U	20 U	20 U	20 U	20 U	
4-Methylphenol	670	670	670	670	29	23	20 U	58	20 U	
2,4-Dimethylphenol	29	29	29	29	20 U	20 U	20 U	20 U	20 U	
Pentachlorophenol	360	690	360	690	99 U	99 U	99 U	98 U	99 U	
Benzyl Alcohol	57	73	57	73	20 U	20 U	20 U	20 U	20 U	
Benzoic Acid	650	650	650	650	200 U	200 U	200 U	200 U	200 U	

NOTES:

***** TOC concentration outside of range (0.5 to 3.5 percent) for OC normalization. AET

U = Not detected at the reporting limit indicated.

J = Estimated value.

T = Value is between the MRL and MDL.

Blank indicates no AET/SMS criteria established or sample not analyzed for specific

Italics indicate reporting limit is above AET/SMS criteria.

Boxed value exceeds LAET/SQS criteria. Bold value exceeds 2LAET/CSL criteria.

Double-lined boxed value exceeds BSL for mercury.

Table 4-3. Summary of Geotechnical Testing Data

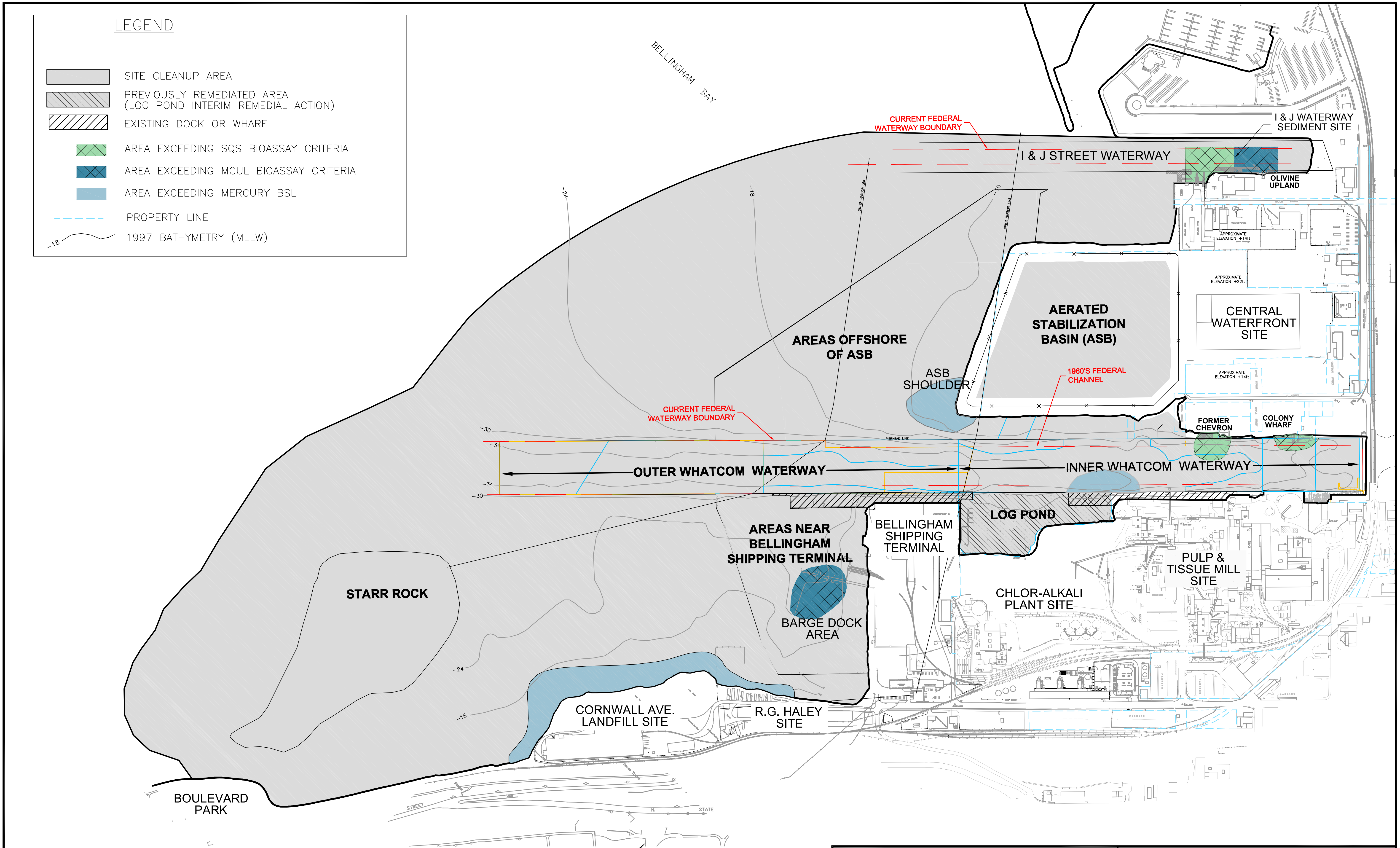
Sample ID	Sampling Date	Moisture Content (%)	Atterburg Limits				Specific Gravity (Std. units)	Wet Density (pcf)	Dry Density (pcf)
			PI	LL	PL	USCS			
BLVD-SC-04-8-10'	9/23/08	160.8	22.0	89.4	67.4	MH	2.40		
BLVD-SC-04-10-10.5'	9/23/08	164.1						76.5	29.0
BLVD-SC-05-9.5-10'	9/22/08	60.32	21.5	45.3	23.8	CL	2.67		
BLVD-SC-05-10-10.5'	9/22/08	43.78						110.1	76.6
BLVD-SC-05-10.5-12'	9/22/08	35.52	NA	NA	NA	Non-Plastic	2.68		
BLVD-SC-06-6-8'	9/22/08	146.3	35.0	84.5	49.5	MH	2.44		
BLVD-SC-06-8-9'	9/22/08	119.4						84.4	38.5
BLVD-SC-06-12-14'	9/22/08	111.5	69.3	116.5	47.2	MH	2.63		
BLVD-SC-06-14-14.5'	9/22/08	107.5						92.7	44.7
BLVD-SC-08-2-2.5'	9/23/08	121.6					2.60	91.9	41.5
BLVD-SC-08-2.5-4'	9/23/08	121.7	41.7	86.4	44.7	MH	2.44		
BLVD-SC-08-8-8.5'	9/23/08	110.0						88.1	42.0
BLVD-SC-08-8.5-10'	9/23/08	120.4	42.3	84.7	42.4	MH	2.63		
BLVD-SC-08-14-14.5'	9/23/08	99.72						89.6	44.9
BLVD-SC-09-8-8.5'	9/23/08	130.4						80.9	35.1
BLVD-SC-09-8.5-9.7'	9/23/08	151.5	43.5	97.7	54.1	MH	2.46		

NOTES:
NA = Non-plastic.
PI = Plasticity Index, LL = Liquid Limit, PL = Plastic Limit

TABLE A-2
SOIL ANALYTICAL RESULTS
HISTORIC DATA
BOULEVARD PARK

Station Number Sample Depth (ft) Sample Date	COB-BLVD-01 0.5-2 01/31/2007	COB-BLVD-01 2.5-4 01/31/2007	COB-BLVD-01 5-6.5 01/31/2007	COB-BLVD-01 10-11.5 01/31/2007	COB-BLVD-01 15-16.5 01/31/2007	COB-BLVD-02 0.5-2 02/15/2007	COB-BLVD-02 2.5-4 02/15/2007	COB-BLVD-02 20-21.5 02/15/2007	COB-BLVD-02 22.5-24 02/15/2007	MTCA Method A Cleanup Levels
CONVENTIONALS (%)										
Total Organic Carbon	2.02	0.936						50.9	12.5	
Total Solids	83.1	80.7						24.8	50	
Moisture Content		23.69	158	163	201.9	14.29	16.77			
Organic Content			41.31	56.53	64.94					
GRAIN SIZE (%)										
Gravel		9.3				25	3.2			
Sand		52				53.6	61.5			
Silt		29.8				14.7	29.4			
Clay		8.9				6.8	6			
Total Fines		38.7				21.5	35.4			
TOTAL METALS (mg/kg)										
Cadmium	0.4	0.5						0.8 U	0.5	2
Chromium	**43.2** [a]	**39.6** [a]						6	12	19/2000 [b]
Copper	25.2	32.3						17.5	9.6	
Lead	78	25						10	4 U	250
Mercury	0.06	0.06						0.2 U	0.15	2
Nickel	37	43						6	13	
Zinc	93.1	89.1						88	31	
PETROLEUM HYDROCARBONS (mg/kg)										
Diesel	6.8	31						200	1700	2000
Motor Oil	44	290						87	550	2000
Total	50.8	321						287	**2250**	2000
SVOCs (mg/kg)										
2-Methylnaphthalene		0.02 U							**91**	5
Acenaphthene		0.02 U							33	
Acenaphthylene		0.02 U							32	
Anthracene		0.02 U							65	
Benzo(a)anthracene		0.049							47	
Benzo(a)pyrene		0.055							**43**	0.1
Benzo(b)fluoranthene		0.047							26	
Benzo(g,h,i)perylene		0.035							23	
Benzo(k)fluoranthene		0.049							34	
Bis(2-ethylhexyl)phthalate		0.065							0.16 U	
Chrysene		0.059							44	
Dibenz(a,h)anthracene		0.02 U							3.6	
Dibenzofuran		0.02 U							39	
Fluoranthene		0.086							120	
Fluorene		0.02 U							59	
Indeno(1,2,3-cd)pyrene		0.03							24	
Naphthalene		0.02 U							**240**	5
Phenanthrene		0.032							200	
Pyrene		0.066							120	
Benzo(a)pyrene(TEQ) [c]		0.081							**57.98**	0.1

Notes:
Bold and boxed values exceed the MTCA Method A Soil Cleanup Level for Unrestricted Use (Table 740-1).
U indicates value is below the detection limit;
[a] Value exceeds Chromium VI cleanup level; but it's reasonable to assume Chromium in soil is likely in Chromium III form.
[b] Chromium VI cleanup level is 19 mg/kg dry weight and Chromium III cleanup level is 2,000 mg/kg.
[c] Total concentration of all carginogenic PAHs using the toxicity equivalency methodology in WAC 173-340-708(8).



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ENSR | AECOM

Merged with ENSR in 2007
RETEC

WHATCOM WATERWAY
CLEANUP ACTION PLAN
PORTB-18876-300

DATE: 7/3/07
DRWN: E.M./SEA

SITE LOCATION

FIGURE 1-1

Table A-1. Preliminary Site Soil Screening Levels

Constituent	Preliminary Site Soil Screening Levels (a) (mg/kg)	Source
Metals		
Cadmium	1.2	MTCA Method B Protective of Marine Surface Water (b)
Total Chromium	48	Background Concentration for Puget Sound Region Soils (c)
Copper	36	Background Concentration for Puget Sound Region Soils (c)
Lead	50	Indicator Soil Concentrations for Site Specific Terrestrial Evaluations MTCA Table 749-3
Mercury	0.07	Background Concentration for Puget Sound Region Soils (c)
Nickel	48	Background Concentration for Puget Sound Region Soils (c)
Zinc	86	Indicator Soil Concentrations for Site Specific Terrestrial Evaluations MTCA Table 749-3
PAHS		
Naphthalene	see total napthlanenes	--
1-Methylnaphthalene	see total napthlanenes	--
2-Methylnaphthalene	see total napthlanenes	--
Total Napthalene	5	MTCA Method A, Table 740-1
Acenaphthylene	--	--
Acenaphthene	66	MTCA Method B Protective of Marine Surface Water (b)
bis(2-ethylhexyl)phthalate	4.9	MTCA Method B Protective of Marine Surface Water (b)
Fluorene	550	MTCA Method B Protective of Marine Surface Water (b)
Phenanthrene	--	--
Anthracene	12000	MTCA Method B Protective of Marine Surface Water (b)
Fluoranthene	89	MTCA Method B Protective of Marine Surface Water (b)
Pyrene	2400	MTCA Method B Protective of Direct Contact
Benzo(g,h,i)perylene	--	--
Dibenzofuran	160	MTCA Method B Protective of Direct Contact
Benzo(a)pyrene	0.35	MTCA Method B Protective of Marine Surface Water (b)
Benzo(a)anthracene	0.13	MTCA Method B Protective of Marine Surface Water (b)
Benzo(b)fluoranthene	0.44	MTCA Method B Protective of Marine Surface Water (b)
Benzo(k)fluoranthene	0.44	MTCA Method B Protective of Marine Surface Water (b)
Chrysene	0.14	MTCA Method B Protective of Marine Surface Water (b)
Dibenzo(a,h)anthracene	0.64	MTCA Method B Protective of Marine Surface Water (b)
Indeno(1,2,3-cd)pyrene	1.2	MTCA Method B Protective of Marine Surface Water (b)
Total cPAH - benzo(a)pyrene TEQ	0.14	MTCA Method B Protective of Direct Contact
VOCs		
Acetone	8000	MTCA Method B Protective of Direct Contact
Benzene	0.29	MTCA Method B Protective of Marine Surface Water (b)
2-Butanone	48000	MTCA Method B Protective of Direct Contact
Ethylbenzene	18	MTCA Method B Protective of Marine Surface Water (b)
Styrene	33	MTCA Method B Protective of Direct Contact

Table A-1. Preliminary Site Soil Screening Levels

Constituent	Preliminary Site Soil Screening Levels (a) (mg/kg)	Source
Toluene	109	MTCA Method B Protective of Marine Surface Water (b)
Xylene	16000	MTCA Method B Protective of Direct Contact
Methylene chloride	2.6	MTCA Method B Protective of Marine Surface Water (b)
Phenols		
2,4-Dimethylphenol	4.5	MTCA Method B Protective of Marine Surface Water (b)
2-Methylphenol	4000	MTCA Method B Protective of Direct Contact
4-Methylphenol	400	MTCA Method B Protective of Direct Contact
Phenol	5000	MTCA Method B Protective of Marine Surface Water (b)
Gasoline Range Organics	100	Indicator Soil Concentrations for Site Specific Terrestrial Evaluations MTCA Table 749-3
Diesel Range Organics	200	Indicator Soil Concentrations for Site Specific Terrestrial Evaluations MTCA Table 749-3

(a) Site screening levels are based on the lowest protective criterion established under state and federal laws and MTCA Method B cleanup levels protective of human direct contact, groundwater as marine surface water, and terrestrial ecological receptors. When the lowest criterion is greater than background soil concentrations the criterion was adjusted to the background concentration. MTCA Method A criteria were used when MTCA Method B and state and federal criteria were not available.

(b) Calculated using fixed parameter 3-phase partitioning model, WAC 173-340-747(4) and preliminary groundwater screening levels.

(c) Washington State Department of Ecology, Toxics Cleanup Program, Natural Background Soil Metals Concentrations in Washington State Publication #94-115. October 1994

Table A-2. Soil Sample Analytical Results and Comparison to Screening Levels

		BLVD-01		BLVD-02						
		BLVD0001	BLVD0002	BLVD0016	BLVD0017	SS-2	SS-3	SS-4	SS-5	SS-6
	Preliminary Site	0.5 - 2 ft bgs	2.5 -4 ft bgs	20 - 21.5 ft bgs	22.5 - 24 ft bgs	--	--	--	--	--
	Soil Screening Level	1/31/2007	1/31/2007	2/15/2007	2/15/2007	4/18/1991	4/18/1991	4/18/1991	4/18/1991	4/18/1991
Diesel-Range Hydrocarbons (mg/kg)										
Diesel	200	6.8	31	200	1700	NA	NA	NA	NA	NA
Motor Oil	200	44	290	87	550	NA	NA	NA	NA	NA
Metals (mg/kg)										
Cadmium	1.2	0.4	0.5	0.8 U	0.5	NA	NA	NA	NA	NA
Chromium	48	43.2	39.6	0.2 U	12	NA	NA	NA	NA	NA
Copper	36	25.2	32.3	6	9.6	NA	NA	NA	NA	NA
Lead	50	78	25	17.5	4 U	NA	NA	NA	NA	NA
Mercury	0.07	0.06	0.06	0.2 U	0.15	NA	NA	NA	NA	NA
Nickel	48	37	43	6	13	NA	NA	NA	NA	NA
Zinc	86	93.1	89.1	88	31	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (mg/kg)										
Naphthalene	see total napthalenes	NA	0.02 U	NA	240	0.3 U	0.3 U	1.5 U	0.3 UJ	1.5 U
2-Methylnaphthalene	see total napthalenes	NA	0.02 U	NA	91	NA	NA	NA	NA	NA
Acenaphthylene	--	NA	0.02 U	NA	32	0.3 U	0.3 U	1.5 U	0.4 j	1.5 U
Acenaphthene	66	NA	0.02 U	NA	33	0.3 U	0.3 U	1.5 U	0.3 UJ	1.5 U
Dibenzofuran	160	NA	0.02 U	NA	39	0.3 U	0.3 U	1.5 UJ	0.3 UJ	1.5 U
Fluorene	550	NA	0.02 U	NA	59	0.3 U	0.3 U	1.5 U	0.4 J	1.5 U
Anthracene	12,000	NA	0.02 U	NA	65	0.3 U	0.3 U	1.5 U	0.4 J	1.5 U
Dibenz(a,h)anthracene	0.64	NA	0.02 U	NA	3.6	NA	NA	NA	NA	NA
Phenanthrene	--	NA	0.032	NA	200	0.3 U	0.3 U	2.2	2.0 J	4.7
Fluoranthene	89	NA	0.086	NA	120	0.3 U	0.3 U	3.4	1.1 J	3.9
Pyrene	2,400	NA	0.066	NA	120	0.3 U	0.3 U	5.6	1.7 J	5.9
Benzo(a)anthracene	0.13	NA	0.049	NA	47	0.3 U	0.3 U	2.9	0.6 J	2.4
Chrysene	0.14	NA	0.059	NA	44	0.3 U	0.3 U	3.3	0.8 J	3.1
Benzo(b)fluoranthene	0.44	NA	0.047	NA	26	0.3 U	0.3 U	2	0.3	1.6
Benzo(k)fluoranthene	0.44	NA	0.049	NA	34	0.3 U	0.3 U	1.8	0.4 J	1.5 U
Benzo(a)pyrene	0.35	NA	0.055	NA	43	0.3 U	0.3 U	2.7	0.4 J	2.2
Indeno(1,2,3-cd)pyrene	1.2	NA	0.03	NA	24	0.3 U	0.3 U	1.5 U	0.3 UJ	1.5 U
Benzo(g,h,i)perylene	--	NA	0.035	NA	23	0.3 U	0.3 U	1.5 U	0.3 UJ	1.5 U
Benzo(a)pyrene TEQ	0.14	NA	0.081	NA	57.98	NC	NC	NC	NC	NC
Bis(2-ethylhexyl)phthalate	4.9	NA	0.065	NA	0.16 U	NA	NA	NA	NA	NA
Total Napthalene	5	NA	0.02 U	NA	331	ND	ND	ND	ND	ND
Volatile Organic Compounds (mg/kg)										
Acetone	8,000	NA	NA	NA	NA	60 U	60 U	60 U	50 U	50 U
Methylene Chloride	0.29	NA	NA	NA	NA	18	12 U	12 U	10 U	10 U
Conventionals (mg/kg)										
Total Organic Carbon	--	2.02	0.936	50.9	12.5	NA	NA	NA	NA	NA

Notes:
Shaded cells indicate an exceedance of the preliminary site soil screening level.
ND = Not Detected
NA = Not Analyzed
U = The analyte was not detected in the sample at the given reporting limit.
J = Indicates the analyte was positevely
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
(a) Total napthalenes is the the sum of napthalene and 2-methylnaphthalene.

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
AN-SS-301	10/26/1998	0	10 cm	Acenaphthene	mg/kg	0.23							
AN-SS-301	10/26/1998	0	10 cm	Acenaphthylene	mg/kg	0.7							
AN-SS-301	10/26/1998	0	10 cm	Anthracene	mg/kg	1.4		Exceeds LAET	0.96				
AN-SS-301	10/26/1998	0	10 cm	Fluorene	mg/kg	0.43							
AN-SS-301	10/26/1998	0	10 cm	Naphthalene	mg/kg	1.4							
AN-SS-301	10/26/1998	0	10 cm	Phenanthrene	mg/kg	2.4		Exceeds LAET	1.5				
AN-SS-301	10/26/1998	0	10 cm	Total LPAH	mg/kg	6.56		Exceeds LAET	5.2				
AN-SS-301	10/26/1998	0	10 cm	2-Methylnaphthalene	mg/kg	0.57							
AN-SS-301	10/26/1998	0	10 cm	Benzo(a)pyrene	mg/kg	5.1		Exceeds 2LAET	3				
AN-SS-301	10/26/1998	0	10 cm	Benzo(g,h,i)perylene	mg/kg	3.1		Exceeds 2LAET	0.72				
AN-SS-301	10/26/1998	0	10 cm	Chrysene	mg/kg	5.1		Exceeds 2LAET	2.8				
AN-SS-301	10/26/1998	0	10 cm	Dibenz(a,h)anthracene	mg/kg	1.3		Exceeds 2LAET	0.54				
AN-SS-301	10/26/1998	0	10 cm	Fluoranthene	mg/kg	6.4		Exceeds 2LAET	2.5				
AN-SS-301	10/26/1998	0	10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	3.4		Exceeds 2LAET	0.69				
AN-SS-301	10/26/1998	0	10 cm	Pyrene	mg/kg	7.7		Exceeds 2LAET	3.3				
AN-SS-301	10/26/1998	0	10 cm	Benz(a)anthracene	mg/kg	4.4							
AN-SS-301	10/26/1998	0	10 cm	Benzo(b)fluoranthene	mg/kg	3							
AN-SS-301	10/26/1998	0	10 cm	Benzo(k)fluoranthene	mg/kg	2.6							
AN-SS-301	10/26/1998	0	10 cm	Benzofluoranthenes	mg/kg	5.6							
AN-SS-301	10/26/1998	0	10 cm	Total HPAH	mg/kg	42.1		Exceeds 2LAET	17				
AN-SS-301	10/26/1998	0	10 cm	Mercury	mg/kg	1		Exceeds 2LAET	0.59				
AN-SS-301	10/26/1998	0	10 cm	1,2,4-Trichlorobenzene	mg/kg	0.04	UJG	Exceeds LAET	0.031				
AN-SS-301	10/26/1998	0	10 cm	1,2-Dichlorobenzene	mg/kg	0.04	U	Exceeds LAET	0.035				
AN-SS-301	10/26/1998	0	10 cm	Hexachlorobenzene	mg/kg	0.04	U	Exceeds LAET	0.022				
AN-SS-301	10/26/1998	0	10 cm	Hexachlorobutadiene	mg/kg	0.08	U	Exceeds LAET	0.011				
AN-SS-301	10/26/1998	0	10 cm	N-Nitrosodiphenylamine	mg/kg	0.04	U	Exceeds LAET	0.028				
AN-SS-301	10/26/1998	0	10 cm	2,4-Dimethylphenol	mg/kg	0.04	U	Exceeds LAET & 2LAET	0.029				
AN-SS-301	10/26/1998	0	10 cm	1,4-Dichlorobenzene	mg/kg	0.04	UJG						
AN-SS-301	10/26/1998	0	10 cm	Arsenic	mg/kg	12							
AN-SS-301	10/26/1998	0	10 cm	Benzoic Acid	mg/kg	0.4	U						
AN-SS-301	10/26/1998	0	10 cm	Benzyl Alcohol	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Bis(2-Ethylhexyl)phthalate	mg/kg	0.057							
AN-SS-301	10/26/1998	0	10 cm	Butylbenzylphthalate	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Cadmium	mg/kg	0.9	J						
AN-SS-301	10/26/1998	0	10 cm	Chromium	mg/kg	67							
AN-SS-301	10/26/1998	0	10 cm	Clay	%	26.8							
AN-SS-301	10/26/1998	0	10 cm	Copper	mg/kg	51							
AN-SS-301	10/26/1998	0	10 cm	CPAH-TEQ	mg/kg	7.5							
AN-SS-301	10/26/1998	0	10 cm	Dibenzofuran	mg/kg	0.24							
AN-SS-301	10/26/1998	0	10 cm	Dibutylphthalate	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Diethylphthalate	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Dimethylphthalate	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Di-N-Octyl Phthalate	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	Fines	%	9.4							
AN-SS-301	10/26/1998	0	10 cm	Gravel	%	2.3							
AN-SS-301	10/26/1998	0	10 cm	Lead	mg/kg	29							
AN-SS-301	10/26/1998	0	10 cm	o-Cresol	mg/kg	0.04	U						
AN-SS-301	10/26/1998	0	10 cm	p-Cresol	mg/kg	0.086							
AN-SS-301	10/26/1998	0	10 cm	Pentachlorophenol	mg/kg	0.2	UJG						
AN-SS-301	10/26/1998	0	10 cm	pH	pH	7.6							
AN-SS-301	10/26/1998	0	10 cm	Phenol	mg/kg	0.04	UJG						
AN-SS-301	10/26/1998	0	10 cm	Sand	%	39							
AN-SS-301	10/26/1998	0	10 cm	Silt	%	32							
AN-SS-301	10/26/1998	0	10 cm	Silver	mg/kg	2	U						

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
AN-SS-301	10/26/1998		0 10 cm	Total Organic Carbon	%	8.8							
AN-SS-301	10/26/1998		0 10 cm	Total Solids	%	33.2							
AN-SS-301	10/26/1998		0 10 cm	Water Content	%	2							
AN-SS-301	10/26/1998		0 10 cm	Zinc	mg/kg	90							
AN-SS-304	10/26/1998		0 10 cm	Acenaphthene	mg/kg	0.1							
AN-SS-304	10/26/1998		0 10 cm	Acenaphthylene	mg/kg	0.22							
AN-SS-304	10/26/1998		0 10 cm	Anthracene	mg/kg	0.48							
AN-SS-304	10/26/1998		0 10 cm	Fluorene	mg/kg	0.22							
AN-SS-304	10/26/1998		0 10 cm	Naphthalene	mg/kg	0.71							
AN-SS-304	10/26/1998		0 10 cm	Phenanthrene	mg/kg	1.9		Exceeds LAET	1.5				
AN-SS-304	10/26/1998		0 10 cm	Total LPAH	mg/kg	3.63							
AN-SS-304	10/26/1998		0 10 cm	2-Methylnaphthalene	mg/kg	0.16							
AN-SS-304	10/26/1998		0 10 cm	Pyrene	mg/kg	3		Exceeds LAET	2.6				
AN-SS-304	10/26/1998		0 10 cm	Benzo(g,h,i)perylene	mg/kg	0.98		Exceeds 2LAET	0.72				
AN-SS-304	10/26/1998		0 10 cm	Fluoranthene	mg/kg	3.4		Exceeds 2LAET	2.5				
AN-SS-304	10/26/1998		0 10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	1.2		Exceeds 2LAET	0.69				
AN-SS-304	10/26/1998		0 10 cm	Benzo(a)pyrene	mg/kg	1.8		Exceeds LAET	1.6				
AN-SS-304	10/26/1998		0 10 cm	Chrysene	mg/kg	1.4							
AN-SS-304	10/26/1998		0 10 cm	Dibenz(a,h)anthracene	mg/kg	0.3		Exceeds LAET	0.23				
AN-SS-304	10/26/1998		0 10 cm	Benz(a)anthracene	mg/kg	1.4							
AN-SS-304	10/26/1998		0 10 cm	Benzo(b)fluoranthene	mg/kg	1.5							
AN-SS-304	10/26/1998		0 10 cm	Benzo(k)fluoranthene	mg/kg	1.2							
AN-SS-304	10/26/1998		0 10 cm	Benzofluoranthenes	mg/kg	2.7							
AN-SS-304	10/26/1998		0 10 cm	Total HPAH	mg/kg	16.18		Exceeds LAET	12				
AN-SS-304	10/26/1998		0 10 cm	Hexachlorobutadiene	mg/kg	0.038	U	Exceeds LAET	0.011				
AN-SS-304	10/26/1998		0 10 cm	1,2,4-Trichlorobenzene	mg/kg	0.019	UJG						
AN-SS-304	10/26/1998		0 10 cm	1,2-Dichlorobenzene	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	1,4-Dichlorobenzene	mg/kg	0.019	UJG						
AN-SS-304	10/26/1998		0 10 cm	2,4-Dimethylphenol	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Arsenic	mg/kg	3							
AN-SS-304	10/26/1998		0 10 cm	Benzoic Acid	mg/kg	0.19	U						
AN-SS-304	10/26/1998		0 10 cm	Benzyl Alcohol	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Bis(2-Ethylhexyl)phthalate	mg/kg	0.076	J						
AN-SS-304	10/26/1998		0 10 cm	Butylbenzylphthalate	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Cadmium	mg/kg	1	U						
AN-SS-304	10/26/1998		0 10 cm	Chromium	mg/kg	16							
AN-SS-304	10/26/1998		0 10 cm	Clay	%	3.2							
AN-SS-304	10/26/1998		0 10 cm	Copper	mg/kg	22							
AN-SS-304	10/26/1998		0 10 cm	CPAH-TEQ	mg/kg	2.5							
AN-SS-304	10/26/1998		0 10 cm	Dibenzofuran	mg/kg	0.12							
AN-SS-304	10/26/1998		0 10 cm	Dibutylphthalate	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Diethylphthalate	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Dimethylphthalate	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Di-N-Octyl Phthalate	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Fines	%	8.1							
AN-SS-304	10/26/1998		0 10 cm	Gravel	%	5.6							
AN-SS-304	10/26/1998		0 10 cm	Hexachlorobenzene	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	Lead	mg/kg	29							
AN-SS-304	10/26/1998		0 10 cm	Mercury	mg/kg	0.062	J						
AN-SS-304	10/26/1998		0 10 cm	N-Nitrosodiphenylamine	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	o-Cresol	mg/kg	0.019	U						
AN-SS-304	10/26/1998		0 10 cm	p-Cresol	mg/kg	0.12							
AN-SS-304	10/26/1998		0 10 cm	Pentachlorophenol	mg/kg	0.095	UJG						
AN-SS-304	10/26/1998		0 10 cm	pH	pH	8.1							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
AN-SS-304	10/26/1998		0 10 cm	Phenol	mg/kg	0.036							
AN-SS-304	10/26/1998		0 10 cm	Sand	%	88.8							
AN-SS-304	10/26/1998		0 10 cm	Silt	%	2.4							
AN-SS-304	10/26/1998		0 10 cm	Silver	mg/kg	2	U						
AN-SS-304	10/26/1998		0 10 cm	Total Organic Carbon	%	9.2							
AN-SS-304	10/26/1998		0 10 cm	Total Solids	%	55.8							
AN-SS-304	10/26/1998		0 10 cm	Water Content	%	0.8							
AN-SS-304	10/26/1998		0 10 cm	Zinc	mg/kg	72							
BLVD1	12/1/1997		0 10 cm	Acenaphthene	mg/kg	0.26							
BLVD1	12/1/1997		0 10 cm	Acenaphthylene	mg/kg	0.8							
BLVD1	12/1/1997		0 10 cm	Anthracene	mg/kg	1.3		Exceeds LAET	0.96				
BLVD1	12/1/1997		0 10 cm	Fluorene	mg/kg	0.43							
BLVD1	12/1/1997		0 10 cm	Naphthalene	mg/kg	1.4							
BLVD1	12/1/1997		0 10 cm	Phenanthrene	mg/kg	1.6		Exceeds LAET	1.5				
BLVD1	12/1/1997		0 10 cm	1-Methylnapthalene	mg/kg	0.38							
BLVD1	12/1/1997		0 10 cm	2-Methylnaphthalene	mg/kg	0.39							
BLVD1	12/1/1997		0 10 cm	Total LPAH	mg/kg	5.8		Exceeds LAET	5.2				
BLVD1	12/1/1997		0 10 cm	Benzo(a)anthracene	mg/kg	3.3		Exceeds 2LAET	1.6				
BLVD1	12/1/1997		0 10 cm	Benzo(a)pyrene	mg/kg	3.3		Exceeds 2LAET	3				
BLVD1	12/1/1997		0 10 cm	Benzo(g,h,i)perylene	mg/kg	1.6		Exceeds 2LAET	0.72				
BLVD1	12/1/1997		0 10 cm	Benzofluoranthenes	mg/kg	4.6		Exceeds 2LAET	3.6				
BLVD1	12/1/1997		0 10 cm	Chrysene	mg/kg	3.7		Exceeds 2LAET	2.8				
BLVD1	12/1/1997		0 10 cm	Dibenz(a,h)anthracene	mg/kg	0.61		Exceeds 2LAET	0.54				
BLVD1	12/1/1997		0 10 cm	Fluoranthene	mg/kg	4.8		Exceeds 2LAET	2.5				
BLVD1	12/1/1997		0 10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	1.8		Exceeds 2LAET	0.69				
BLVD1	12/1/1997		0 10 cm	Pyrene	mg/kg	6.5		Exceeds 2LAET	3.3				
BLVD1	12/1/1997		0 10 cm	Total HPAH	mg/kg	30		Exceeds 2LAET	17				
BLVD1	12/1/1997		0 10 cm	Total PAH	mg/kg	36							
BLVD1	12/1/1997		0 10 cm	2,4-Dimethylphenol	mg/kg	0.57	U	Exceeds LAET & 2LAET	0.029				
BLVD1	12/1/1997		0 10 cm	Benzoic Acid	mg/kg	1.1	U	Exceeds LAET & 2LAET	0.65				
BLVD1	12/1/1997		0 10 cm	2-Methylphenol	mg/kg	0.018	J						
BLVD1	12/1/1997		0 10 cm	4-Methylphenol	mg/kg	0.16							
BLVD1	12/1/1997		0 10 cm	Arsenic	mg/kg	5							
BLVD1	12/1/1997		0 10 cm	Cadmium	mg/kg	0.4	U						
BLVD1	12/1/1997		0 10 cm	Carbazole	mg/kg	0.1	J						
BLVD1	12/1/1997		0 10 cm	Chromium	mg/kg	33							
BLVD1	12/1/1997		0 10 cm	Clay	%	4							
BLVD1	12/1/1997		0 10 cm	Copper	mg/kg	26							
BLVD1	12/1/1997		0 10 cm	Coprostanol	mg/kg	2.3	U						
BLVD1	12/1/1997		0 10 cm	Dibenzofuran	mg/kg	0.28							
BLVD1	12/1/1997		0 10 cm	Gravel	%	3							
BLVD1	12/1/1997		0 10 cm	Lead	mg/kg	11							
BLVD1	12/1/1997		0 10 cm	Mercury	mg/kg	0.095	J						
BLVD1	12/1/1997		0 10 cm	Retene	mg/kg	1.2							
BLVD1	12/1/1997		0 10 cm	Sand	%	69							
BLVD1	12/1/1997		0 10 cm	Silt	%	24							
BLVD1	12/1/1997		0 10 cm	Silver	mg/kg	0.5	U						
BLVD1	12/1/1997		0 10 cm	Total Organic Carbon	% @ 70 (	3.4							
BLVD1	12/1/1997		0 10 cm	Total Organic Carbon	% @ 104	3.7							
BLVD1	12/1/1997		0 10 cm	Total Solids	%	55.1							
BLVD1	12/1/1997		0 10 cm	Zinc	mg/kg	59							
BLVD2	12/1/1997		0 10 cm	Acenaphthene	mg/kg	0.16						7.0	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Acenaphthylene	mg/kg	0.44						19.1	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Anthracene	mg/kg	0.55						23.9	mg/kg OC

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD2	12/1/1997		0 10 cm	Fluorene	mg/kg	0.23						10.0	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Naphthalene	mg/kg	1.2						52.2	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Phenanthrene	mg/kg	0.98						42.6	mg/kg OC
BLVD2	12/1/1997		0 10 cm	1-Methylnapthalene	mg/kg	0.26							
BLVD2	12/1/1997		0 10 cm	2-Methylnaphthalene	mg/kg	0.26						11.3	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Total LPAH	mg/kg	3.6						157	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Benzo(g,h,i)perylene	mg/kg	0.86		Exceeds 2LAET	0.72	Exceeds SQS	31	37.4	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	0.97		Exceeds 2LAET	0.69	Exceeds SQS	34	42.2	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Dibenz(a,h)anthracene	mg/kg	0.4	J	Exceeds LAET	0.23	Exceeds SQS	12	17.4	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Benzo(a)anthracene	mg/kg	1.4		Exceeds LAET	1.3			60.9	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Benzo(a)pyrene	mg/kg	1.6						69.6	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Benzofluoranthenes	mg/kg	2.2						95.7	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Chrysene	mg/kg	1.5		Exceeds LAET	1.4			65.2	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Fluoranthene	mg/kg	2.2		Exceeds LAET	1.7			95.7	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Pyrene	mg/kg	2.7		Exceeds LAET	2.6			117	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Total HPAH	mg/kg	14	J	Exceeds LAET	12			609	mg/kg OC
BLVD2	12/1/1997		0 10 cm	2,4-Dimethylphenol	mg/kg	0.1	U	Exceeds LAET & 2LAET	0.029				
BLVD2	12/1/1997		0 10 cm	2-Methylphenol	mg/kg	0.1	U	Exceeds LAET & 2LAET	0.063				
BLVD2	12/1/1997		0 10 cm	Benzoic Acid	mg/kg	1	U	Exceeds LAET & 2LAET	0.65				
BLVD2	12/1/1997		0 10 cm	4-Methylphenol	mg/kg	0.18							
BLVD2	12/1/1997		0 10 cm	Arsenic	mg/kg	4							
BLVD2	12/1/1997		0 10 cm	Cadmium	mg/kg	0.4	U						
BLVD2	12/1/1997		0 10 cm	Carbazole	mg/kg	0.066	J						
BLVD2	12/1/1997		0 10 cm	Chromium	mg/kg	26							
BLVD2	12/1/1997		0 10 cm	Clay	%	2							
BLVD2	12/1/1997		0 10 cm	Copper	mg/kg	23							
BLVD2	12/1/1997		0 10 cm	Coprostanol	mg/kg	2.1	U						
BLVD2	12/1/1997		0 10 cm	Dibenzofuran	mg/kg	0.17						7.4	mg/kg OC
BLVD2	12/1/1997		0 10 cm	Gravel	%	11							
BLVD2	12/1/1997		0 10 cm	Lead	mg/kg	22							
BLVD2	12/1/1997		0 10 cm	Mercury	mg/kg	0.074	J						
BLVD2	12/1/1997		0 10 cm	Retene	mg/kg	0.69							
BLVD2	12/1/1997		0 10 cm	Sand	%	73							
BLVD2	12/1/1997		0 10 cm	Silt	%	14							
BLVD2	12/1/1997		0 10 cm	Silver	mg/kg	0.5	U						
BLVD2	12/1/1997		0 10 cm	Total Organic Carbon	% @ 70 (	2.3							
BLVD2	12/1/1997		0 10 cm	Total Organic Carbon	% @ 104	2.3							
BLVD2	12/1/1997		0 10 cm	Total PAH	mg/kg	18	J						
BLVD2	12/1/1997		0 10 cm	Total Solids	%	65.4							
BLVD2	12/1/1997		0 10 cm	Zinc	mg/kg	69							
BLVD3	12/1/1997		0 10 cm	2-Methylnaphthalene	mg/kg	2.3		Exceeds 2LAET	1.4				
BLVD3	12/1/1997		0 10 cm	Acenaphthene	mg/kg	1.3		Exceeds 2LAET	0.73				
BLVD3	12/1/1997		0 10 cm	Anthracene	mg/kg	4.5		Exceeds 2LAET	4.4				
BLVD3	12/1/1997		0 10 cm	Benzo(a)anthracene	mg/kg	11		Exceeds 2LAET	1.6				
BLVD3	12/1/1997		0 10 cm	Benzo(a)pyrene	mg/kg	10		Exceeds 2LAET	3				
BLVD3	12/1/1997		0 10 cm	Benzo(g,h,i)perylene	mg/kg	6.2		Exceeds 2LAET	0.72				
BLVD3	12/1/1997		0 10 cm	Benzofluoranthenes	mg/kg	16		Exceeds 2LAET	3.6				
BLVD3	12/1/1997		0 10 cm	Chrysene	mg/kg	13		Exceeds 2LAET	2.8				
BLVD3	12/1/1997		0 10 cm	Dibenz(a,h)anthracene	mg/kg	1.8		Exceeds 2LAET	0.54				
BLVD3	12/1/1997		0 10 cm	Dibenzofuran	mg/kg	1.7		Exceeds 2LAET	0.7				
BLVD3	12/1/1997		0 10 cm	Fluoranthene	mg/kg	21		Exceeds 2LAET	2.5				
BLVD3	12/1/1997		0 10 cm	Fluorene	mg/kg	2.1		Exceeds 2LAET	1				
BLVD3	12/1/1997		0 10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	6.3		Exceeds 2LAET	0.69				
BLVD3	12/1/1997		0 10 cm	Naphthalene	mg/kg	12		Exceeds 2LAET	2.4				

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth		Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD3	12/1/1997		0	10 cm	Phenanthrene	mg/kg	14		Exceeds 2LAET	5.4				
BLVD3	12/1/1997		0	10 cm	Pyrene	mg/kg	24		Exceeds 2LAET	3.3				
BLVD3	12/1/1997		0	10 cm	Total HPAH	mg/kg	110		Exceeds 2LAET	17				
BLVD3	12/1/1997		0	10 cm	Total LPAH	mg/kg	37		Exceeds 2LAET	13				
BLVD3	12/1/1997		0	10 cm	2,4-Dimethylphenol	mg/kg	0.1	J	Exceeds LAET & 2LAET	0.029				
BLVD3	12/1/1997		0	10 cm	2-Methylphenol	mg/kg	0.13	J	Exceeds LAET & 2LAET	0.063				
BLVD3	12/1/1997		0	10 cm	4-Methylphenol	mg/kg	1.4		Exceeds LAET & 2LAET	0.67				
BLVD3	12/1/1997		0	10 cm	Acenaphthylene	mg/kg	3.4		Exceeds LAET & 2LAET	1.3				
BLVD3	12/1/1997		0	10 cm	Benzoic Acid	mg/kg	1.9	U	Exceeds LAET & 2LAET	0.65				
BLVD3	12/1/1997		0	10 cm	1-Methylnapthalene	mg/kg	2.1							
BLVD3	12/1/1997		0	10 cm	Arsenic	mg/kg	5.5							
BLVD3	12/1/1997		0	10 cm	Cadmium	mg/kg	0.69							
BLVD3	12/1/1997		0	10 cm	Carbazole	mg/kg	0.95							
BLVD3	12/1/1997		0	10 cm	Chromium	mg/kg	30							
BLVD3	12/1/1997		0	10 cm	Clay	%	2							
BLVD3	12/1/1997		0	10 cm	Copper	mg/kg	45							
BLVD3	12/1/1997		0	10 cm	Coprostanol	mg/kg	3.2	U						
BLVD3	12/1/1997		0	10 cm	Gravel	%	2							
BLVD3	12/1/1997		0	10 cm	Lead	mg/kg	38							
BLVD3	12/1/1997		0	10 cm	Mercury	mg/kg	0.094	J						
BLVD3	12/1/1997		0	10 cm	Retene	mg/kg	5.3							
BLVD3	12/1/1997		0	10 cm	Sand	%	76							
BLVD3	12/1/1997		0	10 cm	Silt	%	20							
BLVD3	12/1/1997		0	10 cm	Silver	mg/kg	0.5	U						
BLVD3	12/1/1997		0	10 cm	Total Organic Carbon	% @ 70 (	8.8							
BLVD3	12/1/1997		0	10 cm	Total Organic Carbon	% @ 104	9.5							
BLVD3	12/1/1997		0	10 cm	Total PAH	mg/kg	150							
BLVD3	12/1/1997		0	10 cm	Total Solids	%	43.1							
BLVD3	12/1/1997		0	10 cm	Zinc	mg/kg	92							
BLVD4	12/1/1997		0	10 cm	Benzo(a)anthracene	mg/kg	2.8		Exceeds 2LAET	1.6				
BLVD4	12/1/1997		0	10 cm	Benzo(g,h,i)perylene	mg/kg	1.6		Exceeds 2LAET	0.72				
BLVD4	12/1/1997		0	10 cm	Benzofluoranthenes	mg/kg	4.4		Exceeds 2LAET	3.6				
BLVD4	12/1/1997		0	10 cm	Chrysene	mg/kg	3.5		Exceeds 2LAET	2.8				
BLVD4	12/1/1997		0	10 cm	Dibenz(a,h)anthracene	mg/kg	0.67	J	Exceeds 2LAET	0.54				
BLVD4	12/1/1997		0	10 cm	Fluoranthene	mg/kg	6.3		Exceeds 2LAET	2.5				
BLVD4	12/1/1997		0	10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	1.8		Exceeds 2LAET	0.69				
BLVD4	12/1/1997		0	10 cm	Naphthalene	mg/kg	4.6		Exceeds 2LAET	2.4				
BLVD4	12/1/1997		0	10 cm	Pyrene	mg/kg	6.9		Exceeds 2LAET	3.3				
BLVD4	12/1/1997		0	10 cm	Total HPAH	mg/kg	31	J	Exceeds 2LAET	17				
BLVD4	12/1/1997		0	10 cm	2-Methylnaphthalene	mg/kg	0.77		Exceeds LAET	0.67				
BLVD4	12/1/1997		0	10 cm	Anthracene	mg/kg	1.5		Exceeds LAET	0.96				
BLVD4	12/1/1997		0	10 cm	Benzo(a)pyrene	mg/kg	2.8		Exceeds LAET	1.6				
BLVD4	12/1/1997		0	10 cm	Dibenzofuran	mg/kg	0.62		Exceeds LAET	0.54				
BLVD4	12/1/1997		0	10 cm	Fluorene	mg/kg	0.74		Exceeds LAET	0.54				
BLVD4	12/1/1997		0	10 cm	Phenanthrene	mg/kg	4.5		Exceeds LAET	1.5				
BLVD4	12/1/1997		0	10 cm	Total LPAH	mg/kg	13		Exceeds LAET	5.2				
BLVD4	12/1/1997		0	10 cm	2,4-Dimethylphenol	mg/kg	0.68	U	Exceeds LAET & 2LAET	0.029				
BLVD4	12/1/1997		0	10 cm	4-Methylphenol	mg/kg	0.8		Exceeds LAET & 2LAET	0.67				
BLVD4	12/1/1997		0	10 cm	Benzoic Acid	mg/kg	1.7		Exceeds LAET & 2LAET	0.65				
BLVD4	12/1/1997		0	10 cm	1-Methylnapthalene	mg/kg	0.64							
BLVD4	12/1/1997		0	10 cm	2-Methylphenol	mg/kg	0.052	J						
BLVD4	12/1/1997		0	10 cm	Acenaphthene	mg/kg	0.48							
BLVD4	12/1/1997		0	10 cm	Acenaphthylene	mg/kg	1							
BLVD4	12/1/1997		0	10 cm	Arsenic	mg/kg	3.7							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth		Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD4	12/1/1997		0	10 cm	Cadmium	mg/kg	0.47							
BLVD4	12/1/1997		0	10 cm	Carbazole	mg/kg	0.28							
BLVD4	12/1/1997		0	10 cm	Chromium	mg/kg	29							
BLVD4	12/1/1997		0	10 cm	Clay	%	2							
BLVD4	12/1/1997		0	10 cm	Copper	mg/kg	42							
BLVD4	12/1/1997		0	10 cm	Coprostanol	mg/kg	1.9	J						
BLVD4	12/1/1997		0	10 cm	Gravel	%	2							
BLVD4	12/1/1997		0	10 cm	Lead	mg/kg	36							
BLVD4	12/1/1997		0	10 cm	Mercury	mg/kg	0.072	J						
BLVD4	12/1/1997		0	10 cm	Retene	mg/kg	1.8							
BLVD4	12/1/1997		0	10 cm	Sand	%	78							
BLVD4	12/1/1997		0	10 cm	Silt	%	18							
BLVD4	12/1/1997		0	10 cm	Silver	mg/kg	0.5	U						
BLVD4	12/1/1997		0	10 cm	Total Organic Carbon	% @ 70 (	6.9							
BLVD4	12/1/1997		0	10 cm	Total Organic Carbon	% @ 104	7.3							
BLVD4	12/1/1997		0	10 cm	Total PAH	mg/kg	44	J						
BLVD4	12/1/1997		0	10 cm	Total Solids	%	46.6							
BLVD4	12/1/1997		0	10 cm	Zinc	mg/kg	90							
BLVD5	12/1/1997		0	10 cm	Benzo(g,h,i)perylene	mg/kg	0.81		Exceeds 2LAET	0.72				
BLVD5	12/1/1997		0	10 cm	Dibenz(a,h)anthracene	mg/kg	0.78	U	Exceeds 2LAET	0.54				
BLVD5	12/1/1997		0	10 cm	Fluoranthene	mg/kg	3.5		Exceeds 2LAET	2.5				
BLVD5	12/1/1997		0	10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	0.94		Exceeds 2LAET	0.69				
BLVD5	12/1/1997		0	10 cm	Naphthalene	mg/kg	3.5		Exceeds 2LAET	2.4				
BLVD5	12/1/1997		0	10 cm	Fluorene	mg/kg	0.6		Exceeds LAET	0.54				
BLVD5	12/1/1997		0	10 cm	Phenanthrene	mg/kg	2.9		Exceeds LAET	1.5				
BLVD5	12/1/1997		0	10 cm	Pyrene	mg/kg	3.2		Exceeds LAET	2.6				
BLVD5	12/1/1997		0	10 cm	Total HPAH	mg/kg	14	J	Exceeds LAET	12				
BLVD5	12/1/1997		0	10 cm	Total LPAH	mg/kg	8.8		Exceeds LAET	5.2				
BLVD5	12/1/1997		0	10 cm	2,4-Dimethylphenol	mg/kg	0.78	U	Exceeds LAET & 2LAET	0.029				
BLVD5	12/1/1997		0	10 cm	Benzoic Acid	mg/kg	1.6	U	Exceeds LAET & 2LAET	0.65				
BLVD5	12/1/1997		0	10 cm	1-Methylnapthalene	mg/kg	0.48							
BLVD5	12/1/1997		0	10 cm	2-Methylnaphthalene	mg/kg	0.54							
BLVD5	12/1/1997		0	10 cm	2-Methylphenol	mg/kg	0.049	J						
BLVD5	12/1/1997		0	10 cm	4-Methylphenol	mg/kg	0.53							
BLVD5	12/1/1997		0	10 cm	Acenaphthene	mg/kg	0.34							
BLVD5	12/1/1997		0	10 cm	Acenaphthylene	mg/kg	0.68							
BLVD5	12/1/1997		0	10 cm	Anthracene	mg/kg	0.78							
BLVD5	12/1/1997		0	10 cm	Arsenic	mg/kg	5.6							
BLVD5	12/1/1997		0	10 cm	Benzo(a)anthracene	mg/kg	1.1							
BLVD5	12/1/1997		0	10 cm	Benzo(a)pyrene	mg/kg	1.3							
BLVD5	12/1/1997		0	10 cm	Benzofluoranthenes	mg/kg	2.1	J						
BLVD5	12/1/1997		0	10 cm	Cadmium	mg/kg	0.48							
BLVD5	12/1/1997		0	10 cm	Carbazole	mg/kg	0.26							
BLVD5	12/1/1997		0	10 cm	Chromium	mg/kg	30							
BLVD5	12/1/1997		0	10 cm	Chrysene	mg/kg	1.3							
BLVD5	12/1/1997		0	10 cm	Clay	%	2							
BLVD5	12/1/1997		0	10 cm	Copper	mg/kg	48							
BLVD5	12/1/1997		0	10 cm	Coprostanol	mg/kg	3.1	U						
BLVD5	12/1/1997		0	10 cm	Dibenzofuran	mg/kg	0.53							
BLVD5	12/1/1997		0	10 cm	Gravel	%	3							
BLVD5	12/1/1997		0	10 cm	Lead	mg/kg	40							
BLVD5	12/1/1997		0	10 cm	Mercury	mg/kg	0.38	J						
BLVD5	12/1/1997		0	10 cm	Retene	mg/kg	1.5							
BLVD5	12/1/1997		0	10 cm	Sand	%	75							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth		Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD5	12/1/1997		0	10 cm	Silt	%	20							
BLVD5	12/1/1997		0	10 cm	Silver	mg/kg	0.5	U						
BLVD5	12/1/1997		0	10 cm	Total Organic Carbon	% @ 70 (	5.8							
BLVD5	12/1/1997		0	10 cm	Total Organic Carbon	% @ 104	5.9							
BLVD5	12/1/1997		0	10 cm	Total PAH	mg/kg	23	J						
BLVD5	12/1/1997		0	10 cm	Total Solids	%	44.6							
BLVD5	12/1/1997		0	10 cm	Zinc	mg/kg	92							
BLVD5	12/1/1997	DUP	0	10 cm	Benzo(a)anthracene	mg/kg	2.8		Exceeds 2LAET	1.6				
BLVD5	12/1/1997	DUP	0	10 cm	Benzo(g,h,i)perylene	mg/kg	1.5		Exceeds 2LAET	0.72				
BLVD5	12/1/1997	DUP	0	10 cm	Benzofluoranthenes	mg/kg	4.2		Exceeds 2LAET	3.6				
BLVD5	12/1/1997	DUP	0	10 cm	Chrysene	mg/kg	3.2		Exceeds 2LAET	2.8				
BLVD5	12/1/1997	DUP	0	10 cm	Dibenz(a,h)anthracene	mg/kg	0.59	J	Exceeds 2LAET	0.54				
BLVD5	12/1/1997	DUP	0	10 cm	Fluoranthene	mg/kg	5.8		Exceeds 2LAET	2.5				
BLVD5	12/1/1997	DUP	0	10 cm	Indeno(1,2,3-cd)pyrene	mg/kg	1.7		Exceeds 2LAET	0.69				
BLVD5	12/1/1997	DUP	0	10 cm	Naphthalene	mg/kg	4		Exceeds 2LAET	2.4				
BLVD5	12/1/1997	DUP	0	10 cm	Pyrene	mg/kg	6.2		Exceeds 2LAET	3.3				
BLVD5	12/1/1997	DUP	0	10 cm	Total HPAH	mg/kg	29	J	Exceeds 2LAET	17				
BLVD5	12/1/1997	DUP	0	10 cm	Anthracene	mg/kg	1		Exceeds LAET	0.96				
BLVD5	12/1/1997	DUP	0	10 cm	Benzo(a)pyrene	mg/kg	2.6		Exceeds LAET	1.6				
BLVD5	12/1/1997	DUP	0	10 cm	Fluorene	mg/kg	0.59		Exceeds LAET	0.54				
BLVD5	12/1/1997	DUP	0	10 cm	Phenanthrene	mg/kg	3.2		Exceeds LAET	1.5				
BLVD5	12/1/1997	DUP	0	10 cm	Total LPAH	mg/kg	10		Exceeds LAET	5.2				
BLVD5	12/1/1997	DUP	0	10 cm	2,4-Dimethylphenol	mg/kg	0.67	U	Exceeds LAET & 2LAET	0.029				
BLVD5	12/1/1997	DUP	0	10 cm	4-Methylphenol	mg/kg	0.68		Exceeds LAET & 2LAET	0.67				
BLVD5	12/1/1997	DUP	0	10 cm	Benzoic Acid	mg/kg	1.5	U	Exceeds LAET & 2LAET	0.65				
BLVD5	12/1/1997	DUP	0	10 cm	1-Methylnapthalene	mg/kg	0.6							
BLVD5	12/1/1997	DUP	0	10 cm	2-Methylnaphthalene	mg/kg	0.66							
BLVD5	12/1/1997	DUP	0	10 cm	2-Methylphenol	mg/kg	0.047	J						
BLVD5	12/1/1997	DUP	0	10 cm	Acenaphthene	mg/kg	0.38							
BLVD5	12/1/1997	DUP	0	10 cm	Acenaphthylene	mg/kg	0.95							
BLVD5	12/1/1997	DUP	0	10 cm	Arsenic	mg/kg	3.4							
BLVD5	12/1/1997	DUP	0	10 cm	Cadmium	mg/kg	0.4							
BLVD5	12/1/1997	DUP	0	10 cm	Carbazole	mg/kg	0.24							
BLVD5	12/1/1997	DUP	0	10 cm	Chromium	mg/kg	30							
BLVD5	12/1/1997	DUP	0	10 cm	Clay	%	3							
BLVD5	12/1/1997	DUP	0	10 cm	Copper	mg/kg	44							
BLVD5	12/1/1997	DUP	0	10 cm	Coprostanol	mg/kg	2.7	U						
BLVD5	12/1/1997	DUP	0	10 cm	Dibenzofuran	mg/kg	0.5							
BLVD5	12/1/1997	DUP	0	10 cm	Gravel	%	2							
BLVD5	12/1/1997	DUP	0	10 cm	Lead	mg/kg	0.35							
BLVD5	12/1/1997	DUP	0	10 cm	Mercury	mg/kg	0.084	J						
BLVD5	12/1/1997	DUP	0	10 cm	Retene	mg/kg	1.5							
BLVD5	12/1/1997	DUP	0	10 cm	Sand	%	79							
BLVD5	12/1/1997	DUP	0	10 cm	Silt	%	16							
BLVD5	12/1/1997	DUP	0	10 cm	Silver	mg/kg	0.5	U						
BLVD5	12/1/1997	DUP	0	10 cm	Total Organic Carbon	% @ 70 (	4.6							
BLVD5	12/1/1997	DUP	0	10 cm	Total Organic Carbon	% @ 104	4.8							
BLVD5	12/1/1997	DUP	0	10 cm	Total PAH	mg/kg	39	J						
BLVD5	12/1/1997	DUP	0	10 cm	Total Solids	%	48.6							
BLVD5	12/1/1997	DUP	0	10 cm	Zinc	mg/kg	91							
SS-7	4/18/1991		0	0.3 ft	Acenaphthene	mg/kg	5		Exceeds 2LAET	0.73				
SS-7	4/18/1991		0	0.3 ft	Acenaphthylene	mg/kg	3		Exceeds LAET & 2LAET	1.3				
SS-7	4/18/1991		0	0.3 ft	Anthracene	mg/kg	12		Exceeds 2LAET	4.4				
SS-7	4/18/1991		0	0.3 ft	Fluorene	mg/kg	6		Exceeds 2LAET	1				

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth		Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
SS-7	4/18/1991		0	0.3 ft	Naphthalene	mg/kg	10		Exceeds 2LAET	2.4				
SS-7	4/18/1991		0	0.3 ft	Phenanthrene	mg/kg	47		Exceeds 2LAET	5.4				
SS-7	4/18/1991		0	0.3 ft	Total LPAH	mg/kg	83		Exceeds 2LAET	13				
SS-7	4/18/1991		0	0.3 ft	Benzo(a)anthracene	mg/kg	22		Exceeds 2LAET	1.6				
SS-7	4/18/1991		0	0.3 ft	Benzo(a)pyrene	mg/kg	22		Exceeds 2LAET	3				
SS-7	4/18/1991		0	0.3 ft	Benzo(g,h,i)perylene	mg/kg	15		Exceeds 2LAET	0.72				
SS-7	4/18/1991		0	0.3 ft	Benzofluoranthenes	mg/kg	42		Exceeds 2LAET	3.6				
SS-7	4/18/1991		0	0.3 ft	Chrysene	mg/kg	31		Exceeds 2LAET	2.8				
SS-7	4/18/1991		0	0.3 ft	Fluoranthene	mg/kg	35		Exceeds 2LAET	2.5				
SS-7	4/18/1991		0	0.3 ft	Indeno(1,2,3-cd)pyrene	mg/kg	15		Exceeds 2LAET	0.69				
SS-7	4/18/1991		0	0.3 ft	Pyrene	mg/kg	54		Exceeds 2LAET	3.3				
SS-7	4/18/1991		0	0.3 ft	Benzo(b)fluoranthene	mg/kg	23							
SS-7	4/18/1991		0	0.3 ft	Benzo(k)fluoranthene	mg/kg	19							
SS-7	4/18/1991		0	0.3 ft	Total HPAH	mg/kg	236		Exceeds 2LAET	17				
SS-7	4/18/1991		0	0.3 ft	Dibenzofuran	mg/kg	4		Exceeds 2LAET	0.7				
SS-7	4/18/1991		0	0.3 ft	Acetone	mg/kg	0.3							
SS-8	4/18/1991		0	0.3 ft	Acenaphthene	mg/kg	1.5	U	Exceeds 2LAET	0.73				
SS-8	4/18/1991		0	0.3 ft	Anthracene	mg/kg	1.5	U	Exceeds LAET	0.96				
SS-8	4/18/1991		0	0.3 ft	Fluorene	mg/kg	1.5	U	Exceeds 2LAET	1				
SS-8	4/18/1991		0	0.3 ft	Naphthalene	mg/kg	1.5	U						
SS-8	4/18/1991		0	0.3 ft	Phenanthrene	mg/kg	1.5	U						
SS-8	4/18/1991		0	0.3 ft	Acenaphthylene	mg/kg	1.5	U	Exceeds LAET & 2LAET	1.3				
SS-8	4/18/1991		0	0.3 ff	Total LPAH	mg/kg	1.5	U						
SS-8	4/18/1991		0	0.3 ft	Benzo(a)anthracene	mg/kg	2.7		Exceeds 2LAET	1.6				
SS-8	4/18/1991		0	0.3 ft	Benzo(a)pyrene	mg/kg	3.1		Exceeds 2LAET	3				
SS-8	4/18/1991		0	0.3 ft	Benzo(g,h,i)perylene	mg/kg	1.9		Exceeds 2LAET	0.72				
SS-8	4/18/1991		0	0.3 ft	Benzofluoranthenes	mg/kg	7.3		Exceeds 2LAET	3.6				
SS-8	4/18/1991		0	0.3 ft	Chrysene	mg/kg	3.4		Exceeds 2LAET	2.8				
SS-8	4/18/1991		0	0.3 ft	Fluoranthene	mg/kg	3.7		Exceeds 2LAET	2.5				
SS-8	4/18/1991		0	0.3 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.8		Exceeds 2LAET	0.69				
SS-8	4/18/1991		0	0.3 ft	Pyrene	mg/kg	4.5		Exceeds 2LAET	3.3				
SS-8	4/18/1991		0	0.3 ft	Benzo(b)fluoranthene	mg/kg	4.6							
SS-8	4/18/1991		0	0.3 ft	Benzo(k)fluoranthene	mg/kg	2.7							
SS-8	4/18/1991		0	0.3 ft	Total HPAH	mg/kg	28.4		Exceeds 2LAET	17				
SS-8	4/18/1991		0	0.3 ft	Dibenzofuran	mg/kg	1.5	U	Exceeds 2LAET	0.7				
SS-8	4/18/1991		0	0.3 ft	Acetone	mg/kg	0.08	U						
SS-9	4/18/1991		0	0.3 ft	Acenaphthene	mg/kg	0.5	UJ						
SS-9	4/18/1991		0	0.3 ft	Acenaphthylene	mg/kg	0.7	J						
SS-9	4/18/1991		0	0.3 ft	Anthracene	mg/kg	0.8	J						
SS-9	4/18/1991		0	0.3 ft	Fluorene	mg/kg	0.5	UJ						
SS-9	4/18/1991		0	0.3 ft	Naphthalene	mg/kg	1.3	J						
SS-9	4/18/1991		0	0.3 ft	Phenanthrene	mg/kg	0.8	J						
SS-9	4/18/1991		0	0.3 ft	Total LPAH	mg/kg	3.6	J						
SS-9	4/18/1991		0	0.3 ft	Benzo(a)anthracene	mg/kg	2.2	J	Exceeds 2LAET	1.6				
SS-9	4/18/1991		0	0.3 ft	Benzo(g,h,i)perylene	mg/kg	0.9	J	Exceeds 2LAET	0.72				
SS-9	4/18/1991		0	0.3 ft	Chrysene	mg/kg	3.5	J	Exceeds 2LAET	2.8				
SS-9	4/18/1991		0	0.3 ft	Indeno(1,2,3-cd)pyrene	mg/kg	0.9	J	Exceeds 2LAET	0.69				
SS-9	4/18/1991		0	0.3 ft	Pyrene	mg/kg	4.7	J	Exceeds 2LAET	3.3				
SS-9	4/18/1991		0	0.3 ft	Benzo(a)pyrene	mg/kg	2.4	J	Exceeds LAET	1.6				
SS-9	4/18/1991		0	0.3 ft	Benzofluoranthenes	mg/kg	3.3	J	Exceeds LAET	3.2				
SS-9	4/18/1991		0	0.3 ft	Fluoranthene	mg/kg	2.5	J	Exceeds LAET	1.7				
SS-9	4/18/1991		0	0.3 ft	Total HPAH	mg/kg	20.4	J	Exceeds 2LAET	17				
SS-9	4/18/1991		0	0.3 ft	Acetone	mg/kg	0.08	U						
SS-9	4/18/1991		0	0.3 ft	Benzo(b)fluoranthene	mg/kg	1.3	J						

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
SS-9	4/18/1991	0	0.3 ft	Benzo(k)fluoranthene	mg/kg	2	J						
SS-9	4/18/1991	0	0.3 ft	Dibenzofuran	mg/kg	0.5	UJ						
SS-10	4/18/1991	0	0.3 ft	Acenaphthene	mg/kg	5	U	Exceeds 2LAET	0.73				
SS-10	4/18/1991	0	0.3 ft	Acenaphthylene	mg/kg	5	U	Exceeds LAET & 2LAET	1.3				
SS-10	4/18/1991	0	0.3 ft	Anthracene	mg/kg	5	U	Exceeds 2LAET	4.4				
SS-10	4/18/1991	0	0.3 ft	Fluorene	mg/kg	5	U	Exceeds 2LAET	1				
SS-10	4/18/1991	0	0.3 ft	Naphthalene	mg/kg	7		Exceeds 2LAET	2.4				
SS-10	4/18/1991	0	0.3 ft	Phenanthrene	mg/kg	7		Exceeds 2LAET	5.4				
SS-10	4/18/1991	0	0.3 ft	Total LPAH	mg/kg	14		Exceeds 2LAET	13				
SS-10	4/18/1991	0	0.3 ft	Benzo(a)anthracene	mg/kg	5	U	Exceeds 2LAET	1.6				
SS-10	4/18/1991	0	0.3 ft	Benzo(a)pyrene	mg/kg	5	U	Exceeds 2LAET	3				
SS-10	4/18/1991	0	0.3 ft	Benzo(g,h,i)perylene	mg/kg	5	U	Exceeds 2LAET	0.72				
SS-10	4/18/1991	0	0.3 ft	Benzofluoranthenes	mg/kg	5	U	Exceeds 2LAET	3.6				
SS-10	4/18/1991	0	0.3 ft	Chrysene	mg/kg	5	U	Exceeds 2LAET	2.8				
SS-10	4/18/1991	0	0.3 ft	Dibenzofuran	mg/kg	5	U	Exceeds 2LAET	0.7				
SS-10	4/18/1991	0	0.3 ft	Fluoranthene	mg/kg	7		Exceeds 2LAET	2.5				
SS-10	4/18/1991	0	0.3 ft	Indeno(1,2,3-cd)pyrene	mg/kg	5	U	Exceeds 2LAET	0.69				
SS-10	4/18/1991	0	0.3 ft	Pyrene	mg/kg	7		Exceeds 2LAET	3.3				
SS-10	4/18/1991	0	0.3 ft	Total HPAH	mg/kg	14		Exceeds LAET	12				
SS-10	4/18/1991	0	0.3 ft	Acetone	mg/kg	0.25	U						
SS-10	4/18/1991	0	0.3 ft	Benzo(b)fluoranthene	mg/kg	5	U						
SS-10	4/18/1991	0	0.3 ft	Benzo(k)fluoranthene	mg/kg	5	U						
BLVD-SS-01	9/19/2008	0	12 cm	1,2,4-Trichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.051	Exceeds CSL	1.8	2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	1,2-Dichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.05			2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	N-Nitrosodiphenylamine	mg/kg	0.059	U	Exceeds 2LAET	0.04			2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Hexachlorobenzene	mg/kg	0.059	U	Exceeds LAET	0.022	Exceeds SQS	0.38	2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Benzyl Alcohol	mg/kg	0.059	U	Exceeds LAET	0.057				
BLVD-SS-01	9/19/2008	0	12 cm	Hexachlorobutadiene	mg/kg	0.059	U	Exceeds LAET	0.011			2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	2,4-Dimethylphenol	mg/kg	0.059	U	Exceeds LAET & 2LAET	0.029				
BLVD-SS-01	9/19/2008	0	12 cm	1,3-Dichlorobenzene	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	1,4-Dichlorobenzene	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	1-Methylnapthalene	mg/kg	0.059	U						
BLVD-SS-01	9/19/2008	0	12 cm	2-Methylnaphthalene	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	2-Methylphenol	mg/kg	0.059	U						
BLVD-SS-01	9/19/2008	0	12 cm	4-Methylphenol	mg/kg	0.06							
BLVD-SS-01	9/19/2008	0	12 cm	Acenaphthene	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Acenaphthylene	mg/kg	0.1						3.4	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Ammonia	mg/kg	11.4							
BLVD-SS-01	9/19/2008	0	12 cm	Anthracene	mg/kg	0.17						5.8	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Arsenic	mg/kg	9	U						
BLVD-SS-01	9/19/2008	0	12 cm	Benzo(a)anthracene	mg/kg	0.6						20.4	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Benzo(a)pyrene	mg/kg	0.7						23.8	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Benzo(b)fluoranthene	mg/kg	0.58							
BLVD-SS-01	9/19/2008	0	12 cm	Benzo(g,h,i)perylene	mg/kg	0.23						7.8	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Benzo(k)fluoranthene	mg/kg	0.57							
BLVD-SS-01	9/19/2008	0	12 cm	Benzofluoranthenes	mg/kg	1.15						39.1	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Benzoic Acid	mg/kg	0.59	U						
BLVD-SS-01	9/19/2008	0	12 cm	bis(2-Ethylhexyl)phthalate	mg/kg	0.049	J					1.7	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Butylbenzylphthalate	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Cadmium	mg/kg	0.6							
BLVD-SS-01	9/19/2008	0	12 cm	Chromium	mg/kg	31.6							
BLVD-SS-01	9/19/2008	0	12 cm	Chrysene	mg/kg	0.7						23.8	mg/kg OC
BLVD-SS-01	9/19/2008	0	12 cm	Clay	%	13.3							
BLVD-SS-01	9/19/2008	0	12 cm	Copper	mg/kg	32.5							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth			Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD-SS-01	9/19/2008		0	12	cm	Dibenz(a,h)anthracene	mg/kg	0.071						2.4	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Dibenzofuran	mg/kg	0.031	J					1.1	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Diesel	mg/Kg	29							
BLVD-SS-01	9/19/2008		0	12	cm	Diethylphthalate	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Dimethylphthalate	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Di-n-Butylphthalate	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Di-n-Octyl phthalate	mg/kg	0.059	U					2.0	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Fluoranthene	mg/kg	1.7						57.8	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Fluorene	mg/kg	0.062						2.1	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Gravel	%	1.9							
BLVD-SS-01	9/19/2008		0	12	cm	Hexachloroethane	mg/kg	0.059	U						
BLVD-SS-01	9/19/2008		0	12	cm	Indeno(1,2,3-cd)pyrene	mg/kg	0.25						8.5	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Lead	mg/kg	32							
BLVD-SS-01	9/19/2008		0	12	cm	Mercury	mg/kg	0.1							
BLVD-SS-01	9/19/2008		0	12	cm	Motor Oil	mg/Kg	72							
BLVD-SS-01	9/19/2008		0	12	cm	Naphthalene	mg/kg	0.045	J					1.5	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Nickel	mg/kg	30							
BLVD-SS-01	9/19/2008		0	12	cm	Pentachlorophenol	mg/kg	0.3	U						
BLVD-SS-01	9/19/2008		0	12	cm	Phenanthrene	mg/kg	0.9						30.6	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Phenol	mg/kg	0.094							
BLVD-SS-01	9/19/2008		0	12	cm	Pyrene	mg/kg	1.3						44.2	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Sand	%	75.4							
BLVD-SS-01	9/19/2008		0	12	cm	Silt	%	9.2							
BLVD-SS-01	9/19/2008		0	12	cm	Silver	mg/kg	0.5	U						
BLVD-SS-01	9/19/2008		0	12	cm	Sulfide	mg/kg	441							
BLVD-SS-01	9/19/2008		0	12	cm	Total LPAH	mg/kg	1.28						43.4	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Total HPAH	mg/kg	6.7						228	mg/kg OC
BLVD-SS-01	9/19/2008		0	12	cm	Total Organic Carbon	%	2.94							
BLVD-SS-01	9/19/2008		0	12	cm	Total Solids	%	54.1							
BLVD-SS-01	9/19/2008		0	12	cm	Total Solids, Preserved	%	41							
BLVD-SS-01	9/19/2008		0	12	cm	Zinc	mg/kg	85							
BLVD-SS-02	9/19/2008		0	12	cm	Ammonia	mg/kg	17.1							
BLVD-SS-02	9/19/2008		0	12	cm	Arsenic	mg/kg	10	U						
BLVD-SS-02	9/19/2008		0	12	cm	Cadmium	mg/kg	0.8							
BLVD-SS-02	9/19/2008		0	12	cm	Chromium	mg/kg	35							
BLVD-SS-02	9/19/2008		0	12	cm	Copper	mg/kg	46.4							
BLVD-SS-02	9/19/2008		0	12	cm	Diesel	mg/Kg	31							
BLVD-SS-02	9/19/2008		0	12	cm	Lead	mg/kg	34							
BLVD-SS-02	9/19/2008		0	12	cm	Mercury	mg/kg	0.1							
BLVD-SS-02	9/19/2008		0	12	cm	Motor Oil	mg/Kg	66							
BLVD-SS-02	9/19/2008		0	12	cm	Nickel	mg/kg	37							
BLVD-SS-02	9/19/2008		0	12	cm	Silver	mg/kg	0.7	U						
BLVD-SS-02	9/19/2008		0	12	cm	Sulfide	mg/kg	1740							
BLVD-SS-02	9/19/2008		0	12	cm	Total Organic Carbon	%	3.25							
BLVD-SS-02	9/19/2008		0	12	cm	Total Solids	%	40.2							
BLVD-SS-02	9/19/2008		0	12	cm	Total Solids, Preserved	%	30							
BLVD-SS-02	9/19/2008		0	12	cm	Zinc	mg/kg	93							
BLVD-SS-03	9/19/2008		0	12	cm	Ammonia	mg/kg	27.5							
BLVD-SS-03	9/19/2008		0	12	cm	Arsenic	mg/kg	20	U						
BLVD-SS-03	9/19/2008		0	12	cm	Cadmium	mg/kg	1.2							
BLVD-SS-03	9/19/2008		0	12	cm	Chromium	mg/kg	43							
BLVD-SS-03	9/19/2008		0	12	cm	Copper	mg/kg	45.9							
BLVD-SS-03	9/19/2008		0	12	cm	Diesel	mg/Kg	31							
BLVD-SS-03	9/19/2008		0	12	cm	Lead	mg/kg	24							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth			Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BLVD-SS-03	9/19/2008		0	12	cm	Mercury	mg/kg	0.3							
BLVD-SS-03	9/19/2008		0	12	cm	Motor Oil	mg/Kg	70							
BLVD-SS-03	9/19/2008		0	12	cm	Nickel	mg/kg	60							
BLVD-SS-03	9/19/2008		0	12	cm	Silver	mg/kg	1	U						
BLVD-SS-03	9/19/2008		0	12	cm	Sulfide	mg/kg	1270							
BLVD-SS-03	9/19/2008		0	12	cm	Total Organic Carbon	%	9							
BLVD-SS-03	9/19/2008		0	12	cm	Total Solids	%	23.6							
BLVD-SS-03	9/19/2008		0	12	cm	Total Solids	%	23							
BLVD-SS-03	9/19/2008		0	12	cm	Zinc	mg/kg	142							
BLVD-SS-04	9/19/2008		0	12	cm	Ammonia	mg/kg	17							
BLVD-SS-04	9/19/2008		0	12	cm	Arsenic	mg/kg	20	U						
BLVD-SS-04	9/19/2008		0	12	cm	Cadmium	mg/kg	1.2							
BLVD-SS-04	9/19/2008		0	12	cm	Chromium	mg/kg	43							
BLVD-SS-04	9/19/2008		0	12	cm	Copper	mg/kg	40.6							
BLVD-SS-04	9/19/2008		0	12	cm	Diesel	mg/Kg	26							
BLVD-SS-04	9/19/2008		0	12	cm	Lead	mg/kg	21							
BLVD-SS-04	9/19/2008		0	12	cm	Mercury	mg/kg	0.4							
BLVD-SS-04	9/19/2008		0	12	cm	Motor Oil	mg/Kg	43							
BLVD-SS-04	9/19/2008		0	12	cm	Nickel	mg/kg	57							
BLVD-SS-04	9/19/2008		0	12	cm	Silver	mg/kg	1	U						
BLVD-SS-04	9/19/2008		0	12	cm	Sulfide	mg/kg	749							
BLVD-SS-04	9/19/2008		0	12	cm	Total Organic Carbon	%	12.2							
BLVD-SS-04	9/19/2008		0	12	cm	Total Solids	%	26.8							
BLVD-SS-04	9/19/2008		0	12	cm	Total Solids, Preserved	%	24.6							
BLVD-SS-04	9/19/2008		0	12	cm	Zinc	mg/kg	85							
BLVD-SS-05	9/19/2008		0	12	cm	Ammonia	mg/kg	22.7							
BLVD-SS-05	9/19/2008		0	12	cm	Arsenic	mg/kg	20	U						
BLVD-SS-05	9/19/2008		0	12	cm	Cadmium	mg/kg	1.1							
BLVD-SS-05	9/19/2008		0	12	cm	Chromium	mg/kg	68							
BLVD-SS-05	9/19/2008		0	12	cm	Copper	mg/kg	53.4							
BLVD-SS-05	9/19/2008		0	12	cm	Diesel	mg/Kg	31							
BLVD-SS-05	9/19/2008		0	12	cm	Lead	mg/kg	15							
BLVD-SS-05	9/19/2008		0	12	cm	Mercury	mg/kg	0.2							
BLVD-SS-05	9/19/2008		0	12	cm	Motor Oil	mg/Kg	54							
BLVD-SS-05	9/19/2008		0	12	cm	Nickel	mg/kg	98							
BLVD-SS-05	9/19/2008		0	12	cm	Silver	mg/kg	1	U						
BLVD-SS-05	9/19/2008		0	12	cm	Sulfide	mg/kg	2710							
BLVD-SS-05	9/19/2008		0	12	cm	Total Organic Carbon	%	4.87							
BLVD-SS-05	9/19/2008		0	12	cm	Total Solids	%	28.2							
BLVD-SS-05	9/19/2008		0	12	cm	Total Solids, Preserved	%	22							
BLVD-SS-05	9/19/2008		0	12	cm	Zinc	mg/kg	112							
BBP-SS-02	8/26/2008		0	12	cm	Gravel	%	9.1							
BBP-SS-02	8/26/2008		0	12	cm	Sand	%	74.6							
BBP-SS-02	8/26/2008		0	12	cm	Fines	%	16.2							
BBP-SS-02	8/26/2008		0	12	cm	Dioxins-TEQ	ng/kg	2.82							
BBP-SS-02	8/26/2008		0	12	cm	Arsenic	mg/kg	8	U						
BBP-SS-02	8/26/2008		0	12	cm	Cadmium	mg/kg	0.3							
BBP-SS-02	8/26/2008		0	12	cm	Chromium	mg/kg	25.2							
BBP-SS-02	8/26/2008		0	12	cm	Copper	mg/kg	14.5							
BBP-SS-02	8/26/2008		0	12	cm	Lead	mg/kg	8							
BBP-SS-02	8/26/2008		0	12	cm	Mercury	mg/kg	0.11							
BBP-SS-02	8/26/2008		0	12	cm	Nickel	mg/kg	30							
BBP-SS-02	8/26/2008		0	12	cm	Silver	mg/kg	0.5	U						
BBP-SS-02	8/26/2008		0	12	cm	Zinc	mg/kg	46							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth	Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BBP-SS-02	8/26/2008		0 12 cm	Naphthalene	mg/kg	0.08							
BBP-SS-02	8/26/2008		0 12 cm	Acenaphthylene	mg/kg	0.17							
BBP-SS-02	8/26/2008		0 12 cm	Acenaphthene	mg/kg	0.11							
BBP-SS-02	8/26/2008		0 12 cm	Fluorene	mg/kg	0.38							
BBP-SS-02	8/26/2008		0 12 cm	Phenanthrene	mg/kg	2.0		Exceeds LAET	1.5				
BBP-SS-02	8/26/2008		0 12 cm	Anthracene	mg/kg	0.43							
BBP-SS-02	8/26/2008		0 12 cm	2-Methylnaphthalene	mg/kg	0.099							
BBP-SS-02	8/26/2008		0 12 cm	1-Methylnaphthalene	mg/kg	0.14							
BBP-SS-02	8/26/2008		0 12 cm	Total LPAHs	mg/kg	3.409							
BBP-SS-02	8/26/2008		0 12 cm	Fluoranthene	mg/kg	2.4		Exceeds LAET	1.7				
BBP-SS-02	8/26/2008		0 12 cm	Pyrene	mg/kg	2.0							
BBP-SS-02	8/26/2008		0 12 cm	Benzo(a)anthracene	mg/kg	1.1							
BBP-SS-02	8/26/2008		0 12 cm	Chrysene	mg/kg	1.2							
BBP-SS-02	8/26/2008		0 12 cm	Benzo(b)fluoranthene	mg/kg	1.1							
BBP-SS-02	8/26/2008		0 12 cm	Benzo(k)fluoranthene	mg/kg	1.1							
BBP-SS-02	8/26/2008		0 12 cm	Total Benzofluoranthenes	mg/kg	2.2							
BBP-SS-02	8/26/2008		0 12 cm	Benzo(a)pyrene	mg/kg	1.2							
BBP-SS-02	8/26/2008		0 12 cm	Indeno(1,2,3-cd)pyrene	mg/kg	0.4							
BBP-SS-02	8/26/2008		0 12 cm	Dibenz(a,h)anthracene	mg/kg	0.076							
BBP-SS-02	8/26/2008		0 12 cm	Benzo(g,h,i)perylene	mg/kg	0.36							
BBP-SS-02	8/26/2008		0 12 cm	Total HPAHs	mg/kg	10.936							
BBP-SS-02	8/26/2008		0 12 cm	1,2-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	1,3-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	1,4-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	1,2,4-Trichlorobenzene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Hexachlorobenzene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Dimethylphthalate	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Diethylphthalate	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Di-n-Butylphthalate	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Butylbenzylphthalate	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	bis(2-Ethylhexyl)phthalate	mg/kg	0.035							
BBP-SS-02	8/26/2008		0 12 cm	Di-n-Octyl phthalate	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Dibenzofuran	mg/kg	0.093							
BBP-SS-02	8/26/2008		0 12 cm	Hexachlorobutadiene	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	N-Nitrosodiphenylamine	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Hexachloroethane	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Phenol	mg/kg	0.015	T						
BBP-SS-02	8/26/2008		0 12 cm	2-Methylphenol	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	4-Methylphenol	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	2,4-Dimethylphenol	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Pentachlorophenol	mg/kg	0.098	U						
BBP-SS-02	8/26/2008		0 12 cm	Benzyl Alcohol	mg/kg	0.02	U						
BBP-SS-02	8/26/2008		0 12 cm	Benzoic Acid	mg/kg	0.2	U						
BBP-SS-02	8/26/2008		0 12 cm	Moisture Content	%	59.92							
BBP-SS-02	8/26/2008		0 12 cm	Preserved Total Solids	%	50.9							
BBP-SS-02	8/26/2008		0 12 cm	Total Solids	%	62.2							
BBP-SS-02	8/26/2008		0 12 cm	Total Organic Carbon	%	4.1							
BBP-SS-02	8/26/2008		0 12 cm	Diesel Range Hydrocarbons	mg/kg	15							
BBP-SS-02	8/26/2008		0 12 cm	Motor Oil	mg/kg	16	U						
BBP-SS-02	8/26/2008		0 12 cm	Ammonia (NH3) as Nitrogen (N)	mg/kg	6.93							
BBP-SS-02	8/26/2008		0 12 cm	Sulfide	mg/kg	265							
BBP-SS-02	8/26/2008		0 12 cm	Specific Gravity		2.65							
BBP-SS-03	8/26/2008		0 12 cm	Dioxins-TEQ	ng/kg	16.1							
BBP-SS-03	8/26/2008		0 12 cm	Arsenic	mg/kg	20	U						

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth			Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BBP-SS-03	8/26/2008		0	12	cm	Cadmium	mg/kg	2							
BBP-SS-03	8/26/2008		0	12	cm	Chromium	mg/kg	15							
BBP-SS-03	8/26/2008		0	12	cm	Copper	mg/kg	32							
BBP-SS-03	8/26/2008		0	12	cm	Lead	mg/kg	30							
BBP-SS-03	8/26/2008		0	12	cm	Mercury	mg/kg	0.2	U						
BBP-SS-03	8/26/2008		0	12	cm	Nickel	mg/kg	19							
BBP-SS-03	8/26/2008		0	12	cm	Silver	mg/kg	1	U						
BBP-SS-03	8/26/2008		0	12	cm	Zinc	mg/kg	84							
BBP-SS-03	8/26/2008		0	12	cm	Naphthalene	mg/kg	0.17							
BBP-SS-03	8/26/2008		0	12	cm	Acenaphthylene	mg/kg	0.20							
BBP-SS-03	8/26/2008		0	12	cm	Acenaphthene	mg/kg	0.044							
BBP-SS-03	8/26/2008		0	12	cm	Fluorene	mg/kg	0.05							
BBP-SS-03	8/26/2008		0	12	cm	Phenanthrene	mg/kg	0.86							
BBP-SS-03	8/26/2008		0	12	cm	Anthracene	mg/kg	0.27							
BBP-SS-03	8/26/2008		0	12	cm	2-Methylnaphthalene	mg/kg	0.044							
BBP-SS-03	8/26/2008		0	12	cm	1-Methylnaphthalene	mg/kg	0.039							
BBP-SS-03	8/26/2008		0	12	cm	Total LPAHs	mg/kg	1.677							
BBP-SS-03	8/26/2008		0	12	cm	Fluoranthene	mg/kg	1.5							
BBP-SS-03	8/26/2008		0	12	cm	Pyrene	mg/kg	1.5							
BBP-SS-03	8/26/2008		0	12	cm	Benzo(a)anthracene	mg/kg	1.0							
BBP-SS-03	8/26/2008		0	12	cm	Chrysene	mg/kg	1.2							
BBP-SS-03	8/26/2008		0	12	cm	Benzo(b)fluoranthene	mg/kg	1.3							
BBP-SS-03	8/26/2008		0	12	cm	Benzo(k)fluoranthene	mg/kg	0.94							
BBP-SS-03	8/26/2008		0	12	cm	Total Benzofluoranthenes	mg/kg	2.24							
BBP-SS-03	8/26/2008		0	12	cm	Benzo(a)pyrene	mg/kg	1.4							
BBP-SS-03	8/26/2008		0	12	cm	Indeno(1,2,3-cd)pyrene	mg/kg	0.34							
BBP-SS-03	8/26/2008		0	12	cm	Dibenz(a,h)anthracene	mg/kg	0.065							
BBP-SS-03	8/26/2008		0	12	cm	Benzo(g,h,i)perylene	mg/kg	0.31							
BBP-SS-03	8/26/2008		0	12	cm	Total HPAHs	mg/kg	9.555							
BBP-SS-03	8/26/2008		0	12	cm	1,2-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	1,3-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	1,4-Dichlorobenzene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	1,2,4-Trichlorobenzene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Hexachlorobenzene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Dimethylphthalate	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Diethylphthalate	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Di-n-Butylphthalate	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Butylbenzylphthalate	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	bis(2-Ethylhexyl)phthalate	mg/kg	0.29							
BBP-SS-03	8/26/2008		0	12	cm	Di-n-Octyl phthalate	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Dibenzofuran	mg/kg	0.048							
BBP-SS-03	8/26/2008		0	12	cm	Hexachlorobutadiene	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	N-Nitrosodiphenylamine	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Hexachloroethane	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Phenol	mg/kg	0.023							
BBP-SS-03	8/26/2008		0	12	cm	2-Methylphenol	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	4-Methylphenol	mg/kg	0.063							
BBP-SS-03	8/26/2008		0	12	cm	2,4-Dimethylphenol	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Pentachlorophenol	mg/kg	0.099	U						
BBP-SS-03	8/26/2008		0	12	cm	Benzyl Alcohol	mg/kg	0.02	U						
BBP-SS-03	8/26/2008		0	12	cm	Benzoic Acid	mg/kg	0.2	U						
BBP-SS-03	8/26/2008		0	12	cm	Preserved Total Solids	%	18.8							
BBP-SS-03	8/26/2008		0	12	cm	Total Solids	%	20.4							
BBP-SS-03	8/26/2008		0	12	cm	Total Organic Carbon	%	86.5							

Table A-3. Surface Sediment Samples and Comparison to Screening Levels

Station	Date	Dup?	Sample Depth			Parameter	Units	Result	Q	AET screen	Threshold	SMS Screen	Threshold	TOC Normalized	Units
BBP-SS-03	8/26/2008		0	12	cm	Ammonia (NH3) as Nitrogen (N)	mg/kg	2.82							
BBP-SS-03	8/26/2008		0	12	cm	Sulfide	mg/kg	290							
BBP-SS-03	8/26/2008		0	12	cm	Diesel Range Hydrocarbons	mg/kg	61							
BBP-SS-03	8/26/2008		0	12	cm	Motor Oil	mg/kg	180							

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	1,2,4-Trichlorobenzene	mg/kg	0.06	U	Exceeds 2LAET	0.051
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	1,2-Dichlorobenzene	mg/kg	0.06	U	Exceeds 2LAET	0.05
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzo(a)anthracene	mg/kg	10		Exceeds 2LAET	1.6
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzo(a)pyrene	mg/kg	12		Exceeds 2LAET	3
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzo(g,h,i)perylene	mg/kg	2.6		Exceeds 2LAET	0.72
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzofluoranthenes	mg/kg	16		Exceeds 2LAET	3.6
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Chrysene	mg/kg	11		Exceeds 2LAET	2.8
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Dibenz(a,h)anthracene	mg/kg	1		Exceeds 2LAET	0.54
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Fluoranthene	mg/kg	14		Exceeds 2LAET	2.5
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Indeno(1,2,3-cd)pyrene	mg/kg	3.1		Exceeds 2LAET	0.69
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	N-Nitrosodiphenylamine	mg/kg	0.06	U	Exceeds 2LAET	0.04
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Pyrene	mg/kg	14		Exceeds 2LAET	3.3
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Anthracene	mg/kg	1.3		Exceeds LAET	0.96
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzyl Alcohol	mg/kg	0.06	U	Exceeds LAET	0.057
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Hexachlorobenzene	mg/kg	0.06	U	Exceeds LAET	0.022
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Hexachlorobutadiene	mg/kg	0.06	U	Exceeds LAET	0.011
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Phenanthrene	mg/kg	2.4		Exceeds LAET	1.5
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	2,4-Dimethylphenol	mg/kg	0.06	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	1,3-Dichlorobenzene	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	1,4-Dichlorobenzene	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	1-Methylnapthalene	mg/kg	0.13			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	2-Methylnaphthalene	mg/kg	0.22			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	2-Methylphenol	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	4-Methylphenol	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Acenaphthene	mg/kg	0.14			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Acenaphthylene	mg/kg	1.2			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Arsenic	mg/kg	10	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzo(b)fluoranthene	mg/kg	8.5			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzo(k)fluoranthene	mg/kg	7.5			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Benzoic Acid	mg/kg	0.6	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.1			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Butylbenzylphthalate	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Cadmium	mg/kg	0.9			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Chromium	mg/kg	41			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Copper	mg/kg	50.3			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Dibenzofuran	mg/kg	0.1			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Diesel	mg/kg	130			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Diethylphthalate	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Dimethylphthalate	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Di-n-Butylphthalate	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Di-n-Octyl phthalate	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Fluorene	mg/kg	0.31			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Hexachloroethane	mg/kg	0.06	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Lead	mg/kg	48			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Mercury	mg/kg	0.3	J		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Motor Oil	mg/kg	190			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Naphthalene	mg/kg	0.38			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Pentachlorophenol	mg/kg	0.3	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Phenol	mg/kg	0.12			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Silver	mg/kg	0.8	U		
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Total LPAH	mg/kg	5.73		Exceeds LAET	5.2
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Total HPAH	mg/kg	83.7		Exceeds 2LAET	17
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Total Organic Carbon	%	11.8			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Total Solids	%	40.7			
BLVD-SC-01	BLVD-SC-01-0-2'	0	2 ft	Zinc	mg/kg	110			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	1,2,4-Trichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.051
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	1,2-Dichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.05
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzo(a)anthracene	mg/kg	15		Exceeds 2LAET	1.6
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzo(a)pyrene	mg/kg	19		Exceeds 2LAET	3
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzo(g,h,i)perylene	mg/kg	4.1		Exceeds 2LAET	0.72
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzofluoranthenes	mg/kg	25		Exceeds 2LAET	3.6
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Chrysene	mg/kg	16		Exceeds 2LAET	2.8
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Dibenz(a,h)anthracene	mg/kg	1.6		Exceeds 2LAET	0.54
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Fluoranthene	mg/kg	18		Exceeds 2LAET	2.5
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Indeno(1,2,3-cd)pyrene	mg/kg	12		Exceeds 2LAET	0.69
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	N-Nitrosodiphenylamine	mg/kg	0.059	U	Exceeds 2LAET	0.04
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Pyrene	mg/kg	19		Exceeds 2LAET	3.3
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Anthracene	mg/kg	1.5		Exceeds LAET	0.96
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzyl Alcohol	mg/kg	0.059	U	Exceeds LAET	0.057
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Hexachlorobenzene	mg/kg	0.059	U	Exceeds LAET	0.022
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Hexachlorobutadiene	mg/kg	0.059	U	Exceeds LAET	0.011
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Phenanthrene	mg/kg	2.2		Exceeds LAET	1.5
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	2,4-Dimethylphenol	mg/kg	0.059	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Acenaphthylene	mg/kg	2.1		Exceeds LAET & 2LAET	1.3
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	1,3-Dichlorobenzene	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	1,4-Dichlorobenzene	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	1-Methylnapthalene	mg/kg	0.17			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	2-Methylnaphthalene	mg/kg	0.33			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	2-Methylphenol	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	4-Methylphenol	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Acenaphthene	mg/kg	0.24			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Arsenic	mg/kg	10	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzo(b)fluoranthene	mg/kg	13			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzo(k)fluoranthene	mg/kg	12			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Benzoic Acid	mg/kg	0.59	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.1			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Butylbenzylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Cadmium	mg/kg	0.8			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Chromium	mg/kg	40			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Copper	mg/kg	39.5			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Dibenzofuran	mg/kg	0.12			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Diesel	mg/kg	290			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Diethylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Dimethylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Di-n-Butylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Di-n-Octyl phthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Fluorene	mg/kg	0.44			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Hexachloroethane	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Lead	mg/kg	52			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Mercury	mg/kg	0.4			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Motor Oil	mg/kg	330			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Naphthalene	mg/kg	0.54			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Pentachlorophenol	mg/kg	0.3	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Phenol	mg/kg	0.087			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Silver	mg/kg	0.8	U		
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Total Organic Carbon	%	10.2			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Total Solids	%	38.5			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Zinc	mg/kg	102			
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Total LPAH	mg/kg	7.02		Exceeds LAET	5.2
BLVD-SC-01	BLVD-SC-01-2-4'	2	4 ft	Total HPAH	mg/kg	129.7		Exceeds 2LAET	17
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	1,2,4-Trichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.051
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	1,2-Dichlorobenzene	mg/kg	0.059	U	Exceeds 2LAET	0.05
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzo(a)anthracene	mg/kg	4.6		Exceeds 2LAET	1.6
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzo(a)pyrene	mg/kg	8		Exceeds 2LAET	3
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzo(g,h,i)perylene	mg/kg	3		Exceeds 2LAET	0.72
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzofluoranthenes	mg/kg	9.5		Exceeds 2LAET	3.6
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Chrysene	mg/kg	4.6		Exceeds 2LAET	2.8
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Dibenz(a,h)anthracene	mg/kg	1		Exceeds 2LAET	0.54
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Fluoranthene	mg/kg	7.8		Exceeds 2LAET	2.5
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Indeno(1,2,3-cd)pyrene	mg/kg	3.4		Exceeds 2LAET	0.69
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	N-Nitrosodiphenylamine	mg/kg	0.059	U	Exceeds 2LAET	0.04
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Pyrene	mg/kg	7.1		Exceeds 2LAET	3.3
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzyl Alcohol	mg/kg	0.059	U	Exceeds LAET	0.057
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Hexachlorobenzene	mg/kg	0.059	U	Exceeds LAET	0.022
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Hexachlorobutadiene	mg/kg	0.059	U	Exceeds LAET	0.011
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	2,4-Dimethylphenol	mg/kg	0.059	U	Exceeds LAET & 2LAET	0.029

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	1,3-Dichlorobenzene	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	1,4-Dichlorobenzene	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	1-Methylnapthalene	mg/kg	0.083			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	2-Methylnaphthalene	mg/kg	0.15			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	2-Methylphenol	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	4-Methylphenol	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Acenaphthene	mg/kg	0.093			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Acenaphthylene	mg/kg	0.82			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Anthracene	mg/kg	0.66			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Arsenic	mg/kg	10	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzo(b)fluoranthene	mg/kg	5.5			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzo(k)fluoranthene	mg/kg	4			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Benzoic Acid	mg/kg	0.59	UJ		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.084			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Butylbenzylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Cadmium	mg/kg	0.6			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Chromium	mg/kg	32			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Copper	mg/kg	36.5			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Dibenzofuran	mg/kg	0.046	J		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Diesel	mg/kg	87			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Diethylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Dimethylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Di-n-Butylphthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Di-n-Octyl phthalate	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Fluorene	mg/kg	0.17			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Hexachloroethane	mg/kg	0.059	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Lead	mg/kg	36			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Mercury	mg/kg	0.2			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Motor Oil	mg/kg	140			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Naphthalene	mg/kg	0.24			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Pentachlorophenol	mg/kg	0.3	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Phenanthrene	mg/kg	1			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Phenol	mg/kg	0.1			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Silver	mg/kg	0.6	U		
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Total Organic Carbon	%	7.63			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Total Solids	%	52.3			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Zinc	mg/kg	96			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Total LPAH	mg/kg	2.98			
BLVD-SC-01	BLVD-SC-01-4-6'	4	6 ft	Total HPAH	mg/kg	49		Exceeds 2LAET	17
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzo(a)anthracene	mg/kg	2		Exceeds 2LAET	1.6
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzo(g,h,i)perylene	mg/kg	1.2		Exceeds 2LAET	0.72
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzofluoranthenes	mg/kg	4.4		Exceeds 2LAET	3.6

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Fluoranthene	mg/kg	2.7		Exceeds 2LAET	2.5
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.2		Exceeds 2LAET	0.69
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	N-Nitrosodiphenylamine	mg/kg	0.046	U	Exceeds 2LAET	0.04
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	1,2,4-Trichlorobenzene	mg/kg	0.046	U	Exceeds LAET	0.031
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	1,2-Dichlorobenzene	mg/kg	0.046	U	Exceeds LAET	0.035
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzo(a)pyrene	mg/kg	2.5		Exceeds LAET	1.6
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Chrysene	mg/kg	2.4		Exceeds LAET	1.4
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Dibenz(a,h)anthracene	mg/kg	0.4		Exceeds LAET	0.23
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Hexachlorobenzene	mg/kg	0.046	U	Exceeds LAET	0.022
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Hexachlorobutadiene	mg/kg	0.046	U	Exceeds LAET	0.011
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	2,4-Dimethylphenol	mg/kg	0.046	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	1,3-Dichlorobenzene	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	1,4-Dichlorobenzene	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	1-Methylnapthalene	mg/kg	0.044	J		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	2-Methylnaphthalene	mg/kg	0.05			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	2-Methylphenol	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	4-Methylphenol	mg/kg	0.034	J		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Acenaphthene	mg/kg	0.069			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Acenaphthylene	mg/kg	0.55			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Anthracene	mg/kg	0.48			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Arsenic	mg/kg	20	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzo(b)fluoranthene	mg/kg	2.4			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzo(k)fluoranthene	mg/kg	2			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzoic Acid	mg/kg	0.46	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Benzyl Alcohol	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.048			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Butylbenzylphthalate	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Cadmium	mg/kg	1.2			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Chromium	mg/kg	34			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Copper	mg/kg	36.3			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Dibenzofuran	mg/kg	0.068			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Diesel	mg/kg	72			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Diethylphthalate	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Dimethylphthalate	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Di-n-Butylphthalate	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Di-n-Octyl phthalate	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Fluorene	mg/kg	0.099			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Hexachloroethane	mg/kg	0.046	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Lead	mg/kg	44			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Mercury	mg/kg	0.3			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Motor Oil	mg/kg	140			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Naphthalene	mg/kg	0.16			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Pentachlorophenol	mg/kg	0.23	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Phenanthrene	mg/kg	0.67			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Phenol	mg/kg	0.052			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Pyrene	mg/kg	2.5			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Silver	mg/kg	1	U		
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Total Organic Carbon	%	23.9			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Total Solids	%	20.9			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Zinc	mg/kg	86			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Total LPAH	mg/kg	2.028			
BLVD-SC-02	BLVD-SC-02-2-4'	2	4 ft	Total HPAH	mg/kg	19.3		Exceeds 2LAET	17
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzo(a)anthracene	mg/kg	1.7		Exceeds 2LAET	1.6
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzo(g,h,i)perylene	mg/kg	1.1		Exceeds 2LAET	0.72
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzofluoranthenes	mg/kg	3.8		Exceeds 2LAET	3.6
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.2		Exceeds 2LAET	0.69
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Mercury	mg/kg	2		Exceeds 2LAET	0.59
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	1,2,4-Trichlorobenzene	mg/kg	0.039	U	Exceeds LAET	0.031
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	1,2-Dichlorobenzene	mg/kg	0.039	U	Exceeds LAET	0.035
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzo(a)pyrene	mg/kg	2.3		Exceeds LAET	1.6
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Chrysene	mg/kg	1.8		Exceeds LAET	1.4
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Dibenz(a,h)anthracene	mg/kg	0.4		Exceeds LAET	0.23
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Fluoranthene	mg/kg	2		Exceeds LAET	1.7
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Hexachlorobenzene	mg/kg	0.039	U	Exceeds LAET	0.022
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Hexachlorobutadiene	mg/kg	0.039	U	Exceeds LAET	0.011
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	N-Nitrosodiphenylamine	mg/kg	0.039	U	Exceeds LAET	0.028
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	2,4-Dimethylphenol	mg/kg	0.039	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	1,3-Dichlorobenzene	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	1,4-Dichlorobenzene	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	1-Methylnapthalene	mg/kg	0.032	J		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	2-Methylnaphthalene	mg/kg	0.037	J		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	2-Methylphenol	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	4-Methylphenol	mg/kg	0.047			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Acenaphthene	mg/kg	0.06			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Acenaphthylene	mg/kg	0.56			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Anthracene	mg/kg	0.26			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Arsenic	mg/kg	10	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzo(b)fluoranthene	mg/kg	2			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzo(k)fluoranthene	mg/kg	1.8			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzoic Acid	mg/kg	0.39	UJ		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Benzyl Alcohol	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.055			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Butylbenzylphthalate	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Cadmium	mg/kg	1.2			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Chromium	mg/kg	73			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Copper	mg/kg	57.8			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Dibenzofuran	mg/kg	0.053			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Diesel	mg/kg	80			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Diethylphthalate	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Dimethylphthalate	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Di-n-Butylphthalate	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Di-n-Octyl phthalate	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Fluorene	mg/kg	0.054			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Hexachloroethane	mg/kg	0.039	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Lead	mg/kg	65			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Motor Oil	mg/kg	130			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Naphthalene	mg/kg	0.11			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Pentachlorophenol	mg/kg	0.2	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Phenanthrene	mg/kg	0.37			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Phenol	mg/kg	0.03	J		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Pyrene	mg/kg	2			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Silver	mg/kg	0.7	U		
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Total Organic Carbon	%	5.98			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Total Solids	%	44.8			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Zinc	mg/kg	135			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Total LPAH	mg/kg	1.414			
BLVD-SC-02	BLVD-SC-02-6-8'	6	8 ft	Total HPAH	mg/kg	16.3		Exceeds LAET	12
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Mercury	mg/kg	0.7		Exceeds 2LAET	0.59
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Arsenic	mg/kg	10	U		
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Cadmium	mg/kg	1.1			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Chromium	mg/kg	57			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Copper	mg/kg	54.4			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Diesel	mg/kg	74			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Lead	mg/kg	43			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Motor Oil	mg/kg	92			
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Silver	mg/kg	0.8	U		
BLVD-SC-03	BLVD-SC-03-4-6'	4	6 ft	Zinc	mg/kg	95			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Arsenic	mg/kg	10	U		
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Cadmium	mg/kg	1.3			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Chromium	mg/kg	69			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Copper	mg/kg	57.1			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Diesel	mg/kg	52			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Lead	mg/kg	78			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Mercury	mg/kg	0.4			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Motor Oil	mg/kg	65			
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Silver	mg/kg	0.8	U		

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-03	BLVD-SC-03-6-8'	6	8 ft	Zinc	mg/kg	340			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	1,2,4-Trichlorobenzene	mg/kg	0.06	U	Exceeds 2LAET	0.051
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	1,2-Dichlorobenzene	mg/kg	0.06	U	Exceeds 2LAET	0.05
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Fluoranthene	mg/kg	4.1		Exceeds 2LAET	2.5
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Indeno(1,2,3-cd)pyrene	mg/kg	0.73		Exceeds 2LAET	0.69
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	N-Nitrosodiphenylamine	mg/kg	0.06	U	Exceeds 2LAET	0.04
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzo(a)anthracene	mg/kg	1.6		Exceeds LAET	1.3
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzo(a)pyrene	mg/kg	2.7		Exceeds LAET	1.6
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzofluoranthenes	mg/kg	3.6		Exceeds LAET	3.2
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzyl Alcohol	mg/kg	0.06	U	Exceeds LAET	0.057
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Chrysene	mg/kg	1.7		Exceeds LAET	1.4
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Dibenz(a,h)anthracene	mg/kg	0.26		Exceeds LAET	0.23
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Hexachlorobenzene	mg/kg	0.06	U	Exceeds LAET	0.022
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Hexachlorobutadiene	mg/kg	0.06	U	Exceeds LAET	0.011
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	2,4-Dimethylphenol	mg/kg	0.06	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	1,3-Dichlorobenzene	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	1,4-Dichlorobenzene	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	1-Methylnapthalene	mg/kg	0.068			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	2-Methylnaphthalene	mg/kg	0.076			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	2-Methylphenol	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	4-Methylphenol	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Acenaphthene	mg/kg	0.066			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Acenaphthylene	mg/kg	0.42			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Anthracene	mg/kg	0.58			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Arsenic	mg/kg	20	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzo(b)fluoranthene	mg/kg	1.8			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzo(g,h,i)perylene	mg/kg	0.66			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzo(k)fluoranthene	mg/kg	1.8			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Benzoic Acid	mg/kg	0.6	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.035	J		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Butylbenzylphthalate	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Cadmium	mg/kg	1.1			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Chromium	mg/kg	44			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Copper	mg/kg	66.3			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Dibenzofuran	mg/kg	0.039	J		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Diesel	mg/kg	130			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Diethylphthalate	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Dimethylphthalate	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Di-n-Butylphthalate	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Di-n-Octyl phthalate	mg/kg	0.06	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Fluorene	mg/kg	0.1			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Hexachloroethane	mg/kg	0.06	U		

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Lead	mg/kg	25			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Mercury	mg/kg	0.2			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Motor Oil	mg/kg	210			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Naphthalene	mg/kg	0.15			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Pentachlorophenol	mg/kg	0.3	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Phenanthrene	mg/kg	0.33			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Phenol	mg/kg	0.24			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Pyrene	mg/kg	2.3			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Silver	mg/kg	1	U		
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Total Organic Carbon	%	17.7			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Total Solids	%	21.5			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Zinc	mg/kg	88			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Total LPAH	mg/kg	1.646			
BLVD-SC-04	BLVD-SC-04-0-2'	0	2 ft	Total HPAH	mg/kg	17.65		Exceeds 2LAET	17
BLVD-SC-04	BLVD-SC-04-10-10.5'	10	10.5 ft	Dry Density	lb/ft3	29			
BLVD-SC-04	BLVD-SC-04-10-10.5'	10	10.5 ft	Moisture Content	%	164.1			
BLVD-SC-04	BLVD-SC-04-10-10.5'	10	10.5 ft	Wet Density	lb/ft3	76.5			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzo(a)anthracene	mg/kg	3.4		Exceeds 2LAET	1.6
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzo(a)pyrene	mg/kg	4.5		Exceeds 2LAET	3
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzo(g,h,i)perylene	mg/kg	1.4		Exceeds 2LAET	0.72
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzofluoranthenes	mg/kg	6.9		Exceeds 2LAET	3.6
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Chrysene	mg/kg	3.9		Exceeds 2LAET	2.8
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Fluoranthene	mg/kg	8.7		Exceeds 2LAET	2.5
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.1		Exceeds 2LAET	0.69
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Pyrene	mg/kg	6		Exceeds 2LAET	3.3
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	1,2,4-Trichlorobenzene	mg/kg	0.04	U	Exceeds LAET	0.031
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	1,2-Dichlorobenzene	mg/kg	0.04	U	Exceeds LAET	0.035
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Anthracene	mg/kg	1.4		Exceeds LAET	0.96
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Dibenz(a,h)anthracene	mg/kg	0.46		Exceeds LAET	0.23
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Hexachlorobenzene	mg/kg	0.04	U	Exceeds LAET	0.022
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Hexachlorobutadiene	mg/kg	0.04	U	Exceeds LAET	0.011
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	N-Nitrosodiphenylamine	mg/kg	0.04	U	Exceeds LAET	0.028
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	2,4-Dimethylphenol	mg/kg	0.037	J	Exceeds LAET & 2LAET	0.029
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	1,3-Dichlorobenzene	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	1,4-Dichlorobenzene	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	1-Methylnapthalene	mg/kg	0.11			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	2-Methylnaphthalene	mg/kg	0.098			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	2-Methylphenol	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	4-Methylphenol	mg/kg	0.067			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Acenaphthene	mg/kg	0.21			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Acenaphthylene	mg/kg	0.84			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzo(b)fluoranthene	mg/kg	2.6			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzo(k)fluoranthene	mg/kg	4.3			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzoic Acid	mg/kg	0.4	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Benzyl Alcohol	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.13			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Butylbenzylphthalate	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Dibenzofuran	mg/kg	0.12			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Diethylphthalate	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Dimethylphthalate	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Di-n-Butylphthalate	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Di-n-Octyl phthalate	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Fluorene	mg/kg	0.32			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Hexachloroethane	mg/kg	0.04	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Naphthalene	mg/kg	0.25			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Pentachlorophenol	mg/kg	0.2	U		
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Phenanthrene	mg/kg	0.38			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Phenol	mg/kg	0.047			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Total Organic Carbon	%	6.88			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Total Solids	%	32.3			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Total LPAH	mg/kg	3.4			
BLVD-SC-04	BLVD-SC-04-2-4'	2	4 ft	Total HPAH	mg/kg	36.36		Exceeds 2LAET	17
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	1,2,4-Trichlorobenzene	mg/kg	0.12	U	Exceeds 2LAET	0.051
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	1,2-Dichlorobenzene	mg/kg	0.12	U	Exceeds 2LAET	0.05
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzo(a)anthracene	mg/kg	6.2		Exceeds 2LAET	1.6
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzo(a)pyrene	mg/kg	6.8		Exceeds 2LAET	3
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzo(g,h,i)perylene	mg/kg	1.8		Exceeds 2LAET	0.72
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzofluoranthenes	mg/kg	10.5		Exceeds 2LAET	3.6
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzyl Alcohol	mg/kg	0.12	U	Exceeds 2LAET	0.073
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Chrysene	mg/kg	5.8		Exceeds 2LAET	2.8
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Dibenz(a,h)anthracene	mg/kg	0.59		Exceeds 2LAET	0.54
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Fluoranthene	mg/kg	14		Exceeds 2LAET	2.5
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Hexachlorobenzene	mg/kg	0.12	U	Exceeds 2LAET	0.07
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Indeno(1,2,3-cd)pyrene	mg/kg	2		Exceeds 2LAET	0.69
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	N-Nitrosodiphenylamine	mg/kg	0.12	U	Exceeds 2LAET	0.04
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Pyrene	mg/kg	12		Exceeds 2LAET	3.3
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	1,4-Dichlorobenzene	mg/kg	0.12	U	Exceeds LAET	0.11
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Anthracene	mg/kg	2.3		Exceeds LAET	0.96
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Butylbenzylphthalate	mg/kg	0.12	U	Exceeds LAET	0.063
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Dimethylphthalate	mg/kg	0.12	U	Exceeds LAET	0.071
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Hexachlorobutadiene	mg/kg	0.12	U	Exceeds LAET	0.011
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Pentachlorophenol	mg/kg	0.6	U	Exceeds LAET	0.36
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	2,4-Dimethylphenol	mg/kg	0.12	U	Exceeds LAET & 2LAET	0.029
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	2-Methylphenol	mg/kg	0.12	U	Exceeds LAET & 2LAET	0.063

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Acenaphthylene	mg/kg	1.5		Exceeds LAET & 2LAET	1.3
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzoic Acid	mg/kg	1.2	U	Exceeds LAET & 2LAET	0.65
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	1,3-Dichlorobenzene	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	1-Methylnapthalene	mg/kg	0.15			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	2-Methylnaphthalene	mg/kg	0.16			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	4-Methylphenol	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Acenaphthene	mg/kg	0.3			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzo(b)fluoranthene	mg/kg	4.9			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Benzo(k)fluoranthene	mg/kg	5.6			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	bis(2-Ethylhexyl)phthalate	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Dibenzofuran	mg/kg	0.18			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Diethylphthalate	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Di-n-Butylphthalate	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Di-n-Octyl phthalate	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Fluorene	mg/kg	0.22			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Hexachloroethane	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Naphthalene	mg/kg	0.44			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Phenanthrene	mg/kg	1.5			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Phenol	mg/kg	0.12	U		
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Total Organic Carbon	%	8.83			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Total Solids	%	31.2			
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Total LPAH	mg/kg	6.26		Exceeds LAET	5.2
BLVD-SC-04	BLVD-SC-04-4-6'	4	6 ft	Total HPAH	mg/kg	59.69		Exceeds 2LAET	17
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Arsenic	mg/kg	10	U		
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Cadmium	mg/kg	1.7			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Chromium	mg/kg	53			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Clay	%	50.3			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Copper	mg/kg	61.1			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Diesel	mg/kg	60			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Gravel	%	3.5			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Lead	mg/kg	49			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Liquid Limit	%	89.4			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Mercury	mg/kg	0.36			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Moisture Content	%	160.8			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Motor Oil	mg/kg	84			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Plastic Limit	%	67.4			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Plasticity Index	%	22			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Sand	%	17.8			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Silt	%	28.5			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Silver	mg/kg	0.8	U		
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Specific Gravity	Std Units	2.4			
BLVD-SC-04	BLVD-SC-04-8-10'	8	10 ft	Zinc	mg/kg	109			

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth			Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Arsenic	mg/kg	7			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Cadmium	mg/kg	0.8			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Chromium	mg/kg	16.3			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Clay	%	14.5			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Copper	mg/kg	9.4			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Diesel	mg/kg	6.8	U		
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Gravel	%	0.7			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Lead	mg/kg	3	U		
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Mercury	mg/kg	0.05	U		
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Moisture Content	%	35.52			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Motor Oil	mg/kg	14	U		
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Sand	%	76.3			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Silt	%	8.4			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Silver	mg/kg	0.4	U		
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Specific Gravity	Std Units	2.68			
BLVD-SC-05	BLVD-SC-05-10.5-12'	10.5	12	ft	Zinc	mg/kg	27			
BLVD-SC-05	BLVD-SC-05-10-10.5'	10	10.5	ft	Dry Density	lb/ft3	76.6			
BLVD-SC-05	BLVD-SC-05-10-10.5'	10	10.5	ft	Moisture Content	%	43.78			
BLVD-SC-05	BLVD-SC-05-10-10.5'	10	10.5	ft	Wet Density	lb/ft3	110.1			
BLVD-SC-05	BLVD-SC-05-13.5-14'	13.5	14	ft	Clay	%	12.1			
BLVD-SC-05	BLVD-SC-05-13.5-14'	13.5	14	ft	Gravel	%	23.8			
BLVD-SC-05	BLVD-SC-05-13.5-14'	13.5	14	ft	Sand	%	58.9			
BLVD-SC-05	BLVD-SC-05-13.5-14'	13.5	14	ft	Silt	%	5.3			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Arsenic	mg/kg	10	U		
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Cadmium	mg/kg	1.6			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Chromium	mg/kg	59			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Copper	mg/kg	56.3			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Diesel	mg/kg	79			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Lead	mg/kg	30			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Mercury	mg/kg	0.35			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Motor Oil	mg/kg	99			
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Silver	mg/kg	0.7	U		
BLVD-SC-05	BLVD-SC-05-6-8'	6	8	ft	Zinc	mg/kg	109			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Arsenic	mg/kg	10			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Cadmium	mg/kg	1.1			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Chromium	mg/kg	45.1			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Copper	mg/kg	32.2			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Diesel	mg/kg	12			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Lead	mg/kg	8			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Mercury	mg/kg	0.1			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Motor Oil	mg/kg	20			
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5	ft	Silver	mg/kg	0.5	U		

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
BLVD-SC-05	BLVD-SC-05-8-9.5'	8	9.5 ft	Zinc	mg/kg	67			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Clay	%	28.4			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Gravel	%	0.9			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Liquid Limit	%	45.3			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Moisture Content	%	60.32			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Plastic Limit	%	23.8			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Plasticity Index	%	21.5			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Sand	%	51.6			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Silt	%	18.9			
BLVD-SC-05	BLVD-SC-05-9.5-10'	9.5	10 ft	Specific Gravity	Std Units	2.67			
SB-7	SB-7	1	2 ft	Acenaphthene	mg/kg	1.5	U	Exceeds 2LAET	0.73
SB-7	SB-7	1	2 ft	Benzo(a)anthracene	mg/kg	2.1		Exceeds 2LAET	1.6
SB-7	SB-7	1	2 ft	Benzo(g,h,i)perylene	mg/kg	1.5	U	Exceeds 2LAET	0.72
SB-7	SB-7	1	2 ft	Dibenzofuran	mg/kg	1.5	U	Exceeds 2LAET	0.7
SB-7	SB-7	1	2 ft	Fluoranthene	mg/kg	3.5		Exceeds 2LAET	2.5
SB-7	SB-7	1	2 ft	Fluorene	mg/kg	1.5	U	Exceeds 2LAET	1
SB-7	SB-7	1	2 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.5	U	Exceeds 2LAET	0.69
SB-7	SB-7	1	2 ft	Pyrene	mg/kg	4.6		Exceeds 2LAET	3.3
SB-7	SB-7	1	2 ft	Anthracene	mg/kg	1.5	U	Exceeds LAET	0.96
SB-7	SB-7	1	2 ft	Benzo(a)pyrene	mg/kg	2.1		Exceeds LAET	1.6
SB-7	SB-7	1	2 ft	Chrysene	mg/kg	2.8		Exceeds LAET	1.4
SB-7	SB-7	1	2 ft	Phenanthrene	mg/kg	2.6		Exceeds LAET	1.5
SB-7	SB-7	1	2 ft	Acenaphthylene	mg/kg	1.5	U	Exceeds LAET & 2LAET	1.3
SB-7	SB-7	1	2 ft	Acetone	mg/kg	0.08	U		
SB-7	SB-7	1	2 ft	Benzo(b)fluoranthene	mg/kg	1.5	U		
SB-7	SB-7	1	2 ft	Benzo(k)fluoranthene	mg/kg	2			
SB-7	SB-7	1	2 ft	Benzofluoranthenes	mg/kg	2			
SB-7	SB-7	1	2 ft	Naphthalene	mg/kg	1.9			
SB-7	SB-7	1	2 ft	Total LPAH	mg/kg	4.5			
SB-7	SB-7	1	2 ft	Total HPAH	mg/kg	17.1		Exceeds 2LAET	17
SB-8	SB-8	1	2 ft	Acenaphthene	mg/kg	1.5	U	Exceeds 2LAET	0.73
SB-8	SB-8	1	2 ft	Benzo(a)anthracene	mg/kg	5.5		Exceeds 2LAET	1.6
SB-8	SB-8	1	2 ft	Benzo(a)pyrene	mg/kg	5.3		Exceeds 2LAET	3
SB-8	SB-8	1	2 ft	Benzo(g,h,i)perylene	mg/kg	2.9		Exceeds 2LAET	0.72
SB-8	SB-8	1	2 ft	Benzofluoranthenes	mg/kg	9.6		Exceeds 2LAET	3.6
SB-8	SB-8	1	2 ft	Chrysene	mg/kg	6.8		Exceeds 2LAET	2.8
SB-8	SB-8	1	2 ft	Dibenzofuran	mg/kg	1.5	U	Exceeds 2LAET	0.7
SB-8	SB-8	1	2 ft	Fluoranthene	mg/kg	8.7		Exceeds 2LAET	2.5
SB-8	SB-8	1	2 ft	Fluorene	mg/kg	1.5	U	Exceeds 2LAET	1
SB-8	SB-8	1	2 ft	Indeno(1,2,3-cd)pyrene	mg/kg	3.2		Exceeds 2LAET	0.69
SB-8	SB-8	1	2 ft	Pyrene	mg/kg	9.7		Exceeds 2LAET	3.3
SB-8	SB-8	1	2 ft	Anthracene	mg/kg	2.2		Exceeds LAET	0.96

Table A-4. Subsurface Sediment Samples and Comparison to Screening Levels

Location	Sample Location	Sample Depth		Parameter	Units	Result	Q	AET screen	AET Threshold (mg/kg)
SB-8	SB-8	1	2 ft	Phenanthrene	mg/kg	2.7		Exceeds LAET	1.5
SB-8	SB-8	1	2 ft	Acenaphthylene	mg/kg	1.5	U	Exceeds LAET & 2LAET	1.3
SB-8	SB-8	1	2 ft	Acetone	mg/kg	0.05	U		
SB-8	SB-8	1	2 ft	Benzo(b)fluoranthene	mg/kg	4.6			
SB-8	SB-8	1	2 ft	Benzo(k)fluoranthene	mg/kg	5			
SB-8	SB-8	1	2 ft	Naphthalene	mg/kg	1.6			
SB-8	SB-8	1	2 ft	Total LPAH	mg/kg	6.5		Exceeds LAET	5.2
SB-8	SB-8	1	2 ft	Total HPAH	mg/kg	51.7		Exceeds 2LAET	17
SB-9	SB-9	1	2 ft	Acenaphthene	mg/kg	1.5	U	Exceeds 2LAET	0.73
SB-9	SB-9	1	2 ft	Benzo(g,h,i)perylene	mg/kg	1.5	U	Exceeds 2LAET	0.72
SB-9	SB-9	1	2 ft	Dibenzofuran	mg/kg	1.5	U	Exceeds 2LAET	0.7
SB-9	SB-9	1	2 ft	Fluorene	mg/kg	1.5	U	Exceeds 2LAET	1
SB-9	SB-9	1	2 ft	Indeno(1,2,3-cd)pyrene	mg/kg	1.5	U	Exceeds 2LAET	0.69
SB-9	SB-9	1	2 ft	Anthracene	mg/kg	1.5	U	Exceeds LAET	0.96
SB-9	SB-9	1	2 ft	Benzo(a)anthracene	mg/kg	1.5	U	Exceeds LAET	1.3
SB-9	SB-9	1	2 ft	Chrysene	mg/kg	1.5	U	Exceeds LAET	1.4
SB-9	SB-9	1	2 ft	Acenaphthylene	mg/kg	1.5	U	Exceeds LAET & 2LAET	1.3
SB-9	SB-9	1	2 ft	Acetone	mg/kg	0.05	U		
SB-9	SB-9	1	2 ft	Benzo(a)pyrene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Benzo(b)fluoranthene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Benzo(k)fluoranthene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Benzofluoranthenes	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Fluoranthene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Naphthalene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Phenanthrene	mg/kg	1.5	U		
SB-9	SB-9	1	2 ft	Pyrene	mg/kg	2.2			
SB-9	SB-9	1	2 ft	Total LPAH	mg/kg	1.5			
SB-9	SB-9	1	2 ft	Total HPAH	mg/kg	2.2			

APPENDIX B
SAMPLING AND ANALYSIS PLAN

South State Street Manufactured Gas Plant
Remedial Investigation/Feasibility Study

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August 6, 2010

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ACRONYMS AND ABBREVIATIONS

AET	Apparent Effects Threshold
ARI	Analytical Resources, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BAP	benzo(a)pyrene
bgs	below ground surface
BNA	Base Neutral Acid
BNSF	Burlington Northern Santa Fe Railway Corporation
BTEX	benzene, toluene, ethylbenzene, xylenes
BTX	benzene, toluene, xylenes
City	City of Bellingham
CLARC	Cleanup Levels and Risk Calculations
Cm	centimeter
COPCs	constituents of potential concern
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CSL	cleanup screening level
DAHP	Department of Archaeology and Historic Preservation
DQOs	data quality objectives
Dx	Diesel-range and Oil-range organic hydrocarbons
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
FCR	field change record
GRO	gas-range hydrocarbons
HASP	Health and Safety Plan
Herrenkohl	Herrenkohl Consulting LLC
LAET	lowest apparent effect threshold
2LAET	second lowest apparent effect threshold
Landau Associates	Landau Associates, Inc.

MADEP	Massachusetts Department of Environmental Protection
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
mg/kg OC	milligrams per kilogram normalized to organic carbon
mg/L	milligrams per liter
MGP	manufactured gas plant
MLLW	mean lower low water
MTBE	methyl tert-butyl ether
MTCA	Model Toxics Control Act
NAD	North American Datum
NAPL	nonaqueous phase liquid
NAVD	North American Vertical Datum
NWTPH	Northwest Total Petroleum Hydrocarbons
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons-Diesel, -Oil
NWTPH-GRO	Northwest Total Petroleum Hydrocarbons-Gasoline
PAHs	Polycyclic aromatic hydrocarbons
Park	Boulevard Park
PCBs	polychlorinated biphenyls
PSE	Puget Sound Energy
PSEP	Puget Sound Estuary Program
PVOCs	petroleum volatile organic compounds
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
SAP	sampling and analysis plan
SIM	Selective Ion Monitoring
SL	screening level
SMS	Washington State Sediment Management Standards
SQS	sediment quality standard
SSSMGP	South State Street Manufactured Gas Plant
SVOCs	semivolatile organic compounds
TOC	total organic carbon

TPH	total petroleum hydrocarbons
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
VPH	volatile petroleum hydrocarbons
VOCs	volatile organic compounds
WAC	Washington Administrative Code
WAD	weak acid dissociable
WDNR	Washington State Department of Natural Resources
WDFW	Washington State Department of Fish and Wildlife
WISHA	Washington Industrial Safety and Health Act
WQC	water quality criteria

1 INTRODUCTION

This document is the sampling and analysis plan (SAP) for the remedial investigation and feasibility study (RI/FS) of the South State Street Manufactured Gas Plant (SSSMGP) Site located in Bellingham, Washington (Figure B-1). This SAP provides specific guidance for field methodology and quality assurance procedures that will be followed by Herrenkohl Consulting LLC (Herrenkohl Consulting), Landau Associates, Inc. (Landau Associates), and subcontractors. Herrenkohl Consulting and Landau Associates are conducting this work under contract No. 2008-011C with the City of Bellingham, Parks and Recreation Department (City), with direction from the Washington State Department of Ecology (Ecology) Toxics Cleanup Program. This SAP has been prepared in accordance with an Agreed Order and Statement of Work (SOW) negotiated between the City, Puget Sound Energy (PSE), and Ecology and signed April 30, 2010 (Document No. 7655), and was developed to meet the requirements of an RI/FS as defined by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation [Washington Administrative Code (WAC) 173-340-350].

This SAP has been prepared for RI sampling and analysis activities in general accordance with WAC 173-340-820, WAC 173-204-600, and the Sediment Sampling and Analysis Appendix, as updated (Ecology 2008a).

Several documents are cited repeatedly and accompany this SAP. Altogether, these documents are referred to as the Work Plans for the SSSMGP Site RI/FS:

- ***Work Plan*** for the RI/FS of the SSSMGP Site Bellingham, Washington. The Work Plan provides information on existing data for the SSSMGP Site and the sampling strategy and design to meet the data needs and project objectives for completing the RI/FS. The Work Plan also describes the project management strategy for implementing and reporting RI/FS activities for the Site, including project team responsibilities and schedule.
- ***Quality Assurance Project Plan*** (Appendix C of the Work Plan) for the RI/FS of the SSSMGP Site, Bellingham, Washington. The QAPP describes analytical method reporting limit goals, field and laboratory quality assurance/quality control (QA/QC) requirements and reporting requirements for the RI/FS for the Site.
- ***Project Health and Safety Plan*** (Appendix D of the Work Plan) for the RI/FS of the SSSMGP Site, Bellingham, Washington. The HASP has been prepared in accordance with WAC 173-340-810, applicable Washington Industrial Safety and Health Act (WISHA) regulations, and project requirements. It addresses those activities associated with work to be performed at the Site. The project HASP is not reviewed by Ecology.

Section 2 of this SAP provides the field methods for Site preparation, sample collection and handling methods. Sample identification is described in Section 3 followed by guidelines for sample handling and storage in Section 4. Section 5 presents the procedures for field documentation. Decontamination procedures and management of investigation-derived wastes are presented in Sections 6 and 7, respectively. References are presented in Section 8.

Referenced figures and tables are presented at the end of each section. Attachment A contains field forms.

1.1 PROJECT DESCRIPTION AND BACKGROUND

The SSSMGP Site is located in Bellingham, Washington in the general vicinity of Bayview Drive and South State Street (Figure B-1). The Site is situated on the northern portion of a City-managed park (Boulevard Park) and includes nearshore uplands and adjacent aquatic lands located in Bellingham Bay. The preliminary Site boundary is shown on Figure B-1[1]. Uplands include a portion of the upper and lower public park areas, which were first developed into a park by the City from the late 1970s to the mid 1980's. Also included within the preliminary Site boundary are approximately 2 acres of aquatic lands adjacent to and outside of the Inner Harbor line and managed by the Washington State Department of Natural Resources (WDNR). The Site is also intersected by active railroad tracks owned and managed by Burlington Northern Santa Fe Railway (BNSF).

From approximately 1890 to the late 1940's, a coal gasification plant operated on the upper portion of the Site. The facility manufactured gas from coal, supplying residents and local businesses of Bellingham with gas for heating, cooking, and lighting. The gas plant consisted of above-ground gas holder tanks, fuel oil tanks, a retort and purifying facility, tar wells and separator, a coal shed and a coke shed used for storage. Of the original gas plant structures, a concrete above-ground gas holder tank foundation (gas holder #1), a small brick electrical utility building, remnants of concrete foundations and underground piping remain in the upper Site area. The coal gasification plant was originally operated by the Bellingham Bay Gas Company, a predecessor of PSE. Cascade Natural Gas and Bellingham Gas Company, a predecessor of Cascade Natural Gas Corporation, also owned and/or operated the property for some time beginning in the late 1940's. Eventually, residential developers purchased the property in the 1960s. In 1975, the City acquired ownership of the majority of the gas plant property from a private owner and Burlington Northern Railroad Company (Griffin 2007). Boulevard Park was dedicated by the City for public use in June 1980.

Between 1984 and 2009, a number of investigations [U.S. Environmental Protection Agency (EPA) 1984, E&E 1991, Erickson and Cubbage 1998, Norton and Summers 1998, Integral 2007, Herrenkohl and Landau Associates 2009, Hart Crowser 2009] detected the presence of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) (benzene, toluene, and xylene) in surface water, soil, and sediment at the Site. In 1991, Ecology conducted a Site Hazard Assessment (SHA) and placed the Site (then referred to as the Boulevard Park Site) on the Hazardous Sites List. The Site's hazard ranking, an estimation of the potential threat to human health and/or the environment relative to other Washington State sites assessed at that time, was determined to be a 1, where 1 represents the highest relative risk and 5 the lowest.

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[1] The preliminary Site boundary was negotiated between the City, PSE, and Ecology based on current available data and is subject to change as additional data is collected for the RI.

In January 2004, the Boulevard Park Site was excluded by EPA from the "eligible response site" list under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) because of its preliminary hazard ranking score in their database (EPA 2004). Ecology concurred with EPA's decision, taking over jurisdiction of the Site (Ecology 2004a).

On August 12, 2005, Ecology notified the City of potential liability for the Site and designated the City as a "Potential Liable Party" (PLP) under MTCA (Chapter 173-340 WAC) (Ecology 2005). Without admitting any liability, the City, accepted its PLP status in an August 22, 2005 response letter (City of Bellingham 2005). On March 31, 2008, the City made a formal request to Ecology to initiate negotiations for an Agreed Order to complete an RI/FS for the Site (City of Bellingham 2008). In that letter to Ecology, the City also asked Ecology to designate PSE, and BNSF as additional PLPs for the Boulevard Park Site. On December 31, 2008, Ecology notified PSE of potential liability for the Site and designated PSE as a PLP (Ecology 2008b). Without admitting any liability, PSE accepted its PLP status in a January 7, 2009 response letter (PSE 2009). After public notice and opportunity to comment, an Agreed Order for completing an RI/FS was signed between the City, PSE, and Ecology on April 30, 2010 (Document No. 7655). Under the terms of the Agreed Order, the City and PSE will conduct an RI/FS at the Site, with Ecology oversight.

1.2 RI/FS OBECTIVES AND SCOPE

The primary objectives of the Site RI/FS are to provide critical data necessary to understand the nature and extent of contamination at the site, to characterize the fate and transport of identified contaminants, to assess potential risk to human health and the environment, and to evaluate and determine if cleanup actions are required. These objectives will be met by sampling surface water, groundwater, soil, soil vapor, and sediments and evaluating the results in concert with other existing data. Other major project objectives are provided in Section 1.3 of the accompanying Work Plan.

The proposed sampling locations for soil and groundwater are shown on Figure B-2. Tables B-1 and B-2 present the proposed soil sampling locations and testing for the lower and upper portions of the Site, respectively. Table B-3 presents the proposed groundwater sampling locations and testing for the Site. Surface water and sediment sampling locations are shown on Figure B-3. Table B-4 presents the proposed surface water sampling locations and testing followed by Table B-5 which presents the proposed sediment sampling locations and testing for the Site. Tables and figures are presented at the end of Section 2. Additional information on the analytical methods and laboratory QA/QC and reporting requirements are presented in the accompanying QAPP (Appendix C of the Work Plan).

1.3 HEALTH AND SAFETY

General health and safety provisions to protect workers from potential hazards during field activities described in this SAP are presented in the accompanying HASP (Appendix D of the Work Plan). Ecology does not approve health and safety plans.

The HASP applies to the employees of Herrenkohl Consulting, Landau Associates and subcontractors while conducting the following field activities at the site:

- Groundwater sampling
- Surface water sampling
- Surface sediment sampling
- Hand auger soil borings
- Hollow-stem auger soil and sediment borings
- Groundwater monitoring well installation
- Direct-push soil borings
- Soil vapor sampling.

A copy of the HASP will be with the field crew during field activities. All individuals performing fieldwork must read, understand, and comply with this plan before undertaking field activities. Once the information has been read and understood, the individual must sign the Acknowledgment Form provided, which becomes part of the project file.

The HASP may be modified at any time based on the judgment of the site safety and health officer in consultation with the project manager. Any modification will be presented to the onsite team during a safety briefing and will be recorded in the field notebook.

2 FIELD INVESTIGATION METHODS

This section presents the field sampling methods to be used by Herrenkohl Consulting, Landau Associates, and their subcontractors for the SSSMGP Site investigation. In general, field and sample processing methods will follow WAC 173-340-820, WAC 173-204-600, the Sediment Sampling and Analysis Appendix (Ecology 2008a), and Puget Sound Estuary Program (PSEP) guidelines for marine sediments and surface waters (PSEP 1986, 1995, 1997a,b,c, 1998).

2.1 SITE PREPARATION

Proposed sampling stations in the upland portions of the Site will first be located using a backpack Trimble Global Positioning System (GPS) with an accuracy of approximately ±3 m. A clearly marked stake will be driven into the ground for each location. Prior to commencing intrusive field activities, a utility location survey will be conducted using the regional One-Call service (1-800-424-5555) to locate and identify all known underground utilities near the study area. In addition, the City's Park Maintenance and Operations Department will locate any known utilities that are not covered by the One-Call Service including wastewater lines, irrigation systems, and electrical lines (from the meters out). If utility lines interfere with proposed sample locations, alternate locations will be identified and marked before sampling begins.

A private locating company will be used to identify, if possible, the location of underground pipes and drains associated with the previous MGP operations. The surface location and depth of the pipes/drains will be marked by the locating company before sampling begins. Sampling locations may be moved or added to provide additional information on the potential impacts of the pipes/drains to surrounding soils and groundwater.

A tide staff will be installed on one of the pier pilings or wharf located near the proposed sediment sampling stations. The tide staff will be calibrated to the vertical datum of mean lower low water (MLLW) by a professional land surveyor.

Herrenkohl Consulting, Landau Associates, and their subcontractors have been given approval by the City to access Park property for sampling operations in support of the Site RI/FS. This may include the establishment of sample processing stations and storage of drilling and other field equipment and supplies on site as needed during the field investigation. Permits are currently pending for access approval for WDNR and BNSF managed property within the Site (refer to Section 6.5 in the Work Plan). Approval is expected before sampling operations begin in August-September 2010.

2.2 HORIZONTAL AND VERTICAL CONTROL METHODS

Once sampling has been completed for the upland portion of the Site, sampling stations and other site features (e.g., locations of pipes/drains) will be located by a professional land surveyor using conventional Total Station positioning methods and RTX GPS. Survey control stations established previously within the Park will be utilized to maintain system accuracy. Northing and easting coordinates will be provided in both North American Datum 1927 (NAD 27) and NAD 1983 (NAD 83) with recent corrections and an accuracy of 0.1 ft. The City currently uses the NAD 27 horizontal datum for its projects but Ecology uses NAD 83 with recent corrections. Using control points established by the professional land surveyor, the elevation of each upland sample station (ground surface) will be determined by differential leveling. Station elevations will be referenced to the geodetic North American Vertical Datum of 1988 (NAVD 88) and the City of Bellingham coordinate system with an accuracy of 0.01 ft. Both the top of monitoring well casing elevation and ground surface elevation adjacent to the monitoring well will be measured by the surveyors.

Station positioning and the locations of each sediment station will be determined onboard the sampling vessel using differential GPS (DGPS) with an accuracy of about ±3 m (PSEP 1998). Station coordinates (NAD83 with recent corrections) along with water depth will be documented for each sampling location on field log forms. The water depth in feet will be converted to an elevation (MLLW) based on visual measurements taken from the tide staff during sampling.

2.3 SOIL INVESTIGATION

The soil investigation will consist of collecting soil samples from 54 proposed locations presented on Figure B-2. Except on steeply sloped areas, soil borings will be used to collect soil samples for chemical analyses, to characterize site lithology, and to install groundwater monitoring wells. Hand implements such as hand augers and shovels will be used to collect soil samples on steeply sloped areas. Soil borehole drilling and soil sample collection methods and laboratory analyses to be used during the RI are described below.

2.3.1 Soil Borings

Boreholes for collecting soil samples will be drilled using a limited access, track-mounted Geoprobe® direct-push drilling rig[2]. Because there is a possibility for residual MGP wastes to be present as dense non-aqueous phase liquid (DNAPL), which could potentially migrate downward to a confining layer such as the sandstone bedrock located below Site soil, each soil boring will extend to bedrock to the extent practicable. Based on documentation from previous soil explorations, depth to bedrock in the lower portion of the Site likely ranges from 10 to 25 ft below ground surface (bgs) and from 1 to 20 ft bgs in the upper portion of the Site. All soil borings will be completed by a licensed driller and under the supervision of a geologist licensed in the State of Washington. Soil will be described in accordance with the Unified Soil Classification System (USCS) (ASTM D2487) using the visual-manual procedures for describing soils (ASTM D2488).

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[2] If the limited access, direct-push rig cannot obtain soil samples because of refusal (e.g., fill materials) a limited access hollow-stem auger rig will be used to obtain samples at depth. The hollow-stem auger rig will also be used to install groundwater monitoring wells (see Section 2.4.1).

Before drilling equipment is first used at the Site, between drilling each station location, and at the completion of drilling activities, all down-hole drilling equipment will be cleaned using a high-pressure hot water or steam washer as described in Section 6.0.

2.3.1.1 Soil Sample Collection Procedures

Continuous soil samples will be collected to the full extent of each boring to describe the soil lithology, and identify the potential presence of contamination, if any. A closed-piston sampling device with a 48-inch long, 1.5-inch inside-diameter (ID) core sampler will be used to collect the soil samples. The sampler will be advanced to the top of the sample interval with the piston in a locked position. The piston tip will then be loosened and the sampler will be advanced over the desired depth interval, thereby coring the soil inside the sampler's disposable, single-use liner. The sampler will then be withdrawn to retrieve the liner and soil sample. After the liner is cut to remove the soil sample, a new liner will be placed in the core sampler and this process will be repeated until the total borehole depth has been reached.

After the liner is cut, the soil type will be evaluated by the field geologist and recorded on a Log of Exploration form (Attachment A). The soil column retained in the sample liner will be field-screened for evidence of contamination, as described in Section 2.3.3. Soil samples collected for analysis of gasoline-range petroleum hydrocarbons by Method NWTPH-Gx and for analysis of VOCs will be collected in accordance with EPA Method 5035A. Soil samples to be submitted for chemical analysis of constituents other than VOCs and gasoline-range petroleum hydrocarbons will be placed into decontaminated stainless-steel bowls and homogenized until the sample is of uniform color and texture using a decontaminated stainless-steel spoon prior to being placed into laboratory-supplied containers.

2.3.1.2 Sample Depth Intervals

Because the depth to bedrock varies greatly across the Site, the number of soil samples and the depth intervals identified for sample collection will largely be dependant on the boring location. However, in general, the following sampling strategy will be used to characterize the subsurface soil vertically across the Site:

- At locations where no evidence of contamination is observed based on field screening [visual, odor, and/or photoionization detector (PID) measurements], three soil samples will be collected for analysis:
    1. One sample will be collected from the upper 2 ft of soil.
    2. A second sample will be collected from a 1-ft depth interval between 2 and 6 ft bgs to evaluate contaminant concentrations (such as metals that cannot be screened for in the field) above the MTCA conditional point-of-compliance for terrestrial ecological receptors (6 ft bgs).
    3. A third sample will be collected from a 1-ft depth interval between 10 to 15 bgs to characterize soil above the MTCA human health point-of-compliance for direct contact (15 ft bgs).

- At locations where evidence of contamination is observed based on field screening, one soil sample will be collected and analyzed from the zone of contamination and another soil sample will be collected from a depth interval below the zone of contamination (based on screening evidence) to define the vertical extent of contamination. These soil samples may be in addition to the soil sample collected within the upper 2 ft of soil, but may replace the soil samples to be collected at deeper intervals as described above for those explorations where no evidence of contamination is observed.

2.3.2 Hand Auger Explorations

A hand auger will be used to collect soil samples along the slope separating the upper and lower portions of the Site. Because depth to bedrock is expected to be 2 ft or less along the slope, only one depth interval will be collected at each location. This depth interval will extend from the soil surface to bedrock. Soil samples collected for analysis of gasoline-range petroleum hydrocarbons by Method NWTPH-Gx and for analysis of VOCs will be collected in accordance with EPA Method 5035A. Soil samples to be submitted for chemical analysis of constituents other than VOCs and gasoline-range petroleum hydrocarbons will be placed into decontaminated stainless-steel bowls and homogenized until the sample is of uniform color and texture using a decontaminated stainless-steel spoon prior to being placed into laboratory-supplied containers.

2.3.3 Field Screening

Field screening will be conducted during the soil investigation to identify potential zones of contamination. The field screening will consist of visual observations, sheen testing, and headspace screening. Visual screening will consist of inspecting the soil for the presence of stains indicative of residual petroleum hydrocarbons and coal tar. Sheen testing will involve immersion of a portion of the soil sample in water and observing the water surface for signs of petroleum sheen. Headspace screening will involve the semi-quantitative measurement of total volatile compounds in the air above the sample material using a PID.

2.3.4 Laboratory Analyses

Soil samples will be analyzed for the constituents of potential concern (COPCs) that may be present at MGP sites as identified in the Work Plan. These consist of PAHs, phenols, VOCs (e.g., BTEX), cyanide, metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, silver, selenium, and zinc), petroleum hydrocarbons (gasoline-range, diesel-range, and heavy oil-range), and polychlorinated biphenyls (PCBs). Not all samples will be analyzed for each of these COPCs as explained below and as summarized in Tables B-1 and B-2 located at the end of this section.

- All selected soil samples will be analyzed for PAHs. Additionally, at least 20% of the samples will be analyzed for the full list of semivolatile organic compounds (SVOCs) to evaluate the presence of phenols.

- A minimum of 20% of the soil samples will be analyzed for VOCs and gasoline-range petroleum hydrocarbons. These will include soil samples collected from the former fuel tank areas and soil samples collected from other locations where the results from headspace screening are 10 parts per million (ppm) above background levels.
- A minimum of 20% of the soil samples will be analyzed for diesel and motor oil-range petroleum hydrocarbons. These will include soil samples collected in the former fuel tank areas and where field observations (visual and olfactory) indicate the potential presence of these compounds.

There are different laboratory methods for analysis for petroleum hydrocarbons. The NWTPH methods provide one result with broad coverage of both aliphatic and aromatic gasoline-range organic components and diesel-range and motor oil-range organics. The petroleum mixture can also be fractionated into smaller carbon chain ranges, treating aliphatics and aromatics separately, to provide more comprehensive information on the composition of the mixture (e.g., comparing to standards for coal tar/creosote). Fractionation data are necessary to calculate site-specific petroleum cleanup levels, rather than relying on default cleanup levels for petroleum mixtures. Gasoline-range petroleum hydrocarbons can be fractionated using the volatile petroleum hydrocarbons (VPH) analysis. Diesel-range and residual-range (motor oil and heavier oils) petroleum hydrocarbons can be fractionated using the extractable petroleum hydrocarbons (EPH) analysis. Selected soil samples will be analyzed initially using the NWTPH methods. Only those soil samples that yield detected concentrations above the Site screening levels (100 mg/kg and 200 mg/kg) using NWTPH methods will be considered for fractionation analyses. In some cases, not all of the samples with detected concentrations above the screening levels will be submitted for fractionation. Best professional judgment through consultation between parties will be used based on the number of samples with detected concentrations above the screening levels in an area and an understanding of the historical land uses or practices at each sample location.

Physical testing (index parameters) will also be conducted using selected subsurface soil samples. Locations and sample depths will be determined in the field but will at a minimum include soil samples collected from the saturated zone. Physical testing will include grain size analysis on up to 14 soil samples and Atterburg limits, specific gravity, and moisture content/bulk density on up to 7 soil samples.

Proposed chemical analysis and physical testing to be conducted for the soil investigation are summarized in Tables B-1 and B-2. Chemical analytical and physical testing methods and the associated reporting limit goals are summarized in Table C-2 of the QAPP.

2.4 GROUNDWATER INVESTIGATION

The groundwater investigation will consist of installing 14 shallow groundwater monitoring wells (MGP-MW-1 through MGP-MW-14), collecting and analyzing groundwater samples from each well, measuring groundwater elevations, and evaluating the groundwater hydraulic conductivity and tidal influence on groundwater flow. Proposed monitoring well locations are shown on Figure B-2. Locations may change based on conditions observed in subsurface soils during drilling activities.

The procedures described previously in Section 2.3 regarding logging of soil samples for lithology, locating drilling locations, and conducting a utility locate also apply to drilling conducted for the groundwater investigation.

2.4.1 Monitoring Well Installation and Construction

The 14 new monitoring wells will be installed within the shallow groundwater zone. Boreholes for groundwater monitoring wells will be advanced using a limited access, tack-mounted hollow-stem auger drilling rig. Prefabricated 2-inch-outside diameter wells will be installed in the borings. The monitoring wells will be constructed with 2-inch diameter, flush-threaded, Schedule 40 PVC pipe and 5-ft screens with 0.020-inch machine slotted casing and filter pack material consisting of pre-washed, pre-sized number 20/40 silica sand. The filter pack will be placed from the bottom of the well to approximately 2 ft above the top of the screen. Filter pack material will be placed slowly and carefully to avoid bridging of material. A bentonite seal will be placed above the filter sand pack material to within about 3 ft of ground surface. Grout will be used to backfill the boring to the subgrade for placement of the protective cover. The wells will be completed with flush-mounted protective casings.

The well names and the identification numbers assigned by Ecology will be marked on the well identification tags supplied by Ecology and will be attached to each well casing following well installation.

Monitoring wells will be constructed by a drilling contractor licensed in the State of Washington in accordance with the Minimum Standards for Construction and Maintenance of Wells (WAC 173-160; Ecology 2006). Oversight of drilling and well installation activities will be supervised by a licensed geologist familiar with environmental sampling and construction of resource protection wells.

2.4.2 Monitoring Well Development

The monitoring wells will be developed after construction to remove formation material from the well borehole and the filter pack prior to groundwater level measurement and sampling. Development will be achieved by repeatedly surging the well with a surge block and purging the well until the water runs clear. A minimum of 5 well casing volumes will be purged. During development, the purged groundwater will be monitored for the following field parameters:

- pH
- Conductivity
- Temperature
- Turbidity.

The wells will be developed until the turbidity of the purged groundwater decreases to 5 Nephelometric turbidity units (NTUs), if practicable. If the well dewaters during the initial surging and purging effort, one final well casing volume will be removed after the well has fully recharged, if practicable. Well development activities will be recorded on a Well Development form (Attachment A).

2.4.3 Groundwater Sampling

Groundwater samples will be collected from each of the monitoring wells once during the dry season (July through October) and once during the rainy season (October to April). During each event, groundwater samples from monitoring wells located in the lower portion of the Site will be collected within 1 hour before and 1 hour after a low tide so that samples will represent groundwater discharging from the Site that may be minimally influenced by marine surface water. Collection of groundwater samples will be completed at each monitoring well using the following procedures:

- Immediately following removal of each well monument cover, the well head will be observed for damage, leakage, and staining. Additionally, immediately following removal of the well head cap, any odors emanating from the well will be recorded and the condition of the well opening will be observed. Any damage, leakage, or staining to the well head or well opening will be recorded.
- Prior to sampling, each well will be purged using a pump that is attached to dedicated purge and sample collection Teflon-coated tubing (types of pumps used may vary depending on purge volume and depth and may include a centrifugal pump, a peristaltic pump, or an electric submersible pump). During each sampling event, the intake end of the tubing will be slowly and carefully lowered into place at the center or slightly above the center of the well screen interval to minimize excessive mixing of stagnant water in the casing. Purging will begin with a small pumping rate. The rate will be adjusted upward slowly to minimize drawdown (with a target drawdown of less than 0.33 ft) during purging.
- Field parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity, will be continuously monitored during purging using a flow cell meter. Purging of the well will be considered to be complete when all field parameters become stable for three successive readings. The successive readings should be within +/- 0.1 pH units, +/- 3% for conductivity, and +/- 10% for dissolved oxygen and turbidity.
- Purge data will be recorded on a Groundwater Sample Collection form including purge volume (Attachment A); time of commencement and termination of purging; any observations regarding color, turbidity, or other factors that may have been important in evaluation of sample quality; and field measurements of pH, specific conductance, temperature, dissolved oxygen, and turbidity.
- Following the stabilization of field parameters, the flow cell meter will be disconnected and groundwater samples will be collected. Sample data will be recorded on a Groundwater Sample Collection form, including sample number and time collected; the

observed physical characteristics of the sample (e.g., color, turbidity, etc.); and field parameters (pH, specific conductance, temperature, and turbidity).

- Four replicate field measurements of temperature, pH, specific conductance, dissolved oxygen, and turbidity will be obtained using the following procedures:
    - A 250-mL plastic beaker will be rinsed with deionized water followed by sample water.
    - The electrodes and temperature compensation probe will be rinsed with deionized water followed by sample water.
    - The beaker will be filled with sample water; the probes will be placed in the beaker until the readings are stabilized. Temperature, pH, specific conductance, dissolved oxygen, and turbidity measurements will be recorded on the Groundwater Sample Collection form.
    - The above step will be repeated to collect remaining replicates.
- Any problems or significant observations will be noted in the “comments” section of the Groundwater Sample Collection form (Attachment A).
- Groundwater samples will be collected into the appropriate sample containers using a peristaltic pump. To prevent degassing during sampling for VOCs, a pumping rate will be maintained below about 100 ml/min. The VOC containers will be filled completely so that no head space remains. Samples will be chilled to 4°C immediately after collecting the sample. Clean gloves will be worn when collecting each sample.
- Groundwater for dissolved metals analyses will be collected last and field filtered through a 0.45 micron, in-line disposable filter. Dissolved metal samples will be preserved, as specified in Section 4.0. A note will be made on the sample label, sample collection form, and chain-of-custody (COC) to indicate the sample has been field filtered and preserved, including the type of preservative used.
- Groundwater samples will be submitted to the laboratory for analysis as described in the following section.

2.4.4 Laboratory Analyses

Each groundwater sample will be analyzed for the COPCs described in the Work Plan, except PCBs. These COPCs include SVOCs, VOCs, cyanide, metals (antimony, arsenic, barium cadmium, chromium, copper, lead, mercury, silver, selenium, and zinc), and petroleum hydrocarbons (gasoline-range, diesel-range, and heavy oil-range). Groundwater samples will be collected and analyzed for PCBs if PCBs are detected in soil samples at concentrations exceeding the PCB soil screening level based on protection of groundwater. Groundwater samples will be analyzed for both total and dissolved metals. Also, groundwater samples in the lower portion of the Site will be analyzed for total dissolved solids (TDS) during the first groundwater monitoring event to evaluate the suitability of groundwater in this portion of the Site as a potable water source. Proposed analysis for groundwater samples are summarized in

Table B-3 at the end of this section. Chemical analytical and physical testing methods and the associated reporting limit goals are summarized in Table C-2 of the QAPP.

2.4.5 Water Level Monitoring

Water levels will be monitored by measuring depth-to-water at each of the new wells prior to sample collection. Water level measurements will be obtained at each monitoring well prior to purging and sample collection. All water levels will be measured from a surveyed reference point on the top of the well casing using an electronic water level indicator and recorded to the nearest 0.01 ft on a field data sheet.

2.4.6 Groundwater Tidal Impacts Evaluation

To evaluate the tidal influence on groundwater flow, water levels in three of the nine monitoring wells located in the lower portion of the Site (possibly MW-07, -11, and -12) and in Bellingham Bay will be recorded using a combination of pressure transducers with internal dataloggers and an electronic water level indicator. The data collection will include continuous (every 15 minutes) transducer-based water level measurements in wells and in the bay. The datalogger will be programmed to automatically convert pressure changes to water levels. If possible, a vented transducer will be used that internally corrects for fluctuations in atmospheric pressure.

Procedures for conducting the 48-hour tidal study are summarized below:

1. At each monitoring well, a pressure transducer will be lowered into the well and securely fastened to the top of the well casing for the duration of the monitoring period. A transducer will also be lowered into the bay from a secured location.

2. The transducers will be set to record the height of the water column above the transducer at 15-minute intervals.

3. Pressure transducers will be rated to a minimum 15 pounds per square inch range capable of measuring a water level change of 23 ft with a resolution of 0.01 ft.

4. Depth to water will also be measured from the top of the well casing to the nearest 0.01 ft with a manual electronic water level indicator. Depth-to-water level will be manually measured a minimum of four times during the monitoring period.

5. At the end of the monitoring period, the pressure transducers will be removed and the water level data will be uploaded to a computer.

Similar procedures will be used to monitor surface water levels in the bay.

2.4.7 Hydraulic Conductivity Evaluation

Hydraulic conductivity for groundwater in the lower portion of the Site will be estimated from water elevation data collected during the tidal study using a technique for estimating transmissivity in tidally-influenced aquifers. Transmissivity using this technique is computed from the following equation (Ferris 1951):

$$T = (x^2 S t_0)/(4\pi t_1^2)$$

where:

$T =$ transmissivity (L^2/t)

$S =$ storativity (dimensionless)

$x =$ distance from well to subaqueous outcrop (L)

$t_0 =$ time between tidal maxima or minima in Bellingham Bay (t)

$t_1 =$ time lag between the occurrence of the maxima or minima in Bellingham Bay and in the monitoring well (t).

2.5 SURFACE WATER INVESTIGATION

Surface water will be collected from each stormwater outfall (MGP-SW-01 and -02) using either a portable peristaltic pump equipped with Teflon-lined tubing or direct filling of sample bottles. Two rounds of surface water samples will be collected from the outfalls, once during the wet season and once during a storm event in the dry season. The dry season sample will be collected between July and October. The wet season sample will be collected between November and June.

Surface water samples will be collected utilizing the following procedure:

- Immediately before collecting the sample, record the temperature, dissolved oxygen, pH, turbidity, and specific conductance using a water quality meter and following the manufacturer's specifications.

- Direct the mouth of the sampling bottle under the flow of the water and collect a sample. VOC samples will be collected first.

- A peristaltic pump can also be used if available and appropriate. The Teflon-lined tube should be placed in the middle of the exiting water stream at the mouth of the outfall.

- Preserve containers as follows:

    - VOCs – Laboratory will provide preservative with (hydrochloric acid) in sample bottles. The bottles should be filled until a meniscus is observed at the mouth of bottle. Care should be taken not to overfill bottle. Check the bottle for the presence of trapped air by tapping the bottle when filled and capped.

    - Other Parameters – Laboratory will provide preservatives as necessary. Fill required bottles.

- Complete sample logs, labels, custody seals, and chain of custody forms. Record sample information in the field notebook.

- Place the analytical samples in a cooler for shipment and chill to 4°±2° C.

- Decontaminate sampling equipment in accordance with Section 6.

Surface water samples collected from the stormwater outfalls will be analyzed for hardness, total suspended solids (TSS), TOC, metals (including calcium and magnesium), SVOCs, and diesel-range, motor oil-range, and gasoline-range petroleum hydrocarbons, as summarized in Table B-4 at the end of this section. Analytical and testing methods and the associated reporting limit goals are summarized in Table C-2 of the QAPP.

2.6 SEDIMENT INVESTIGATION

Surface sediment samples (0-12 cm) will be collected from the following six Site locations and reference location(s) (Figure B-3):

- MGP-SS-01
- MGP-SS-02
- MGP-SS-04
- MGP-SS-06
- MGP-SS-08
- MGP-SS-12
- Reference location(s) planned for Samish Bay.

After surface samples have been collected, sediment borings will be collected at 12 stations (MGP-SC-01 to MGP-SC-12), at the locations shown on Figure B-3.

2.6.1 Surface Sediment Sampling

Sediment samples for chemical and toxicity testing will be collected using either a 0.1 m^2 van Veen or Young van Veen grab sampler. A hydraulic winch system will be used to deploy the sampler at a rate not exceeding 1 m/sec to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, the jaws will be slowly closed by retrieving the slack on the winch line and then the sampler will be brought to the deck of the vessel at a rate not exceeding 1 m/sec to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, the time, depth and location of sample acquisition will be recorded in the field sampling log.

Once onboard, the sampler will be secured, any overlying water will be carefully siphoned off, and the sample will be inspected to determine acceptability. Criteria used to determine acceptability are those detailed in PSEP (1997a). These criteria include but are not limited to:

- minimal or no excessive water leakage from the jaws of the sampler;
- no excessive turbidity in the water overlying the sample;
- the sampler is not over-filled with sediment;
- the sediment surface appears to be intact with minimal disturbance; and
- the penetration depth is sufficient (12 cm for Bellingham Bay; dependent on grain size).

If the sample meets acceptability criteria, the sample will be recorded and observations of the sediment physical characteristics and field screening results (e.g. PID readings) will be entered into a sample description form or log. If after multiple sampling attempts a surface sample does not meet acceptability criteria (e.g., over-penetration), the sample will still be collected but the sampler will document the reasons for not meeting criteria on the field sampling form and a Field Change Request (FCR) form (refer to Section 5.4).

Once the sample has been characterized/described following PSEP (1997a) and the visual-manual procedures for describing soils (ASTM D2487/2488), the sediment will then be sub-sampled for chemical analysis and bioassay testing. Sediment for chemical and/or toxicity analyses will be removed from the sampler using a stainless steel spoon. To prevent possible cross contamination, sediments touching the margins of the sampler will not be used.

Samples for volatile compounds (either organics or sulfides) will be collected directly into the pre-cleaned sample container provided by the laboratory while sediment is still in the sampler using a decontaminated stainless steel spoon. The volatile organics sample jar should be tightly packed with sediment (to eliminate obvious air pockets) and filled so that there is no head-space remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample will be preserved with 2 Normal zinc acetate provided by the laboratory.

The remaining sediment will then be placed into a pre-cleaned stainless steel container or bowl for compositing. Typically, sediment from a minimum of three separate casts of the sampler will be composited at each station (less may be required when using a double van Veen grab sampler). Once a sufficient amount of material has been collected, the sediment will be homogenized to obtain a smooth consistency based on color and texture. The composited sediment then will be dispensed into pre-cleaned sample jars provided by the laboratory for the various chemical/biological analyses, and will be placed into coolers with ice (4 ± 2^{o} C) until they are transported to the laboratory. A portion of each sample will be preserved and retained for possible future analyses.

2.6.2 Sediment Borings

A variety of sampling techniques are available for collection of marine sediment subsurface samples. Some of these include: auger drilling with split-spoon sampler or Gregory Undisturbed Sampler (GUS) with Shelby tubes, piston coring, impact coring, vibracoring, diver operated push-coring, and hand auger coring at low tide. Hollow stem auger drilling is the selected method of subsurface sediment sampling for the SSSMGP Site because of the coarse-grained nature of sediments within the nearshore area of the Site and desire to drill to the underlying bedrock. Sediment borings will be drilled using a bolt-connected hollow stem auger (4.5 in diameter) advanced with a truck mounted drill rig positioned on either a barge or landing craft.

Sampling equipment will be mobilized and the drill will be positioned on the barge by the drilling contractor. The drilling contractor will also be responsible for all drilling equipment and drill rig coring operations. The field operations manager will direct, coordinate, and assist the drillers when needed.

The barge will be maneuvered directly to the sampling locations using DGPS onboard the vessel. Anchors will be set on the sediment bottom and/or onshore, and/or ropes will be tied to the existing pilings and pier to securely hold the barge on station. The intent is to securely position the barge on station with the least amount of sediment disturbance and impact to local eelgrass beds. The water depth will then be measured with a lead line or onboard fathometer in order to determine the amount of auger necessary to reach the sediment surface. The measurement will be recorded in the field log. The auger will be lowered through the “moon pool” of the barge until it rests upright on the sediment surface. The length of the auger used to reach the sediment surface will also be recorded in the field log.

A stainless steel, 3-inch diameter, 2-ft long split-spoon sampler or GUS/2-ft long Shelby tube sampler will be attached to the drill rod, and the first sediment sample will be collected from the station. If a split-spoon is used, the sampler will be driven two feet into the sediments using either a 140- or 300-pound hammer. The number of blows from the hammer (blow counts) for each 6 inches driven will be recorded in the field log following the standard penetration test (SPT) ASTM D1586 modified[3]. A Shelby tube will be either hydraulically or pneumatically (with nitrogen gas) driven into the sediment.

In order to advance the auger to the next desired depth in which a split-spoon or Shelby tube is then driven, the tidal changes in water level must be taken into account. The water depth will be measured and recorded to determine the water level change, and adjust the distance the auger must be advanced, accordingly. For example, if the water level increases by 0.5 feet, then the auger must be advanced an additional 0.5 feet to compensate for the increase in water level.

A field log book will be kept by the field operations manager or designee and will be used to record at least the following information and observations:

- Date

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[3] SPT conversion will be used for oversized samplers.

- Location
- Weather
- Drilling company
- Drill crew names and phone numbers
- Start and stop time of all drilling activities including:
- Mobilization
- Drilling/reaming/augering
- Sampling
- Backfilling
- Drill rig decontamination
- Any other relevant events
- Footage for the above activities
- Relevant information such as heave and blow counts
- Type and quantity of drilling equipment (especially auger flights and drill stems)
- Condition of drilling equipment
- Problems causing delays during drilling activities
- Photos

Repeat the steps described above until all samples from a borehole are collected.

Once the sampling has been completed at a sediment location, the sampler and rod will be removed from the auger. The auger will be backfilled with bentonite chips to help prevent migration of contaminated materials to the surface. As the auger is removed from the sediment, the filler material will be poured or pumped through tremie pipe into the auger. The auger, drilling rods, and samplers will be decontaminated using procedures described in Section 6.

Sediment Processing

Visual, sheen, and headspace screening will be conducted in the field on all sediment samples collected during this investigation. Compositing will only be performed within individual locations to ensure that adequate sediment is available for the required analyses[4]. Split-spoon and Shelby tube samples not used for analysis will be managed in accordance with applicable investigation-derived waste requirements as described in Section 7.1.

Split-spoon samples will be processed according to the following step-by-step procedure:

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[4] Compositing and homogenizing is not appropriate for the analysis of volatile organics. Discrete samples will be collected only for analysis of volatile organics in sediments.

1. Describe sediments following PSEP (1997a), USCS (ASTM D2487), and the visual-manual method (ASTM D2488).
2. Transfer the sediment section from split-spoon to a clean stainless steel bowl and cover with aluminum foil.
3. Stir the composite sample (non-VOC samples) until the sample is of uniform color and texture. If any material (e.g., shells, rocks) has to be removed from the sample, note it in the field logbook or on the sample description sheet.
4. Fill jars for physical, chemical, and biological analyses.
5. After sample information is written on the bottle label it should be wrapped with clear tape.
6. Seal each glass container in a plastic bag in case of breakage. Place in ice chest and pack samples to minimize the chances of breaking. Keep samples at 4^{o}±2^{o} C until delivery to laboratory.
7. Decontaminate the equipment as described in Section 6.
8. Collect excess sediment from the composite and dispose of as investigation derived waste, as discussed in Section 7.1.

Shelby tube samples will be processed according to the following:

1. Once the core is brought on board, remove it from the rod, and immediately cap and tape both ends. It is preferable to put a layer of foil on each end prior to capping. Label the core with station, sampling depth interval, time of collection, and core orientation (top of core).

2. Place the core in an upright box or stand with ice until it is processed. Cover the cores in the holding box with a tarp to prevent sample contamination from airborne particles (e.g., vessel engine gases) and to keep them out of direct sunlight.

3. The Shelby tube cores may be processed on the barge, onshore near the site, or at storage/laboratory facility. During transit, the tubes must remain upright and cool.

4. When prepared to process a core, remove the cap from the upper end of the core (holes present where the core is attached to the sampler and rod). Place the core horizontally in the extruder core holder, so that open end is toward the extruder. Secure the core in the holder and remove the other cap at the bottom of the core. Place an appropriate sized plug wrapped in foil into the top end of the core, insert the extruder rod and screw, and wind the plug until if touches the top end of the sediment. A tray wrapped in aluminum foil should be placed at the bottom end of the core, and a person wearing nitrile or polyethylene gloves should be present to catch and guide the core as it is extruded. Use a drill or ratchet (depending on how stiff the core is) to wind the screw, pushing the core from the Shelby tube. If the core is particularly stiff, it may be necessary to hit the side of the core tube with a rubber hammer or other device while winding the extruder.

Alternatively, if the core is particularly soft, the core may be readily extruded by simply pushing the plug with a rod by hand.

5. If required, immediately pass the probe of an organic vapor monitoring device (PID) down the length of the sample to detect organic vapors emanating from the sample. Record the readings in the sediment coring log sheet or the field log. Also, test for oily sheen by taking a representative portion of the sample and placing it in a jar with water. Record information on boring log and field notebook.

6. Follow the steps for describing the sediments, compositing, filling bottles, and transport as presented for split-spoon samples above.

2.6.3 Laboratory Analysis

Surface sediment samples will be analyzed using a tiered approach. First, each sediment sample will be analyzed for the following (refer to Table B-5):

- Conventional parameters including ammonia, total sulfides, TOC, total solids, and grain size
- SMS metals including arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc
- SVOCs.

In addition, a representative sample from each location will be archived for possible future analysis (e.g., dioxins/furans). Based on the chemical results of the surface sediment samples, toxicity testing will be performed at those locations where concentrations exceed sediment quality standard screening levels (SQS SLs). The proposed tests are:

- Acute Amphipod (*Eohaustorius estuarius*) 10-day mortality test (Ecology 2008a)
- Acute Larval (*Mytilus galloprovincialis*) development test (Ecology 2008a)
- Chronic Juvenile Polychaete (*Neanthes arenaceodentata*) 20-day mortality and growth test (Ecology 2008a).

Sediment for toxicity testing may be stored in the dark for a maximum of up to 8 weeks. Sample bottles will be stored either with no headspace or headspace purged with nitrogen gas (refer to Table B-6).

Selected subsurface sediment samples from each boring will be analyzed for the following:

- TOC
- SMS metals including arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc
- PAHs.

Additionally, at least 20% of the samples will be analyzed for the full SVOC list to evaluate the presence of phenols.

Four samples from each sediment boring will be analyzed from the list above (refer to Table B-5). Physical testing (index parameters) will also be analyzed for selected subsurface sediment samples (locations and sample depths to-be-determined in the field). In addition, a representative sample from all depths will be archived for possible future analysis (e.g., dioxins/furans).

Analytical and testing methods and the associated reporting limit goals are summarized in Table C-3 of the QAPP.

2.7 SOIL VAPOR INVESTIGATION

The soil vapor investigation will consist of collecting soil vapor samples from up to six locations (to-be-determined) at the Site. Soil vapor analysis results will be used to evaluate the potential risks of volatile COPCs in indoor air to human health.

2.7.1 Soil Vapor Sampling

Vapor monitoring will be conducted using a direct push probe and post-run tubing (PRT) tooling setup. This setup allows polyethylene tubing to be inserted through the bottom of the rod and sealed once the rod has been driven to the appropriate sampling depth. The tubing can then be directly connected to the purge and sampling devices with minimal potential for rod leakage and reduction of the dead volume that must be purged prior to sampling. The specific sampling procedures include:

- The probe rod will be driven to a depth of no more than 5 ft bgs to ensure that the sample depth is above the measured groundwater elevation which has been observed to approximately 5 to 7 ft bgs.
- Dedicated vapor sampling tubing (polyethylene) and a PRT adapter will be inserted into the rod bore and connected to the point holder.
- The rod will be pulled back 2 ft (the sample interval will be from 3 ft to 5 ft bgs), leaving the expendable point at the bottom of the bore hole.
- A surface seal of hydrated bentonite will be placed around the top of the drill rods at the soil surface and leak checked by the driller to prevent intrusion of atmospheric air.
- If using a hand pump, the sampling end of the tubing will be fitted with a valve to prevent atmospheric air from re-entering the tubing. The valve will be in the closed position. If using a peristaltic pump, Masterflex® tubing will be connected to the end of sampling tube and threaded through the peristaltic pump. The pump will be clamped and placed in the off position.

- If using a valve, the valve will be opened or the peristaltic pump will be turned on and purged continuously for 5 to 10 minutes. Near the end of purging, a PID will be used to "sniff" the air from the tubing to determine if high levels of vapors are present.
- If using a valve, the valve will be closed prior to ceasing the purge, or the pump will be turned off and the tubing left in the clamped position to prevent backflow of air into the tubing.
- An individually certified Summa canister connected to a critical orifice assembly (COA) will be attached to tubing using an air tight swage-loc.
- The valve on the tubing will be opened first or the peristaltic pump clamp will be released, and then the flow control device on the canister will be opened immediately. Each canister holds 6 L and will take approximately 15 minutes to fill based on the pre-set flow rate of the attached COA. Initial canister vacuum pressures will range from 28 to 29 inches of mercury (Hg) and samples will be collected until the pressure is reduced to approximately 5 inches Hg or less.
- The canister will be closed first, and then disconnected from the tubing. An identification label will be affixed to the canister with a zip-tie, the sample will be recorded on the chain-of-custody, and the sample canister will be placed back into the cardboard shipping container.

At the end of the field day or the following business day, samples and equipment will be packed and shipped to Columbia Analytical Services, Inc. located in Simi Valley, California for analysis.

2.7.2 Laboratory Analysis

Soil vapor samples will be analyzed using EPA Method TO-15 for the following analytes: 1,3-butadiene; 1,3,5-trimethylbenzene; 1,2,4-trimethylbenzene and using the Massachusetts Department of Environmental Protection (MADEP) APH Method for the analysis of Methyl tert-Butyl Ether (MTBE), BETX, naphthalene, C5-C8 aliphatic hydrocarbons (C5-C8); C9-C12 aliphatic hydrocarbons (C9-C12); and C9-C10 aromatic hydrocarbons (C9-C10). The MADEP AHP Method quantifies the total concentrations of aliphatic and aromatic hydrocarbons in air within these ranges. The MADEP APH method is based on EPA Method TO-14, which (similar to TO-15) employs passive stainless steel vacuum canisters for sample collection, followed by gas chromatography/mass spectrometry to identify and quantify analytes.

Chemical analytical methods and the associated reporting limit goals are summarized in Table C-4 of the QAPP.

2.8 CULTURAL RESOURCE PROCEDURES

As stated in Sections 3.7 and 5.5 of the Work Plan, cultural resource information strongly suggests there are no prehistoric archeological deposits within the preliminary site boundary. The site has been disturbed over the past 100 or more years from construction and operation activities associated with the MGP, railroad, lumber mill, and park. However, to address the unlikely possibility of encountering cultural artifacts, the following procedures will be implemented during all field activities:

- Soils and sediments in the borings will be logged by a geologist, with attention paid to looking for evidence of non-soil materials;
- If apparent archaeological artifacts are encountered, work will stop and the field/project manager will contact City and PSE project representatives;
- City/PSE representatives will notify Ecology, the Department of Archaeology and Historic Preservation (DAHP), the Lummi Nation, and Nooksack Tribe, and will invite the parties to attend an onsite inspection with a professional archaeologist contracted by the City/PSE. The archaeologist will document the discovery in a report submitted to DAHP so that they may control access to information regarding potential sensitive-site locations, in accordance with Chapter 27.53 RCW; the report will be referenced, but not included in the Site RI/FS report.
- In the event of an inadvertent discovery of potential human remains, work will be immediately halted in the discovery area, and the apparent remains will be covered and secured against further disturbance. The City Police Department and Whatcom County Medical Examiner would be immediately contacted, along with DAHP and authorized Tribal representatives. A treatment plan would be developed by a professional archaeologist in accordance with applicable state law.

Table B-1. Proposed Soil Sampling and Analysis for Lower Portion and Sloped Areas of Site

Location Description	Number of Explorations	Sample Depth Interval[1] (ft bgs)	Metals[2]	Dx[3]	PAHs[4]	VOCs and GRO[5]	Cyanide[6]	Physical Testing[7]
Adjacent to test pits TP-3 and TP-10	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
East and West of TP-10	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Downgradient of TP-3	1	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
North, south, east, and west of COB-BLVD-02	4	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Base of slope separating upper and lower portions of Site	6	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Proposed monitoring well locations	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**	TBD	TBD
Slope locations[8]	8	0 to 1	✓	*	✓	**	TBD	TBD
Total Exploration/ Maximum Samples Per Analysis	25		59	Minimum of 11	59	Minimum of 11	TBD	TBD

✓ Indicates samples will be analyzed.
TBD – To-be-determined in the field.
*Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for NWTPH-Dx (~11 samples)
**Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for VOCs and gasoline-range petroleum hydrocarbons (~11 samples).

[1] The first soil sample will be a discrete 3-in to 6-in sample from the upper 2 ft of soil (0 to 2 ft bgs), the second sample will be a 1-ft composite collected between 4 and 6 ft bgs, and the third sample will be a 1-ft composite collected between 10 and 15 ft bgs. Only the upper 2 ft of soil will be collected from locations proposed for the slope area.

[2] Metals include antimony, arsenic, cadmium, barium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7471)

[3] Diesel-range and motor oil-range petroleum hydrocarbons will be analyzed by Ecology method NWTPH-Dx. Selected samples may also be analyzed for EPH.

[4] PAHs will be analyzed using EPA Method 8270D SIM. A minimum of 20% of the samples will be analyzed for the full SVOC list (~11 samples).

[5] VOCs will be analyzed using EPA Method 8260B and gasoline-range petroleum hydrocarbons will be analyzed by Ecology Method NWTPH-Gx. Selected samples may also be analyzed for VPH.

[6] Both total and WAD cyanide will be analyzed (EPA Method 335.4 and Standard Method 4500CNI). Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[7] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 14 samples for grain size and 7 samples for the other tests) will be determined in the field.

[8] Additional slope locations on either side of the walkway (from upper to lower park) may be sampled pending access to this area.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, PAHs, SVOCs, and cyanide). No field blank samples will be collected for this study. Archive samples will be collected and preserved (frozen) for all sample depths for possible future analysis.

Table B-2. Proposed Soil Sampling and Analysis for Upper Portion of Site

Location Description	Number of Explorations	Sample Depth Interval[1] (ft bgs)	Metals[2]	Dx[3]	PAHs[4]	VOCs and GRO[5]	Cyanide[6]	PCBs[7]	Physical Testing[8]
Footprints of former gas holder tanks	7	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Valve house between former tanks	1	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Adjacent to previous exploration B-5 and tar/water separator	1	0-2 4 to 6 10 to 15	✓	*	✓	**			TBD
Footprints of former fuel/oil tanks	2	0 to 2 4 to 6 10 to 15	✓	✓	✓	**			TBD
Footprint of former processing facility	5	0 to 2 4 to 6 10 to 15	✓	*	✓	**	✓		TBD
Electrical/Generator House	4	0 to 2	✓	*	✓	**		✓	TBD
Proposed Additional Monitoring Well Locations MW-02, -04	2	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Miscellaneous Areas for Confirmation	7	0 to 2 4 to 6 10 to 15	✓	*	✓	**			TBD
Total Explorations/ Maximum Samples per Analyses	29		79	Minimum of 16	79	Minimum of 16	Minimum of 16	4	TBD

✓ Indicates samples will be analyzed.

TBD – To-be-determined in the field.

* Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for NWTPH-Dx (~16 samples).

******Indicates analysis will be conducted based on field observations of potential contamination; however, at least 20% of the overall soil samples collected at the Site will be analyzed for VOCs and gasoline-range petroleum hydrocarbons (~16 samples).

[1] The first soil sample will be a discrete 3-in to 6-in sample from the upper 2 ft of soil (0 to 2 ft bgs); the second sample will be a 1-ft composite collected between 4 and 6 ft bgs; and the third sample will be a 1-ft composite collected between 10 and 15 ft bgs. Only the upper 2 ft of soil will be collected from locations in and adjacent to the electrical/generator building.

[2] Metals include antimony, arsenic, barium, cadmium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7471).

[3] Diesel-range and motor oil-range petroleum hydrocarbons will be analyzed by Ecology method NWTPH-Dx. Selected samples may also be analyzed for EPH.

[4] PAHs will be analyzed using EPA Method 8270D SIM. A minimum of 20% of the samples will be analyzed for the full SVOC list (~16 samples).

[5] VOCs will be analyzed using EPA Method 8260B and gasoline-range petroleum hydrocarbons will be analyzed by Ecology Method NWTPH-Gx. Selected samples may also be analyzed for VPH.

[6] Both total and WAD cyanide will be analyzed (EPA Method 335.4 and Standard Method 4500CNI). Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[7] PCBs will be analyzed using EPA Method 8082.

[8] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 14 samples for grain size and 8 samples for the other tests) will be determined in the field.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, SVOCs, cyanide, and PCBs). No field blank samples will be collected for this study. Archive samples will be collected for all sample depths for possible future analysis.

Table B-3. Proposed Groundwater Sampling and Analysis

Monitoring Well Identification	Easting (ft)	Northing (ft)	Metals and TDS[1]	NWTPH-GRO/Dx[2]	SVOCs[3]	VOCs[4]	Cyanide[5]
MGP-MW-1	1238438.74	636593.70	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-2	1238353.70	636507.56	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-3	1238285.94	636418.57	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-4	1238147.59	636344.81	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-5	1238101.13	636292.36	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-6	1238283.52	636543.76	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-7	1238220.61	636492.01	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-8	1238164.74	636448.51	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-9[6]	1238053.20	636473.55	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-10	1238000.98	636344.04	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-11	1238009.61	636520.39	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-12	1237908.82	636413.20	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-13	1237939.21	636581.07	✓✓	✓✓	✓✓	✓✓	✓
MGP-MW-14	1237836.01	636509.83	✓✓	✓✓	✓✓	✓✓	✓
Total Samples			28	28	28	28	14

✓ Indicates analysis will be conducted during the first groundwater monitoring event only.
✓✓ Indicates analysis will be conducted during both groundwater monitoring events.
-- Included in final Work Plan.

[1] Samples will be analyzed for TDS using EPA Method 160.1 and both total and dissolved metals and will include antimony, arsenic, barium, cadmium, total chromium, copper, lead, mercury, selenium, silver, and zinc (EPA Methods 200.8/6020/7470).

[2] Petroleum hydrocarbons will include gasoline-range, diesel-range, and motor oil-range petroleum hydrocarbons by Ecology methods NWTPH-GRO and NWTPH-Dx.

[3] SVOCs will be analyzed using EPA Method 8270D SIM.

[4] VOCs will be analyzed using EPA Method 8260B.

[5] Both total and WAD cyanide will be analyzed during the first groundwater monitoring event using EPA Method 335.4 and Standard Method 4500CNI. Cyanide speciation may also be analyzed to assist with transport and toxicity evaluations.

[6] MGP-WM-9 may be moved closer to the BNSF railroad pending direct-push drilling results.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, NWTPH-Dx, SVOCs and conventionals only). No field blank samples will be collected for this study. Archive samples will be collected for all sample depths for possible future analysis.

Table B-4. Proposed Surface Water Sampling Locations and Testing

Station	Northing (ft)	Easting (ft)	Metals[1]	NWTPH-GRO/Dx[2]	SVOCs[3]	Conv. Testing[4]
MGP-SW-01	1238229.47	636604.97	✓✓	✓✓	✓✓	✓✓
MGP-SW-02	1238049.34	636548.45	✓✓	✓✓	✓✓	✓✓

-- Included in final Work Plan.
✓✓ Indicates analysis will be conducted during both surface water monitoring events.

[1] Metals analysis will include arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc (SMS Metals) and calcium and magnesium (EPA Methods 200.8/6010B/7470).

[2] NWTPH-Gx and -Dx analysis (Ecology 1997) will include gasoline-range, diesel-range, and motor oil-range petroleum hydrocarbons.

[3] SVOCs will be analyzed by EPA Method SW8270 low levels for comparison to SLs.

[4] Conventional testing includes TOC (EPA Method 415.1), TSS (EPA Method 160.2), and Hardness (SM 2340B).

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event. No field blank samples will be collected for this study.

Table B-5. Proposed Sediment Sampling Locations and Testing

Station	Northing (ft)	Easting (ft)	Depth (bgs)	Metals[1]	PAHs/ SVOCs[2]	Conv. Testing[3]	Physical Testing[4]	Bioassays[5]
Surface Sediment Samples			(cm)					
MGP-SS-01	1238114.82	636505.18	0 to 12	✓	SVOCs	✓*		
MGP-SS-02	1238155.51	636563.61	0 to 12	✓	SVOCs	✓*		
MGP-SS-04	1238059.96	636544.08	0 to 12	✓	SVOCs	✓*		
MGP-SS-06	1238145.49	636649.76	0 to 12	✓	SVOCs	✓*		
MGP-SS-08	1238056.15	636652.15	0 to 12	✓	SVOCs	✓*		
MGP-SS-12	1237928.71	636656.54	0 to 12	✓	SVOCs	✓*		
Reference	--	--	0 to 12			✓*		
Sediment Boring Samples[6]			(ft)					
MGP-SB-01	1238114.82	636505.18	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-02	1238155.51	636563.61	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-03	1238209.31	636628.65	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-04	1238059.96	636544.08	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-05	1238102.55	636596.07	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-06	1238145.49	636649.76	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-07	1238013.26	636593.45	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-08	1238056.15	636652.15	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-09	1238101.92	636714.54	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-10	1237992.83	636651.05	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-11	1238036.37	636727.08	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
MGP-SB-12	1237928.71	636656.54	0 to 2	✓	✓	✓		
			4 to 6	✓	✓	✓		
			8 to 10	✓	✓	✓		
			12 to 14	✓	✓	✓		
Total Samples				**54**	**54**	**55**	**15**	**TBD[7]**

Notes for Table B-5:

[1] Metals analysis will include arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc (SMS Metals).

[2] PAHs and SVOCs will be analyzed by EPA Method SW8270 SIM or low levels. SVOCs will be analyzed for all site surface samples. PAHs will be analyzed for selected subsurface samples with 20% of those samples analyzed for complete suite of SVOCs (~11 subsurface sediment samples).

[3] Conventional testing includes: Total organic carbon will be analyzed by EPA Method SW9060 modified for sediment analysis. Samples (✓*) planned for bioassay testing will also be analyzed for total solids (PSEP 1986), ammonia (Plumb 1981/EPA Method 350.1), total sulfides (PSEP 1986/EPA Method 9030), and grain size (ASTM 422-63 w/hydrometer).

[4] Physical testing will include grain size (ASTM D 422-63 w/hydrometer), Atterburg limits (ASTM D 4318-95), Specific Gravity (ASTM 854-92), and moisture content/bulk density (ASTM 2216). Sample selection (up to 15 samples) will be determined in the field.

[5] Bioassay testing will include the 10-day Amphipod, Larvae, and 20-day Polychaete (species to-be-determined).

[6] Selection of sediment samples for analysis may change during the field.

[7] TBD- MGP-SS-01, -02, -04, -06, -08, -12 will be chemically analyzed first and compared to SQS numeric criteria. The need for bioassay testing will be determined in consultation with Ecology.

Note: Field duplicate samples will be collected at a frequency of 1 per 20 field samples or 1 per sampling event (analyze metals, SVOCs, and conventionals only). No field blank samples will be collected for this study. Archive samples will be collected for all sample depths for possible future analysis (e.g., dioxins/furans).

3 SAMPLE IDENTIFICATION

This section presents the proposed sample identification procedures for sediment, soil, surface water, and groundwater samples collected as part of the SSSMGP Site field investigation.

Sediment samples will be assigned an individual sample identification number in the following manner:

MGP-SB-## - ##

Where: = Manufactured Gas Plant (MGP)

Sample Type: SS, SB = Surface Sediment (SS) and Sediment Boring (SB) Sample

Sample Location: ## = Sediment Sample Number

Depth Interval: - ## = top and bottom depth increment in cm (SS) and feet (SB) using 0.1 ft increments

Soil samples will be assigned an individual sample identification number in the following manner:

MGP-GP-## - ##

Where: = Manufactured Gas Plant (MGP)

Sample Type: GP, HA = GeoProbe® Direct Push (GP) and Hand Auger (HA) Sample

Sample Location: ## = Soil Sample Number

Depth Interval: - ## = top and bottom depth increment in feet (using 0.1 ft increments)

Sediment/soil sample processing will occur at a processing station or onboard the vessel as described in the previous sections. Sample processing methods are intended to result in high-quality samples that meet the program's quality assurance objectives. Guidelines for sample handling and storage are presented in Table B-6. All samples will be placed immediately in a cooler with ice to preserve them at 4^{o}±2^{o} C and will be kept at this temperature at all times. All samples will be labeled and identified in accordance with Section 5.5.1.

Surface water samples will be assigned an individual sample identification number in the following manner:

MGP-SW-##

Where: Manufactured Gas Plant (MGP)

SW-## = Surface Water Sample Number

Groundwater samples will be assigned an individual sample identification number in the following manner:

MGP-GW-##

Where: Manufactured Gas Plant (MGP)

GW-## = Groundwater Sample Number

4 SAMPLE CONTAINERS, HOLDING TIMES, AND PRESERVATION

Guidelines for sample handling and storage are presented in Table B-6. All samples will be placed immediately in a cooler with ice to preserve them at 4 ± 2^{o} C and will be kept at this temperature at all times. All samples will be labeled and identified in accordance with Section 5.5.1.

Table B-6 – Required Sample Containers, Preservatives, and Holding Times[1]

Analysis Type	Matrix	Container Size	Holding Time[1]	Preservation
NWTPH-GRO	Soil/Sediment	Method 5035A/4 oz glass with Teflon coated or Septum lid	14 days extraction/analysis	Method 5035A/ Ice (4°C)
VOCs	Soil	Method 5035A	14 days extraction/analysis	Method 5035A/ Ice (4°C)
NWTPH-Dx	Soil/Sediment	4 oz glass	14 days extraction/40 days analysis 1 year until analysis	Ice (4°C) Frozen (-18°C)
PAHs/SVOCs	Soil/Sediment	8 oz glass	14 days extraction/40 days analysis 1 year until analysis	Ice (4°C) Frozen (-18°C)
PCBs	Soil/Sediment	8 oz glass	14 days extraction/40 days analysis 1 year until analysis	Ice (4°C) Frozen (-18°C)
Total Cyanide	Soil/Sediment	4 oz glass	14 days extraction/analysis	Ice (4°C)
WAD Cyanide	Soil/Sediment	Inc.	14 days extraction/analysis	Ice (4°C)
Metals	Soil/Sediment	4 oz glass	6 months/28 days* 2 years until analysis (except mercury)	Ice (4°C) Frozen (-18°C)
TOC	Soil/Sediment	4 oz glass	14 days 6 months	Ice (4°C) Frozen (-18°C)
Total Sulfides/Ammonia	Soil/Sediment	4 oz glass (zero headspace)	7 days	Ice (4°C)
Grain size	Soil/Sediment	16 oz glass	6 months	Ice (4°C)
Atterburg Limits	Soil/Sediment	Inc.	NA	Ice (4°C)
Specific Gravity	Soil/Sediment	Inc.	NA	Ice (4°C)
Moisture Content/Bulk Density	Soil/Sediment	Inc.	NA	Ice (4°C)
VOCs	Water	Three 40-mL glass with Teflon lined Septum lid	14 days extraction/analysis	1+1 HCl to a pH <2 Ice (4°C)
NWTPH-GRO or VOCs	Water	Three 40-mL glass with Teflon lined Septum lid	14 days extraction/analysis	1+1 HCl to a pH <2 Ice (4°C)
NWTPH-Dx	Water	One 1-liter amber glass	14 days extraction/analysis	1+1 HCl to a pH <2 Ice (4°C)
SVOCs	Water	Two 1-liter amber glass	7 days extraction/40 days analysis	Ice (4°C)
Total Cyanide		500 mL HDPE	14 days extraction/analysis	1 ml 10N NaOH Ice (4°C)
WAD Cyanide	Water	500 mL HDPE	14 days extraction/analysis	2 ml 10N NaOH Ice (4°C)
Metals*	Water	One 1-liter HDPE	6 months/28 days extraction/analysis**	Ice (4°C), HNO_3 pH<2
TOC	Water	One 500-mL HDPE	28 days	Ice (4°C), H_2SO_4 pH<2
TDS/TSS	Water	One 1-liter HDPE	--	Ice (4°C)
Hardness	Water	One 1-liter HDPE	--	Ice (4°C)
Bioassays	Sediment	Three 1-liter amber glass	8 weeks	Ice (4°C) No Headspace or Purged with Nitrogen Gas
VOCs (TO-15/APH Method Modified)	Soil Vapor	One 1-liter Summa canister	28 days / 30 days***	--

Notes: All holding times are from the date of sampling. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis without being qualified. [1] Storage temperatures and maximum holding times for physical/chemical analyses and sediment toxicity tests (PSEP 1997a,b, Ecology 2008a). * Dissolved metals samples must be filtered prior to preservation; therefore, samples will be filtered in the field. ** Holding time for mercury is 28 days. Holding time for the other metals is 6 months. *** Holding time for MADEP APH Method is 28 days. Holding time for TO-15 Method is 30 days.

5 FIELD DOCUMENTATION PROCEDURES

The primary types of documentation that will be used for this project include site logbook, photo logs, sample log forms, FCR forms, and sample tracking forms. The site logbooks are vital for documenting all onsite activities. Photo documentation will be used to provide an accurate account of the material sampled, sample locations, and environmental conditions. Sample log forms are used to summarize sampling data collected for various sample locations. The FCR forms are used to document any modifications made to the original project plans during field activities. Sample tracking forms include the sample labels, custody seals, sample summary log, and chain-of-custody form. Sample labels are used to provide essential information and identification for all samples collected during field activities. Custody seals are used on all sample shipment containers to detect any tampering that may have occurred during transport or shipment. The chain-of-custody form is used to track sample custody, which is an important aspect of field investigation activities that documents the proper handling and integrity of the samples. A description of each of these documentation methods is provided in the following sections. Example field forms are presented in Attachment A.

5.1 FIELD LOGBOOKS

The field logbooks will be used to document all field sampling activities performed at the project site. The logbooks will contain the date, time, and description of all field activities performed; names of personnel; weather conditions; the names of visitors to the site; areas where photographs were taken; and any other data pertinent to the project. The site logbooks will also contain all sample collection and identification information and (if appropriate) a drawing of each area sampled, along with the exact location (coordinates) of where the sample was taken. The sampling information will be transferred to sample log forms when the sampler returns to the site office. The logbook is the official, legal record of site activities, and will serve as the key to sample designations and locations, and will include the date, time, site/sample location, sample identification number, sample matrix, how the sample was collected, any comments, and the sampler's name.

Each page of the field logbook will be numbered, dated, and signed by the author. The logbooks will be sturdy, weatherproof, and bound to prevent the removal of pages. All writing will be done in waterproof, black, permanent ink. No pages may be removed from the site logbooks for any reason. Blank pages, if any, will be marked "page intentionally left blank." Any mistakes will be crossed out with a single line, initialed, and dated. If multiple logbooks are used, they will be numbered sequentially. Field logs will be scanned weekly and stored in an electronic project file.

5.2 PHOTO DOCUMENTATION

Photographs will be taken at sampling locations and of selected samples. These photos will help identify the location and will provide an accurate visual record of the material being sampled. All photographs taken will be identified in the field logbooks (preferably in a separate section of the book set aside for that purpose). Photographic logs will contain, at a minimum, the digital file number, the photo number, the date, the time, the initials of the photographer, and a description of the image in the photograph.

5.3 SAMPLE COLLECTION INFORMATION FORM

Sampling logs and collection forms will be used to document site and sample characteristic data, which should agree with the information recorded in the site logbooks. Field personnel are required to fill out one sample log form for each sample collected. A copy of these forms will be stored in the field office or field files, with the original stored in the project file. A copy of these forms will also be included in the final data report and other documents, as appropriate. At a minimum, the log for each sample will contain the sample number, the date and time of sample collection, and a description of the sampling site, as well as the physical characteristics of the sample, the planned analysis, and the initials of the sampler.

5.4 FIELD CHANGE REQUEST FORM

The Field Operations Manager will be responsible for all environmental sampling activities, and will occasionally be required to adjust the field program, to accommodate site-specific needs after consultation with the project manager and/or QA Coordinator. When it becomes necessary to modify a program or task, the changes will be documented on a FCR form. If a field change is later found to be unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from the established program practices and appropriate action taken. All field changes will be numbered consecutively starting with the number 001.

5.5 SAMPLE TRACKING FORMS

Sample tracking is an important aspect of field investigation activities, as it documents the proper handling and integrity of the samples. Sample tracking forms to be used for the project will include sample labels, custody seals, sample summary logs, and chain-of-custody forms.

5.5.1 Sample Labels

Sample containers will be clearly labeled with waterproof black ink at the time of sampling. Sample labels will contain the following information:

- Sample identification numbers

- Sample date
- Sample time
- Preservation used, if any
- Analysis requested
- Initials of samplers.

The sample label will be attached to the sample container prior to, or just after, the container is filled and the lid secured. As an added measure of security, the finished label should be covered with clear packaging tape to protect the ink from moisture and to tightly secure the label to the sample container. Information on the sample label must match the information on the chain-of-custody form and in the site logbook for each sample.

5.5.2 Custody Seals

Custody seals will be used on sample shipping containers (coolers) that will either be shipped or sent by messenger to the laboratory. Custody seals will be attached to the lid and body of the coolers to detect any tampering during shipment. The custody seals will be signed and dated by the sampler or sample shipper. Custody seals are not required for samples delivered by hand directly to the lab unless left unattended.

5.5.3 Sample Summary Log

Sample summary logs will be maintained by the Field Operations Manager and used to keep track of all phases of the sampling and analysis process for all individual samples. The summary sample logs will include sample collection dates, sample delivery dates, dates analytical results are received, laboratory sample delivery group, and laboratory work order number.

5.5.4 Chain-of-Custody Form

The chain-of-custody form is used to document the history of each sample and its handling from its collection through all transfers of custody until it reaches the analytical laboratory. Internal laboratory records will document custody of the sample from the time it is received in the lab through its final disposition. The chain-of-custody form will be filled out after the samples have been collected and will be double-checked prior to the transport of the samples to the laboratory. At a minimum, the chain-of-custody form will contain the following information:

- Name of project
- Names of samplers
- Sample identification numbers
- Sampling date
- Sampling time

- Number and type of containers per sample
- Sample matrix
- Sample preservation, if any
- Analysis requested.

The completed chain-of-custody form will be placed in a large capacity Ziploc® bag and secured to the sample transport container. If coolers are used to transport samples, the chain-of-custody form will be taped to the underside of the cooler lid.

5.5.5 Sample Custody/Tracking Procedures

The samples collected must be traceable from the time they are collected until they or their derived data are used in the final report. In general, the following provisions apply to sample handling:

- The Field Operations Manager, or sampler, will be responsible for the care and custody of the samples collected until they are properly transferred or dispatched to the laboratory.
- All appropriate documentation forms will be used, including sample labels, chain-of-custody forms, sample logs, and any other appropriate forms. Documentation will be completed neatly using waterproof, black ink.
- When transferring possession of samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain of custody form. Containers shipped by common carrier will have the chain-of-custody form enclosed in a watertight container (e.g., plastic resealable bag) and placed in the container prior to sealing.
- Samples will be packaged properly according to the current U.S. Department of Transportation requirements and promptly dispatched to the laboratory for analysis. Sample containers will be packed in coolers (or other shipping containers) with a low-density packing material, such as bubble wrap, and Blue Ice® or its equivalent. The coolers will be securely sealed.
- Each cooler will be accompanied by its own chain of custody form identifying its contents. A copy of the chain of custody form will be retained by the field team leader for inclusion in project records.
- For coolers shipped via express delivery service, custody seals will be affixed to the outside of the coolers (shipping containers). The field team leader, sampler, or shipper will sign and date the custody seals.
- All samples will be shipped via express delivery for overnight delivery or hand delivered to the laboratory.

6 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination of all equipment upon arrival to the Site, between sample locations, and prior to removal from the Site.

Upon arrival onsite, all drilling equipment (i.e., drilling rods and augers) will be cleaned using a high-pressure hot water or steam washer before initial use. Drilling equipment will also be steam cleaned between sampling locations and prior to removal from the Site. Decontamination fluids will be containerized and handled as investigation derived wastes, as discussed in Section 7.

All non-disposable sampling components of the soil/sediment drilling equipment (e.g., split spoons), or other equipment used to collect soil/sediment samples that contacts the soils/sediments, will be decontaminated as follows:

- Potable water rinse
- Alconox/Liquinox detergent wash
- Potable water rinse
- Deionized (DI) water rinse
- Air dry.

If non-aqueous phase liquids (NAPL) are encountered in the soils/sediments, the following extra steps may be included in decontaminating equipment:

- Potable water rinse
- Alconox detergent wash
- Paper towel wipe to remove water
- Hexane rinse to remove NAPL film
- DI water rinse.

All sampling equipment that is used in sampling groundwater and surface water will be decontaminated as follows:

- Potable water rinse
- Alconox/Liquinox detergent wash
- Potable water rinse
- DI water rinse
- Air dry.

All liquids generated as a result of decontamination processes will be containerized and handled as investigation derived wastes, as discussed in Section 7.

7 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

The primary waste streams to be generated during this project and the proposed storage/disposal methods are provided in Table B-7 and discussed in the following sections. Soil, sediment and water IDW will be stored in labeled 55-gallon drums behind fenced containment areas onsite (locations to-be-determined) until proper off-site transport and disposal. Proper spill containment materials (i.e., plastic covering ground) will be installed in each fenced holding area.

7.1 EXCESS/REJECTED SOIL/SEDIMENT SAMPLES

Sediment/soil samples that are rejected and/or determined to be in excess of what is required to conduct analytical sampling will be collected in labeled 55-gallon drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting and Landau Associates.

7.2 SOIL/SEDIMENT BORING DRILL CUTTINGS

Sediment/soil drill cuttings will be collected by the driller and contained in labeled 55-gallon drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting and Landau Associates.

7.3 DECONTAMINATION AND DEWATERING WASTEWATERS

Liquid wastes (i.e., dewatering water and decontamination waters) will be potentially contaminated with petroleum hydrocarbons and PAHs. The presence of any chemical constituents in the wastewaters is expected to be diluted; therefore, the wastewaters are not expected to be classified as dangerous or hazardous waste. Although the wastewaters are not likely to contain hazardous waste pursuant to the contained-in policy (i.e., environmental media that contain a listed hazardous waste are to be managed as a hazardous waste), they will be collected in labeled 55-gallon drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting and Landau Associates.

In the use of solvents (e.g., methanol and hexane), decontamination activities will be conducted so as to minimize the potential for spills/releases of wastewaters. Spent decontamination solvents must be stored in leak-proof container(s) with secured lid(s). The lid is to remain closed except when the container is being used for decontamination activities. It is anticipated that liquid solvent wastes be placed in 5-gallon buckets or similar containers for offsite disposal or onsite evaporation (if applicable). Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting and Landau Associates.

7.4 PERSONAL PROTECTIVE EQUIPMENT/MISCELLANEOUS DEBRIS

Used personal protective equipment (PPE) and miscellaneous spent supplies and waste materials will be generated during sampling activities. Interim storage of these materials in plastic bags is acceptable. The bags are to be disposed of at an appropriate solid waste facility dumpster after the completion of each sampling event. Disposal of material will be the responsibility of field personnel.

Table B-7. Primary Waste Streams and Disposal Methods.

Waste Stream	Estimated Quantity	Storage/Disposal Method
Excess/Rejected Soil/Sediment Samples, Drill Cuttings	*<2000 lbs*	Labeled 55-gallon drums; off-site disposal by City personnel
Excess Surface Water/Groundwater Samples	*<20 gallons*	Labeled 55-gallon drums; off-site disposal by City personnel
Development Water and Purged Groundwater before Sampling	*<500 gallons*	Labeled 55-gallon drums; off-site disposal by City personnel
Decontamination Wastewaters (except solvents)	*<200 gallons*	Labeled 55-gallon drums; off-site disposal by City personnel
Personal Protective Equipment (PPE)/ Miscellaneous Supplies and Materials	*<100 cubic ft*	Containerize/offsite disposal by field personnel
Decontamination Solvents (methanol and hexane)	*<10 gallons*	Containerize and allow to evaporate

8 REFERENCES

Ecology. 1995. Sediment Management Standards. Chapter 173-204 WAC. Washington State Department of Ecology. Olympia, WA. Last updated December 29, 1995.

Ecology. 2007. Model Toxics Control Act (MTCA) Cleanup Regulation Chapter 173-340 WAC. Washington State Department of Ecology. Publication No. 94-06. Olympia, WA. Last updated October 12, 2007.

Ecology. 2008a. Sediment Sampling and Analysis Plan Appendix. Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Prepared by the Washington State Department of Ecology, Olympia, WA. Ecology Publication No. 03-09-043, Last updated February 2008.

Ecology. 2008b. Notice of Potential Liability for the Release of Hazardous Substances under the Model Toxics Control Act, Boulevard Park (Facility Site #2865), Bellingham, Washington. Letter to Steve Secrist, Deputy General Council, Puget Sound Energy, Bellevue, WA. Letter from Mary O'Herron, Site Manager, Washington State Department of Ecology, Bellingham, Washington. Dated December 30, 2008.

Ferris, J.G. 1951. "Cyclic Fluctuations of Water Level as a Basis for Determining Aquifer Transmissibility." *Intl. Assoc. Sci. Hydrology*. Publ. 33. pp. 148-155.
PSEP. 1986. Recommended protocols for measuring conventional sediment variables in Puget Sound. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

PSEP. 1995. Puget Sound Estuary Program: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington. Revised July 1995.

PSEP. 1997a. Puget Sound Estuary Program: Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

PSEP. 1997b. Puget Sound Estuary Program: Recommended Guidelines for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

PSEP. 1997c. Puget Sound Estuary Program: Recommended Protocols for Measuring Metals in Puget Sound Sediment and Tissue Samples. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

PSEP. 1998. Puget Sound Estuary Program: Recommended Guidelines for Station Positioning in Puget Sound. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

Puget Sound Energy. 2009. Response to PLP Notification, Boulevard Park (Facility Site 2865), Bellingham, Washington. Letter to Mary O'Herron, Site Manager, Department of Ecology, Bellingham, Washington. Letter prepared by Steve Secrist, Deputy General Counsel, Director of Environmental Policy and Sustainability. Dated January 7, 2009.

USEPA. 2010. SW-846 On-line, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. U.S. Environmental Protection Agency. http://www.epa.gov/epaoswer/hazwaste/test/main.htm.

USEPA. 1984. Boulevard Park Site Assessment. Prepared by the U.S. Environmental Protection Agency, Region 10, Seattle, WA.

ATTACHMENT A

FIELD FORMS

- Figure B1 – site and vicinity map (same as work plan Fig. 1 above)
- Figure B2 – proposed soil and groundwater sampling locations (same as work plan Fig. 7 above)
- Figure B3 – proposed sediment and surface water sampling locations (same as work plan Fig. 8 above)

APPENDIX C
QUALITY ASSURANCE PROJECT PLAN

South State Street Manufactured Gas Plant Remedial Investigation/Feasibility Study

Prepared for

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August 6, 2010

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ACRONYMS AND ABBREVIATIONS

BNSF	Burlington Northern Santa Fe Railway Corporation
City	City of Bellingham
cm	centimeter
CSV	comma separated values
CVAA	cold vapor absorption spectrometry
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EPA	United State Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
EIM	Environmental Information Management
GC/FID	gas chromatography/electron capture detector
GC/FID	gas chromatography/flame ionization detector
GC/MS	gas chromatography/mass spectrometry
Herrenkohl	Herrenkohl Consulting LLC
ICP/MS	inductively coupled plasma/mass spectrometry
ICP-OES	inductively coupled plasma-optical emission spectrometry
Landau Associates	Landau Associates, Inc.
mg/L	milligrams per liter
MGP	manufactured gas plant
MS/MSD	matrix spike/matrix spike duplicate
NWTPH	Northwest Total Petroleum Hydrocarbons
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons-Diesel, -Oil
NWTPH-Gx	Northwest Total Petroleum Hydrocarbons-Gasoline
PAHs	Polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
PQLs	practical quantitation limits
PSE	Puget Sound Energy

ACRONYMS AND ABBREVIATIONS

PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
QAO	quality assurance officer
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
RPD	relative percent difference
SAP	sampling and analysis plan
SAPA	sampling and analysis plan appendix
SIM	selected ion monitoring
SMS	Washington State Sediment Management Standards
SOPs	standard operating procedures
SQS	sediment quality standard
SSSMGP	South State Street Manufactured Gas Plant
SVOCs	semivolatile organic compounds
TICs	tentatively identified compounds
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TDS	total dissolved solids
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code

1 INTRODUCTION

This quality assurance project plan (QAPP) establishes the quality assurance/quality control (QA/QC) procedures in support of the remedial investigation/feasibility study (RI/FS) at the South State Street Manufactured Gas Plant (SSSMGP) site (Site) located in Bellingham, Washington. This QAPP is an appendix to the SSSMGP Site Work Plan, one of the required deliverables under the Agreed Order (No. 7655) dated April 30, 2010 between the City of Bellingham (City), Puget Sound Energy (PSE), and the Washington State Department of (Ecology). This QAPP was prepared using Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004).

The SSSMGP Site consists of approximately 6 acres located in Bellingham, Washington in the general vicinity of Bayview Drive and South State Street (Figure C-1). The Site is situated on the northern portion of a City-managed park, Boulevard Park, and includes nearshore uplands and adjacent aquatic lands located in Bellingham Bay. Uplands include a portion of the upper and lower public park areas. Also included within the Site boundary are approximately 2 acres of aquatic lands adjacent to and outside of the Inner Harbor line and managed by the Washington State Department of Natural Resources (WDNR). The Site is also intersected by active railroad tracks owned and managed by Burlington Northern Santa Fe (BNSF) Railway.

The field effort will include the collection and analysis of soil, sediment, soil vapor, surface water, and groundwater samples from Site and background/reference locations. Selected samples will be analyzed for conventional parameters (e.g., total organic carbon, hardness), physical tests (e.g., grain size), heavy metals, cyanide, petroleum hydrocarbons, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and polychlorinated biphenyls (PCB) Aroclors. Selected surface sediment samples may also be evaluated for toxicity using a suite of marine bioassay tests. Sampling and testing details are provided in the Sampling and Analysis Plan (SAP) which accompanies this document (Appendix B of the Work Plan).

Section 2 of this QAPP summarizes the project organization followed by the quality assurance objectives in Section 3. Laboratory methods are presented in Section 4 and Section 5 provides quality assurance/quality control (QA/QC) procedures. Corrective actions are presented in Section 6 followed by data management procedures in Section 7 and data reduction, validation, and reporting in Section 8. References are presented in Section 9. Referenced figures and tables are presented at the end of each section.

2 PROJECT ORGANIZATION

The SSSMGP Site RI/FS will be implemented by the City's Parks and Recreation Department and PSE with direction from Ecology. The organizational structure for the project is illustrated in Figure C-2. Contact information is provided in Table C-1. Gina Austin and John Rork are the City's and PSE's project managers, respectively. Herrenkohl Consulting, LLC (Herrenkohl Consulting) and Landau Associates, Inc. (Landau Associates) are responsible for preparing and implementing the project Work Plans, and preparing the RI/FS report for the City and PSE. They are conducting this work under contract (No. 2008-011C) with the City. Mark Herrenkohl of Herrenkohl Consulting is the RI/FS project manager and will communicate directly with Gina Austin and John Rork. Mr. Herrenkohl will be responsible for implementing and executing the technical, QA, and administrative aspects of the RI/FS for the project. Stacy Lane of Landau Associates is responsible for project-specific QA/QC, including field and laboratory QC, and for management of Landau Associates' staff working on the project. Mr. Herrenkohl and Dylan Frazer of Landau Associates will manage field operations. Mr. Herrenkohl will report field progress and problems to Ms. Austin on a daily basis and will be responsible for managing subcontractors associated with the RI. Mr. Frazer will report field progress and problems to Mr. Herrenkohl and Ms. Lane on a daily basis. Mr. Frazer will also be the designated Health and Safety Officer for all field activities at the Site. Larry Beard of Landau Associates will provide senior quality assurance review and consultation, as appropriate.

The QA officer, Ms Lane, will be responsible for QA oversight during investigation activities including sampling events, analytical laboratory coordination, and direct implementation of this QAPP. The QA officer will be responsible for overseeing data validation and for confirming that the QA objectives of the project are met.

3 QUALITY ASSURANCE OBJECTIVES

The QA objectives for this project are to develop and implement procedures that will ensure collection of representative data of known, acceptable, and defensible quality. The data quality parameters used to assess the acceptability of the data are precision, accuracy, representativeness, comparability, and completeness. These parameters are discussed in the following sections.

3.1 DECISION QUALITY OBJECTIVES

The decision quality objectives specify how good the project decisions must be to accomplish the overall project goal. As stated in the Agreed Order, the RI/FS is intended to provide sufficient data, analysis, and evaluations to enable Ecology to select a cleanup action for the Site.

The decisions required to meet this goal include:

- The number of samples to collect and the locations of the samples that will be considered sufficient for evaluating cleanup action alternatives.

- The analytical methods required to evaluate the data against screening criteria protective of human health and the environment.

- The type of media (e.g., soil, groundwater, surface water, soil vapor, and sediment) that may require cleanup.

To achieve the overall project goal, the decision quality objectives will be to obtain data that is representative of site conditions and that is comparable to selected screening criteria, as described below.

3.1.1 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Representativeness can be evaluated using replicate samples, representative sampling locations, and blanks. Representativeness for the RI sampling will be accomplished using appropriate selection of sampling locations for each media of potential concern (soil, groundwater, surface water, soil vapor, and sediment). A general description of the sampling plan for each media of concern is described below. A detailed description is provided in the Work Plan and the SAP.

- Fourteen groundwater monitoring wells are planned to be installed at locations dispersed throughout the Site such that groundwater flow can be evaluated and groundwater quality can be determined at and down-gradient of potential source areas. Groundwater monitoring, including water level measurements and sample collection, will be conducted twice, once in a dry season and once in a wet season, to evaluate the influence of seasonal groundwater fluctuations on groundwater quality and flow.

- Soil samples will be collected at 54 locations dispersed throughout the Site, including areas where known MGP site activities occurred. Soil samples will be collected from additional locations, as required, to determine the extent of any contamination identified based on field observations. At each location, soil samples will be collected from depth intervals with evidence of contamination and from below the zone of contamination to define the vertical limits of the contamination. At locations where no evidence of contamination is present, at least two to three soil samples will be collected in the upper 15 ft of soil.

- Sediment samples will be collected from twelve locations. These data will be evaluated along with data from previous sediment sampling locations. Samples will be collected from the upper 12 centimeters (cm), which is considered the bioactive zone for Bellingham Bay. Below 12 cm, sediment samples will be collected at 2-ft intervals to a depth of 25 ft or refusal.

- Soil vapor samples will be collected from up to six locations within the preliminary site boundary. The locations will be determined based on field screening and observations made during the soil sampling investigation. Soil vapor will be collected from at least one location adjacent to the property boundary with the Spinnaker Condominiums.

To determine that the analytical results are representative of the sampled item and not influenced by cross-contamination, method blanks will be analyzed with each analysis (if appropriate) as described in Section 5.0.

3.1.2 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this work, comparability of data will be established through the use of standard analytical methodologies with reporting limits that can meet screening level criteria to the extent practicable, standard reporting formats, and of common traceable calibration and reference materials. Methods to be used for analysis of sediment, soil, soil vapor, groundwater and surface water are discussed in Section 4.0.

3.2 MEASUREMENT QUALITY OBJECTIVES

The measurement quality objectives (MQOs) for the project specify how good the data must be in order to meet the objectives of the project and are based on precision and accuracy, as described in this Section.

3.2.1 Precision

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

Analytical precision measurements will be carried out on project-specific soil, sediment, and groundwater samples at a minimum frequency of 1 per sample analysis group or 1 in 20 samples, whichever is more frequent per matrix analyzed, as practical. Due to the few number of surface water and soil vapor samples planned for analysis, analytical precision measurements may be evaluated on non-project samples for these media types. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria provided by the laboratory.

Field precision will be evaluated by the collection of blind field duplicates or replicates at a minimum frequency of 1 per sampling event or 1 in 20 samples. Control limits for the field duplicates and replicates will be 20% for groundwater and surface water and 35% for soil (including soil vapor) and sediment unless the duplicate/replicate sample values are within five times the reporting limit, in which case the control limit interval will be plus or minus the reporting limit for waters, and plus or minus two times the reporting limit for soil/sediment.

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

$$RPD = \left| \frac{C_1 - C_2}{(C_1 + C_2)/2} \right| x\,100$$

where: C_1 = first sample value
C_2 = second sample value (duplicate)
RPD = relative percent difference.

3.2.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Field accuracy is controlled by adherence to sample collection procedures as outlined in the SAP.

Analytical accuracy may be assessed by analyzing “spiked” samples with known standards (surrogates, laboratory control samples, and/or matrix spike) and measuring the percent recovery. Accuracy measurements on matrix spike samples will be carried out at a minimum frequency of 1 per laboratory analysis group or 1 in 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against quantitative matrix spike and surrogate spike recovery performance criteria provided by the laboratory. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\begin{array}{c}\textit{Percent}\\ \textit{Recovery}\end{array} = \frac{\textit{(Spiked Sample Result - Unspiked Sample Result)}}{\textit{Amount of Spike Added}} \; x \; 100$$

Control limits for percent recovery for soil, sediment, surface water, and groundwater samples will be laboratory acceptance limits generated according to U.S. Environmental Protection Agency (EPA) guidelines. Control limits for percent recovery for sediment samples will be as specified in Washington State Department of Ecology's (Ecology) *Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards* (Ecology 2008), presented in Section 5.0.

3.2.3 Bias

Bias is the systematic or persistent distortion of a measured process that causes errors in one direction. Bias of the laboratory results will be evaluated based on analysis of method blanks and matrix spike samples as described in Section 4.0.

3.2.4 Sensitivity

Sensitivity is the ability to discern the difference between very small amounts of a substance. For the purposes of this project, sensitivity is the lowest concentration that can be accurately detected by the analytical method. The analytical method will be considered sufficiently sensitive if the reporting limits are below project screening levels. Proposed method and target reporting limits are discussed in Section 4.0.

3.2.5 Completeness

Completeness is a measure of the proportion of data obtained from a task sampling plan that is determined to be valid. It is calculated as the number of valid data points divided by the total number of data points requested. The QA objective for completeness during this project will be 95%. Completeness will be routinely determined and compared to this control criterion.

4 LABORATORY METHODS

Samples of all matrix types collected for this study will be analyzed for chemical constituents. Toxicity tests will additionally be conducted for selected sediment samples. Sediment and soil samples will also be tested for physical characteristics. The laboratory methods that will be used to complete the chemical, biological, and physical testing are described below.

4.1 CHEMICAL ANALYSES

Soil, groundwater, surface water, and sediment samples will be analyzed for metals, organic compounds, and conventional analytes. Soil vapor samples will be analyzed for volatile petroleum hydrocarbons and trimethylbenzenes. Detailed analyte lists and method reporting limits are provided in Tables C-2, C-3, and C-4 for each sample type. Method reporting limits are equivalent to the concentration of the lowest calibration standard (i.e., the practical quantitation limit) and represent the low end of the calibration range. Analytes that are detected at concentrations below the reporting limit will be reported, but will be qualified as estimated (a “J” qualifier will be applied to the result by the laboratory).

Laboratory methods for sample preparation and analysis are summarized in Tables C-2, C-3, and C-4 and described in the following sections. Sample containers, preservation, and holding times are provided in Table B-6 of the SAP (Appendix B of the Work Plan).

4.1.1 Metals

Sediment and soil samples will be analyzed for metals by EPA Method 6010/6020 and for mercury by EPA Method 7471. Strong acid digestion with nitric acid and hydrogen peroxide will be used to prepare samples for analysis of metals other than mercury using EPA Method 3050. Analysis will be completed by inductively coupled plasma/mass spectrometry (ICP/MS). Mercury samples will be digested with aqua regia and oxidized using potassium permanganate. Analysis will be completed by cold vapor atomic absorption spectrometry (CVAA).

Three methods will be used to analyze groundwater and surface water samples for total metals. Digestion with nitric and hydrochloric acids will be used to prepare samples for analysis of metals other than mercury using EPA Method 3005. Analysis for these metals will be completed by ICP/MS (EPA Method 200.8). Calcium and magnesium analyses will be completed by inductively coupled plasma-optical emission spectrometry (ICP-OES) using EPA Method 6010B. Calcium and magnesium concentrations will be used to calculate water hardness. Mercury samples will be digested with aqua regia, oxidized using potassium permanganate, and analyzed by CVAA (EPA Method 7470).

4.1.2 Cyanide

Soil and groundwater samples will be analyzed for both total and amenable cyanide and weak acid dissociable (WAD) cyanide. Human health criteria for cyanide are often expressed as total cyanide (although the drinking water MCL is expressed as free cyanide); whereas ecological criteria are expressed as WAD cyanide. Analysis of groundwater and soil samples for total cyanide will be performed using semi-automated colorimetry (EPA Method 335.4). Analysis of groundwater and soil samples for WAD cyanide will be performed by Standard Method 4500-CN. This procedure requires distillation at a slightly acidic pH. Any suspended material in the groundwater and surface water samples will be allowed to settle prior to collecting an aliquot for total and/or WAD analysis.

4.1.3 Petroleum Hydrocarbons

Selected soil, groundwater, and surface water samples will be analyzed for diesel- and motor oil-range petroleum hydrocarbons following Ecology's Northwest Total Petroleum Hydrocarbons (NWTPH-Dx) method. An acid/silica gel cleanup will be applied to all soil samples analyzed for NWTPH-Dx. These samples may additionally be analyzed for extractable petroleum hydrocarbons (EPH) if screening levels are exceeded. Selected soil, groundwater, and surface water samples will also be analyzed for gasoline-range petroleum hydrocarbons (NWTPH-Gx). These samples may be analyzed for volatile petroleum hydrocarbons (VPH) if screening levels are exceeded. Details regarding the decision to analyze samples for VPH or EPH are provided in Section 6.0 of the Work Plan.

For diesel- and oil-range petroleum hydrocarbons, samples will be extracted with methylene chloride and solvent-exchanged into hexane. Silica gel chromatography will be used to separate the aliphatic and aromatic hydrocarbons in the samples. The fractions will be analyzed separately by GC/FID.

GRO and VPH will be extracted from soil samples using methanol, followed by purge and trap with a carbon-based trap. Groundwater and surface water samples will be purged directly without prior extraction. The contents of the trap will be analyzed by gas chromatography (GC) with a flame ionization detector (FID) for NWTPH-Gx. Samples for VPH will be analyzed using both FID and a photo-ionization detector (PID). The FID detects both aliphatic and aromatic hydrocarbons, whereas the PID detects only the aromatic hydrocarbons. The aliphatic hydrocarbons are calculated as the difference between the FID and PID responses.

Any suspended material in the groundwater and surface water samples will be allowed to settle prior to collecting an aliquot for NWTPH-Dx and/or EPH analysis.

Soil vapor samples will be analyzed petroleum hydrocarbons [C5-C8 aliphatic hydrocarbons (C5-C8); C9-C12 aliphatic hydrocarbons (C9-C12); and C9-C10 aromatic hydrocarbons (C9-C10] the Massachusetts Department of Environmental Protection (MADEP) air sampling analysis method.

4.1.4 SVOCs

SVOCs in soil, groundwater, surface water, and sediment samples will be analyzed by EPA Method 8270D with modifications recommended by PSEP (1997a,b) to allow lower reporting limits including selective ion monitoring (SIM). Modifications for sediments will also include the use of additional cleanup procedures (e.g., silica gel) and a larger sample volume, corresponding to 50 g of dry sediment and a final extract volume of 0.5 mL.

Soil and sediment samples will be extracted by sonication using EPA Method 3550B. Gel permeation chromatography (EPA Method 3640B) may be used to cleanup the sample extracts. Samples will be analyzed by GC with mass spectrometry (GC/MS).

Continuous liquid-liquid extraction will be used to extract SVOCs from groundwater and surface water samples (EPA Method 3510C). SVOCs will be analyzed by GC/MS with a large-volume injector to enhance sensitivity. Any suspended material in the groundwater and surface water samples will be allowed to settle prior to collecting an aliquot for SVOC analysis.

Tentatively identified compounds (TICs) will not be reported for this study.

4.1.5 VOCs

VOCs in soil, groundwater, and surface water will be analyzed by EPA Method 8260C with modifications recommended by PSEP (1997a,b) to allow lower reporting limits including SIM.

VOCs will be extracted from soil samples using methanol, followed by purge and trap with a carbon-based trap (EPA Method 5035). Groundwater and surface water samples will be purged directly without prior extraction (EPA Method 5030). The contents of the trap will be analyzed by GC/MS.

Soil vapor samples will be analyzed for selected VOCs [methyl tert-butyl ether (MTBE); BTEX; and naphthalene] using the MADEP air sampling analysis method and for 1,3-butadiene; 1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene using EPA Method TO-15.

TICs will not be reported for this study.

4.1.6 PCBs

PCB Aroclors in soil samples will be analyzed using EPA Method 8082. Samples will be extracted by sonication. Extracts will be cleaned using sulfuric acid cleanup, silica gel cleanup, and sulfur cleanup. Samples will be analyzed by GC with electron capture detector (GC/ECD).

4.1.7 Conventional Parameters

Conventional analyses of sediment samples will include total solids, total sulfides, ammonia, and TOC. Soil samples will also be analyzed for total solids. EPA and PSEP methods will be used as shown in Tables C-2 and C-3.

Total solids in soil and sediment samples will be determined according to PSEP (1986). These results will be used to calculate analyte concentrations on a dry-weight basis and will also be reported in the database.

Total sulfide analysis in sediment samples will include distillation of the sulfide into a sodium hydroxide trap and analysis by colorimetry (EPA 376.2).

Ammonia in sediment samples will be analyzed by EPA Method 350.1. The method, originally developed for use in water samples, will be modified for sediment samples by adding an extraction with a potassium chloride solution. Colorimetry will be used to determine ammonia concentrations.

TOC in sediment samples will be analyzed as described in EPA Method SW 9060 (Ecology modified). Samples will be pretreated with hydrochloric acid to remove inorganic carbon, dried at 70° C, and analyzed by combustion in an induction furnace.

Conventional analyses of surface water and groundwater samples will include total suspended solids (TSS), total dissolved solids (TDS), TOC, and hardness. TDS will be analyzed using EPA Method 160.1. For TSS determination, surface water samples will be filtered through a pre-weighed glass fiber filter. The filter will be dried and weighed and the TSS determined by difference (EPA Method 160.2).

Total organic carbon in water samples will be analyzed by EPA Method 415.1. Organic carbon in the samples will be oxidized and the evolved CO_2 will be analyzed using an infrared detector. Samples will be pretreated with hydrochloric acid to remove inorganic carbon.

The hardness of the water samples will be calculated using the results for calcium and magnesium which will be obtained by ICP/OES as described for metals.

4.2 BIOLOGICAL TESTING

Toxicity testing will be in compliance with the procedures and QA/QC performance standards described in PSEP (1995), as revised by subsequent agency-approved updates, and as described in sub-appendix D of the SAPA (Ecology 2008). The biological laboratory standard operating procedures (SOPs) will be provided once a lab is selected.

Three sediment toxicity tests (bioassays) may be conducted on the samples:

- Acute Amphipod (*Eohaustorius estuarius*) 10-day mortality test (Ecology 2008)
- Acute Larval (*Mytilus galloprovincialis*) development test (Ecology 2008)
- Chronic Juvenile Polychaete (*Neanthes arenaceodentata*) 20-day mortality and growth test (Ecology 2008).

4.3 PHYSICAL TESTING

Physical testing (index parameters) will also be analyzed for selected subsurface soil and sediment samples to assist in evaluating excavation, filling and capping methods, and capacity of existing soils and sediments to provide foundation support for filling/capping material. In addition, soil samples will be collected from selected well borings and analyzed for grain size to assist in estimating aquifer hydraulic conductivity. Physical testing will include grain size, Atterburg limits, specific gravity, and moisture content/bulk density. Test methods are listed in Tables C-2 and C-3.

4.3.1 Grain Size

Grain size will be analyzed by the hydrometer and sieve method following ASTM Method D422-07 (ASTM 2007), and will provide information on site geologic character and engineering properties of soil/sediment proposed for remediation.

4.3.2 Atterberg Limits

Atterberg limits will be determined for selected samples of soil and sediment samples in accordance with ASTM D4318-10 (includes organic determination). Atterberg limits, which include the liquid limit, plastic limit, and the plasticity index, are used to define plasticity characteristics of clays and other cohesive sediments.

4.3.3 Specific Gravity

Specific gravity will be measured on samples selected for engineering properties in accordance with ASTM D854-10. The specific gravity of soil/sediment samples is used to determine sediment removal and the bed consolidation after filling/capping.

4.3.4 Moisture Content

Moisture content will be measured on selected samples analyzed for engineering properties in accordance with ASTM D2216-05. Moisture content is used to determine the initial in situ void ratio of the soil/sediment and to estimate the short-term bulking (or increase in volume) during excavation activities.

5 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

This section describes the procedures that will be implemented to: 1) ensure sample integrity from the time of sample collection to the time of analysis in the laboratory, 2) obtain the appropriate chemical and physical data, 3) collect field and laboratory quality control samples, 4) monitor performance of the laboratory and field measurement systems, 5) correct any deviations from the methods or QA requirements established in this QAPP, and 6) report and validate the data.

5.1 LABORATORY INSTRUMENT CALIBRATION

The analytical laboratory project manager is responsible for maintaining laboratory instruments in proper working order including routine maintenance and calibration, and training of personnel in maintenance and calibration procedures. Laboratory instruments will be properly calibrated with appropriate check standards and calibration blanks for each parameter before beginning each analysis. Instrument performance check standards, where required, and calibration blank results will be recorded in a laboratory logbook dedicated to each instrument. At a minimum, the preventive maintenance schedules contained in the USEPA methods and in the equipment manufacturer's instructions will be followed. Laboratory calibration procedures and schedules will be as described in the laboratory QAPP (Attachment A).

5.2 FIELD EQUIPMENT CALIBRATION

Field meters, including pH, conductivity, dissolved oxygen (DO), temperature probes, and photoionization detector (PID) will be calibrated and maintained in accordance with the manufacture’s specifications. All routine maintenance will be recorded in the field sampling logs.

5.3 FIELD DOCUMENTATION

A complete record of all field activities will be maintained for the duration of the field phase of the work. Documentation will include the following:

- Daily recordkeeping by field personnel of all field activities
- Recordkeeping of all samples collected for analysis (field sampling forms)
- Use of sample labels and tracking forms for all samples collected for analysis.

The field logs will provide a description of all sampling activities, sampling personnel, weather conditions, and a record of all modifications to the procedures and plans identified in the SAP.

The field logs are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period.

Sample possession and handling will also be documented so that it is traceable from the time of sample collection to the laboratory and data analysis. Sample chain-of-custody forms and procedures are described in the SAP.

5.4 SAMPLE HANDLING PROCEDURES AND TRANSFER OF CUSTODY

Samples submitted to the analytical laboratories will be collected in the appropriate sample containers and preserved as specified in Table B-6 of the SAP. The storage temperatures and maximum holding times for physical/chemical analyses are also presented in Table B-6 of the SAP.

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to release of samples. Samples will be logged on a chain-of-custody form and will be kept in coolers on ice until delivery to the analytical laboratory. The chain of custody will accompany each shipment of samples to the laboratory. Procedures for sample transportation and handling are described in Section 5.6 of the SAP.

5.5 FIELD AND LABORATORY QUALITY CONTROL SAMPLES

Field and analytical laboratory control samples will be collected to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for this investigation. A summary of the sediment, soil, surface water, and groundwater quality control samples are described below. The frequency at which they will be collected and/or analyzed is described for groundwater, surface water, and soil samples. The frequency at which they will be collected and/or analyzed for sediment samples are summarized in Tables C-5, C-6, and C-7.

5.5.1 Blind Field Duplicates

A blind field duplicate will be collected at a frequency of at least 1 per 20 samples per sample type per chemical analysis, not including QC samples, but not less than one field duplicate per sampling event (any continuous sampling period not interrupted by more than 2 days). The blind field duplicate will consist of a split sample collected at a single sample location. Except for soil samples collected for VOCs or gasoline analysis, soil and sediment samples will be homogenized until uniform color and texture by mixing in a stainless-steel bowl, split into duplicate sample containers, and submitted blind to the laboratory as discrete samples. No soil blind field duplicate samples will be collected for VOCs or gasoline analysis. Groundwater blind field duplicates will be collected by alternately filling sample containers for both the original and the corresponding duplicate sample at the same location to decrease variability between the duplicates. Blind field duplicate sample results will be used to evaluate data precision. No soil vapor blind field duplicate samples will be collected.

5.5.2 Field Trip Blanks

Field trip blanks will consist of deionized or distilled water sealed in a sample container provided by the analytical laboratory. The trip blank will accompany samples collected for the analysis of VOCs and gasoline-range petroleum hydrocarbons during transportation to and from the field, and then will be returned to the laboratory with each shipment. The trip blank will remain unopened until submitted to the laboratory for analysis. One trip blank per cooler containing samples for VOCs and gasoline-range petroleum hydrocarbons analysis will be evaluated to determine possible sample contamination during transport.

5.5.3 Laboratory Matrix Spike

A minimum of one laboratory MS per 20 samples or one MS sample per batch of samples if fewer than 20 samples are obtained in a sample event will be analyzed for all organics and inorganic analyses, except for the analysis of soil vapor samples. The matrix spikes will be performed using Site samples. These analyses will be performed to provide information on accuracy and to verify that extraction and concentration levels are acceptable. The laboratory spikes will follow USEPA guidance for matrix and blank spikes.

5.5.4 Laboratory Matrix Spike Duplicate

A minimum of one laboratory MSD per 20 samples or one MSD sample per batch of samples if fewer than 20 samples are obtained in a sample event will be analyzed for all organic analyses, except for the analysis of soil vapor samples. The analysis of MSD samples will be performed to provide information on the precision of chemical analyses. The laboratory spikes will follow USEPA guidance for matrix and blank spike duplicates.

5.5.5 Laboratory Duplicates

A minimum of one laboratory duplicate per 20 samples or one laboratory duplicate sample per batch of samples if fewer than 20 samples are obtained in a sample event will be analyzed for metals and cyanide analyses in soil, sediment, surface water, and groundwater. Also, a minimum of one laboratory duplicate per 20 soil vapor samples or one laboratory duplicate sample per batch of soil vapor samples if fewer than 20 soil vapor samples are obtained will be analyzed. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory duplicate will follow USEPA guidance in the method.

5.5.6 Laboratory Triplicates

A minimum of one laboratory triplicate per 20 sediment samples or one laboratory triplicate sample per batch of samples if fewer than 20 samples are obtained in a sample event will be analyzed for grain size, TOC, and total solids. Laboratory triplicates will be collected for sediment samples only.

5.5.7 Laboratory Method Blanks

A minimum of one laboratory method blank per 20 samples, one every 12 hours, or one per batch of samples analyzed (if fewer than 20 samples are analyzed in a sample event) will be analyzed for all parameters (except grain size and total solids) to assess possible laboratory contamination. Dilution water will be used whenever possible. Method blanks will contain all reagents used for analysis. The generation and analysis of additional method, reagent, and glassware blanks may be necessary to verify that laboratory procedures do not contaminate samples.

5.5.8 Laboratory Control Sample

A minimum of one laboratory control sample per 20 samples or one laboratory control sample per sample batch if fewer than 20 samples are obtained in a sample event will be analyzed for all parameters, except grain size and total solids.

5.5.9 Surrogate Spikes

All project samples, except for soil vapor samples, analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined by the analytical methods.

5.6 LABORATORY QA/QC FOR CHEMICAL AND CONVENTIONAL ANALYSES

QA/QC for chemical testing includes laboratory instrument and analytical method QA/QC. Instrument QA/QC monitors the performance of the instrument and method QA/QC monitors the performance of sample preparation procedures. The analytical laboratory will be responsible for instrument and method QA/QC. QA/QC procedures to be performed by the laboratory for analysis of soil, surface water, and groundwater samples will be in accordance with methods specified in Table C-2. QA/QC procedures to be performed by the laboratory for analysis of soil vapor samples will be in accordance with methods specified in C-4. QA/QC procedures to be performed by the laboratory for analysis of sediment are summarized in Table C-5 for analyses of organic compounds, Table C-6 for analyses of metals, and Table C-7 for analyses of conventional parameters. The frequency at which each procedure should be implemented and the control limits for the procedures are also summarized in Tables C-5, C-6, and C-7.

When an instrument or method control limit is exceeded, the laboratory will contact the project QA officer, Ms. Lane, immediately. The laboratory will be responsible for correcting the problem and will reanalyze the samples within the sample holding time if sample reanalysis is appropriate. Corrective actions are described further in Section 6.0.

5.7 BIOLOGICAL TESTING QUALITY CONTROL PROCEDURES

The following sections discuss and summarize the components of the bioassay QA/QC program. QA/QC procedures for biological testing in sediments are summarized in Table C-8.

5.7.1 Toxicity Test Quality Control

All three sediment toxicity tests will incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, reference sediment samples, laboratory replicates, and measurements of water quality during testing, as presented in Table C-8.

The negative control to be used for the sediment toxicity tests will be a clean control, which consists of a clean, inert material and the same diluent seawater used in testing sediment toxicity.

The positive control to be used for the sediment toxicity tests will be a toxic control in which a reference toxicant is used to establish the relative sensitivity of the test organism. The positive control for sediment tests is typically conducted with diluent seawater and without sediment. Sodium dodecyl sulfate will be used as the reference toxicant in the larval tests. Cadmium chloride will be used as the reference toxicant for the amphipod and juvenile polychaete tests.

In addition to the positive control described above, an additional positive control may be conducted using ammonia. Ammonia may be present in marine sediments and can be a significant cause of toxicity observed in toxicity tests. The purpose of the ammonia-positive control is to determine the toxicity of ammonia to the test organisms. Of the three test organisms, the polychaete *Neanthes arenaceodentata* is relatively insensitive to environmental concentrations of ammonia, while both the amphipod and the larval stages of the bivalve can be sensitive to concentrations observed in the environment. For this reason, a positive control may be conducted for only the amphipod and bivalve larval tests. A sediment-spiked ammonia reference toxicant test will be used for the amphipod test series. In addition to these standard ammonia measurements, test chamber interstitial ammonia levels will be evaluated prior to initiating and at the termination of both the amphipod and juvenile polychaete tests. If interstitial ammonia levels are greater than or equal to 20 milligrams per liter (mg/L), then a purging procedure will be followed until interstitial ammonia levels are below this limit. For the larval test, test chambers will be aerated if unionized ammonia concentrations exceed 0.014 mg/L in test waters (PSEP 1995).

A reference sediment sample will also be included with each toxicity test series. Reference sediments provide toxicity data that can be used to separate toxicant effects from unrelated effects, such as those of sediment grain size. They are also used in statistical comparisons to determine if test sediments are toxic. Sediment samples selected to be the test reference sediment should be collected from an area documented to be free from chemical contamination and should represent the range of important natural, physical, and chemical characteristics of the test sediments (specifically, sediment grain size and TOC). The Puget Sound Reference Areas survey was conducted by USEPA and Ecology (PSDDA 1989) to document suitable reference conditions in Puget Sound and defines reference area performance standards. Based on the results of this survey, Samish Bay will be utilized as the biological reference site and will form the basis for assessing compliance with the biological criteria. This reference area was selected for the following reasons: 1) availability of chemical and biological data to document suitability of the reference site, 2) geographic location, and 3) broad range of grain size distributions available to match those anticipated within the site.

Five laboratory replicates of each test sediments, reference sediments, and negative controls will be run for each bioassay. Bioassays require that proper water quality conditions be maintained to ensure survival of the organisms, and to ensure that undue stress is not exerted on the organisms unrelated to test sediments. Salinity, DO, pH, ammonia, total sulfides, and temperature will be measured to monitor water quality during testing.

5.7.2 QA/QC Performance Standards

Bioassay tests will be performed according to the procedures and QA/QC performance standards described in PSEP (1995), as revised by subsequent agency-approved updates, and as described in sub-appendix D of the Sampling and Analysis Plan Appendix (SAPA; Ecology 2008) (refer to Table C-8).

For the amphipod bioassay test, survival is the endpoint. Performance standards are defined as a maximum of 10% mortality in control treatments and less than 25% mortality in treatments using reference sediment.

For the larval bioassay test, normal development and survival are the endpoints. The seawater control has a performance standard of less than 30% combined abnormality and mortality (i.e., a 70% normal survivorship). The reference sediment has a performance standard of less than 35% effective mortality normalized to seawater control (i.e., a 65% normal survivorship of seawater control result).

For the juvenile polychaete bioassay test, survival and growth are the endpoints. The growth rate of organisms exposed to test sediments is compared to the growth rate of organisms in reference sediments. The control sediment has a performance standard of 10% mortality. The reference sediment has a performance standard of 80% of the control growth rate. The control growth rate guideline is 0.38 mg/individual/day.

5.8 PHYSICAL TESTING QC

No field or laboratory quality control samples will be collected or tested for Atterburg limits, specific gravity, and moisture content. Field duplicates for grain size will be tested as described in Section 5.5.1.

6 CORRECTIVE ACTIONS

Corrective actions will be required if there are deviations from the methods or QA requirements established in this QAPP or if there are equipment or analytical malfunctions. Corrective action procedures will be implemented based on the type of unacceptable data and will be developed on a case-by-case basis. The following corrective actions may be included:

- Altering procedures in the field
- Using a different batch of sample containers
- Performing an audit of field or laboratory procedures
- Reanalyzing samples (if holding times allow)
- Resampling
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies
- Accepting the data with no action, acknowledging the level of uncertainty
- Rejecting the data as unusable.

Corrective actions for laboratory analysis of sediment samples are presented in Tables C-6, C-7, and C-8.

During field operations and sampling procedures, the field personnel will be responsible for conducting and reporting required corrective action. A description of any corrective action taken will be entered in the daily field notebook and documented on the field change request form. If field conditions do not allow for conformance with this QAPP, the QA officer will be consulted immediately. For any corrective action or field condition resulting in a revision of this QAPP, the QA officer will authorize changes or exceptions to the QAPP, as necessary and appropriate.

During laboratory analysis, the laboratory QA officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in this QAPP, corrective action generally will follow the guidelines in the USEPA analytical methods noted in this QAPP and the USEPA guidelines for data validation (USEPA 1999, 2004). If analytical conditions are such that nonconformance with this QAPP is indicated, the QA officer will be notified as soon as possible so that any additional corrective actions can be taken.

Corrective action reports will be used to document responses to reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities. Corrective action reports will be reviewed initially for appropriateness of recommendations and actions by the QA officer. The QA officer will define responsibilities for scheduling, performing, documenting, and assessing the effectiveness of the required action. As appropriate, the corrective action reports also may be submitted to City and PSE for review and approval. The QA officer is ultimately responsible for implementation of appropriate corrective action and maintenance of a complete record of QC issues and corrective actions.

7 DATA MANAGEMENT PROCEDURES

All laboratory analytical results, including QC data, will be submitted electronically to Herrenkohl Consulting and Landau Associates. Electronic format will include comma separated value (CSV) files that will be downloaded directly to the project Access database. A hard copy of the laboratory report will be sent to Landau Associates for data validation. Following validation of the data, any qualifiers will be added to the project database. All survey data will be provided electronically in a format that can be downloaded into an Excel spreadsheet. All field data (groundwater field parameter data and water levels measurements) will be entered into an Excel spreadsheet and verified to determine all entered data is correct and without omissions and errors. Following receipt of all RI data, all survey data, water level measurements, field parameters, and analytical results will be formatted electronically and downloaded to Ecology's Environmental Information Management (EIM) system.

Hard copies of the laboratory chemical analytical reports will be equivalent to an EPA Contract Laboratory Program (CLP) Level IV data package and will include the following:

- Case narrative, including adherence to prescribed protocols, nonconformity events, corrective measures, and/or data deficiencies
- Sample analytical results
- Surrogate recoveries
- Matrix spike/matrix spike duplicate results
- Blank spike/blank spike duplicate results
- Laboratory duplicates
- Blank results
- Sample receipt forms (including signed, original chain-of-custody records)
- Analytical responsibility
- Initial and continuing calibration summary forms and raw data
- Instrument raw data (including all associated quantification reports and chromatograms)
- Supporting data (including sample preparation bench sheets)
- Quantitation reports.

Biological testing laboratory reports will include the following:

- A cover letter discussing analytical problems (if any) and procedures
- Sources of test organisms and control sediment
- Test methods used for biological testing and statistical analyses

- Protocol references and description of any nonstandard procedures
- Results for survival, growth, reburial, abnormalities, water quality parameters, reference toxicants, and statistical analyses, as appropriate
- Original data sheets for water quality, survival, growth, reburial, abnormalities, reference toxicant, and statistics
- Identification for each control, reference, and sample duplicate
- Original quality control checklists
- Chain-of-custody records.

8 DATA REDUCTION, VALIDATION, AND REPORTING

Sufficient backup data and QC results to enable reviewers to determine the quality of the data will accompany project analytical reports from the laboratory. The quality assurance officer (QAO) for this project is responsible to the project manager for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the QC elements in this Work Plan. The QAO will also prepare a laboratory data quality evaluation report, based on appropriate sections of the USEPA validation guidelines (USEPA 1999, 2004) and the *Data Validation Guidance Manual for Selected Sediment Variables* (PTI 1989).

This report will include evaluations of the following:

- Chain-of-custody methods
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes and blank spike duplicates
- Laboratory duplicates
- Completeness
- Overall assessment of data quality.

Additionally, a full data validation will be conducted on 10% of the data set; the selection of which will be determined randomly. In addition to evaluating the items listed above, instrument quality control and performance (including initial and continuing calibration, tuning, sensitivity, and degradation) will be evaluated and instrument and sample results from the laboratory instrument responses will be recalculated. For methods requiring spectral interpretation and/or chromatography, all required instrument outputs (e.g., chromatograms, mass spectra, instrument background corrections, and interference corrections) will be checked for correct identification and quantitation of analytes.

9 REFERENCES

Ecology. 1995. Sediment Management Standards. Chapter 173-204 WAC. Washington State Department of Ecology. Amended December.

Ecology. 1997. Analytical Methods for Petroleum Hydrocarbons. Publication No. ECY 97-602. June.

Ecology. 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology. July.

Ecology. 2008. Sediment Sampling and Analysis Plan Appendix. Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Prepared by the Washington State Department of Ecology, Olympia, WA. Ecology Publication No. 03-09-043, Last updated February 2008.

PSDDA. 1996. Sediment Management Program Biennial Report. Dredging Years 1994/1995. PSDDA/SMS Clarification Paper. Neanthes 20-day Growth Bioassay - Further Clarifications on Negative Control Growth Standard, Initial Size, and Feeding Protocol. Puget Sound Dredged Disposal Analysis Program. March.

PSDDA. 1989. Puget Sound Dredged Disposal Analysis: Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase II. U.S. Army Corps of Engineers – Seattle District, U.S. Environmental Protection Agency - Region 10, Washington State Department of Natural Resources, Washington State Department of Ecology.

PSEP. 1997a. Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Prepared by U.S. Environmental Protection Agency, Region 10 for Puget Sound Estuary Program. April.

PSEP. 1997b. Recommended Guidelines for Measuring Organic Compounds in Puget Sound Water Sediment and Tissue Samples. Prepared by U.S. Environmental Protection Agency, Region 10 for Puget Sound Estuary Program. April.

PSEP. 1997c. Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples. Prepared by U.S. Environmental Protection Agency, Region 10 for Puget Sound Estuary Program. April.

PSEP. 1995. Puget Sound Estuary Program: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington. Revised July 1995.

PSEP. 1986. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Final Report. Prepared by U.S. Environmental Protection Agency, Region 10 for Puget Sound Estuary Program. March.

PTI. 1989. Data Validation Guidance Manual for Selected Sediment Variables Prepared for the Washington State Department of Ecology.

USEPA. 1986. Test Methods for Evaluating Solid Waste. EPA/SW-846, Third Edition with 2007 updates. U.S Environmental Protection Agency

USEPA. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA-540/R-99/008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

USEPA. 2004. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA-540/R-04-004. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, D.C. October.

ATTACHMENT A

LABORATORY QUALITY ASSURANCE PLAN
(Compact Disk)

Table C-1. Project Team Contact Information.

Name	Project Role	Phone	Fax	Email
City of Bellingham				
Gina Austin, PE	Project Manager	360-778-7014	360-778-7001	gaustin@cob.org
Puget Sound Energy				
John Rork	Project Manager	425-456-2228	425-462-3587	john.rork@pse.com
Department of Ecology				
Mary O'Herron	Ecology Project Manager	360-715-5224	360-715-5225	mohe461@ecy.wa.gov
Lucy McInerney	Toxics Cleanup Program	425-649-7272	na	lpeb461@ecy.wa.gov
Common Consultants				
Mark Herrenkohl (Herrenkohl Consulting)	Project Manager/Field Operations Mgr.	360-319-0721	360-647-6980 call first	mherrenkohl@msn.com
Stacy Lane (Landau Associates)	Project QA Coordinator/Task Manager	425-329-0311	425-778-6409	slane@landauinc.com
Dylan Frazer (Landau Associates)	Health & Safety Officer/Field Operations Mgr.	425-778-0907	425-778-6409	dfrazer@landauinc.com
Larry Beard (Landau Associates)	Senior Project QA/QC	425-778-0907	425-778-6409	lbeard@landauinc.com
Chemical Laboratories				
Kelly Bottem (Analytical Resources, Inc.)	Laboratory Project Manager	206-695-6211	206-695-6201	kellyb@arilabs.com
Dave Mitchell (Analytical Resources, Inc.)	Laboratory QA Manager	206-695-6205	206-695-6201	davem@arilabs.com
Kate Aguilera (Columbia Analytical Services)	Laboratory Project Manager	805-577-2089	800-526-7270	kaguilera@caslab.com
Bioassay Laboratory				
Gerald Irissarri (Northwest Aquatic Services)	Laboratory Project Manager	541-265-7225	541-265-2799	girissarri@nwaquatic.com
Linda Nemeth (Northwest Aquatic Services)	Laboratory QA Manager	541-265-7225	541-265-2799	lnemeth@intew.net

Table C-2. Soil, Groundwater, and Surface Water Analytical Methods and Target Reporting Limits

	Analytical Method (a)	Target Reporting Limits (b)	
Analyte		**Water**	**Soil**
SEMIVOLATILES			
Phenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Bis-(2-Chloroethyl) Ether	EPA Method 8270	1.0 µg/L	0.067 mg/kg
2-Chlorophenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
1,3-Dichlorobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
1,4-Dichlorobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Benzyl Alcohol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
1,2-Dichlorobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
2-Methylphenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
2,2'-Oxybis(1-Chloropropane)	EPA Method 8270	1.0 µg/L	0.067 mg/kg
4-Methylphenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
N-Nitroso-Di-N-Propylamine	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Hexachloroethane	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Nitrobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Isophorone	EPA Method 8270	1.0 µg/L	0.067 mg/kg
2-Nitrophenol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
2,4-Dimethylphenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Benzoic Acid	EPA Method 8270	10.0 µg/L	0.2 mg/kg
bis(2-Chloroethoxy) Methane	EPA Method 8270	5.0 µg/L	0.33 mg/kg
2,4-Dichlorophenol	EPA Method 8270	1.0 µg/L	0.067 mg/kg
1,2,4-Trichlorobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Naphthalene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
4-Chloroaniline	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Hexachlorobutadiene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
4-Chloro-3-methylphenol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
1-Methylnaphthalene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
2-Methylnaphthalene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Hexachlorocyclopentadiene	EPA Method 8270	5.0 µg/L	0.33 mg/kg
2,4,6-Trichlorophenol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
2,4,5-Trichlorophenol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
2-Chloronaphthalene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
2-Nitroaniline	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Dimethylphthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Acenaphthylene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
3-Nitroaniline	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Acenaphthene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
2,4-Dinitrophenol	EPA Method 8270	1.0 µg/L	0.67 mg/kg
4-Nitrophenol	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Dibenzofuran	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
2,6-Dinitrotoluene	EPA Method 8270	5.0 µg/L	0.067 mg/kg
2,4-Dinitrotoluene	EPA Method 8270	10.0 µg/L	0.33 mg/kg
Diethylphthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
4-Chlorophenyl-phenylether	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Fluorene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
4-Nitroaniline	EPA Method 8270	5.0 µg/L	0.33 mg/kg
4,6-Dinitro-2-Methylphenol	EPA Method 8270	10.0 µg/L	0.67 mg/kg
N-Nitrosodiphenylamine	EPA Method 8270	5.0 µg/L	0.067 mg/kg
4-Bromophenyl-phenylether	EPA Method 8270	1.0 µg/L	0.067 mg/kg

Table C-2. Soil, Groundwater, and Surface Water Analytical Methods and Target Reporting Limits

Analyte	Analytical Method (a)	Target Reporting Limits (b) Water	Soil
SEMIVOLATILES (continued)			
Hexachlorobenzene	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Pentachlorophenol	EPA Method 8270 SIM (c)	0.5 µg/L	--
Phenanthrene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Carbazole	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Anthracene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Di-n-Butylphthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Fluoranthene	EPA Method 8270 SIM (c)	0.01 µg/L	0.067 mg/kg
Pyrene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Butylbenzylphthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
3,3'-Dichlorobenzidine	EPA Method 8270	5.0 µg/L	0.33 mg/kg
Benzo(a)anthracene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
bis(2-Ethylhexyl)phthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Chrysene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Benzo(b)fluoranthene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Benzo(k)fluoranthene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Di-n-Octyl phthalate	EPA Method 8270	1.0 µg/L	0.067 mg/kg
Benzo(a)pyrene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Indeno(1,2,3-cd)pyrene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Dibenz(a,h)anthracene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg
Benzo(g,h,i)perylene	EPA Method 8270 SIM (c)	0.1 µg/L	0.067 mg/kg

Table C-2. Soil, Groundwater, and Surface Water Analytical Methods and Target Reporting Limits

Analyte	**Analytical Method (a)**	**Target Reporting Limits (b) Water**	**Target Reporting Limits (b) Soil**
VOLATILES			
Chloromethane	EPA Method 8260	0.5 µg/L	--
Bromomethane	EPA Method 8260	1.0 µg/L	--
Vinyl Chloride	EPA Method 8260 SIM	0.02 µg/L	--
Chloroethane	EPA Method 8260	0.2 µg/L	--
Methylene Chloride	EPA Method 8260	0.5 µg/L	--
Acetone	EPA Method 8260	5.0 µg/L	--
Carbon Disulfide	EPA Method 8260	0.2 µg/L	--
1,1-Dichloroethene	EPA Method 8260 SIM	0.02 µg/L	--
1,1-Dichloroethane	EPA Method 8260	0.2 µg/L	--
trans-1,2-Dichloroethene	EPA Method 8260	0.2 µg/L	--
cis-1,2-Dichloroethene	EPA Method 8260	0.2 µg/L	--
Chloroform	EPA Method 8260	0.2 µg/L	--
1,2-Dichloroethane	EPA Method 8260	0.2 µg/L	--
2-Butanone	EPA Method 8260	5.0 µg/L	--
1,1,1-Trichloroethane	EPA Method 8260	0.2 µg/L	--
Carbon Tetrachloride	EPA Method 8260	0.2 µg/L	--
Vinyl Acetate	EPA Method 8260	1.0 µg/L	--
Bromodichloromethane	EPA Method 8260	0.2 µg/L	--
1,2-Dichloropropane	EPA Method 8260	0.2 µg/L	--
cis-1,3-Dichloropropene	EPA Method 8260	0.2 µg/L	--
Trichloroethene	EPA Method 8260	0.2 µg/L	--
Dibromochloromethane	EPA Method 8260	0.2 µg/L	--
1,1,2-Trichloroethane	EPA Method 8260	0.2 µg/L	--
Benzene	EPA Method 8260	0.2 µg/L	--
trans-1,3-Dichloropropene	EPA Method 8260	0.2 µg/L	--
2-Chloroethylvinylether	EPA Method 8260	1.0 µg/L	--
Bromoform	EPA Method 8260	0.2 µg/L	--
4-Methyl-2-Pentanone (MIBK)	EPA Method 8260	5.0 µg/L	--
2-Hexanone	EPA Method 8260	5.0 µg/L	--
Tetrachloroethene	EPA Method 8260	0.2 µg/L	--
1,1,2,2-Tetrachloroethane	EPA Method 8260	0.2 µg/L	--
Toluene	EPA Method 8260	0.2 µg/L	--
Chlorobenzene	EPA Method 8260	0.2 µg/L	--
Ethylbenzene	EPA Method 8260	0.2 µg/L	--
Styrene	EPA Method 8260	0.2 µg/L	--
Trichlorofluoromethane	EPA Method 8260	0.2 µg/L	--
1,1,2-Trichlorotrifluoroethane	EPA Method 8260	0.2 µg/L	--
m,p-Xylene	EPA Method 8260	0.4 µg/L	--
o-Xylene	EPA Method 8260	0.2 µg/L	--
1,2-Dichlorobenzene	EPA Method 8260	0.2 µg/L	--
1,3-Dichlorobenzene	EPA Method 8260	0.2 µg/L	--
1,4-Dichlorobenzene	EPA Method 8260	0.2 µg/L	--
Acrolein	EPA Method 8260	5.0 µg/L	--
Methyl Iodide	EPA Method 8260	0.2 µg/L	--
Bromoethane	EPA Method 8260	0.2 µg/L	--
Acrylonitrile	EPA Method 8260	1.0 µg/L	--
1,1-Dichloropropene	EPA Method 8260	0.2 µg/L	--

Table C-2. Soil, Groundwater, and Surface Water Analytical Methods and Target Reporting Limits

Analyte	Analytical Method (a)	Target Reporting Limits (b) Water	Target Reporting Limits (b) Soil
VOLATILES (continued)			
Dibromomethane	EPA Method 8260	0.2 µg/L	--
1,1,1,2-Tetrachloroethane	EPA Method 8260	0.2 µg/L	--
1,2-Dibromo-3-chloropropane	EPA Method 8260	0.5 µg/L	--
1,2,3-Trichloropropane	EPA Method 8260	0.5 µg/L	--
trans-1,4-Dichloro-2-butene	EPA Method 8260	1.0 µg/L	--
1,3,5-Trimethylbenzene	EPA Method 8260	0.2 µg/L	--
1,2,4-Trimethylbenzene	EPA Method 8260	0.5 µg/L	--
Hexachlorobutadiene	EPA Method 8260	0.5 µg/L	--
Ethylene Dibromide	EPA Method 8260	0.2 µg/L	--
Bromochloromethane	EPA Method 8260	0.2 µg/L	--
2,2-Dichloropropane	EPA Method 8260	0.2 µg/L	--
1,3-Dichloropropane	EPA Method 8260	0.2 µg/L	--
Isopropylbenzene	EPA Method 8260	0.2 µg/L	--
n-Propylbenzene	EPA Method 8260	0.2 µg/L	--
Bromobenzene	EPA Method 8260	0.2 µg/L	--
2-Chlorotoluene	EPA Method 8260	0.2 µg/L	--
4-Chlorotoluene	EPA Method 8260	0.2 µg/L	--
tert-Butylbenzene	EPA Method 8260	0.2 µg/L	--
sec-Butylbenzene	EPA Method 8260	0.2 µg/L	--
4-Isopropyltoluene	EPA Method 8260	0.2 µg/L	--
n-Butylbenzene	EPA Method 8260	0.2 µg/L	--
1,2,4-Trichlorobenzene	EPA Method 8260	0.5 µg/L	--
Naphthalene	EPA Method 8260	0.5 µg/L	--
1,2,3-Trichlorobenzene	EPA Method 8260	0.5 µg/L	--
METALS (d)			
Antimony	EPA Method 200.8/6020	0.2 µg/L	0.2 mg/kg
Arsenic	EPA Method 200.8/6020	0.2 µg/L	0.2 mg/kg
Barium	EPA Method 200.8/6020	0.5 µg/L	0.5 mg/kg
Calcium (e)	EPA Method 6010	50 µg/L	--
Magnesium (e)	EPA Method 6010	50 µg/L	--
Cadmium	EPA Method 200.8/6020	0.2 µg/L	0.2 mg/kg
Chromium	EPA Method 200.8/6020	0.5 µg/L	0.5 mg/kg
Copper	EPA Method 200.8/6010	0.5 µg/L	0.5 mg/kg
Lead	EPA Method 200.8/6010	1.0 µg/L	1.0 mg/kg
Mercury	EPA Method 7470/7471	0.1 µg/L	0.05 mg/kg
Selenium	EPA Method 200.8/6020	0.5 µg/L	0.5 mg/kg
Silver	EPA Method 200.8/6020	0.2 µg/L	0.2 mg/kg
Zinc	EPA Method 200.8/6020	4.0 µg/L	4.0 mg/kg
PCBs			
Aroclor 1016	EPA Method 8082	--	0.033 mg/kg
Aroclor 1242	EPA Method 8082	--	0.033 mg/kg
Aroclor 1248	EPA Method 8082	--	0.033 mg/kg
Aroclor 1254	EPA Method 8082	--	0.033 mg/kg
Aroclor 1260	EPA Method 8082	--	0.033 mg/kg
Aroclor 1221	EPA Method 8082	--	0.033 mg/kg
Aroclor 1232	EPA Method 8082	--	0.033 mg/kg

Table C-2. Soil, Groundwater, and Surface Water Analytical Methods and Target Reporting Limits

Analyte	Analytical Method (a)	Target Reporting Limits (b) Water	Target Reporting Limits (b) Soil
Total Petroleum Hydrocarbons			
Diesel-Range Petroleum Hydrocarbons	NWTPH-Dx (f)	0.25 mg/L	5.0 mg/kg
Motor Oil-Range Petroleum Hydrocarbons	NWTPH-Dx (f)	0.5 mg/L	10.0 mg/kg
Gasoline-Range Petroluem Hydrocarbons	NWTPH-Gx (f)	0.3 mg/L	0.5 mg/kg
CONVENTIONALS			
Cynanide (Total)	EPA 335.4	0.005 mg/L	0.25 mg/kg
Cyanide (Weak Acid Dissociable)	SM4500 CN I	0.005 mg/L	0.25 mg/kg
Total Dissolved Solids	EPA 160.1	5 mg/L	--
Total Suspended Solids	EPA 160.2	1.0 mg/L	--
Total Organic Carbon	EPA Method 415.1	--	200 mg/kg
Hardness	Calculated (g)	--	--
PHYSICAL TESTS			
Grain Size	ASTM D 422-07	--	--
Atterburg Limits	ASTM D 4318-10	--	--
Specific Gravity	ASTM-854-10	--	--
Moisture Content/Bulk Density	ASTM2216-05	--	--

SIM = Selected ion monitoring

(a) Analytical methods are from SW-846 (EPA 1986) and upddates.
(b) Reporting limits goals are based on current laboratory data and may be modified during the investigation process as methodology is refined. Laboratory reporting will be based on the lowest standard on the calibration curve. Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limits.
(c) PAH analysis for selected samples will be performed using low level EPA Method 8270 SIM.
(d) Groundwater samples will be analyzed for both total and dissolved metals
(e) Only surface water samples will be analyzed for calcium and magnesium
(f) Methods NWTPH-Dx and NWTPH-Gx as described in *Analytical Methods for Petroleum Hydrocarbons* Washington State Department of Ecology, Publication ECY97-602, June 1997 (Ecology 1997)
(g) Hardness will be calculated using results for calcium and magnesium.

Table C-3. Sediment Sample Preparation, Cleanup, Analytical Methods, and Target Reporting Limits (Ecology 2008)

Chemical	Recommended Sample Preparation Methods (a)	Recommended Sample Cleanup Methods (b)	Recommended Analytical Methods (c)	Recommended Practical Quantitation Limits (d,e)
Metals				**(mg/kg dry weight)**
Arsenic	PSEP/3050B	--	6010B/6020/7061A	19
Cadmium	PSEP/3050B	--	6010B/6020/7131A	1.7
Chromium	PSEP/3050B	--	6010B/6020/7191	87
Copper	PSEP/3050B	--	6010B/6020	130
Lead	PSEP/3050B	--	6010B/6020	150
Mercury	-- (f)	--	7471A/245.5	0.14
Silver	PSEP/3050B	--	6010B/6020	2
Zinc	PSEP/3050B	--	6010B/6020	137
Nonionizable Organic Compounds				**(µg/kg dry weight or as listed)**
LPAH Compounds				
Naphthalene	3540C/3550B/3545	3640A/3660B	8270D/1625C	700
Acenaphthylene	3540C/3550B/3545	3640A/3660B	8270D/1625C	433
Acenaphthene	3540C/3550B/3545	3640A/3660B	8270D/1625C	167
Fluorene	3540C/3550B/3545	3640A/3660B	8270D/1625C	180
Phenanthrene	3540C/3550B/3545	3640A/3660B	8270D/1625C	500
Anthracene	3540C/3550B/3545	3640A/3660B	8270D/1625C	320
2-Methylnaphthalene	3540C/3550B/3545	3640A/3660B	8270D/1625C	223
HPAH Compounds				
Fluoranthene	3540C/3550B/3545	3640A/3660B	8270D/1625C	567
Pyrene	3540C/3550B/3545	3640A/3660B	8270D/1625C	867
Benz[a]anthracene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	433
Chrysene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	467
Total benzofluoranthenes (g)	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	1067
Benzo[a]pyrene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	533
Indeno[1,2,3-cd]pyrene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	200
Dibenz[a,h]anthracene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	77
Benzo[ghi]perylene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	223
Chlorinated Benzenes				
1,2-Dichlorobenzene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	35
1,3-Dichlorobenzene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	57
1,4-Dichlorobenzene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	37
1,2,4-Trichlorobenzene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	31
Hexachlorobenzene	3540C/3550B/3545	3640A/3660B	8270D (h) / 1625C	22
Phthalate Esters				
Dimethyl phthalate	3540C/3550B/3545	3640A/3660B	8270D/1625C	24
Diethyl phthalate	3540C/3550B/3545	3640/A3660B	8270D/1625C	67
Di-n-butyl phthalate	3540C/3550B/3545	3640A/3660B	8270D/1625C	467
Butyl benzyl phthalate	3540C/3550B/3545	3640A/3660B	8270D/1625C	21
Bis[2-ethylhexyl]phthalate	3540C/3550B/3545	3640A/3660B	8270D/1625C	433
Di-n-octyl phthalate	3540C/3550B/3545	3640A/3660B	8270D/1625C	2067
Miscellaneous Extractable Compounds				**(µg/kg dry weight or as listed)**
Dibenzofuran	3540C/3550B/3545	3640A/3660B	8270D/1625C	180
Hexachlorobutadiene	3540C/3550B/3545	3640A/3660B	8270D/1625C	11
Hexachloroethane	3540C/3550B/3545	3640A/3660B	8270D/1625C	47
N-nitrosodiphenylamine	3540C/3550B/3545	3640A/3660B	8270D/1625C	28
PCBs				
PCB Aroclors®	3540/3550	3620B/3640A/3660B	8082	6
Conventional Sediment Variables				
Ammonia	-- (j)	--	Plumb (1981)	100 mg/L
Grain size	-- (j)	--	ASTM 422-07 w/hydrometer	1%
Total solids	-- (j)	--	PSEP	0.1% (wetwt)
Total organic carbon (TOC)	-- (j)	--	9060	0.10%
Total sulfides	-- (j)	--	Plumb (1981)/ 9030B	10 (mg/kg)
Site Specific Compounds				**(µg/kg dry weight or as listed)**
Ammonia	-- (j)	--	See above	100
Other potentially toxic metals (e.g., antimony, beryllium, nickel)	PSEP	--	See above	Sb 50, Ni 47

Table C-3. Sediment Sample Preparation, Cleanup, Analytical Methods, and Target Reporting Limits (Ecology 2008)

USEPA - U.S. Environmental Protection Agency
GPC - gel permeation chromatography
HPAH - high molecular weight polycyclic aromatic hydrocarbon
LPAH - low molecular weight polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PSEP - Puget Sound Estuary Program
TOC - total organic carbon

(a) Recommended sample preparation methods are:
- PSEP (1997a)
- Method 3050B and 3500 series - sample preparation methods from SW-846 (USEPA 1996) and subjected to changes by USEPA updates

(b) Recommended sample cleanup methods are:
- Sample extracts subjected to GPC cleanup follow the procedures specified by USEPA SW-846 Method 3640A. Special care should be used during GPC to minimize loss of analytes.
- If sulfur is present in the samples (as is common in most marine sediments), cleanup procedures specified by EPA SW-846 Method 3660B should be used
- All PCB extracts should be subjected to sulfuric acid/permanganate cleanup as specified by EPA SW-846 Method 3665A
- Additional cleanup procedures may be necessary on a sample-by-sample basis. Alternative cleanup procedures are described in PSEP (1997b) and U.S. EPA (1986)

(c) Recommended analytical methods are:
- Method 6000, 7000, 8000, and 9000 series - analytical methods from SW-846 (U.S. EPA 1986) and updates
- The SW-846 and updates are available from the web site at: http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm
- Method 1613 - analytical method from USEPA-821/B-94-005 (1994)
- Method 1624C/1625C - isotope dilution method (U.S. EPA 1989)
- NCASI – analytical methods from the National Council for Air and Stream Improvement, Inc.
- Plumb (1981) - USEPA/U.S. Army Corps of Engineers Technical Report EPA/CE-81-1
- PSEP (1986)
- Acid volatile sulfide method for sediment (USEPA 1991).
- Krone (1989) – Krone, C. A., D. W. Brown, D. G. Burrows, R. G. Bogar, S. L. Chan and U. Varanasi, 1989. A Method for the Analysis of Butyltin Species and the Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound
- Marine Environmental Research 27:1-18.

(d) To achieve the recommended practical quantitation limits for organic compounds, it may be necessary to use a larger sample size approximately 100 g) a smaller final extract volume for gas chromatography/mass spectrometry analyses (0.5 mL), and one of the recommended sample cleanup methods as necessar to reduce interference, using different analytical methods with better sensitivity. Detection limits are on a dry-weight basis unless otherwise indicated For sediment samples with low TOC, it may be necessary to achieve even lower detection limits for certain analytes in order to compare the TOC-normalized concentrations with applicable numerical criteria (see Table 1)

(e) The recommended practical quantitation limits are based on a value equal to one third of the 1988 dry weight lowest apparent effects threshold value (LAET, Barrick et al 1988) except for the following chemicals: 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, hexachlorobenzene, hexachlorobutadiene n-nitrosodiphenylamine, 2-methylphenol, 2,4-dimethylphenol, and benzyl alcohol, for which the recommended maximum detection limit is equal t the full value of the 1988 dry weight LAET.

(f) The sample digestion method for mercury is described in the analytical method (Method 7471A, September 1994)

(g) Total benzofluoranthenes represent the sum of the b, j, and k isomers

(h) Selected ion monitoring may improve the sensitivity of method 8270C and is recommended in cases when detection limits must be lowered to human health criteria levels or when TOC levels elevate detection limits above ecological criteria levels. See PSEP organics chapter, appendix B - Guidance for Selected Ion Monitoring (1997b).

(i) Sample preparation methods for volatile organic compound analyses are described in the analytical methods

(j) Sample preparation methods for sediment conventional analyses are described in the analytical methods

Table C-4. Soil Vapor Analytical Method and Target Reporting Limits

Analyte	Analytical Method	Target Reporting Limits (a) µg/m³	ppbV
VOLATILES			
1,3-Butadiene	EPA Method TO-15	0.5	0.23
Methyl tert-Butyl Ether	MAPH Method	0.5	0.14
Benzene	MAPH Method	0.5	0.16
Toluene	MAPH Method	0.5	0.13
Ethylbenzene	MAPH Method	0.5	0.12
m,p-Xylene	MAPH Method	1.0	0.23
o-Xylene	MAPH Method	0.5	0.12
Naphthalene	MAPH Method	0.5	0.095
1,2,4-Trimethylbenzene	EPA Method TO-15	0.5	0.10
1,3,5-Trimethylbenzene	EPA Method TO-15	0.5	0.10
Petroleum Hydrocarbons			
C5-C8 Aliphatic Hydrocarbons	MAPH Method	20	--
C9-C12 Aliphatic Hydrocarbons	MAPH Method	10	--
C9-C10 Aromatic Hydrocarbons	MAPH Method	5	--

(a) Reporting limits goals are based on current laboratory data and may be modified during the investigation process as methodology is refined. Laboratory reporting will be based on the lowest standard on the calibration curve. Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limits.

Table C-5. Sediment Quality Control Procedures for Organic Analyses (Ecology 2008)

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration (a)	See reference method(s) in Table C-3	See reference method(s) in Table C-3	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration (a)	See reference method(s) in Table C-3	See reference method(s) in Table C-3	Laboratory to recalibrate if correlation coefficient or responsefactor does not meet method requirements
Method Quality Assurance/Quality Control			
Holding Times (a,b)	Not applicable	See SAP	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits(a,b)	Annually	See reference method(s) in Table C-3	Laboratory must initiate correctiveactions (which may include additional cleanup steps as well as other measures, see Table 5) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks(a,b)	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates (a,b) and Matrix Spike Duplicates (a,b)	1 duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Compound and matrix specific RPD . 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes (a,b)	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Compound and matrix specific	Matrix interferences should be assessed and explained in case narrative accompanying the data package.

Table C-5. Sediment Quality Control Procedures for Organic Analyses (Ecology 2008)

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Surrogate Spikes (a,b)	Added to every organics sample as specified in analytical protocol	Compound specific	Follow corrective actions specified in SW-846.
Laboratory Control Samples (LCS), Certified or Standard Reference Material (a,b)	One per analytical batch or every 20 samples, whichever is more frequent	Compound specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method of Table 5 or performance based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples
Field Quality Assurance/Quality Control			
Field Replicates	At project manager's discretion	Not applicable	Not applicable
Field Blanks	At project manager's discretion	Analyte concentration PQL	Compare to method blank results to rule out laboratory contamination; modify samplecollection and equipment decontamination procedures

CLP - Contract Laboratory Program (USEPA)
COV - coefficient of variation
EPA - U.S. Environmental Protection Agency
PCB - polychlorinated biphenyl
PQL - practical quantitation limit
RPD - relative percent difference
RSD - relative standard deviation
SVOC - semivolatile organic compound
VOC - volatile organic compound

(a) Subject to QA2 review
(b) Subject to QA1 review

Table C-6. Sediment Quality Control Procedures for Inorganic Analyses (Ecology 2008)

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration (a)	Daily	Correlation coefficient ≥ 0.995	Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples
Initial Calibration Verification (a)	Immediately after initial calibration	90 - 110 % recovery for ICP-AES, ICP-MS and GFAA (80 - 120 % for mercury), or performance based intralaboratory control limits, whichever is lower	Laboratory to resolve discre-pancy prior to sample analysis
Continuing Calibration Verification (a)	After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample	90 -110 % recovery for ICP-AES and GFAA, 85-115 % for ICP-MS (80 - 120 % for mercury)	Laboratory to recalibrate and reanalyze affected samples
Initial and Continuing Calibration Blanks (a)	Immediately after initial calibration, then 10 percent of samples or every 2 hours, whichever is more frequent, and after the last sample	Analyte concentration < PQL	Laboratory to recalibrate and reanalyze affected samples
ICP Interelement Interference Check Samples 9a)	At the beginning and end of each analytical sequence or twice per 8 hour shift, whichever is more frequent	80 - 120 percent of the true value	Laboratory to correct problem, recalibrate, and reanalyze affected samples
Method Quality Assurance/Quality Control			
Holding Times (a,b)	Not applicable	See SAP	Qualify data or collect fresh samples
Detection Limits (a,b)	Not applicable	See Table C-3	Laboratory must initiate corrective actions and contact the QA/QC coordinator and/or the project manager immediately
Method Blanks (a,b)	With every sample batch or every 20 samples, whichever is more frequent		Laboratory to redigest and reanalyze samples with analyte concentrations < 10 times the highest method blank
Analytical (Laboratory) Replicatesab and Matrix Spike Duplicates (a,b)	1 duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike replicates when samples are not expected to contain target analytes	RPD ≤ 20 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analyticalproblems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes (a,b)	With every sample batch or every 20 samples, whichever is more frequent	75 - 125 % recovery applied when the sample concentration is < 4 times the spiked concentration for a particular analyte	Laboratory may be able to correct or minimize problem; or qualify and accept data
Laboratory Control Samples, Certified or Standard Reference Material (a,b)	Overall frequency of 5 percent of field samples	80 - 20 % recovery, or performance based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples
Field Quality Assurance/Quality Control			
Field Replicates	At project manager's discretion	Not applicable	Not applicable
Field Blanks	At project manager's discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination; modify sample collection and equipment decontamination procedures

Table C-6. Sediment Quality Control Procedures for Inorganic Analyses (Ecology 2008)

Quality Control Procedure	Frequency	Control Limit	Corrective Action

CLP - Contract Laboratory Program (EPA)
EPA - U.S. Environmental Protection Agency
GFAA - graphite furnace atomic absorption
ICP-MS - inductively coupled plasma/mass spectrometry
ICP-AES - inductively coupled plasma/atomic emission spectrometry
PQL - practical quantitation limit
RPD - relative percent difference

(a) Subject to QA2 review
(b) Subject to QA1 review

Note:

Instrument and method QA/QC monitor the performance of the instrument and sample preparation procedures, and are the responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples. Instrument and method QA/QC results reported in the final data package should always meet control limits (with a very small number of exceptions that apply to difficult analytes as specified by EPA for the CLP). If instrument and method QA/QC procedures meet control limits, laboratory procedures are deemed to be adequate. Matrix and field QA/QC procedures monitor matrix effects and field procedures and variability. Although poor analytical procedures may also result in poor spike recovery or duplicate results, the laboratory is not held responsible for meeting control limits for these QA/QC samples. Except in the possible case of unreasonably large exceedances, any reanalyses will be performed at the request and expense of the project manager.

Table C-7 Quality Control Procedures for Conventional Analyses (Ecology 2008)

	Suggested Control Limit						
Analyte	**Initial Calibration (a)**	**Continuing Calibration (a)**	**Calibration Blanks (a)**	**Laboratory Control Samples**	**Matrix Spikes (a,b)**	**Laboratory Triplicates (a,b)**	**Method Blank (a,b)**
Ammonia	Correlation coefficient >0.995	90 - 110 percent recovery	Analyte concentration < PQL	80.120 percent recovery	75.125 percent recovery	20 % RSD	Analyte concentration < PQL
Grain size	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20 % RSD	Not applicable
Total organic carbon	Correlation coefficient >0.995	90 - 110 percent recovery	Analyte concentration < PQL	80 -120 percent recovery	75 -125 percent recovery	20 % RSD	Analyte concentration < PQL
Total sulfides	Correlation coefficient >0.990	85 - 115 percent recovery	Not applicable	65-135 percent recovery	65-135 percent recovery	20 % RSD	Analyte concentration < PQL
Total solids	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20 % RSD	Analyte concentration < PQL

EPA - U.S. Environmental Protection Agency
PSEP - Puget Sound Estuary Program
PQL - practical quantitation limit
QA/QC - quality assurance and quality control
RSD relative standard deviation

(a) Subject to QA2 review
(b) Subject to QA1 review

Notes:

EPA and PSEP control limits are not available for conventional analytes. The control limits provided above are suggested limits only. They are based on EPA control limits for metals analyses (see Table H-5), and an attempt has been made to take into consideration the expected analytical accuracy using PSEP methodology. Corrective action to be taken when control limits are exceeded is left to the Project Manager's discretion. The corrective action indicated for metals in Table H-5 may be applied to conventional analytes.

When applicable, the QA/QC procedures indicated in this table should be completed at the same frequency as for metals analyses (see Table C-4).

Table C-8. Marine and Estuarine Sediment Toxicity Test Conditions (from Ecology 2008)

Toxicity Test ***Test Species***	**Frequency of Water Quality Monitoring**		**Control Limits**			**Control Samples**			**Performance Standards**[a]
	Temperature, Salinity, Dissolved Oxygen, pH	Sulfides, Ammonia	Temp (°C)	Salinity (ppt)	Dissolved Oxygen (% saturation)	Negative Control	Positive Control	Reference Sediment	
Acute Effects Tests									
Amphipod *Eohaustorius estuarius*	Daily	Beginning/ end (optional)	15±1	Ambient (same as interstitial)	NA[b]	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
Larval Mussel (*Mytilus* sp.)[d]	Daily	Beginning/ end	16±1	28±1	>60[c]	Clean seawater	Reference toxicant in seawater	Yes	Mean normal survivorship in seawater control ≥70 percent at time final.
Chronic Effects Tests									
Juvenile polychaete *Neanthes* sp.	Every third day	Beginning/ end (optional)	20±1	28±2	NA[b]	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean individual growth ≥ 0.72 mg/ind/day. A test failed when growth rate <0.38 mg/ind./da. Mean individual growth rate in reference sediment ≥80 percent of mean individual growth rate in control sediment.

Notes:

[a] Performance standards in WAC 173-204-315(2).

[b] Continuous aeration is required by the protocol, so the dissolved oxygen concentration should not be cause for concern.

[c] Aeration should be initiated if the dissolved oxygen concentration declines below 60 percent of saturation.

[d] PSEP (1995) and the SMS refer only to the use of *Mytilus edulis* in this test. However, it may be more accurate to refer to the test organisms used as members of the *Mytilus edulis* sibling species complex. Recent taxonomic studies of west coast mussels (McDonald and Koehn 1988; McDonald et al. 1991; Geller et al. 1993) indicate that the mussels in Washington state are either *M. trossulus* (a more northerly species) or *M. galloprovincialis* (a more southerly species). The mussel species being used by most biological laboratories in the northwest is *M. galloprovincialis*. *M. edulis* does not occur locally and is therefore unlikely to be used in toxicity tests. This does not constitute a change in test organisms, but an acknowledgment that the organisms may have been previously misidentified.