Final
Remedial Investigation/Feasibility Study
North Marina Ameron/Hulbert Site
Everett, Washington

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Prepared for

Port of Everett
Everett, Washington

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ACC	American Construction Company
AET	Apparent Effects Threshold
AO	Agreed Order
ARARs	Applicable or Relevant and Appropriate Requirements
AST	Aboveground Storage Tank
ATC/MOC	American Tugboat Company/Manson Osberg Construction
BBP	benzyl butyl phthalate
BE	Biological Evaluation
BEHP	bis(2-ethylhexyl)phthalate
BGS	Below Ground Surface
CAP	Cleanup Action Plan
CCP	Contamination Contingency Plan
CLARC	Cleanup Levels and Risk Calculations
COCs	Constituents of Concern
Cm	Centimeter
Cm/sec	Centimeter per Second
cPAH	Carcinogenic Polycyclic Aromatic Hydrocarbons
CSL	Cleanup Screening Level
CSM	Conceptual Site Model
CUL	Cleanup Level
DGI	Data Gaps Investigation
DO	Dissolved Oxygen
ECI	Earth Consultants Inc.
Ecology	Washington State Department of Ecology
EMPC	Estimated Maximum Possible Concentrations
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
FS	Feasibility Study
Ft/day	Feet per Day
HBU	Highest Beneficial Use
HCID	Hydrocarbon Identification
IHS	Indicator Hazardous Substances
LNAPL	Light Nonaqueous Phase Liquid
MDL	Method Detection Limit
MEK	Methyl Ethyl Ketone
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MLLW	Mean Lower Low Water
MNR	Monitored Natural Attenuation
MSRC	Marine Spill Response Corporation
MTCA	Model Toxics Control Act
NTU	Nepholemetric Units
O&M	Operation and Maintenance
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Act
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCL	Preliminary Cleanup Level

LIST OF ABBREVIATIONS AND ACRONYMS Con’t

Port	Port of Everett
PQL	Practical Quantitation Limits
PRB	Permeable Reactive Barrier
PSI	Puget Sound Initiative
PSTL	Puget Sound Truck Lines
PSDDA	Puget Sound Dredged Disposal Analysis
PVC	Polyvinyl Chloride
RAO	Remedial Action Objective
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
Site	North Marina West End Site
SMS	Sediment Management Standard
SGMP	Soil and Groundwater Management Plan
SQS	Sediment Quality Standard
SVE	Soil Vapor Extraction
SVOCs	Semivolatile Organic Compounds
TBT	Tributyl Tin
TEF	Toxicity Equivalency Factors
TEQ	Toxicity Equivalency Quotient
TOC	Total Organic Compound
TPH	Total Petroleum Hydrocarbon
TSCA	Toxics Substance Control Act
TVS	Total Volatile Solids
µg/L	Micrograms per Liter
µS/cm	MicroSiemens per Centimeter
UST	Underground Storage Tank
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act
Yd^3	Cubic Yards

1.0 INTRODUCTION

This report presents the results of a remedial investigation/feasibility study (RI/FS) conducted for the North Marina Ameron/Hulbert Site (Site), located within the former Port of Everett (Port) North Marina Redevelopment project site boundary in Everett, Washington. The Site is on the Washington State Department of Ecology's (Ecology) Hazardous Sites List under Facility Site Number 68853261. The regional location of the Site is shown on Figure 1. Information obtained during investigations and from interim actions conducted prior to the RI is presented in this report, along with information from the RI, to provide a comprehensive evaluation of the nature and extent of contamination at the Site, and to develop and evaluate appropriate cleanup action alternatives.

The Site is owned by the Port and is part of a larger area, referred to as the North Marina Area (Figure 2), which is being redeveloped into a mixed-use development by the Port. Previous investigations of the Site and an interim cleanup action have been conducted under Ecology's Voluntary Cleanup Program (VCP). However, Ecology requested that the final cleanup action for the Site be conducted under Ecology's formal program as part of the Puget Sound Initiative (PSI). As a result, the RI/FS is being performed under Agreed Order DE 6677 (AO) between the Port, Ameron International and the Hulberts [the potentially liable parties (PLPs)], and Ecology.

This report was prepared for submittal to Ecology in accordance with the provisions of the AO, and was developed to meet the general requirements of an RI and FS as defined by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation [Washington Administrative Code (WAC) 173-340-350]. The RI describes the environmental setting of the Site and identifies the nature and extent of contamination for affected media. The FS develops and evaluates alternatives for cleanup of the Site.

2.0 SITE BACKGROUND

The Site is part of the former North Marina Redevelopment project site, for which cleanup was being conducted under Ecology's VCP (VCP No. 1249). As a result of Ecology's request that cleanup for the North Marina Redevelopment project site be conducted as part of the PSI, the North Marina Redevelopment project site was removed from the VCP on November 14, 2007, and the former site was subdivided into six separate sites. The Site is one of three sites that are being addressed under formal agreements with Ecology as part of the PSI. The other three sites within the former North Marina Redevelopment project site are being addressed under the VCP. The former North Marina Redevelopment project site will be referred to as the North Marina Area in this document. The Site is located within the northern portion of the North Marina Area, as shown on Figure 2. The preliminary Site boundary is also shown on Figure 2. The final Site boundary will be determined based on the results of the RI for the Site. Based on the preliminary Site boundary, the Site consists of approximately 30 acres, including about 18 acres of upland and 12 acres of adjacent in-water area. As a point of reference, the approximate center of the Manufacturing Building on the current Ameron leasehold is located at 48°00'9.29" North and 122°12'55.55" West.

Because the environmental investigations and remediation activities conducted prior to the RI/FS that are described in this report were performed under the VCP, some of the terminology used in previous reports does not conform to the terminology used in the MTCA formal process. For instance, active remediation under the interim cleanup actions was described as "cleanup action," even though, under the formal process, the cleanup action is not performed until after the RI/FS and cleanup action plan (CAP) have been approved. Another example is the reference to "cleanup action areas," which would normally be referred to as "interim action areas" if the Site had been processed under the formal program from the beginning. For ease of reference, terms used in the VCP documents are carried over where this report discusses activities/reports that were carried out while the Site was under the VCP.

Interim actions for the Site were conducted in 1991, 1993, and between October 2005 and October 2007. The 1991 and 1993 interim actions were conducted with less rigorous documentation of the interim action design (A-1 Pump Service 1991; Kleinfelder 1993), but were generally consistent with the standard of practice at that time. The 2005-2008 interim action was conducted for cleanup of the North Marina Area, in accordance with a CAP and subsequent CAP addendum developed for the North Marina Area under the VCP (Landau Associates 2006a and 2006b). The CAP was developed for the cleanup of contaminated soil located across a majority of the North Marina Area (Landau Associates 2006a). The CAP addendum (Landau Associates 2006b) was developed for cleanup of soil in Area G-1, in the northwest corner of the current Ameron leasehold. These interim actions are described in detail in the *Interim Action Report* (Landau Associates 2010a), which can be viewed on Ecology's website using the following weblink: https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=3546. Note that all documents referenced throughout this report as being available on Ecology's website can be accessed using the weblink above.

In August of 2011, an emergency action cleanup was conducted at the Site to address petroleum hydrocarbon soil contamination in a portion of the Site that is being redeveloped by the Port as an expansion of the Port's existing Craftsman District boatyard. The emergency cleanup action was conducted in accordance with the *Emergency Action Cleanup Plan* (Landau Associates 2011a) and the results are documented in a technical memorandum as discussed in Section 3.3. Documents associated with the emergency cleanup action can be viewed on Ecology's website.

The remainder of this section describes the Site's development history, historical operations and Site uses, and current redevelopment plans for the Site. Historical and current Site features are shown on Figures 3 and 4, respectively. Area designations used during previous Landau Associates environmental investigations (G, I, J, and M) are applied here as shown on the report figures and used in the discussion of Site features to assist the reader in locating the referenced features.

2.1.1 SITE DEVELOPMENT HISTORY

This section describes the Site development history including a discussion of the filling history, the paving sequence, and a description of the recent redevelopment activities at the Site. Information from this section was developed based on previous investigation reports; a detailed historical evaluation conducted to assist with the RI work plan for the Site (Historical Report; Pinnacle GeoSciences 2010; Appendix A); site reconnaissance completed in February 2010; and interviews with the following individuals:

- Paul Vannini, Plant Manager, Ameron International (Vannini, P. 2010 personal communication)
- Ken Gerry, Production Supervisor, Ameron International (Gerry, K. 2010 personal communication)
- Steve Wetzel, Sales Manager, Dunlap Industrial Hardware (Wetzel, S. 2010 personal communication)
- Jim Weber, Maintenance Foreman, Port of Everett (Weber, J. 2010 personal communication)
- Rick Adams, Maintenance Lead, Port of Everett (Adams, R. 2010 personal communication)
- William Hulbert III (Hulbert, B. 2010 personal communication)
- Jim Schack, former president Oldcastle Precast, current president Norton Industries (Schack, J. 2010 personal communication)
- Don Heirman, Churchill Brother Marine Canvas (Heirman, D. 2010 personal communication)
- Brandy Stoutenburg, Central Collision Inc. (Stoutenburg, B. 2010 personal communication)

- Dean Shaughnessey, former Marina Operations Manager, Port of Everett (Shaughnessey, D. 2010 personal communication).

2.1.2 SITE FILLING HISTORY

The Site filling history is detailed in the Historical Report (Appendix A), which should be reviewed for a more detailed discussion of the Site filling history. In summary, the entire Site is constructed on former tidelands. Historical information indicates that the original high water line was located just west of the railroad tracks currently located on the eastern side of West Marine View Drive. The first saw milling operations on the Site reportedly started when Fred K. Baker purchased a portion of the Site in 1913. A shingle mill operated by the Fred K. Baker Lumber Company is shown on the Site in historical maps generated by the Sanborn Map Company (Sanborn Maps) in 1914. The mill was constructed above tide level on piles over Port Gardner. Based on historical information, the Site was filled in a sequence of large scale events, as shown on Figure 4 of the Historical Report, and described by Pinnacle GeoSciences (2010):

- Between the mid-1930s and approximately 1941, fill from an unknown source was placed westward beginning at the rail alignment east of West Marine View Drive and extending west approximately 330 feet (ft) to approximately the east wall of the Collins Building. The Collins Building is identified on Figure 3 of this RI/FS report. This filling event affected the eastern portions of Area G and Area M. Aerial photographs suggest that the upper 4 ft of fill was placed after 1947 and consisted of non-dredge fill, which is consistent with a log from a soil boring advanced in this area by Earth Consultants Inc. (ECI; Appendix A).
- In 1947, a sheetpile wall was constructed to form the fill area south of the mill, including primarily the North Marina peninsula and portions of the southern Site area. It is believed the sheetpile wall enclosed a planned dredge fill that was completed by 1953. The wall enclosed an area measuring approximately 40 acres in the southern portion of Area G, the remainder of Area M, and the majority of the southern portion of Area J to the west side of the Collins Building. Photographs and the nature of dredge fills suggest that the filling elevation was likely 3 ft to 5 ft lower than the Collins Building and several feet lower than the 13th Street grade elevation.
- Non-dredge soil filling also occurred on the Site between 1947 and 1953. By 1953, an area immediately west of the Collins Building, comprising small portions of Areas M and G and most of Area J, appeared to be graded differently than other parts of the 1947 to 1953 dredge fill suggesting other "structural filling" of this area. Soil boring logs from this area indicate non-dredge fill to a depth of 2 ft to 4 ft below ground surface (BGS) and underlain by dredge fill.
- By 1961, most of Area G was filled, although the source of the fill has not been determined. It is not clear if the fill was hydraulically placed below the mill structures or if the fill was placed after the mill structures were removed. The lumber docks, lumber sheds, planing mills, and a portion of the kilns associated with the mill were destroyed in a fire in 1956, and the remaining structures were removed by 1965. Between 1956 and 1961, a bulkhead was placed along the northern boundary of Area G extending west across the eastern third of Area I, and along the western boundary of the former lumber docks. Exploration logs from the 1956 to 1961 fill area indicate non-dredge fill to a depth of approximately 11 ft BGS,

underlain by dredge fill. Localized areas of wood and concrete debris were reported within the non-dredge fill unit.

- In 1973, another dredge fill occurred over most of Area I and small portions of Areas G and J in conjunction with construction of the 12th Street Channel. A shore dike was constructed from soil excavated at the north end, and “imported quarry waste” at the south end. A berm was present along the approximate eastern boundary of Area I and extending onto Area G at the north end. The berm is visible in aerial photographs until 1981, at which time only a small remnant remained in the northwest corner of Area G. The source of fill used to construct the berm is not known. The dredge fill was found beneath a layer of non-dredge fill at depths of 1.5 ft to 5 ft BGS in Area I to a depth of at least 16 ft BGS (the maximum depth explored).
- Aerial photographs from 1980 indicate active grading and filling in Areas I and J. Photographs from 1980 indicate filling in the northern portion of Area G with what appears to be concrete debris.
- Aerial photographs from 1982 indicate that Area I had been graded flat to approximately the same grade as Areas J and approximately 2 ft higher than the paved portions of Area G. Only a small portion of the eastern berm is visible at the north end of Area G.
- Filling and grading occurred in 1991 to 2006 in Areas I and G. Filling was conducted in Area J prior to construction of the former Marine Spill Response Corporation (MSRC) building, which was completed in 1994.

2.1.3 PAVING SEQUENCE

The sequence of paving at the Site was documented in the Historical Report (Appendix A) and is summarized on Figures 6 and 7 of the Historical Report. The paving sequence at the Site is generally described as follows:

- The Site was unpaved prior to approximately 1956. Between 1956 and 1961, pavement was added to an area in the southern portion of the Site including the east central portion of Area J, the southern end of Area G, and the southwestern portion of Area M.
- Between 1961 and 1974, much of Area G was paved or covered by buildings, with the exception of the areas to the north, west, and directly south of the manufacturing building, and the southeastern corner of Area G. Also during this timeframe, pavement was placed to the west of the former Collins Building and to the east of the currently existing buildings in the southeastern corner of Area M.
- Between 1974 and 1979, areas directly north and west of the main manufacturing building in Area G were paved; although the pavement did not extend to the northern or the western boundary of Area G.
- In approximately 1980, the area on all sides of the northern building on Area M was paved. The paving likely corresponded to the construction of the building.
- Most of the area to the south of the manufacturing building on Area G was paved between 1980 and 1982. In addition, it is believed the stormwater system running along the northern boundary of Area G was installed and paved over during this time period.
- Between 1982 and 1990, the remaining area in the southernmost portion of Area G was paved, as well as areas to the north and east of the former Collins Building and a small area in the southwestern corner of Area M.

- Between 1991 and 1993, the area to the south of the Collins Building was paved.
- Between 1993 and 1995, the area surrounding the former MSRC building in Area J was paved.
- Area I and portions of Areas J and M were paved in conjunction with the recent redevelopment by the Port as described below.

2.1.4 PORT REDEVELOPMENT

The western and southern portions of the Site were redeveloped by the Port into its Craftsman District to support marine-based businesses and recreational boaters. The Craftsman District includes the entire upland portion of the Site. Recently developed facilities at the Site include the Bayside Marine dry stack storage and marine retail business in the northwest corner, a new Port Marine Operations Center in the west-center area, and a new travel lift in the southwest corner of the Site. Additionally, the former MSRC building constructed in 1993 in the southwest portion of the Site was redeveloped into the Waterfront Center, which holds new Port offices and will accommodate small business bays for marine services providers. The upland portions of the Site lying west of the former Collins Building and west of the western boundary of the Ameron leasehold have been paved with asphalt as part of the Craftsman District development. A boatyard is located to the north and east of the Waterfront Center. The southeastern portion of the Site (location of former Collins Building and Port Maintenance Building) was recently redeveloped as an expansion of the boatyard. Figure 4 shows current upland Site features.

In addition to upland redevelopment, the aquatic portion of the Site (the northern two-thirds of the 12th Street Channel) was redeveloped in 2005/2006 into the 12th Street Yacht Basin. Development of the Yacht Basin included dredging Site aquatic lands to about elevation -16 ft mean lower low water (MLLW) to create the necessary draft for its new use as a marina. A riparian area and intertidal habitat bench was created along the north shoreline of the Yacht Basin as compensation for the marina development-related impacts, as shown on Figure 4. The mitigation area consists of about a 12-ft wide (plan view) strip of upland and intertidal habitat located between the pedestrian esplanade and the subtidal zone that was planted with native vegetation and is being monitored and maintained by the Port along the entire north shore of the 12th Street Yacht Basin. Figure 4 shows current conditions for the aquatic portion of the Site, and Figure 3 shows the area over which Site sediment was dredged for construction of the yacht basin.

Current and historical Site uses are discussed in the following sections based on existing environmental reports for the Site and the Historical Report (Pinnacle GeoSciences 2010).

2.2 HISTORICAL OPERATIONS AND SITE USES

As previously indicated, the Site was first developed as a shingle mill in approximately 1914. The majority of the Site, including the existing mill, was purchased by the Hulbert Mill Company in 1923. As shown on Figure 8 of the Historical Report (Appendix A), historical information indicates that the Port has owned the eastern approximately 180 ft of the Site (eastern portion of Area M and a small portion in the southeastern corner of Area G) and approximately the southern 40 ft of Area I and western 100 ft of Area J since at least 1940 (Pinnacle GeoSciences 2010). The Hulberts sold their portion of the Site to the Port in March of 1991, and the Port has remained the owner of the Site since its purchase in 1991. Current and historic Site ownership along with non-owner occupant information is shown on Figure 8 of Appendix A. It should be noted that the estimated Site boundary does not precisely coincide with the parcels described above.

The Hulbert Mill operated until the early 1960s, though several of the mill features were destroyed in a fire in 1956. The Hulberts leased various portions of the Site to a number of commercial and industrial entities beginning in the early 1970s until they sold the property to the Port in 1991. A number of parcels within the Site are leased (or have previously been leased) by the Hulberts and/or the Port to various tenants, as illustrated on Figure 8 of Appendix A. In addition, portions of the Site are or have been subleased to various tenants. The current and former tenants have utilized the leaseholds for a variety of businesses, primarily related to marine repair; concrete products manufacturing; and other marine, commercial, and light industrial activities. In anticipation of redevelopment, starting in about 2004, the Port began relocating tenants within the North Marina Area, and not renewing leases as lease terms ended. Several businesses located in the southern portion of the Site vacated the premises and the buildings were demolished in 2006. The Ameron leasehold was modified in scope and extends to 2017.

This section identifies and describes the historical uses for properties and leaseholds located within the Site by investigation area. Historical uses of the Site are also summarized in Table 1 of the Historical Report. Former mill operations are described in a separate section because mill operations occupied a large portion of the Site. The Site usage history is based on previous Phase I Environmental Site Assessments (ESAs; Landau Associates 2001 and Kleinfelder 1991); the Historical Report (Pinnacle GeoSciences 2010); and previously referenced interviews. The ESAs referenced above can be viewed on Ecology’s website. These documents should be reviewed for a more thorough description of Site historical uses and environmental conditions. The Historical Report was completed as part of preparation for the RI/FS Work Plan (Landau Associates 2010b) and is included within this RI/FS report as Appendix A. In addition, reconnaissance of the current structures and associated operations was conducted in February 2010.

2.2.1 PORTIONS OF INVESTIGATION AREAS G, I, J, AND M

Based on Sanborn maps, a shingle mill was constructed on pilings over tidelands west of Marine View Drive in approximately 1914. The existing mill was purchased by the William Hulbert Mill Co. in 1923. Features/operations associated with the mill included a saw mill, shingle mill, lumber sheds and planing mills, an electrical plant, boiler house, blacksmith shop, wood refuse burner, water towers, steam dry kilns, and shipping sheds as shown on Figures 2 and 3 of the Historical Report (Appendix A). Wood refuse burners were typically used for burning wood debris associated with milling operations (e.g., sawdust, bark, and edgings) (Pinnacle GeoSciences 2010). Based on review of aerial photographs, bottom ash from the wood refuse burner may have been placed to the south and southwest of the burner, the northern portion of Area J (Pinnacle GeoSciences 2010).

The saw mill fire in 1956 destroyed the lumber docks, lumber sheds, planing mills, and part of the kiln. The mill ceased operations in the early 1960s and remaining mill structures were removed in approximately 1962, with the exception of the wood refuse burner, water tower, and boiler stack, which were removed by 1976 (Pinnacle GeoSciences 2010).

2.2.2 INVESTIGATION AREA G

Investigation Area G roughly consists of the area used as a concrete pole manufacturing facility since 1973. The pole manufacturing plant was originally developed by Centrecon for the purpose of making concrete utility poles. The facility began manufacturing decorative concrete utility poles in 1976. In late 1988, Ameron purchased the manufacturing facility and Ameron has continued making decorative poles.

The manufacturing facility includes four buildings and one covered work area on the current leasehold: the manufacturing building, a laboratory and storage building, a pole polishing building, and a pole finishing and dry storage building (Figure 4). Along with the four buildings, there is a covered work area located over the loading and unloading area between the manufacturing building, pole polishing building, and pole finishing and dry storage area. Based on review of available records (including aerial photographs), the manufacturing building, laboratory/storage building, and pole polishing building were built in approximately 1972. The pole finishing/dry storage building was added in approximately 1985, and the covered area was added in the early 2000s. The following sections discuss operations in each of the Ameron buildings based on historical information and observations made during Site reconnaissance conducted in February 2010.

2.2.2.1 Main Manufacturing Building

The concrete manufacturing building houses the main production facilities (Figure 3). The manufacturing process includes a wet process in the east portion of the building where aggregates are mixed and placed in molds and, subsequently, spun to compaction; and a dry process in the west portion of the building where the poles are released from the molds, and other molds formed. The basic manufacturing process consists of placing the batch concrete into steel molds and spinning the molds to force the concrete aggregate to the exterior of the pole, leaving a fine-grained particulate slurry in the center. The process waste slurry is drained from the mold to create a hollow concrete pole. The decorative poles are created in a number of colors, including grey, white, green, brown, and red. Materials involved in the manufacturing process in this building in addition to the cement and aggregate used to batch concrete, are coloring agents, plasticizer, corrosion inhibitors, and a mold release agent.

Within the building is a basin used in the construction of the long concrete poles produced at the facility. To provide the elevation needed to hold the long pole molds, the basin extends below the water table. Groundwater and floor wash water collect in the basin, but each are collected and handled separately. The floor wash water is collected and pumped to concrete-lined settling ponds on the east side of the manufacturing building. The groundwater is collected in a separate holding facility and discharged to the stormwater system. In 2007, improvements were made so that the groundwater directly discharges to the stormwater system.

After settling the process solids in the concrete-lined basins (identified as Slurry Ponds on Figure 5), the wastewater is recycled or discharged to the sanitary sewer. Solids are periodically removed from the settling basins using a front-end loader and placed in drying bins located to the east of the settling basins. The solids are rotated through the drying bins to aid in dewatering, proceeding from south to north. A small percentage of other waste materials are periodically added to the material in the drying bins (e.g., floor sweepings, wheelabrator dust, and sand blast waste) before the material is removed for offsite disposal. A trench drain and sump system is used to capture drainage water from the slurry solids and stormwater falling within the process area (see Figure 5). The sump collects water from the trench drain and pumps it back to the ponds when the sump fills. Water from the process area is discharged to the sanitary sewer system.

A chemical storage and waste accumulation area is located in the northwest corner of the building. Petroleum products are stored within a concrete bermed area. Good housekeeping practices were observed in this area at the time of the February 2010 Site reconnaissance. A compressor room is located in the northwest corner of the building, south of the chemical storage area. A small release of petroleum was observed beneath the compressor. Absorbent material had been placed over the spill; however, a gap was observed in between the exterior west wall of the compressor room and the concrete floor, which could allow for spilled petroleum to be released to the exterior of the building. Spills were also observed in this area at the time of the 1991 Kleinfelder ESA.

A sandblasting room is located south of the compressor room. Prior to 2006, sandblasting was conducted in this room, but with the door open to the exterior of the building. Sandblast waste accumulation was observed in this area during a 1991 site inspection (Kleinfelder 1991), and is evident in aerial photographs beginning in 1977.

During site reconnaissance in 1991, a drum storage area and some soil staining was observed outside the east side of the building in this area (Kleinfelder 1991). At the time of the 1992 ECI Phase 2 investigation, the drums had been removed and there were no signs of soil or pavement staining remaining. Ameron indicated that the stained soil (characterized as petroleum staining in the Phase 2 investigation) had been excavated and drummed for offsite disposal. To confirm that the stained soil had been removed, ECI collected one surface soil sample in a narrow strip (2-inches wide and 3 ft long) of unpaved area between the asphalt and the building and analyzed the sample using EPA Method 418.1 (ECI 1992). The results of the analysis indicated a TPH concentration of 7,160 mg/kg in the confirmation sample. Note that EPA Method 418.1 provides a gross estimate of TPH and can be biased high by interaction with inorganic and organic soil components, soil organic matter, and clays (Applied and Environmental Soil Science 2012). ECI describes the affected soil as being “limited to a strip two inches wide and about three feet long” and they considered the petroleum contamination to be minor. This area was subsequently developed in 1992 by Ameron into paved holding bins for concrete slurry waste. Drum storage and/or petroleum staining were not observed in this area at the time of the February 2010 Site reconnaissance.

2.2.2.2 Laboratory and Storage Building Area

This building is primarily used for mixing aggregate samples for customers (Figure 3). The interior of the building was not observed at the time of the February 2010 reconnaissance. A 12,000-gallon diesel underground storage tank (UST; identified on Figure 3) was removed in 1988 from the west side of the laboratory/storage building. Following the tank removal, a soil and groundwater investigation was conducted by Sweet-Edwards/Emcon (PSM 1989). The results of the investigation indicated petroleum hydrocarbons were not detected in soil or groundwater at concentrations greater than applicable cleanup levels. Three monitoring wells (one upgradient and two downgradient) installed for the 1989 Sweet-Edwards/Emcon investigation still exist on the Site.

In the 1980s, an unlined settling pond was located north of the laboratory building near the fence line west of the manufacturing building (Figure 3). The pond reportedly collected water, pumped through an underground pipe, from a settling basin adjacent to the pole-polishing building. The pond was created within an earth berm that extended approximately 4 ft above ground surface. The settling pond was closed sometime between 1987 and 1989 based on aerial photo interpretation, although the manner in which it was decommissioned is unknown. In 1989, as part of Ameron's due diligence in purchase of the Centrecon facility, composite samples of the pond surface water and sediment were obtained and analyzed for the priority pollutant metals. The results indicated no exceedances of the metals screening levels identified in the RI/FS work plan for the protection of surface water, with the exception of copper [at 10 micrograms/per liter (µg/L)] in the surface water sample (Landau Associates 2010b). The results also revealed that concentrations of heavy metals in sediment are below Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC) Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSL) for marine sediment (Landau Associates 2010b), although these criteria are not applicable to fresh water pond sediment contained in an upland area.

In 2006, an interim action was conducted in the area where the settling pond was previously located (Area G-1, Figure 6). That excavation concluded with bringing the Site soil down to, and slightly below, grade levels in the adjacent paved area to the east (Landau Associates 2010a). The interim action was not completed due to access issues. An area of impacted soil (arsenic, copper, and lead) remains at the base in the eastern portion of Area G-1.

2.2.2.3 Pole Polishing Building

The pole polishing building is located west of the south end of the main manufacturing building. Poles are moved to this building from the main manufacturing building via rails. Various methods are used to expose aggregate in the poles to meet customer specifications. A shot blast operation is located at the south end of the building and grinding is performed in the northern end of the building. Shot blast waste was observed on the exterior east side of this building during the February 2010 reconnaissance. This material is collected and reused. Air pollution equipment was observed on the exterior south wall of this building. No floor drains were observed within the building.

The polishing process was initiated in approximately 1977 or 1978 when the facility began manufacturing decorative poles rather than standard utility poles (Schack, J. 2010 personal communication). A wet process was initially used in the pole polishing building, which produced a slurry waste (Schack, J. 2010 personal communication). The waste slurry was reportedly discharged to three concrete lined settling ponds located to the east of the building. The material was then pumped to an unlined settling pond located to the north (Figure 3) to settle the solids and infiltrate the process water (PSM 1989). Based on aerial photographs, the unlined settling pond was constructed between 1980 and 1982 and is the pond that is discussed in Section 2.2.2.2. Interpretation of the 1980 aerial photograph suggests that a pipe may have existed that conveyed the waste slurry from the pole polishing building westward to Area I for disposal (Pinnacle GeoSciences 2010) prior to the construction of the unlined pond.

The polishing operation switched from the wet process to a dry process shortly after Ameron began operating at the facility (Gerry, K. 2010 personal communication). Two of the three concrete settling basins to the east of the pole polishing building were reportedly filled with onsite backfill prior to the 1991 Kleinfelder site reconnaissance, and the third was collecting rainwater. Based on available information, the third basin was filled sometime between the 1991 ECI investigation and 1992.

ECI completed two test pits in the former settling basins in 1991 to evaluate the depth and type of fill material present. Blasting sand was identified in the fill material in one of the two test pits (ECI 1992); however, no descriptors other than "blasting sand" were provided on the log or in the text of the report. Elevated arsenic (40 ppm) was detected in the sample of this fill material, but lead and antimony were not detected at the relatively high reporting limits (200 ppm and 100 ppm, respectively). The basins are visible in aerial photographs beginning in 1977 and are oriented in a north-south direction extending east from the eastern side of the building. One basin is visible in photographs from 1990 and none of the basins are evident in the 1992 aerial photographs. The three basins are filled, but concrete rims are visible at ground surface and drilling data indicate the bottoms to be at 5 ft BGS. The drilling data also indicate the basins likely contain the original backfill.

Kleinfelder (1991) noted 55-gallon drums and evidence of sandblasting and concrete pole polishing in the area of the pole polishing building. In addition, a very limited oil-stained surface soil area, estimated to be 2.5 ft in diameter and 1 ft in depth, adjacent to the drum storage area, was observed at the northwest corner of the pole polishing building (ECI 1992). The stained soil was removed by Ameron and a soil sample collected following removal exhibited a TPH concentration of 1,400 milligrams per kilogram (mg/kg) using U.S. Environmental Protection Agency [EPA; Method 418.1 (ECI 1992)]. Drums were not observed in the area of the pole polishing building at the time of the February 2010 Site reconnaissance.

2.2.2.4 Pole Finishing and Dry Storage Buildings

The dry storage building is located directly south of the pole polishing building and is attached to the pole finishing building at the south end. Poles are finished by applying water repellant sealant using spray guns. A concrete-bermed chemical storage area was observed at the southeastern corner of the pole finishing building at the time of the February 2010 Site reconnaissance. Containers of toluene, water repellant, waste paint, and acrylic, and a self -contained parts washer were observed within the concrete-bermed area. The containers were observed to be in good condition. No floor drains were identified inside the building. In 1991, sandblasting debris and a storm drain were observed to the west of the pole finishing and dry storage building during a site reconnaissance (Kleinfelder 1991). At the time of the February 2010 Site reconnaissance, no evidence of sandblasting debris was observed in this area. A storm drain was observed to the east of the building, but not to the west.

2.2.3 INVESTIGATION AREA I

Investigation Area I comprises the property between the 12th Street Channel Waterway (now the 12th Street Yacht Basin) and Investigation Area G to the east, the property line that separates Port property from Norton Industries property to the north, and Investigation Area J to the south. This portion of the Site has been redeveloped as part of the Craftsman District, and currently contains a large Bayside Marine building at the north end, the Port Marina Operations Center near the center, a concrete esplanade along the shoreline, and asphalt pavement covering on the rest of the area.

The first development, prior to the recent redevelopment, was related to the Hulbert Mill, which operated in this area from approximately 1920 to 1962 before Area I was filled. The mill fire destroyed much of the Hulbert Mill operations in 1956; however, log rafting operations continued in this portion of the property until about 1962. Subsequently, several lessees and operations were identified in this area by the Historical Report (Appendix A), and during site reconnaissance and historical Phase I ESA reviews conducted by ECI (1987, 1988, and 1992); Kleinfelder (1991); and Hart Crowser (1991). The environmental conditions observed in this Area by these investigations are discussed below. As described in the Interim Action Report (Landau Associates 2010a), Area I was subject to extensive cleanup during the 2006 interim action. With the exception of residual contamination along the northern boundary of Area I and along the western boundary of Area G-1a (located partially within Area I), and the presence of arsenic-affected crushed rock that was placed beneath the concrete esplanade along the western boundary (discussed in Section 6.0), soil contamination in this area has been remediated as part of the 2005 to 2008 Interim Action. The area of arsenic-affected crushed rock located beneath the concrete esplanade is shown on Figure 8. Previously identified environmental conditions are discussed in the following sections to provide a complete history of the Site.

2.2.3.1 Bayside Marine (Current Tenant)

The northern portion of Area I is leased by the Port to Bayside Marine. Operations at Bayside Marine include retail sales, dry stack boat storage, boat washing, and boat servicing. The Bayside Marine building is a steel structure on a concrete slab and occupies approximately the northern half of Area I. An asphalt-paved parking area is located to the south of the building. Boat washing is performed on a concrete wash pad located to the west of the building. Wastewater is routed to a closed loop treatment/recycling system within the western end of the building. The service center is located in the southeastern portion of the building. Petroleum products used in the service area were observed to be stored within secondary containment. A trench stormwater drain is situated east to west along the south side of the service center. Storm drains were observed in the parking area to the south of the building.

A covered waste accumulation area is located along the east exterior wall of the building. Three steel waste oil tanks are located within secondary containment on a concrete surface. During our 2010 Site reconnaissance, the concrete surface outside the containment area, which drains runoff to the east, exhibited petroleum staining and a petroleum-like sheen. Six empty 55-gallon drums were stored on a gravel surface east of the waste accumulation area. Used batteries were also observed in this area. An asphalt-paved storage area is located to the south of the east side of the building. Several dismantled motors and an engine test tank were observed on the asphalt in this uncovered storage area.

2.2.3.2 Port Marina Operations Center (Current Occupant)

The Port Marina Operations Center is located in the southern portion of Area I. The center consists of a steel building on a concrete slab that houses offices and a wastewater treatment system. Three pressure-washing stations are located to the east of the building. Wastewater from the boat washing area, as well as from the boatyard located in Area M (see discussion below), is routed to the wastewater treatment system and is either recycled or discharged to the sanitary sewer via a lift station located east of the Marina Operations Center. Recycling receptacles for used zinc were observed east of the building. A double-walled steel aboveground storage tank (AST) is located on a concrete pad east of the building, near the boundary between Area I and Area G. The AST was installed in 2009 and contains 500 gallons of gasoline and 500 gallons of diesel fuel and is used for fueling Port vehicles. The AST was observed to be in good condition with no evidence of releases.

A concrete esplanade is located along the western boundary of Area I. The esplanade was constructed in 2005 during the Area I cleanup to support construction of the upland portion of the 12th Street yacht basin. During cleanup in this portion of the Site, crushed rock imported from a commercial source as subgrade support for the esplanade was determined to contain arsenic at levels of up to 126 mg/kg (Landau Associates 2010a). Because the esplanade was fully constructed before it was discovered that the base source layer contained elevated concentrations of arsenic, the Port removed the accessible portion of the imported rock that was located adjacent to and east of the esplanade. The material was placed in Area J-3 where long-term containment was already planned (while the site was under the VCP) for arsenic and carcinogenic polcyclic aromatic hydrocarbons (cPAH)-affected soil and construction debris. The Area J-3 interim action area is shown on Figure 6. The affected base course was left in place where already covered by the concrete walkway. Locations of areas with arsenic-affected crushed rock are shown on Figure 8.

2.2.3.3 Commercial Steel Fabricators (Former Tenant)

Commercial Steel Fabricators leased 2 acres (and possibly an additional 2 acres during the lease term) of Area I from January through December of 1991 (Pinnacle GeoSciences 2010) as shown on Figure 8 of Appendix A. The general location of their operation is also shown on Figure 3. The Port assumed the lease when it purchased the property from Hulbert in March of 1991. The property was being used by Commercial Steel Fabricators at that time to manufacture prefabricated buildings. Operations reportedly included painting and sandblasting. There were no permanent structures associated with Commercial Steel Fabricators operations.

Several environmental concerns were noted by Kleinfelder (1991) in the area used by Commercial Steel Fabricators including:

- An open hazardous materials shed with drums of diesel and gasoline stored inside
- Soil staining in and to the west of the shed
- Areas of paint chips and sandblast grit deposited on soil
- Soil at the storm drain discharge to the 12th Street Channel in the northwest corner of the area noted to be darker than the surrounding soil, although there is no indication that this condition was associated with Commercial Steel Fabricator's operations
- Two 15-ft long PVC pipes placed to prevent ponding of surface water onsite.

Features associated with Commercial Steel Fabricators were removed from this area prior to June of 1992 and the area was reportedly graded with new base rock (AGI 1992).

2.2.3.4 Jensen Reynolds Construction (Former Tenant)

Between 1982 and 1990, Jensen Reynolds Construction subleased the majority of Areas I and J and a portion of Area M from Centrecon (see Figure 8 of Appendix A). Jensen Reynolds was a waterfront construction company and used the property as an administrative base of operations (office building in southwest corner of Area M) as well as a lay-down and fabrication yard for numerous projects (ECI 1987).

Between 1987 and 1990, ECI conducted several environmental investigations of the Jensen Reynolds leasehold (see approximate leasehold boundary depicted in orange on Figure 3) for the Hulbert Mill Company (the property owner at that time). Hart Crowser also conducted a preliminary environmental assessment of the former Jensen Reynolds lease area in 1991 for HNTB (parent company of MSRC) prior to MSRC leasing a portion of the former lease area for a new warehouse.

The 1987 and 1988 ECI reports and the 1991 Hart-Crowser report on the Jensen Reynolds lease identified numerous environmental conditions including drums of varying contents and condition scattered throughout the entire leasehold, leaking drums, areas of paint chips and discolored soil, black sand-blasting waste deposited on soil, and demolished building debris. Within Area I, the following were noted:

- Large areas of discolored soil on the ground in the northern half of the leasehold that appeared to be surficial overspray from the painting of large components fabricated in the yard (ECI 1987)
- An assortment of full, partially full, and empty drums scattered throughout the property, including fifteen 55-gallon drums that showed clear evidence of minor spills and leaks onto unprotected ground along the north property boundary
- Black sand blasting abrasive in small piles east of a metal truss bridge near the eastern fence line
- An accumulation of metal paint chips along the southeast side of the bridge, up to 2 ft high over a 20-ft by 20-ft area southeast quadrant of Area I
- An area about 200 square ft (ft^2) was covered with blasting sand about 4 inches thick in the north-central portion of Area I
- An area of building demolition and household debris immediately north of the blasting sand
- Piles of miscellaneous wood scraps and insulation foam scattered over the entire area
- Piles of gray/black sludge-like material spread randomly around the northern portion of the property (Hart Crowser 1991).

The 1988 ECI report noted that the surficial evidence of spray paint, blasting sand, numerous barrels, and spillage of barrel contents noted in the 1987 ECI audit were no longer apparent. The 1990 ECI report indicated that the accumulation of metal paint chips had been removed and that cleanup measures recommended in the 1987 and 1988 report had been addressed (ECI 1990). However, in November of 1991, Hart Crowser noted several piles of gray/black sludge-like materials around a series of concrete footings. A long stormwater drainage pipe was also noted extending into the bay along the western side of the property that appeared to be drainage for the footing areas.

2.2.3.5 Port Operations

The Port conducted various operations in Investigation Area I subsequent to purchase of the Site in 1991 and prior to the start of recent redevelopment in 2006. Identified operations consisted of conducting petroleum hydrocarbon treatment (landfarming) as described below, the disposal of brush and landscape trimmings in the northeast portion of the area in contemplation of a composting operation (Webber 2010), boat impound storage, and the storage of used creosote-treated piles in the central-eastern portion of the area. In addition to the used piling storage, an alumina crane from the Port's Pier 1, fill soil removed as part of a Pier 1 improvement project, and clean soil removed during 14th Street boat wash area construction were relocated to Area I for storage purposes between 1993 and 1995 (Shaughnessy 2010). In the early 1990s, a submarine was hauled upland from the barge channel and dismantled, and several of its fiberglass panels were stored in the southeast corner of the Site.

Soil landfarming for remediation of petroleum hydrocarbon-contaminated soil was conducted in the northeast corner of Investigation Area I (AGI 1992). Although documentation is limited, available information indicates that the landfarming was related to a number of UST closures conducted by the Port throughout the North Marina Area in the early 1990s. Based on available information, the landfarming area was constructed between October 1991 and June 1992 and was removed prior to August 1993 (Pinnacle GeoSciences 2010). The apparent landfarming area was reportedly lined with plastic sheeting and contained within straw bales (AGI 1992). The former landfarming area is visible in a 1992 aerial photograph of the Site. Much of the area used for landfarming was reportedly cleared of the remnants of the Commercial Steel Fabricators operations and freshly graded with new base rock surfacing by 1992 (AGI 1992), which is also evident in the 1992 aerial photograph.

In addition to these operations, the Port leased a portion of the area along the shoreline to Shaughnessey Co., an industrial moving company, who stored moving containers using the 12th Street Channel barge wharf. They also used steel plates on the ground to support their operations, and stored articulating moving rigs at the property.

On Figure 3, the former boat impound storage is visible in the eastern portion, and former Shaughnessey Co. operations are visible in the western portion of Investigation Area I. The approximate location of the former landfarming area is also shown on Figure 3.

2.2.4 INVESTIGATION AREA J

Most of Investigation Area J was also formerly part of the Jensen Reynolds lease area until the Port bought the property in 1991 (Hart Crowser 1991). The area includes a former open-sided warehouse and the former MSRC leasehold whose building currently remains.

In 1993, a buried concrete structure was discovered during the construction of a drainage swale associated with the partially built MSRC building. The buried concrete structure, located outside the west wall of the southern half of the MSRC building, apparently had been filled with wood debris, soil, and drums containing oil (Kleinfelder 1993). Investigation and cleanup of the historical structure and surrounding soil are discussed in Sections 3.1.1.7, 4.2, and 5.2 of the Interim Action Report (Landau Associates 2010a). Historical information suggests that this structure may have been a concrete pit and associated log dump and waste burner dump related to a business to the west of Area J at that time (Pinnacle GeoSciences 2010). Two historical subgrade concrete vault structures of unknown purpose were also discovered and removed from the west side of the MSRC building during construction activities subsequent to Port purchase of the property.

Environmental conditions observed in Area J during the numerous environmental assessments conducted on the property between 1987 and 1993 are discussed below. In 1993, the MSRC building shown on Figure 3 was constructed. Much of the area around the building was paved when the building was constructed, although portions of the area to the west are unpaved near the fence line. The MSRC building has been expanded and remodeled as part of the Craftsman District redevelopment plan (see Figure 4).

2.2.4.1 Former Covered/Open-sided Warehouse

Before the MSRC building was constructed, a warehouse approximately one-third of the size of the MSRC building was located slightly to the east of, and overlapping, the area where the MSRC building now stands (Figure 3). In 1991, the southern half of the warehouse was being used by Veco Inc. to store welding and construction supplies, and the Port was using the northern half to store old electric meters and light posts removed from marinas, waste oil containers, drums, and wood piles (Hart Crowser 1991). The warehouse and surrounding area were assessed as part of the Phase 1 ESAs conducted between 1987 and 1991. The areas of environmental concern noted in and around the open-sided warehouse included:

- Numerous leaking drums of various contents, some of which include gasoline, diesel, and lubricant
- An AST
- A flooded area with an oily sheen north of the former warehouse and free-standing product on the asphalt in the warehouse
- Piles of blasting sand on the floor inside the warehouse.

ECI made housekeeping recommendations based on their observations (ECI 1988) and a subsequent site reconnaissance in 1989 indicated that the recommended housekeeping measures appeared to have been implemented.

In 1991, Hart Crowser noted waste oil tanks, waste oil in drums, open-topped buckets, and empty drums in very poor condition stored adjacent to the Ameron fenceline and the north side of the open-ended warehouse. They also observed green sand believed to be sandblasting sand west of the open-ended warehouse.

During the 1991 Phase I ESA (Kleinfelder 1991), the former warehouse was being leased by Veco, Inc, but was vacant at that time. No environmental concerns were observed; however, they noted that some of the area was covered by storage lockers and containers.

This area of the former warehouse is currently either paved or within the footprint of the former MSRC building.

2.2.4.2 Former UST

An approximately 10,000-gallon UST used for fueling Port vehicles, and later for waste oil storage, was reportedly removed in the late 1980s from the southwest corner of the Site, at the location shown on Figure 3. No documentation regarding the presence or decommissioning of this UST is available. The existence of the former tank was not known during Site environmental investigations until it was identified by Port personnel during Landau Associates' 2004 Phase II ESA (Landau Associates 2004). Soil and groundwater were characterized in the former UST vicinity during the 2004 Phase II ESA and subsequent data gaps investigation (DGI; Landau Associates 2005a). No evidence of residual contamination associated with the former USTs was identified.

2.2.4.3 Former MSRC Building

The former MSRC building and the attached open-sided work area on its north end were constructed in 1993. The MSRC facility was used for the storage of marine spill response supplies. No environmental issues were identified related to MSRC operations during previous Site investigations or during the February 2010 Site reconnaissance.

The building was recently remodeled into new Port offices and small business bays for marine services providers. Additions have been made to the west and southwest portions of the building (see Figure 4). The area to the east of the MSRC building has been paved and is used as a boatyard. As discussed previously, stormwater from the boatyard is collected and routed to the wastewater treatment system located at the new Marina Operations Center and is either recycled or discharged to the sanitary sewer system.

2.2.5 INVESTIGATION AREA M

Investigation Area M borders West Marine View Drive. The northern section of Area M is narrow and consists primarily of a long building leased by Ameron and partially subleased to various businesses. The southern section of Area M stretches farther to the West and historically consisted of several buildings, including the Hulbert Mill company office, Sandy's Boathouse, Washington Belt and Drive Systems, the Collins Building, the Collins warehouses and employee "smoke shack", a warehouse occupied by Nalley Foods, the Port Marina Maintenance Facility, a warehouse occupied by the Port and Veco, Inc., and two office buildings facing 13th street. The number and locations of some buildings have changed over the operational history of this area. With the exception of the former Washington Belt and Drive Systems building in the southeastern corner of Area M, the buildings in the southern portion of Area M have been removed.

The majority of the southern portion of Area M was recently redeveloped into an extension of the Port's Craftsman District, which required an emergency action to address petroleum hydrocarbon contamination present at the location of the former Collins Building. The location of the Craftsman

District expansion is shown on Figure 4, and the Craftsman District expansion and emergency action are discussed further in Sections 2.2.5.5 and 3.3.

Environmental conditions observed in and around each building in Area M are described below.

2.2.5.1 Northern Building

The northern portion of Area M has a long building oriented north to south, which is leased by Ameron and subleased to various businesses. The building was constructed in the late 1970s. At the time of the 1991 Kleinfelder Phase I ESA, the subleases were (from North to South) Tri-Coatings, Inc., Besco, Inc., Churchill Brothers Sail Loft, and Sunset Body Works, Inc. (Kleinfelder 1991). Several of these subleases have changed since that time. Current tenants (from north to south) are Dunlap Industrial Hardware, Churchill Brothers Marine Canvas (identified in Kleinfelder Phase I as Churchill Brothers Sail Loft), North Central Collision, and Ameron. Brief descriptions of the operations of these past and current businesses are provided in the following sections with the exception of the Ameron offices at the southern end of the building.

Dunlap Industrial Hardware (Current Tenant)

Dunlap Industrial Hardware (previously Dunlap Wire Rope) currently occupies the northern portion of the building. Dunlap is a marine hardware supplier and fabricator and uses the facility primarily as a warehouse and assembly area for wire rope, marine rope, and chain. Dunlap also assembles custom hydraulic hoses. Containers of petroleum products (hydraulic oil and lubricants) ranging in size from 1 quart to 5 gallons, and one 55-gallon drum of toluene were observed in this unit during the February 2010 reconnaissance. Limited petroleum spillage was observed on the surface of the concrete floor beneath machinery in the unit. Based on available information, Dunlap originally occupied a unit farther south in the building, which is currently occupied by North Central Collision (Wetzel, S. 2010 personal communication).

Tri-Coatings, Inc. (Former Tenant)

Tri-Coatings, Inc. formerly occupied the northern unit of the building. Tri-Coatings (now TC-Systems) specializes in commercial coating (paint) applications (Kleinfelder 1991). Their main facility is on the adjacent property to the north, but their maintenance and mechanics shop was located in the northern portion of the northern building on Area M. Kleinfelder observed a concrete sump, reportedly lined with a ¼-inch steel plate, in the northwest corner of the unit that was used for stripping coatings from parts. Kleinfelder indicated “corrosion was observed in the sump floor (the concrete’s aggregate was plainly visible).” The process produced a rinsate containing water, paint, and paint stripper (methylene chloride), which was pumped into 55-gallon drums and stored in the sump area (Kleinfelder

1991). The sump has since been filled in. A monitoring well (ECI-MW-3) was installed downgradient of the sump in 1991 and a groundwater sample was tested for volatile organic compounds (VOCs). VOCs were not detected at concentrations greater than the screening levels.

BESCO, Inc. (Former Tenant)

BESCO, Inc. formerly occupied the southern half of the current Dunlap unit. BESCO is a vehicle and machinery parts supplier. Environmental concerns were not observed during previous investigations. This unit has been merged with the northern unit currently occupied by Dunlap Industrial Hardware.

Churchill Brothers Marine Canvas and Upholstery (Current Tenant)

Churchill Brothers Marine Canvas and Upholstery currently occupies the central unit of the northern building and is the first and only known tenant of this unit of the building. Churchill Brothers fabricates marine canvas and boat interiors. The process involves primarily cutting and sewing and a limited amount of adhesive. No environmental concerns associated with this business have been identified during previous investigations, or during the February 2010 reconnaissance.

North Central Collision (Current Tenant)

North Central Collision operates an auto body shop in the south central portion of the building. This unit was previously occupied by Sunset Body Works, also an auto body shop, and operations have been fairly consistent for approximately 30 years. Operations at this facility include frame straightening, body repair, and painting. Two paint booths are located in the northern end of the unit. A paint storage and mixing area and a waste paint and waste solvent accumulation area are located between the two paint booths. A self-contained spray gun cleaner and a waste paint thinner drum were also observed in this area. Waste automotive fluids and petroleum are stored in 55-gallon drums located along the south wall of the unit. A car washing area is located in the northeastern corner of the unit. Wastewater from the car washing likely enters a storm drain located in the parking area to the east of the building. Limited paint staining was observed on the concrete floor in the paint storage and waste paint accumulation area at the time of the February 2010 Site reconnaissance. In general, the Central Collision facility appeared to have good housekeeping with minor dust for a facility of this kind. All the hydraulic tooling was portable (above ground) with no apparent drips or staining. Two large compressors in a separate insulated compressor room were dusty, but had no major staining present.

In 1991, Kleinfelder observed leakage beneath plastic bags containing still bottoms generated from recycling of waste paints in this unit, which was then occupied by Sunset Body Works, which conducted a similar business (Kleinfelder 1991).

2.2.5.2 Historical Hulbert Mill Company Office

The southern part of Area M has changed more substantially over time. Just south of the Ameron subleased building was a house, built sometime while the former Hulbert Mill was operating. Historically, the house was used as the Hulbert Mill Company Office, but was vacant by the time of Kleinfelder's site reconnaissance in 1991. No noticeable environmental concerns were noted on inspection of the exterior of the building during the Kleinfelder reconnaissance. The building was demolished in the late 1990s. A paved parking lot now covers the area where the house once stood. The former location of the house is shown on Figure 3. A 1957 Sanborn map shows a structure labeled as an oil house located about 75 ft northwest of the office. The purpose of the oil house is not known.

2.2.5.3 Former Port Maintenance Shop (Former Sandy's Boathouse)

In the early 1970s, two buildings were constructed in the southern portion of Area M, along West Marine View Drive (Figure 3). The northern of the two buildings was removed in 2011 to facilitate expansion on the Port's boatyard. The building was most recently occupied by the Port maintenance shop. Prior to the Port, this building was occupied by Sandy's Boathouse, where a parts degreaser, waste oil accumulations, and an engine test tank were noted during the 1991 Phase I ESA (Kleinfelder 1991). The degreaser oil and solvent waste were reportedly being disposed of offsite. Oil and grease associated with the test tank were reportedly being cleaned with oil-absorbent pads and associated wastewater was discharged to the sanitary sewer. An AST storing petroleum hydrocarbons with no visible staining was observed here during the Landau Associates Phase I ESA site reconnaissance in 2000 (Landau Associates 2001). Features associated with the former tenant had been removed by the time of the February 2010 reconnaissance.

As indicated previously, this building was most recently used by the Port for maintenance activities and storage of equipment and parts. The Port occupied this building from late 2009 until it was demolished during the boatyard expansion in 2011. A parts washer and a self-contained sandblast unit were observed in this building. Paint and petroleum products were also used and stored in this building. No evidence of releases from any of the containers was observed at the time of the February 2010 Site reconnaissance. A floor drain was observed in the paint storage area in the southwestern corner of the building.

The area to the west of the building consisted of a gravel surface and was used by the Port for storage. Several steel storage containers were observed in this area at the time of the February 2010 Site reconnaissance. This area is currently being redeveloped as an expansion of the Port's boatyard.

2.2.5.4 Port Net Shed (Formerly Washington Belt and Drive Systems)

The building just south of the Port's former maintenance shop is currently used by the Port as a net shed with the exception of the southern end of the building, which is occupied by Marine Power Services. This entire building was previously occupied by Washington Belt and Drive Systems, a machinery parts retailer. The building has a sanitary sewer drain in the storage area. Limited quantities of hazardous materials are stored in a flammable materials cabinet along the east wall of the building. In 1991, Kleinfelder observed unopened containers of 1,1,1-trichloroethane (1,1,1-TCA) and flammables stored for retail sale, and a sanitary sewer drain that was reported to occasionally back up during high tides (Kleinfelder 1991). During the February 2010 Site reconnaissance, a limited release of hydraulic oil was observed on the concrete floor beneath a hydraulic pump and reel used for winding nets. The area to the west of the building is partially paved and is currently used for net storage. The floor drain reported in the Kleinfelder report was not located, but may have been covered by nets or other materials.

The southern portion of the building currently houses Marine Power Services, which is a marine engine repair shop. The interior of this unit was not accessible at the time of the February 2010 Site reconnaissance. Inspection through the limited visibility of the windows showed diesel and gasoline engines in various stages of repair. Miscellaneous small quantity aerosols could be seen such as WD-40, penetrating oil, etc. Although not visible, a part-cleaning tank and miscellaneous fluids such as motor oil, hydraulic fluid, and antifreeze are often associated with small engine repair operation.

2.2.5.5 Former Collins Building

West of these buildings (southern building A and B) was the Collins Building (formerly North Coast Casket Company), which was built in 1926 and removed in 2010. The Collins Building was originally founded as a casket manufacturer to use the "shorts" from the Hulbert mill operation. There was both construction and finishing of caskets that occurred in the building (Hulbert, B. 2010 personal communication). An abandoned fuel oil boiler system existed at the Collins Building, and small surface stains were observed during the Landau Associates Phase I ESA site reconnaissance in 2000 (Landau Associates 2001). The boiler system and surface stains were not observed during the February 2010 Site reconnaissance. The building was unoccupied and heated using natural gas at the time of the site reconnaissance. A hydraulic system for the elevator was observed on the first floor of the building and remnants of former spray booths were observed on the 2nd and 3rd floors of the building.

This building was previously occupied by Collins Casket Manufacturing. Collins Casket occupied multiple buildings including the former Hulbert Mill office, the Collins manufacturing building, an employee "smoke shack" and covered storage building to the west, and a painting and metal parts fabrication building to the east of the main building. Collins Casket sublet portions of the Collins Building to:

- Michael's Woodcraft (occupied 2nd floor of Collins Building: Manufactured wood products)
- RL Enterprises (occupied 2nd and 3rd floors of Collins Building: Manufactured wood cabinetry).

The paved area to the north of the Collins Building was being used by the Port as a waste accumulation area for boatyard tenants at the time of the 2010 reconnaissance. Drums containing waste oil and smaller containers of various automotive fluids were observed in this area as well as used batteries. No evidence of a release was observed in this area during the 2010 Site reconnaissance.

Following removal of the Collins Building in December of 2010, additional site reconnaissance was completed and identified areas of potential petroleum-hydrocarbon impacted soil. These areas were investigated during the supplemental RI and an emergency cleanup action was conducted in this area in 2011 to remove petroleum-impacted soil (see Section 3.3).

2.2.5.6 Former Collins "Smoke Shack" and Covered Storage Shed

The former Collins "smoke shack" and covered storage shed, built in the 1960s, were located to the west of the Collins Building and were associated with Collins Casket Company operations. The building, located off the northwest corner of the Collins Building, was used as a break room for employees (dubbed the "smoke shack"), and also reportedly stored building materials. During the 1991 Phase I ESA site reconnaissance (Kleinfelder 1991), waste paint containers and stained soil were observed outside in an area northwest of this building. The covered storage shed, located south of the smoke shack and west of the Collins Building, was made up of two connected open warehouses and was reportedly used as open storage for metal parts, wood scraps, and old machinery; no environmental concerns were noted related to this building. The smoke shack and the northern half of the warehouse were demolished in the early 1990's and the southern half of the open warehouse was demolished in 2001 or 2002, and the location is currently paved with asphalt.

2.2.5.7 Collins Casket Warehouse

From approximately 1961 until 2005, a warehouse was located adjacent to the east side of the Collins Building. The building was originally used by Cascade Casket Company for painting and finishing caskets, which included spray painting and metal fabrication (Hulbert, B. 2010 personal communication and Pinnacle 2010). This building was later used for food storage by Nalley Foods. No environmental concerns were identified for this building during previous Phase 1 investigations. However, the occurrence of vinyl chloride in groundwater in this area indicates the potential for historic releases of chlorinated solvents in this area. In addition, former tenants (Cascade Casket Company, Collins Casket Company, Michael’s Woodcraft, and RL Enterprises) all used glues and wood finishing chemicals during the manufacture of wood products and metal finishing were conducted in this building. This area is currently be redeveloped by the Port as part of the boatyard expansion.

2.2.5.8 Port of Everett Marina Maintenance Facility

The former Port Marina Maintenance Facility was built over the northern portion of the smoke shack/and covered storage shed area in the early 1990’s. During Landau Associates’ 2000 Phase I ESA site reconnaissance, an AST containing petroleum hydrocarbons was noted, but no visible surface stains were observed in the paved yard to the south of the maintenance building (Landau Associates 2001). No environmental concerns were identified, although the interior of the building was not observed. The Port Marina Maintenance Facility was demolished in 2007 in conjunction with development of the Craftsman District and construction of the new Marina Operations Center; this area is currently paved.

2.2.5.9 Former Warehouse (Veco, Inc. and Port of Everett)

The southwestern part of Area M was the location of an additional warehouse. The warehouse was built in 1983, and in 1991 was being leased by Veco, Inc. from Jensen-Reynolds Construction for storage and occasional use on large jobs. In 1991, the northern portion of the warehouse was being used by the Port of Everett as a maintenance garage prior to construction of its new maintenance facility (Kleinfelder 1991 and Hart Crowser 1991). Several environmental issues, noted below, were identified at this location by Kleinfelder (1991) and Hart Crowser (1991):

- Dark staining on the surface grating of a storm drain in the building floor, and chemical drums stored onsite and nearby (Kleinfelder 1991)
- Storage of waste oil in cans and drums that showed leakage and spillage outside of the maintenance garage, and small piles of oil absorbent material observed adjacent to lube, motor, and hydraulic oil drums inside the building (Hart Crowser 1991)
- Green sand observed at multiple locations, including behind the maintenance garage; was assumed to be related to sandblasting activities (Hart Crowser 1991).
- Waste oil staining observed on asphalt around a 75-gallon waste oil tank located outside at the northwest corner of the garage, and petroleum odor and sludge identified in stormwater drains and sumps inside the building (Hart Crowser 1991).

The warehouse was demolished in 2007 in conjunction with development of the Craftsman District; this area is currently paved and used as a boatyard.

2.2.5.10 Office Buildings

Two buildings bordering 13th street in Area M served as office buildings. The western-most building was present to the south of the Veco/Port warehouse. The eastern half of the office building was constructed in 1982 and a western expansion was added in the early 1990s. The buildings were demolished in 2006 during construction of the Craftsman District.

Two gasoline USTs and one diesel UST were located within the expanded building footprint, which was reportedly the reason for their removal prior to construction of the building addition. These USTs, erroneously listed in Ecology records as having been removed from Bayside Marine (1100 13th Street), were determined to be incorrectly located; the correct location was identified with the assistance of Port personnel and historic aerial photographs. The correct locations for these former USTs are shown on Figure 3. As discussed in the Interim Action Report (Landau Associates 2010a), an interim action was conducted in this area based on visual evidence of petroleum hydrocarbon contamination observed during decommissioning of three USTs. Based on the soil compliance monitoring results, and the post-interim action groundwater monitoring results, the 1991 interim action conducted in association with the UST removal was effective and further action at this location is not needed.

The other building, a modular home unit used as an office building, briefly existed in Area M between 2002 and 2006, just south of the Collins building, facing 13th Street. No environmental concerns were identified associated with this structure.

2.2.6 IN-WATER AREA

The 12th Street Yacht Basin is located in the 12th Street Channel, and constitutes the aquatic portion of the Site. The currently estimated Site boundary extends from the western shoreline of Area I to the point where the channel intersects the Snohomish River, and from the north shoreline of the channel to the estimated north boundary of the North Marina West End site (about 200 ft north of the Channel's south shoreline). Based on review of historic aerial photos, the Yacht Basin was heavily used for log rafting and other saw milling activities until the Hulbert Mill ceased operations in the 1960s. Based on aerial photos and other information, a navigation channel was dredged along the south side of the channel in the early 1970s to provide adequate vessel draft for both Port and Hulbert operations. The entire Site aquatic area was dredged to about elevation -16 ft MLLW in 2005 as part of the Yacht Basin development, and the Yacht Basin floats and upland infrastructure were built between 2005 and 2007.

Sediment investigation studies prior to the construction of the Yacht Basin are discussed in Section 3.1.3. However, the 2005 dredging of the Yacht Basin likely removed any impacts from historic activities reflected in pre-2005 sediment quality data.

A stormwater outfall present in the northeast corner of the Yacht Basin receives stormwater from a stormwater trunk line that runs easterly from the outfall (Figure 5). The age of the trunk line is uncertain, but it is interpreted to have gone in along the northern boundary of Area I in the mid-1970s in association with the construction of the Centrecon facility and filling of Area I. The trunk line along the north property line of Area G is interpreted to have been installed between 1980 and 1982 during the filling and construction of the property to the north (Pinnacle GeoSciences 2010). Numerous laterals drain into the main trunk line, including laterals from the northern half of the Ameron leasehold and the Norton Industries property to the north of the Site [including the TC Systems (ceased operations in May 2010), Dunlap Industrial Hardware, and O&W Glass businesses]. Stormwater conveyance from the northern portion of the Bayside Marine leasehold and the access roadway to the west of the Bayside building were recently added to the trunk line during the development of the Craftsman District. The stormwater system at the TC Systems site was reconfigured in 2011, but still drains to the trunk line. Due to its age and the limited documentation of its construction, there could be additional, undocumented, laterals connected to the trunk line.

The stormwater trunk line is constructed of 24-inch diameter corrugated metal pipe and, historically, failed on two occasions. Replacement of failed sections of the main trunk line was conducted by Ameron in 2005 and the Port in the spring of 2008 (Landau Associates 2010b). Sink holes developed as a result of failure of the trunk line and observations made during subsequent repair of the failed sections indicated that significant corrosion of the trunk line had occurred. In addition, recent camera surveys in 2008 and 2009 could not be completed because of sediment accumulation in the trunk line. It is also noted that marine surface water backs up into the main trunk line during high tide due to the lack of a properly functioning tidal gate.

Stormwater was collected and tested from the outfall, and marine sediment was collected and tested from the immediate outfall vicinity during previous Site investigations, as discussed in Section 3.1.3.

3.0 PREVIOUS INVESTIGATIONS AND INTERIM ACTION

A large number of environmental investigations and interim actions have been conducted at the Site and are described in this section. These investigations and the interim actions are documented in several reports including the North Marina Ameron/Hulbert Site Interim Action Report (Landau Associates 2010a), which provides a comprehensive overview of the previous investigations and interim actions at the Site. The Interim Action Report can be viewed on Ecology's website.

In addition, in August of 2011, an emergency action cleanup was conducted at the Site to address petroleum hydrocarbon soil contamination in the area of the former Collins Building, which is being redeveloped by the Port as an expansion of the Port's existing Craftsman District boatyard. The emergency action cleanup plan can be viewed on Ecology's website. A technical memorandum documenting the results of the emergency action is provided in Appendix B.

A list of the relevant documents is provided in Appendix C. Also included in Appendix C are data tables and figures summarizing the results of previous investigations. Several of the investigations and interim actions were conducted by Landau Associates when the Site was part of the North Marina Redevelopment Project site and was under Ecology's VCP. At that time, the North Marina Area was subdivided into investigation areas A through L. The upland portion of the Site addressed by this report includes only Investigation Areas G, I, and M, and most of Area J. The northern portion of the 12th Street Yacht Basin is located within the in-water portion of the Site. The investigation areas are shown on Figure 4 and will be referenced in this report when discussing Site features and environmental conditions.

Sampling location identifications (for samples collected by Landau Associates from 2000 onward) were assigned prefixes that match the investigation area in which they are located. For example, sample location G-FA-5 was collected from Investigation Area G. Similarly, identifications of interim action areas have a prefix that matches the investigation area in which they are located. For example, Interim Action Area I-9 is located in Investigation Area I. Interim action Area G-1a is located in both Area G and Area I and the prefix for samples from this area is G-1a. For organizational purposes and easy reference, these letter designations have been carried forward in the RI/FS. Note that samples collected prior to 2000 do not follow this convention.

3.1 ENVIRONMENTAL INVESTIGATIONS

Prior to the Site's entry into the MTCA formal process, a large number of environmental investigations were conducted to determine the nature and extent of contamination within the North Marina Area, including the Site. Up until 2000, investigations were performed by a number of different parties. From 2000 onward, Landau Associates performed all upland environmental investigations at the

Site, starting with a Phase I ESA (Landau Associates 2001) and several subsequent investigations including a Phase II ESA conducted in late 2003 and early 2004 (Landau Associates 2004), a Data Gaps Investigation conducted in late 2004 and early 2005 (Landau Associates 2005a), and an investigation completed in the area where repairs were made to the main trunk line (located near the north fence line in Area G; see Figure 8) in early 2005 (Landau Associates 2005b). Brief descriptions of each environmental investigation are provided in Appendix A of the RI/FS Work Plan, which can be viewed on Ecology's website. It is noted that an RI soil boring completed in the former excavation area associated with the 2005 main trunk line repair confirmed that quarry spalls were used to backfill the excavation. It was previously thought that contaminated stockpiled soil generated from the trunk line repair work was used as backfill for the excavation. The location associated with the final placement of the contaminated soil stockpile is unknown.

Several sediment quality investigations have been conducted for the in-water portion (12th Street Yacht Basin) of the Site. The in-water portion of the Site has been dredged and much of the sediment characterization has been associated with disposal/relocation requirements of the dredged sediment, with the exception of the surface sample collected by SAIC for Ecology in a study covering sediment quality for the entirety of Port Gardner Bay (SAIC 2009). With the exception of the SAIC data, the 2005 dredging for the 12th Street Yacht Basin removed most of the sediment associated with these previous characterization activities.

The number of soil, groundwater, and sediment samples collected for characterization purposes prior to this RI and the types of chemical analyses performed for each are described below. Analytical results for these prior investigations are presented in Section 6.0 in conjunction with the RI data. In addition, figures showing analytical results by parameter (updated to include RI data) and data tables summarizing pre-RI characterization sample results are included in Appendix C. Note that the figures and data tables presented in Appendix C are not representative of current Site conditions.

3.1.1 SOIL

About 290 soil samples have been collected throughout the Site and submitted for laboratory analysis during previous investigations. Laboratory analysis of the soil samples included VOCs, semivolatile organic compounds (SVOCs) including cPAHs, organotins [e.g., tributyl tin ion (TBT)], metals, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons.

3.1.2 GROUNDWATER

Investigation of groundwater quality at the Site has consisted of laboratory analysis of groundwater samples collected from 14 monitoring wells and 15 soil boring locations (temporary well points). In addition, three water samples were collected from a concrete basin settling sump on the eastern side of the Ameron facility and two water samples were collected from a former settling pond in the northwestern portion of Area G. Groundwater samples were selectively analyzed for VOCs, SVOCs including cPAHs, metals, and petroleum hydrocarbons.

3.1.3 SEDIMENT

Three sediment quality investigations were conducted in the 12th Street Channel in advance of it being redeveloped into the 12th Street Yacht Basin to evaluate the sediment quality for open water disposal under the Puget Sound Dredge Disposal Analysis (PSDDA) program. These investigations are described in the Interim Action Report (Landau Associates 2010a).

The sediment quality investigations consisted of laboratory analysis of 18 composite samples collected from 39 sediment cores and one surface sediment sample. Laboratory analysis for sediment samples included VOCs, SVOCs including cPAHs, metals, petroleum hydrocarbons, pesticides, PCBs, organotins, conventional paramaters, and grain size. Selected samples were also submitted for bioassay analysis.

Seven sediment samples were collected by Landau Associates in 2009 from the southern portion of the 12th Street Yacht Basin during the remedial investigation for the adjacent North Marina West End Site (Landau Associates 2009) and one sediment sample was collected from the in-water portion of the Site by SAIC in 2008 to evaluate sediment quality as part of the evaluation of Port Gardner Bay under the PSI (SAIC 2009).

Following submittal of the Interim Action Report, an unsigned Landau Associates report describing a limited stormwater/sediment investigation conducted within the northeastern portion of the 12th Street Channel was discovered in Landau Associates files. In 1997, three surface sediment samples were collected from the tidelands (near the outfall) and one stormwater sample was collected directly from the outfall (the exact sample locations are not known). The samples were analyzed for pH, VOCs, SVOCs, and herbicides. A limited number of volatile and semivolatile compounds were detected in the samples, and the report concluded that the constituents detected are commonly found in marine sediments in urban or industrialized areas (Landau Associates 1997).

3.2 INTERIM ACTIONS

Three interim actions were conducted at the Site by the Port. In 1991, the Port conducted an interim action to address petroleum hydrocarbon contamination encountered during decommissioning of three USTs at the south end of Site. In 1993, an interim action was conducted in conjunction with construction of the MSRC facility in the southwest portion of the Site (Figure 6). The most extensive of the three interim actions was conducted by the Port between 2005 and 2007 in conjunction with the North Marina Redevelopment project to address contaminated soil and groundwater at interim action areas identified based on previous Site characterization activities (Area I subareas I-1 through I-11, G-1, G-1a, J-1 and J-3; and M-1; see Figure 6). The 2005 to 2007 interim action included excavation and offsite disposal of impacted soil and the collection and analysis of compliance monitoring samples to verify that interim action cleanup levels (CULs) were achieved. Planned and final interim action areas are shown on Figure 6 and the interim actions are summarized in Table 1. As shown in Table 1, close to 33,000 tons of contaminated soil, or about 22,000 cubic yards, were removed as part of the interim actions. A detailed description of the interim action is provided in the Interim Action Report, which can be viewed on Ecology's website (Landau Associates 2010a). Soil and groundwater compliance monitoring analytical results are discussed in Section 6.0. The following issues associated with the interim actions were addressed as part of this RI/FS:

- Residual contamination in the G-1 and G-1a area where interim action was terminated due to access issues related to leasehold and utility boundaries.
- Residual contamination in the north sidewall of Area I-5.
- Arsenic-affected crushed rock beneath the esplanade.
- Soil and debris and recently placed crushed rock base course material contained beneath pavement in the J-3 area.
- Arsenic and copper groundwater concentrations exceeded their respective screening levels at the Site.
- Groundwater quality in the J-1 area north of the MSRC building where petroleum was observed during utility construction.

3.3 EMERGENCY CLEANUP ACTION

An emergency action cleanup was conducted in the area of the former Collins Building to address petroleum hydrocarbon contamination in shallow soil in two areas (East Area and West Area) within the Port's Craftsman District boatyard expansion area. Approximately 79 cubic yards of soil were removed from the two areas and transported offsite for treatment. Diesel-range and heavy oil-range petroleum hydrocarbons were not detected in any of the compliance monitoring samples at concentrations greater than the laboratory reporting limits, demonstrating that the emergency action achieved the Site screening levels. The emergency cleanup action was conducted in accordance with the Emergency Action Cleanup Plan (Landau Associates 2011a) and was documented in a technical memorandum (Appendix B). Figure 7 shows the emergency action cleanup areas and associated compliance monitoring locations. The characterization and compliance monitoring data are discussed in Section 6.0.

4.0 REMEDIAL INVESTIGATION ACTIVITIES

RI activities were designed to address data gaps identified in the RI/FS Work Plan (Landau Associates 2010b). Results from previous soil investigations and compliance monitoring associated with the interim actions conducted are considered sufficient for characterizing soil quality for much of Area I and Area J. Therefore, RI soil characterization largely focused on those areas with remaining contamination that required additional delineation and those areas not previously investigated. Additionally, post-interim action groundwater and post-dredging sediment conditions had not been evaluated at the Site. As a result, a Site-wide groundwater evaluation was conducted and sediment quality was evaluated throughout the in-water portion (12th Street Yacht Basin) of the Site during the RI. In addition, to evaluate the potential for recontamination of marine sediment, stormwater sediment samples were collected from selected catch basins and adjacent locations within the stormwater trunk line along the north Site boundary that discharges to the northeast corner of the 12th Street Yacht Basin.

The RI/FS Work Plan can be viewed on Ecology's website. The initial Work Plan activities included sampling of soil and groundwater in Areas G, I, J, and M; sediment sampling throughout the in-water portion of the Site (i.e., within the 12th Street Yacht Basin); and collection of stormwater sediment samples from catch basins along the trunk line. Following completion of the initial RI field activities, the Collins Building was removed from the southeastern portion of the Site by the Port. Based on a site reconnaissance completed in the area of the former Collins Building, additional areas requiring investigation (i.e., areas associated with the former Collins Building) were completed in accordance with Addendum No. 1 to the Work Plan, which can be viewed on Ecology's website (Landau Associates 2011c). Follow-up testing within the area of the former Collins Building was conducted after review and approval by Ecology through a series of email exchanges and conference calls. Based on the results of sampling completed under Addendum No. 1, emergency cleanup activities were conducted in the area of the former Collins Building, as discussed previously in Section 3.3, and in Section 6.0.

Based on the results of the initial RI sampling, two phases of supplemental RI sampling were conducted in accordance with the Addendum No. 2 to the Work Plan (Landau Associates 2011d) and Addendum No. 3 to the Work Plan (Landau Associates 2013), which can be viewed on Ecology's website. The supplemental activities completed under Addendum No. 2 included collection of additional soil samples from Area G and Area M, installation and sampling of two additional monitoring wells in Area G and Area J, and collection of stormwater sediment samples from within the stormwater trunk line. In addition, a second round of groundwater samples were collected from all existing wells to represent dry season conditions, a surface water sample was collected from the in-water area adjacent to the shoreline, and samples were collected from process waste bins located to the east of the Ameron manufacturing building in Area G. The supplemental activities completed under Addendum No. 3 included collection of additional soil samples from Area G and Area M.

RI field activities were completed in general accordance with the Work Plan and Work Plan Addendums. This section describes the RI activities and any deviations from the procedures specified in the Work Plan and Work Plan Addendums. RI results are presented in Section 6.0.

4.1 SOIL

The RI soil investigation consisted of collecting soil samples from about 80 direct-push soil borings, 7 monitoring well boreholes completed with a hollow-stem auger (HSA), and 6 test pits. In addition, nine surface soil samples were collected using hand tools. Soil samples were collected to evaluate soil conditions, including soil type and soil quality. Soil samples from each exploration were selected for chemical analyses, except as described in the following sections. Sampling locations, sample collection, field screening, and chemical analysis are described below.

4.1.1 SAMPLING LOCATIONS

The soil exploration locations are shown on Figure 8. Borings were completed approximately at the locations proposed in the Work Plan and Work Plan Addendums with the following exceptions.

- Due to utilities, two borings in Area I (I-FA-100 and I-FA-101) and one boring in Area J (J-GC-101) were moved from their proposed locations. I-FA-100 was moved approximately 20 ft west and I-FA-101 was moved approximately 50 ft west and 30 ft. south. J-GC-101 was moved about 25 ft east of its planned location.
- During the field investigation for the supplemental RI, additional information became available regarding the location of the former oil-affected area excavation. A marking for a paved-over manhole located in the immediate vicinity of the excavation was identified. As a result, an additional boring (G-FA-115c) was completed to the southwest of the identified manhole. Planned boring G-FA-114a was not completed as two borings (G-FA114 and G-FA-115b) had already been drilled to the east of the former excavation.
- During drilling, evidence of potential petroleum impact was observed at location M-GC-107. As a result, an additional boring (M-GC-107a) was added to the southwest of M-GC-107.

Soil samples were collected from most of the explorations for chemical analysis. However, in accordance with the Work Plan, soil samples were not collected for chemical analysis at locations selected for groundwater monitoring if no evidence of potential soil contamination was observed.

Approximately 66 focused area (FA in sample location identification) borings, surface sample locations, and test pits were located based on knowledge of previous use, observations of potentially affected materials (e.g., a black sand-sized material suspected to be apparent sandblast media) made during previous Site activities, and/or data from soil or groundwater samples collected during previous investigations. Twenty-nine general characterization (GC in sample location identification) borings were located to evaluate soil quality in areas with little existing chemistry data and no suspected source. Note that borings advanced during the supplemental RI to delineate impacts to soil identified in GC borings completed as part of the initial RI were named according to the initial RI location. Further rationale for the sampling locations is presented in Section 8.1 and Table 16 of the Work Plan, and in Work Plan Addendums No. 1, No. 2, and No. 3. All of these documents are available on Ecology's website.

The depths of samples collected were defined by the Work Plan and field screening results. At focused area borings, general characterization borings, and test pits where no evidence of contamination was observed, samples were generally collected from 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft BGS. For borings advanced in paved areas, the 0 to 1 ft sample was collected from soil underlying the pavement and base coarse material and the actual depth of the sample was recorded on the sample collection forms. For example, sample G-FA-113 (0-1) was collected from a depth of 1 to 2 ft BGS due to the presence of asphalt and base coarse material at a depth of 0 to 1 ft BGS. Table 2 reflects both the sample ID and the actual depth (ft BGS) from which the samples were collected.

At locations where evidence of potential contamination (e.g., staining, odor, fill type) was observed, samples were collected from the apparent affected area and below the apparent affected area, if practical. In accordance with the Work Plan, exceptions to this procedure were at J-FA-100, where a soil sample from the capillary fringe was collected, and at I-FA-100 where only a sample from 2 to 3 ft BGS was collected because no evidence of soil contamination was observed at this location during field screening and previous soil interim action cleanup had been completed in this area above 2 ft BGS. Soil samples were not collected from I-FA-101, RI-MW-6, or RI-MW-7 because no evidence of potential soil contamination was observed at these locations during field screening. Additional samples were collected from the top of the saturated zone at RI-MW-2, RI-MW-4, RI-MW-5, M-GC-102, and G-GC-103 to evaluate total organic carbon (TOC) and/or to collect a soil sample for grain size analysis (GSA). Note that locations where soil samples were not collected for chemical analysis are not shown on figures presenting analytical results for the soil investigation.

4.1.2 SOIL SAMPLE COLLECTION

Soil samples were collected using a truck-mounted direct-push drilling rig, a truck-mounted hollow-stem auger drilling rig, hand tools (e.g. hand auger), or a rubber-tired backhoe. Direct-push soil samples were obtained from the soil borings using a closed-piston sampling device with a core sampler. Hollow-stem auger soil samples were collected using a 3.25-inch outside diameter (OD) split-spoon sampler. At locations where the ground surface was paved, 0 ft was considered to be immediately below the asphalt base course layer for sample labeling purposes, although the estimated depth of the sample relative to ground surface was recorded on the exploration logs and is presented in the data tables. Test pit samples collected from 0 to 4 ft BGS were collected by scraping sidewalls with a stainless-steel spoon, while samples from below 4 ft were collected from the excavator bucket, with care taken to collect soil that was not in contact with the sides of the bucket.

Soil samples for laboratory analysis were selected based on the criteria identified in the Work Plan, Work Plan Addendums No. 1, No. 2, and No. 3. and field screening results (described below). Soil samples to be analyzed by U.S. Environmental Protection Agency (EPA) Method 8260 for VOCs or for the analysis of gasoline-range petroleum hydrocarbons [total petroleum hydrocarbons (TPH)-Gx] by Method NWTPH-Gx were collected and preserved in accordance with EPA Method 5035 before disturbing the sample. The remaining portion of the selected soil sample interval was placed into a decontaminated stainless-steel bowl and homogenized using a decontaminated stainless-steel spoon. Larger-sized material [gravel or wood fragments greater than 2 millimeters (mm) in diameter] was removed by hand-sorting. The sample was then transferred to the appropriate laboratory-supplied sample containers. All soil sampling equipment was decontaminated using a tap water rinse, Alconox wash, and distilled water rinse between samples.

4.1.3 SOIL SAMPLE FIELD SCREENING

The soil classification of each soil sample collected was evaluated by the Landau Associates' field representative and recorded on a Log of Exploration form, and the sample was field-screened for evidence of contamination. Field-screening was conducted by visually inspecting the soil for staining and other evidence of environmental impact (e.g., sheen), and monitoring soil vapors for VOCs by performing headspace analysis using a portable photoionization detector (PID). Headspace analysis was conducted by placing a representative portion of the soil in a sealable plastic bag, allowing the soil to vaporize inside the sealed container for 5 minutes, then inserting the PID tip into the bag to measure total VOCs. Sheen testing was conducted by adding water to a portion of the soil core and observing the surface of the water for sheen. Field screening results were recorded on the Log of Exploration form. Exploration logs for each soil boring and monitoring well borehole are provided in Appendix D.

4.1.4 SOIL SAMPLE CHEMICAL ANALYSES

Soil samples collected for analysis under the general characterization protocol and the focused area protocol were analyzed for selected metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, and zinc) using EPA Methods 6020/7470; and selectively analyzed for cPAHs using EPA Method 8270C select ion monitoring (SIM); PCBs by EPA Method 8082; SVOCs by EPA Method 8270; dioxins/furans by EPA Method 1613; TPH by hydrocarbon identification method (NWTPH-HCID) and/or diesel-range and oil-range petroleum hydrocarbons using Method NWTPH-Dx, as indicated in Table 2. Gasoline-range petroleum hydrocarbons using Method NWTPH-Gx and VOCs by EPA Method 8260B were also analyzed if field screening suggested the potential presence of these constituents, and selected samples were analyzed for pH by EPA Method 9045 where evidence of potential concrete-like waste was observed. Samples collected from the saturated zone at selected locations were analyzed for TOC by EPA Method 9060A and GSA by American Society for Testing and Materials (ASTM) Method D422.

At locations where multiple samples were collected, the shallow samples were initially submitted for analysis and samples from the remaining intervals were archived and subsequently analyzed for constituents that were detected at concentrations greater than screening levels in the interval above.

4.2 MARINE SEDIMENT

In accordance with the Work Plan, surface sediment grab samples were collected from 8 sampling stations, identified as A/H-SED-1 through A/H-SED-8, as shown on Figure 5. The samples were collected from the northern three quarters of the 12th Street Marina in the western portion of the Site.

Sediment samples were collected on December 10, 2010 using the procedures described in the *Sediment Investigation Sampling and Analysis Plan* (Sediment SAP; Work Plan Appendix G). Samples were retrieved at each sampling station using a 36-ft landing craft vessel with a Pneumatic Power Grab sampler. Samples for laboratory analysis were collected from the upper 10 centimeters (cm) of sediment in the sampler, homogenized in a stainless-steel bowl, and placed in the appropriate sample container.

In accordance with the Work Plan, the sediment samples were analyzed for the following list of SMS chemicals: metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc and antimony) by EPA Method 6020; SVOCs by EPA Method 8270C; PCBs by EPA Method 8082; and conventional parameters [GSA (ASTM D422); TOC (EPA Method 9060A); total volatile solids (TVS: EPA Method 1680); total solids (EPA Method 160.3); ammonia (SM4500; NH_3D Mod); and total sulfides (SM4500; S^{2-}F Mod]. Sediment samples collected from stations A/H-SED-1 and A/H-SED-4 were also analyzed for dioxins/furans by EPA Method 1613.

For data validation purposes, a blind field duplicate sample was collected at station A/H-SED-1 (duplicate sample identified as A/H-SED-10). The blind field duplicate was analyzed for all of the above analytes.

4.3 GROUNDWATER

Groundwater investigation activities associated with the RI occurred between November 22, 2010 and October 19, 2011. Seven monitoring wells (RI-MW-1 through RI-MW-7) were installed in Area G, Area I, Area J, and Area M. Monitoring well locations were chosen to evaluate groundwater conditions near the point of discharge to surface water, downgradient of current or former industrial operations, and spatially to allow for development of groundwater elevation contours. Grab samples were collected from direct-push borings at 18 locations throughout the Site. Additionally, samples were collected of groundwater discharge from a concrete basin sump located within the Ameron International manufacturing building in Area G. Monitoring wells, grab samples, and sump sample locations were positioned either to characterize groundwater near its point of discharge to surface water along the shoreline, for general characterization purposes, or to further characterize upland areas of interest, as described in Section 8.2 and Table 16 of the Work Plan, and in Work Plan Addendums No. 1 and No. 2.

Additional discussion of the groundwater sampling activities is provided below.

4.3.1 DIRECT-PUSH GROUNDWATER GRAB SAMPLING

Between November 22, 2010 and January 28, 2011, groundwater grab samples were collected from 18 direct-push borings at the locations shown on Figure 9. The locations are similar to those shown in the Work Plan and Work Plan Addendum No. 1. Boreholes were drilled using a truck-mounted direct-push drill rig. Four-ft long stainless-steel well screens were placed in the boreholes at depths ranging between approximately 8 and 10 ft BGS.

The temporary wells were purged using a peristaltic pump until the water was clear or for 10 minutes (whichever occurred first), or until the temporary well had been pumped dry at least once. During purging, field parameters [pH, temperature, conductivity, turbidity, oxidation reduction potential (ORP), and dissolved oxygen (DO)] were monitored and recorded on sample collection forms. In accordance with the procedures described in the Work Plan and Addendum No. 1, groundwater samples collected for heavy metals analysis were field-filtered through a 0.45 micron, in-line disposable filter.. Groundwater samples collected from direct-push borings for organic analyses (except VOCs) were centrifuged to settle particulates prior to analysis. Immediately after completing the sample collection, the screens and casing were removed and the boreholes were filled with bentonite chips.

Direct-push groundwater grab samples were selectively analyzed for dissolved metals, PCBs, TPH, SVOCs, and VOCs, according to the Work Plan and Work Plan Addendum No. 1. Two blind field duplicates were collected. Matrix spikes were collected. Trip blanks accompanied samples analyzed for VOCs; the results for the trip blanks were evaluated during data validation.

4.3.2 GROUNDWATER SUMP SAMPLING

Groundwater grab samples were collected from the discharge of the concrete basin sump in the manufacturing building in Area G on December 20, 2010 and on October 19, 2011. The discharge line from the sump was plumbed on the exterior of the building prior to sampling by Ameron International personnel. The grab sample was collected from a spigot while the sump was operating. The sump samples were analyzed for TPH, dissolved metals, VOCs, and SVOCs.

4.3.3 MONITORING WELL INSTALLATION AND SAMPLING

Monitoring well installation and sampling took place between December 7, 2010 and October 11, 2011. Five monitoring wells (RI-MW-1 through RI-MW-5) were installed and developed in Area I, Area J, and Area M between December 7 and December 13, 2010, in accordance with the Work Plan. Monitoring well locations were chosen to evaluate groundwater conditions near the point of discharge to surface water, downgradient of current or former industrial operations, and spatially to allow for development of groundwater elevation contours. Three existing monitoring wells, located in Area G and Area M, were also re-developed (prior to sampling) between December 10 and December 13, 2010. Based on the initial RI results, two additional monitoring wells (RI-MW-6 and RI-MW-7) were installed and developed in areas J and G on September 30, 2011, as described in Work Plan Addendum No. 2. The additional wells were placed to further evaluate concentration of dissolved metals and petroleum hydrocarbons detected in a sample collected from direct-push boring J-FA-100 and concentrations of dissolved metals detected in a sample collected from direct-push boring G-GC-100.

Locations of new and existing monitoring wells are shown on Figure 9 and are similar to the locations proposed in the Work Plan and Work Plan Addendum No. 2. Two-inch diameter PVC monitoring wells were installed to depths ranging from 12 to 16 ft BGS. Boreholes for the wells were drilled using a truck-mounted HSA drilling rig. The monitoring wells were constructed using a 10-ft. section of 0.010-inch machine-slotted polychlorinated vinyl chloride (PVC) well screen installed to intersect the water table and a 10/20 silica sand filter pack was placed from the bottom of the well to approximately 1 ft above the top of the screen. Due to the presence of multiple utilities, a vactor truck was used to pre-clear the shoreline well locations (RI-MW-1, RI-MW-2, and RI-MW-3) prior to HSA drilling. Wells were developed with a Honda trash pump, a Waterra valve, and/or a peristaltic pump. At least 5 casing volumes were pumped from each well, except at RI-MW-1, RI-MW-3, and RI-MW-6 where wells were pumped dry and allowed to recharge a minimum of three times. Further details regarding well installation and development are provided in the Upland SAP (Appendix F of the RI/FS Work Plan). Exploration logs and as-built diagrams for the newly installed wells are included in Appendix D.

The monitoring wells were sampled during three events. The first event took place on December 15, 2010 (wet season; referred to in this document as the December 2010 sampling event); the second event was conducted on select wells on February 22, 2011 (see discussion below; referred to as the February 2011sampling event); and the third on October 11, 2011 (dry season; referred to as the October 2011 sampling event). Samples collected at wells installed along the shoreline were collected within one hour of low tide to minimize marine surface water influence. Wells farther inland were sampled within approximately 3 hours of low tide. As discussed in Section 6.1.2, the groundwater water level measurements indicate that the inland wells were not appreciably tidally influenced.

During the December 2010 event, eight wells were sampled (RI-MW-1 through RI-MW-5, ECI-MW-3, SEE-EC-3, and P-10). Due to suspected laboratory bis(2-ethylhexyl)phthalate (BEHP) contamination and anomalous results in the December 2010 round of sampling for mercury, arsenic, and oil-range petroleum hydrocarbons, additional groundwater samples were collected from selected monitoring wells on February 22, 2011. This February 2011 groundwater monitoring event consisted of sampling and analyzing samples from monitoring wells ECI-MW-3, RI-MW-1, RI-MW-3, and RI-MW-5 for BEHP; wells RI-MW-1 through RI-MW-4 for dissolved mercury; well ECC-EC-3 for dissolved arsenic; and monitoring well RI-MW-4 for oil-range petroleum hydrocarbons. The additional groundwater monitoring was approved by Ecology via email correspondence on February 17, 2011 (Kallus 2011). The wells sampled in the October 2011 event included monitoring wells RI-MW-1 through RI-MW-7, ECI-MW-3, SEE-EC-3, and P-10.

During the wet (December 2010) and dry season (October 2011) sampling events, blind field duplicates and matrix spikes were collected and analyzed. During the December 2010 event, blind field duplicate samples were collected from ECI-MW-3 (duplicate sample identified as ECI-MW-302) and RI-MW-4 (duplicate sample identified as RI-MW-402). During the October 2011 event, a blind field duplicate sample was collected from RI-MW-5 (identified as RI-MW-502)

During the December 2010 sampling event, all of the monitoring well groundwater samples were analyzed for dissolved metals and VOCs, and selected monitoring wells were also analyzed for hexavalent chromium, SVOCs/cPAHs, PCBs, and/or petroleum hydrocarbons as indicated in Table 3. During the October 2011 sampling event, monitoring wells were analyzed for the same parameters analyzed for during the December 2010 event. Monitoring well RI-MW-6 was analyzed for dissolved metals (arsenic, copper, lead), and petroleum hydrocarbons. Monitoring well RI-MW-7 was analyzed for dissolved metals (arsenic and copper). In accordance with the procedures described in the Work Plan, groundwater samples collected for heavy metals analysis were field-filtered through a 0.45 micron, in-line disposable filter. Groundwater samples collected from monitoring wells for organic analysis (except VOCs) were centrifuged if the turbidity exceeded and average of 10 nepholemetric units (NTU) using four replicate measurements.

During each monitoring event, pH, temperature, conductivity, turbidity, ORP, and DO were measured at each monitoring well. Temperature, conductivity, and pH, DO and ORP were measured using a YSI 556 multiprobe. Turbidity was measured using a Hach turbidity meter. Trip blanks accompanied samples analyzed for VOCs and the results for the trip blanks were evaluated during data validation.

4.3.4 GROUNDWATER LEVEL MEASUREMENTS

Groundwater levels were measured for all monitoring wells at low tide, intermediate tide, and high tide to determine groundwater elevations and evaluate tidal influence on groundwater elevations. High and intermediate water levels were collected on January 21, 2011, and low tide water levels were collected on February 22, 2011, and October 11, 2011 to represent wet season and dry season water elevations, respectively. The depth to groundwater at each well was measured from a surveyed reference point at the top of the PVC well casing.

4.4 SURFACE WATER

During the October 2011 groundwater monitoring event, a surface water sample was collected from the 12th Street Yacht Basin (in-water portion of Site) at low tide just offshore of RI-MW-1, as shown on Figure 9. The sample was analyzed for dissolved arsenic and dissolved copper.

The sample was collected by holding an unpreserved clean laboratory-supplied bottle under the surface of the water with the cap in place. The cap was slowly detached from the bottle to allow water to flow into the bottle without any surface debris entering the bottle, and the cap was replaced before removing the bottle from the water. Using a peristaltic pump, the water from the bottle was then pumped through a 0.45 micron filter into a laboratory bottle preserved with nitric acid, and put on ice to be transferred to the laboratory. Field parameters were not measured during collection of the surface water sample; therefore, field parameters were measured at the approximate location of the surface water sample at low tide on October 19, 2011.

4.5 STORMWATER SYSTEM SOLIDS

Stormwater system solids samples were collected on November 24, 2010 from four catch basins along the stormwater trunk line (SD-3, SD-4, SD-7, and CB111) and one catch basin that contributes to the trunk line near its outfall (CB101), located as shown on Figure 5. Samples were collected by repeatedly scraping the bottom of the catch basin with a dedicated jar attached to a telescoping pole until adequate sample volume was collected. Collected sediment was homogenized in a stainless-steel bowl and placed in appropriate sample containers. Samples from SD-3, SD-4, SD-7, and CB-111 were analyzed for metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, and zinc); SVOCs; TPH-Dx; PCBs; TOC; hexavalent chromium; and percent solids; using the methods previously listed for soil. CB-101 was analyzed for total metals, SVOCs, TPH-Dx, PCBs, TOC, and percent solids. Further details describing catch basin sampling are presented in Section 2.3 of the Work Plan.

Stormwater sediment sub-samples were collected on December 22, 2011 from the stormwater trunk line accessed at catch basins SD-5, SD-6, and SD-7. In accordance with Work Plan Addendum No. 2, stormwater sediment samples were collected from locations with a minimum of 3 to 4 inches of accumulated sediment within the stormwater trunk line. As such, samples were not collected from the trunk line in the vicinity of catch basins SD-4 or CB111 and a sediment sample was not collected from SD-10. Generally, samples were collected in the downstream portion of trunk line piping in the access location. However, samples were occasionally collected from the upstream point of access where greater amounts of sediment had accumulated.

Stormwater sediment sub-samples were collected from the trunk line using a variety of hand tools, depending on the location and thickness of sediment buildup. In locations where sufficient sediment buildup was located 3 or more feet horizontally down the trunk line piping, a 2-inch diameter sampling tube mounted to a long handle was advanced into the sediment in order to collect a representative vertical profile of accumulated solids. In locations where sufficient sediment buildup was less than 3 ft horizontally down the trunkline piping, a stainless-steel trowel was used to collect a representative vertical profile of solids. The sediment samples were then placed into stainless-steel bowls, homogenized, and placed into laboratory-supplied containers.

The laboratory was directed to composite the samples and the composited sample was analyzed for total and Toxicity Characteristic Leaching Procedure (TCLP) Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); SVOCs; TPH-HCID; PCBs; TOC; pH; dioxins/furans; and percent solids.

4.6 PROCESS WASTE

Ecology requested the collection of samples from the process waste solids generated by Ameron operations. Solids are managed in a series of six drying bins located to the east of the manufacturing building. The solids are rotated south to north through the drying bins before being transported offsite for disposal as solid waste. Solids from plant processes consist predominately of accumulated sediment from settling ponds and also include smaller amounts of wheelabrator dust, floor sweepings, and sand blast waste.

As described in Work Plan Addendum No. 2, the proposed process waste characterization consisted of collection of composite samples from three of the six drying bins located to the east of the Ameron International manufacturing building. The Work Plan indicated that composite samples would be collected from the first (southern), third (center), and last (northern) drying bins and would be analyzed for metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, and zinc). On the day of sampling, the third bin was empty. Samples were collected from the bins that contained the most significant quantity of waste material (Bin 1, Bin 2, and Bin 5).

4.7 QUALITY ASSURANCE (QA) SAMPLES

Blind field duplicate and matrix spike samples were collected for soil, groundwater, marine sediment, and stormwater system solids samples. Field duplicate sample frequency was one per 20 samples, or at least one per sampling event for all analyses. Note that during the initial RI, soil samples duplicates collected for VOCs and TPH-G were collected as co-located samples in accordance with the Work Plan. The remaining field soil duplicates were collected by first homogenizing the sample in a stainless-steel bowl and then filling separate containers. During supplemental RI sampling, all duplicate soil samples were collected as co-located samples in accordance with the Work Plan. For groundwater, the main sample and duplicate sample were collected by alternately filling sample containers between the main and duplicate sample. Matrix spike samples were collected at a rate of 1 per 20 samples. A field rinsate blank was also collected following decontamination of non-dedicated soil sampling equipment after collection of a potentially contaminated sample. Following the initial round of groundwater sampling, a filter blank sample was collected to rule out filter media as a potential source of mercury detected in groundwater samples collected on December 15, 2010.

5.0 DISCUSSION OF CLEANUP LEVELS

MTCA provides three approaches for establishing soil and groundwater cleanup levels: Method A, Method B, and Method C. The Method A approach is appropriate for sites that have few hazardous constituents. The Method B approach is applicable to all sites. The Method C approach is applicable for specific site uses and conditions. The Method B and Method C approaches use applicable state and federal laws and risk equations to establish cleanup levels. However, the Method B approach establishes cleanup levels using exposure assumptions and risk levels for unrestricted land uses, whereas the Method C approach uses exposure assumptions and risk levels for restricted land uses such as industrial use. MTCA also requires that cleanup levels developed using MTCA Method B and Method C approaches not be set at levels below the practical quantitation limit (PQL) or natural background.

Exposure pathways and receptors based on current and likely future Site uses were used in identifying the appropriate basis for developing screening levels for Site soil and groundwater. In general, the Method B approach was used for the development of the Site soil and groundwater screening levels because Site uses include commercial activities and public access that do not comply with MTCA criteria for industrial sites [WAC 173-340-745(1)(a)]. However, Method A cleanup levels for unrestricted site use were applied to certain constituents for which Method B cleanup levels have not been promulgated (e.g., lead and petroleum hydrocarbons), and for constituents with unique considerations addressed by Ecology in development of the Method A values (e.g., arsenic).

Sediment quality was evaluated in accordance with the SMS requirements, using the SQS and the CSL criteria.

5.1 CURRENT AND FUTURE LAND AND WATER USES

The Site is located in the city of Everett, which has a population of approximately 98,000. The Site is currently zoned as waterfront commercial, which allows for commercial, residential, and limited commercial and light industrial use. The only industrial use allowed is associated with research/testing labs (does not include mass production or manufacturing of goods). It is not anticipated that the zoning will change following redevelopment. It is unlikely that residential housing will be constructed within the Site boundary, although hospitality services (restaurant use) are present in the southern portion of the Site. Drinking water for the Site is currently supplied by the city of Everett Water District.

Groundwater at, or potentially affected by, the Site is not currently used for drinking water. It is not considered to be a reasonable future source of drinking water due to its to proximity to marine surface water, the limited productivity of the shallow groundwater zone, and the likelihood that, if groundwater was pumped for drinking water use, the proximity of the Site to the marine surface water is likely to cause saltwater intrusion and result in increased groundwater salinity at the point of use. Additionally, the availability of a municipal water supply, and city of Everett ordinances requiring parties within the city limits to connect to the municipal water supply, effectively preclude the use of Site groundwater as a potable water supply.

5.2 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

The potential receptors that may be exposed to the contaminants present at the Site and the potential exposure pathways depend, in part, on the current and likely future land uses for the Site. This section identifies potential receptors and the potential exposure pathways for the receptors based on the future land uses described in Section 5.1.

5.2.1 POTENTIAL RECEPTORS

Potential receptors of Site contaminants could be humans; terrestrial ecological receptors (i.e., wildlife, soil biota, and plants); and aquatic organisms. Each of these was evaluated based on the future land use of the Site, as follows:

- **Humans.** Because the Site is zoned waterfront commercial, which allows for commercial, residential, and limited commercial and light industrial use, humans are considered to be potential receptors.
- **Terrestrial Ecological Receptors.** Currently, and following redevelopment, the Site will be almost entirely covered with buildings and pavement, with landscaping confined to small areas around buildings, along roadways, and within parking areas. Therefore, terrestrial ecological receptors (wildlife, soil biota, and plants) are not considered to be potential receptors. Also, in accordance with WAC 173-340-7491(1)(c)(i), sites that contain less than 1.5 acres of contiguous undeveloped area are excluded from having to conduct a terrestrial ecological evaluation. Because the Site is currently mostly covered with buildings and pavement, and will be following redevelopment, the Site meets the exclusion for a terrestrial ecological evaluation. Ecology's Terrestrial Ecological Exclusion form is included as Appendix D of the RI/FS Work Plan.
- **Benthic and Aquatic Organisms.** Due to the Site's definition including marine surface water in the 12th Street Yacht Basin, benthic organisms in sediment and aquatic organisms in Port Gardner Bay are considered to be potential receptors.

5.2.2 POTENTIAL EXPOSURE PATHWAYS

Potential exposure pathways were identified for the receptors identified in Section 5.2.1 and are presented by medium below.

5.2.2.1 Soil

The potential human health exposure pathways for Site soil are:

- Incidental ingestion and dermal contact with constituents in Site soil (limited due to existing buildings and pavement)
- Exposure through inhalation of soil contaminants (as particulates) that have migrated to air as windblown or fugitive dust (limited due to existing buildings and pavement)
- Excavation activities exposing workers to soil.

5.2.2.2 Groundwater

As discussed in Section 5.1, groundwater at or potentially affected by the Site is not currently used for drinking water and is not a reasonable future source of drinking water due to its proximity to marine surface water and the availability of a municipal water supply. However, shallow groundwater discharges to the adjacent marine surface water. There is also the potential for construction workers in the future to be exposed to contaminated shallow groundwater via direct contact. Exposure pathways associated with marine sediment and surface water are discussed in Sections 5.2.2.3 and 5.2.2.4, respectively.

5.2.2.3 Sediment

The potential exposure pathways for sediment include:

- Exposure of benthic organisms, which may result in acute or chronic effects, to hazardous substances released from the Site (e.g., groundwater to surface water discharge, storm runoff, etc.) in the biologically active zone of sediment (the upper 10 cm below the mudline). This may result in the uptake and bioaccumulation of contaminants in these organisms.
- Human ingestion of marine organisms contaminated by Site hazardous substances that have migrated to sediment.
- Direct contact of sediments due to collection of marine organisms and/or retrieval of equipment or materials from the floor of the marina.

5.2.2.4 Surface Water

The potential exposure pathways for surface water include:

- Exposure of aquatic organisms, which may result in acute or chronic effects, to hazardous substances released from the Site to surface water. This may result in the uptake and bioaccumulation of contaminants in these organisms.
- Human ingestion of contaminated marine organisms contaminated by Site hazardous substances that have migrated to surface water

5.3 DEVELOPMENT OF PRELIMINARY SOIL, GROUNDWATER AND SEDIMENT CLEANUP LEVELS

Soil and groundwater screening levels were developed in accordance with MTCA and sediment cleanup levels were developed based on SMS SQS and CSL. These screening levels were developed based on the potential receptors and potential exposure pathways described above, and were developed for all constituents detected during the RI and present in Site media following completion of the interim actions. Proposed soil and groundwater cleanup levels are developed in Section 8.0 based on the selected indicator hazardous substances (IHS) that are present in Site media at concentrations exceeding the screening levels. Sediment cleanup levels are identified in Section 8.0 for all constituents that exceeded the SQS.

5.3.1 GROUNDWATER

Groundwater screening levels were developed for those constituents detected in groundwater during the RI. Because human ingestion of hazardous substances in groundwater is not a potential exposure pathway, as described in Section 5.2.2.2, groundwater screening levels do not consider applicable criteria for potable water. Instead, groundwater screening levels protective of marine surface water were developed because Site groundwater discharges directly to Port Gardner Bay. Except for arsenic and TPH, MTCA Method B screening levels for marine surface water were developed using ARARs in accordance with WAC 173-340-730(3) for detected constituents in groundwater. However, in the absence of an applicable marine surface water cleanup level, MTCA Method B potable groundwater cleanup levels were used for screening purposes in accordance with WAC 173-340-720 (4). The MTCA Method A cleanup levels were used for arsenic and TPH (WAC 173-340-900 – Table 720-1). screening levels were adjusted to be no less than the PQL in accordance with WAC 173-340-730(5)(c). Reporting limits for the groundwater analytical methods were used as PQLs. Applicable background concentrations for groundwater were not identified for the Site. Groundwater screening levels for detected constituents are presented in Table 4.

5.3.2 SOIL

Soil screening levels were developed for hazardous substances detected in soil remaining at the Site following the interim actions. The soil screening levels were developed to be protective of the potential receptors identified in Section 5.2.1. The potential receptors include humans and aquatic organisms (via soil leaching to groundwater that discharges to marine surface water). The proposed soil screening levels protective of human health and groundwater for the constituents detected in soil remaining at the Site are presented in Table 5.

Soil screening levels protective of human health were developed using applicable human health risk assessment procedures specified in WAC 173-340-708. These procedures include development of screening levels 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 screening levels and that exposure to hazardous substances under unrestricted land use conditions represents the reasonable maximum exposure scenario. As discussed in Section 5.1, residential development of the Site is unlikely; however, hospitality services (restaurant), public access, and office space are present in the southern portion of the Site, and future development could include additional hospitality services (hotel/restaurant). Therefore, soil screening levels 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 screening levels.

Except for the toxics substance control act (TSCA), which establishes cleanup levels for PCBs, there are no soil screening levels established under applicable state or federal laws. Except for arsenic, lead, and TPH, standard MTCA Method B soil screening levels 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 arsenic, lead, and TPH in soil. These cleanup levels are shown in Table 5. The cleanup level for benzo(a)pyrene was used for the sum of cPAHs using toxicity equivalency factors (TEFs) to calculate a toxicity equivalency quotient (TEQ) for total cPAHs in accordance with WAC 173-340-708(8)(e).

Soil screening levels 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, groundwater screening levels were developed based on marine surface water cleanup levels protective of human health and aquatic organisms in accordance with WAC 173-340-730. However, in the absence of an applicable marine surface water cleanup level, MTCA Method B potable groundwater screening levels were used. The three-phase model provides a conservative estimate of the concentration of a contaminant in soil that is protective of groundwater. Soil screening levels protective of groundwater as marine surface water are shown in Table 5.

To develop a single soil screening level for each constituent, the lowest protective criterion was selected as the screening level, as indicated by shaded values in Table 5. Following selection of the lowest criterion, the screening level was adjusted as appropriate, as described below.

Soil cleanup screening levels may be adjusted to be no less than the PQL in accordance with WAC 173-340-730(5)(c) and/or no less than natural background levels in accordance with WAC 173-

340-740(5)(c). The PQL for each constituent (using the laboratory reporting limit as the PQL) and background concentrations for metals [based on Puget Sound 90th percentile values (Ecology 1994)] are shown in Table 5 and were compared to the soil screening levels protective of human direct contact and groundwater. No soil screening levels were adjusted upward to the PQL, except for thallium.

For some constituents present in soil but not detected in groundwater at concentrations above their respective groundwater screening levels (see discussion in the next paragraph), the soil criteria protective of human health (i.e., Method B direct human contact) was selected as the soil screening level regardless if it was higher than screening level based on groundwater protection. In accordance with WAC 173-340-747(9), if an empirical demonstration can be made that concentrations present in soil are not causing exceedances of the groundwater cleanup levels, then development of a soil criterion protective of groundwater is not necessary. WAC 173-340-747(9)(b) lists specific requirements for empirically demonstrating that measured soil concentrations will not cause an exceedance of applicable groundwater cleanup levels. Demonstration that the site area meets these requirements is provided in Appendix E.

As indicated in Appendix E and discussed in Section 6.0, cPAHs, xylenes, BBP, dissolved cadmium, and dissolved zinc were not detected in groundwater at concentrations greater than the screening level during the RI. For these constituents, the soil criteria protective of human health (i.e., Method B direct human contact) was selected as the soil screening level. The soil criteria protective of human health was also used as the soil screening level for copper and mercury, although these constituents were detected in groundwater during the initial sampling event at dissolved concentrations greater than their respective screening levels as discussed below.

The elevated copper concentrations during the initial round of groundwater sampling appear to be associated with elevated turbidity in samples collected from direct-push borings or recently constructed monitoring wells. Additionally, dissolved copper was not detected above the laboratory reporting limit in groundwater samples collected from locations where the co-located soil sample collected from below the groundwater table contained elevated copper concentrations (see results for M-FA-102 in Section 6.0). The combination of the dissolved copper groundwater concentrations below the reporting limit and the highly elevated dissolved copper concentration in a soil sample collected from below the water table at the same location support the conclusion that the elevated concentrations of copper present in Site soil are not causing elevated copper concentrations in groundwater. See Section 6.5.1.1 for further discussion.

Dissolved mercury was only detected above its reporting limit and, in a few locations, above its groundwater screening level during the initial round of sampling. Additional rounds of groundwater sampling did not reveal any positive detections for mercury.

The cause of the dissolved mercury exceedances during the initial sampling event was not determined. In many instances, mercury was the only COC that exceeded its groundwater screening level, so elevated turbidity does not appear to be the cause. There also is no indication in the laboratory QA/QC samples that it was a laboratory issue. Additionally, mercury was only detected in 7 of 66 soil samples tested for mecury, and only exceeded the soil cleanup level for protection of groundwater in 5 of those samples; so mercury is not broadly distributed in Site soil. Whatever the cause, the mercury groundwater exceedances during the initial sampling event do not appear to result from elevated mercury concentrations in soil, and were not reproducible in subsequent groundwater samples. See Section 6.5.1.1 for further discussion.

5.3.3 SEDIMENT

Sediment cleanup standards were developed according to SMS requirements. Two SMS criteria are promulgated by Ecology as follows:

- The marine SQS (WAC 173-204-320), the concentration below which effects to biological resources and human health are unlikely.
- The marine CSL (WAC 173-204-520), the concentration above which more than minor adverse biological effects may be expected.

The SQS and CSL values have been developed for a suite of analytes that includes metals, polycyclic aromatic hydrocarbons (PAHs) and other SVOCs, PCBs, and ionizable organic compounds. The SQS are the most stringent SMS numeric criteria and represent the goal for sediment cleanups. The suite of SMS analytes and the associated SQS and CSL values, some of which are expressed on a TOC-normalized basis, are listed in Table 6. Ecology recommends that, in areas with low TOC values (which results in higher reporting limits), the use of dry-weight equivalents to the SMS TOC-normalized SQS and CSL be considered along with the organic carbon-normalized criteria. As a result, the Apparent Effects Threshold values (AETs), which are the dry weight equivalents to these criteria, are also presented in Table 6.

6.0 RI RESULTS

In addition to previous investigations, which included several hundred soil, groundwater, and sediment samples, the RI field investigation constitutes a very thorough investigation of all areas of concern regarding Site environmental conditions. Areas of suspected contamination were investigated, better limits to known contamination were defined, and areas of general fill were investigated for completeness. During the RI field investigation, a total of 147 soil samples (and 10 blind field duplicate soil samples), 45 groundwater samples (and 5 blind field duplicate groundwater samples), 1 surface water sample, 8 marine surface sediment samples (and 1 blind field duplicate sediment sample), 6 catch basin/trunk line solids samples (and 1 blind field duplicate catch basin sample), and 3 process waste samples were collected and analyzed. Additionally, 9 soil compliance monitoring samples were collected and analyzed as part of the emergency cleanup action conducted in the area of the Collins Building. Twenty-five of the groundwater samples were collected from the 10 groundwater monitoring wells, 18 of the groundwater samples were collected from temporary well points installed in direct-push borings, and 2 groundwater samples were collected from the sump associated with the manufacturing building in Area G.

This section presents the RI results, including Site geology and hydrogeology, and the analytical results for the RI sediment, groundwater, and surface water samples

6.1 ENVIRONMENTAL SETTING

This section describes the Site environmental setting, which includes the Site geology, hydrogeology, and the setting of the in-water area, including habitat, biota, and vegetation.

6.1.1 GEOLOGY

The entire Site is located on former aquatic lands that consisted primarily of intertidal deposits (i.e., tideflats) that were filled to current ground surface elevations ranging from about 16 to 18 ft MLLW. The earliest documented filling began in the early to mid-1900s and by 1973 the entire upland portion of the Site was filled to its current footprint (Pinnacle GeoSciences 2010). The fill used to create the upland portion of the Site is primarily hydraulically placed dredge fill. There are also lesser amounts of fill resulting from Site use and facility development referred to in this document as General Fill and non-soil materials, as discussed below. Site stratigraphy is discussed in the following sections from deepest to shallowest units.

6.1.1.1 Native Tideflat Sediment

Ten borings were drilled to explore for the depth to the native tideflat surface. The native tideflat surface was typically encountered at a depth of about 18 to 20 ft, as might be expected considering that it was primarily an intertidal area. The native tideflat surface was indicated by the occurrence of a black, organic-rich silty sand (J-FA-101and J-FA-102), silt with organic matter and scattered wood fragments (M-GC-106 and RI-MW-4), or at the base of a thick sequence of wood debris in the case of I-FA-101. The native marine sediment encountered below the fill soil is a medium dense, silty sand to sandy silt with wood and shell fragments, which is very similar to the dredge material used to fill the Site as discussed below.

6.1.1.2 Hydraulic Dredge Fill

Several episodes of hydraulically placed dredge filling at the Site have been identified in the historical record (Pinnacle GeoSciences 2010). The hydraulic dredge fill is found throughout the Site, most typically encountered at a depth of between 1 ft and 7 ft BGS, and it generally extends to the native marine tideflat surface. It is typically a gray, loose to medium dense, poorly-graded fine to medium sand with silt, or silty, fine to medium sand, with shell pieces and wood fragments. The white and blue shell fragments, in particular, help to distinguish the unit as a dredge fill. It was interpreted as occurring across the Site, although different areas were filled at different times and some areas likely had several episodes of hydraulic filling. The last documented dredge filling occurred in 1973 and included most of Area I, the northern portion of Area J, and the northwestern corner of Area G. A berm was constructed along the west and east sides of Area I at that time to contain the dredge fill. The location of the eastern berm is shown on Figure 8.

The dredge fill was encountered at the ground surface beneath the eastern portion of the former Collins Building. It was also encountered at a relatively shallow depth of between 1 to 3 ft around the Ameron pole manufacturing building. It was encountered at a depth of 4 to 7 ft in the southern-most portion of Area G (G-GC-106 and G-GC-107, and G-GC-109) and northern portions of Area M. Where observed, its deepest initial occurrence was observed in several of the borings drilled along the northern Site boundary where it was first encountered at depths ranging from approximately 6 to 10 ft BGS. Note that hydraulic fill was not encountered in several borings in this area that extended to 12 ft BGS (G-FA-101a, -b, -c, -d, G-FA-103a, -b, G-FA-114, G-FA-115, G-FA-115c, N-FA-102, N-FA-103). Historical analyses indicate a drainage ditch existed along the northern Site boundary until approximately 1981 or 1982 (Appendix A).

Soil samples were collected from the hydraulic fill saturated zone at three locations (G-GC-103, M-GC-102, and RI-MW-2) and analyzed for TOC for potential use in evaluating groundwater contaminant transport characteristics or for modifying Method B cleanup levels based on Site-specific conditions. Results are presented in Table 7 and indicate a TOC range of 0.1 percent to 1.3 percent.

In addition, GSA were conducted on hydraulic fill samples from the saturated zone at RI-MW-2, RI-MW-4, and RI-MW-5 for potential use in estimating hydraulic conductivity for the uppermost hydrostratigraphic unit. The GSA results are presented in Appendix F and are generally consistent with hydraulic fill. The one exception is the soil sample collected from RI-MW-2 (10 to 11 ft), which is a gravelly medium to coarse sand; RI-MW-2 is located along the shoreline; the coarser soil at this location is likely associated with the dike constructed to retain hydraulically dredged sediment that was used for Site filling in the 1970s.

6.1.1.3 General Fill

General Fill is identified overlying the hydraulic dredge fill across much of the Site. The General Fill appears to be mostly structural fill placed as a trafficking surface to support paving and other Site development purposes such as filling and grading to create suitable conditions for facility construction.

The Site is paved with asphalt except for a small area in the northwest corner of Area G, a narrow strip along the western Area G lease boundary, and in the southeast portion of Area M. Beneath the pavement there is a 0.2 to 1-foot layer of gravelly sand “base course” layer. In several of the GC boring locations (G-GC-100, G-GC-102, G-GC-105), and in the area of the former Collins Building (M-FA-104 through M-FA-108), hydraulic dredge fill was identified directly below the pavement and base course and there was no General Fill identified.

The General Fill is typically a brown to gray, loose to medium dense fine to coarse or fine to medium, sand with varying amounts of gravel and silt. In some locations it is very similar to the dredge sand except it is lacking in shell fragments. In some areas it includes fine roots, organics and/or wood fragments, which may be related to former ground surfaces as some areas of the site were filled in multiple episodes over time (Pinnacle GeoSciences 2010). At several locations, the General Fill includes silt with varying amounts of sand and gravel or gravel with sand. Some specific observations about the General Fill derived from the drilling data reviewed relative to the Site historical analysis include:

- General fill in Area G, which was completed between 1956 and 1965, is generally a 1- to 3-ft-thick layer of brown, fine to medium sand to gravelly fine to coarse sand, with silt and occasionally wood debris. Wood pieces, wood debris, and sawdust were commonly found in the sand encountered below a depth of depth of 3 ft BGS in Area G west and southwest of the manufacturing building.
- The General Fill along the northern property boundary of Areas G and I and southern-most Norton Industries property to the north of the Site (essentially the stormwater trunk line alignment) occurs to a depth of around 6 to 12 ft BGS, where abundant organics and decomposing wood or fine sand with wood fragments and organics are found.
- A few inches of black wood and charcoal were observed at a depth of 6 to 7 ft BGS in one boring (G-GC-108), and hydraulic fill was observed both above and below this layer suggesting several episodes of hydraulic filling in this area.
- General fill placed in the border area along the east side of Area J and west side of Area M (J-GC-100, J-GC-101, and M-GC-104) consists of 2 ft of brown fine to medium sand.

- The deepest occurrence of General Fill was at RI-MW-3 and J-FA-102, where it was observed to extend to 10 and 18 ft BGS, respectively. The thicker fill at RI-MW-3 is most likely a remnant of a soil dike that was constructed to contain dredge fill placed in the 1970s, as discussed above.
- The General Fill encountered at G-FA-115c included a medium to coarse sand and coarse gravel from 1 to 8.5 ft BGS. This may be a more recent fill associated with the 2005 excavation to repair the trunk line in this area.

6.1.1.4 Non-Soil Materials

Local areas of non-soil materials were observed in some explorations around the Site, primarily in those areas previously identified for characterization due to the presence of known or potential contamination shown on Figure 8. These non-soil materials included:

- An angular, black, granular material that may be a sand-blast media. This black sand-size material was observed in pockets and as thin layers along the west border of Area G, generally limited to the upper 1 to 2 ft of soil, in the area previously identified as suspected to contain blasting sand (G-FA-100, G-FA-104 to G-FA-109, and G-FA-105a).
- A similar black to blue-black, granular sand-size material identified as apparent sandblast media was also observed in the south portion of Area M (M-FA-102 at a depth of 7.5 to 8.0 ft BGS; M-FA-102i at a depth of 6 to 8.5 ft BGS; and M-FA-102l at a depth of 7 to 8.5 ft BGS).
- A soft, white to gray silt-like material with a concrete-like odor was observed in G-FA-101, G-FA-101c, G-FA-101f, G-FA-103, and G-FA-114 along the northern Site property line and stormwater trunk line corridor in the area previously identified as containing suspected concrete slurry waste material. At G-FA-115a, a layer of similar silt-like material was encountered that was tan with orange-speckles and included a thin layer of decomposed wood. At G-FA-101e and G-FA-103c , a similar silt-like material was encountered that was green in color.
- Colored (gray, red, tan and orange) silt-like material was observed to comprise a portion of the material used to fill the three former concrete-lined settling basins on the eastern side of the pole polishing building in Area G (G-FA-110, -111, and -112).
- Demolition debris, consisting of broken bricks and broken concrete blocks, was observed at depth in the northern portion of Area J from 13 to 18.5 ft (J-FA-102), and in the southern portion of Area M at depths of 7.5 ft (M-FA-102 and M-FA-102i) and 5.5 ft (M-FA-102h).
- Wood debris was observed at 19 Site locations (G-FA-101a, G-FA-101b, G-FA-101d, G-FA-101g, G-FA-103a, G-FA-103b, G-FA-104, G-FA-115c, G-GC-102, G-GC-113, G-GC-114, I-FA-101, J-FA-100, M-FA-102f, M-FA-102g, M-FA-102j, M-FA-120k, M-FA-102l, and M-GC-102c) and at two locations on the Norton Industries property to the north (N-FA-101 and N-FA-103). The observed wood debris ranged in thickness from less than 1 ft to about 6 ft. The borings were not advanced to below the wood debris at eight locations.

6.1.2 HYDROGEOLOGY

The following sections present hydrogeologic information and estimates of hydrogeologic properties for the Site including saturated thickness, flow direction, and tidal influence; hydraulic conductivity, and groundwater flow velocity.

6.1.2.1 Saturated Thickness, Flow Direction, and Tidal Influence

Water level measurements in the uppermost hydrostratigraphic unit were recorded on January 19, 2011 at high and intermediate tide; on February 22, 2011 at low tide; and on October 11, 2011 at low tide. The measured water levels were then converted to MLLW elevations and are presented in Table 8. The groundwater elevations ranged from 6.36 to 14.49 ft MLLW. Based on the range in depth to groundwater presented in Table 8 and geologic cross sections presented on Figures 10 and 11, the saturated thickness of the hydraulic fill unit is generally about 20 ft. Although there is not a well defined aquitard underlying the hydraulic fill to the depths explored, it is a reasonable estimate of the uppermost hydrostratigraphic unit with respect to groundwater flow because it extends to elevation –15 ft MLLW, and, thus, deeper, unconfined groundwater must migrate upward into the hydraulic fill unit prior to discharge to surface water.

Reference elevations were established for 12 monitoring wells [RI-MW-1 through RI-MW-7, SEE-EC-2 through SEE-EC-4, P10 (G-2), and ECI-MW-3] so groundwater flow could be characterized throughout the Site. Monitoring well reference elevations and groundwater elevations are presented in Table 8. Groundwater elevation contour maps for high, intermediate, and low tides measured between January 19 and February 22, 2011 are presented on Figures 12 through 14, respectively. A groundwater elevation contour map for low tide, as measured on October 11, 2011, is presented as Figure 15. As shown on Figures 12 through 15, groundwater flows generally west-northwest toward surface water. However, groundwater elevations in the northeast portion of the Site appear to be influenced by operation of the groundwater sump located in the Ameron manufacturing building.

Tidal influences on groundwater are significant immediately adjacent to surface water (RI-MW-1 through RI-MW-3) ranging between 0.69 to 4.75 ft, and dissipating to less than an inch of tidal fluctuation about 300 ft from the shoreline.

6.1.2.2 Hydraulic Conductivity

Grain size data collected during the RI were used to estimate hydraulic conductivity of the hydraulic fill unit using the Hazen formula:

$$K = A * C * \tau * d^2_{10}$$

Where:

K = hydraulic conductivity in cm/s

A = the coefficient which defines the dimension of K (for K in cm/s, A = 0.00116)

C = the empirical coefficient that depends on the clayey fraction content of the porous media (C = 1000)

d^2_{10} = diameter, in mm, of the 10 percent passing fraction from a mechanical grain size analysis.

Grain size data for the samples of hydraulic fill are presented in Appendix F. Although material properties for the hydraulic fill vary, the gradation exhibited by samples collected from borings RI-MW-4 and RI-MW-5 are considered typical of hydraulic fill material encountered throughout the Site. Material analyzed from RI-MW-2 consisted of coarse sand and gravel associated with the berm constructed to retain hydraulic dredge material when the western portion of the Site was initially filled, and is not typical of hydraulic fill that constitutes the majority of the uppermost hydrostratigraphic unit. As a result, the grain size data from RI-MW-2 was not used to estimate the hydraulic conductivity of the uppermost hydrostratigraphic unit. The estimated hydraulic conductivity based on samples collected from RI-MW-4 and RI-MW-5 average 4.5×10^{-3} cm/s, or about 13 ft/day, which will be used for the uppermost hydrostratigraphic unit for the purposes of this report.

6.1.2.3 Groundwater Flow

Groundwater average linear velocity (v) is estimated from the equation:

$$v = Ki/n$$

Where:

K = hydraulic conductivity (L/t)

i = hydraulic gradient (dimensionless)

n = effective porosity (dimensionless).

The hydraulic gradient for the Site was estimated from the groundwater elevation difference between the 9-ft contour and the 13-ft contour on groundwater elevation contour for low tide (Figure 14). The distance between these two elevation contours varies between about 200 ft and 500 ft, or an average of 350 ft. This yields an average hydraulic gradient across the Site of about 0.01 ft/ft. Based on the estimated hydraulic conductivity of 13 ft/day, and an assumed effective porosity of 0.30, the estimated average linear velocity for groundwater flow at the Site is about 0.4 ft/day, or about 160 ft/year.

Groundwater discharge (Q) from the Site to surface water is estimated from the equation:

$$Q = KiA$$

Where:

K = hydraulic conductivity (L/t)

i = hydraulic gradient (dimensionless)

A = cross sectional area of aquifer (L^2).

From the geologic cross sections presented on Figures 10 and 11, the saturated thickness to the base of the hydraulic fill layer is about 20 ft and the distance perpendicular to the direction of groundwater flow across the Site along the elevation 12 ft contour is about 700 ft, for an estimated cross sectional area of 14,000 ft^2. Based on the previous estimates for hydraulic conductivity and gradient, the estimated total groundwater flow discharging from the Site to Port Gardner Bay is approximately 1,800 ft^3/day, or about 9.5 gallons per minute (gpm).

6.1.3 IN-WATER AREA

The Site is located on the eastern shoreline of Port Gardner Bay, which is an inlet of Possession Sound (Figure 1). The Snohomish River flows past the west end of the Site into the bay, as shown on Figure 1. The 12th Street Yacht Basin is located in the 12th Street Channel, connected to Port Gardner, and constitutes the in-water portion of the Site. The currently estimated Site boundary extends from the western shoreline of Area I to the point where the channel intersects the Snohomish River, and from the north shoreline of the channel to the estimated north boundary of the North Marina West End site (about 200 ft north of the Channel's south shoreline).

The 12th Street Yacht Basin has been altered by dredging and filling over several decades to convert portions of the shoreline to industrial and commercial uses and to provide navigation. The entire Site in-water area was dredged to about elevation -16 ft MLLW in 2005 as part of the yacht basin development, and the yacht basin floats and upland infrastructure were built between 2005 and 2007. Most, if not all, of the sediment previously characterized in this area was removed.

A biological evaluation (BE) conducted by Pentec Environmental (Pentec 2004) describes the habitat, biota, and vegetation within the 12th Street Waterway and North Marina. According to the Pentec BE, the lower Snohomish River basin, including the 12th Street Channel, is habitat for juvenile salmonid rearing and migration, saltwater-freshwater transition, and possibly adult migration. Salmonid species believed to be present in the Site vicinity include chinook salmon and bull trout, which are listed as threatened species under the federal Endangered Species Act. Coho salmon are also believed to be present in the Site vicinity, and are a candidate specie that may be listed in the future.

Scattered rockweed has been observed on riprap and pilings in the 12th Street Yacht Basin. Eelgrass is not present in the waterway. Forage fish documented in the Port Gardner area include Pacific herring, Pacific sand lance, and surf smelt and may be present in the waterway.

6.1.4 HISTORIC AND CULTURAL RESOURCES

A cultural and historic resource analysis was completed in 2004/2005 as part of the environmental impact statement (EIS) for the North Marina Redevelopment (Johnson Partnership 2005). The purpose of the analysis was to identify cultural and historic resources present or potentially present within the project area that may be affected by the proposed redevelopment project. As part of the analysis, records were researched at the Department of Archaeology and Historic Preservation (DAHP) in Olympia, the city of Everett Register (ER), the State of Washington Register of Historic Places (WHR), the national Register of Historic Places (NHR), the Port of Everett Archives, and the Everett Public Library's Northwest History Room. The records search produced no specific information regarding the presence of historic and cultural resources for the redevelopment project. Additionally, there were no previously recorded archaeological sites and/or historic buildings located within the redevelopment project. However, the report identified the North Coast Casket Co/Collins Building as eligible for listing on the National Register of Historic Landmarks, the Washington State Heritage Register, and the city of Everett Register of Historic Places. The analysis concluded that archaeological resources associated with the Tulalip Tribes or other tribes that may have lived on or near the redevelopment may be affected by construction associated with the proposed project; however, operational impacts to cultural and historic resources are not anticipated.

As part of the EIS, an in-depth analysis of the Collins Building was completed by the Port. Due to advanced deterioration of the foundation, safety concerns, and costs associated with restoration of the building, the analysis concluded that redevelopment of the Collins Building was not financially feasible. The Port entered into a Memorandum of Agreement (MOA) with the U.S. Army Corp of Engineers (USACE), the DAHP, Historic Everett, and the Washington Trust for Historic Preservation, which provided framework for a private developer to restore the Collins Building (if one could be identified) and also outlined the mitigation required in the event that the building were to be removed. In June of 2009, the Port Commission voted to deconstruct the Collins Building after the USACE determined that the Port had fulfilled the requirements of the MOA. Following a review process, the Port reaffirmed the June 2009 decision and the Collins Building was deconstructed in the fall of 2010. In accordance with the MOA, an interpretive program will be developed to document the history of the Collins Building.

Ecology is working with landowners/stakeholders including local Indian tribes to clean up contaminated sites and sediments in the vicinity of the Port Gardner Bay area and the Snohomish River Estuary. Port Gardner Bay is identified as a high-priority, "early-action", cleanup area under the PSI. The Site has been identified as a cleanup site under the PSI. Local tribes that have been actively engaged by Ecology under the PSI at Port Gardner include the Tulalip, Suquamish, Swinomish, and Lummi. Ecology has worked with a tribal liaison to assist in developing contacts and early engagement with cultural and natural resource sections within each of the aforementioned tribes. Engagement with the tribes has consisted of meetings to discuss PSI cleanup sites and cultural resources, providing the Tribes with draft work products for early input, and providing them with a monthly update containing the current status of each PSI site, near-term work products for tribal review, project schedules, and a summary of tribal engagement for the Port Gardner PSI sites.

Based on Ecology's discussion with the Tribes and information provided in a 1973 Historical Survey of Everett (Dilgard and Riddle 1973), people have inhabited the Port Gardner Bay area for thousands of years. For centuries, the northwest point of the peninsula (i.e., Preston Point) was the site of Hebolb, the principal village of the Snohomish Tribe. Its location near the mouth off the Snohomish River and next to Port Gardner Bay provided both abundant food and transportation. Native tribes used the Everett shoreline in part for subsistence activities such as shellfish collection, hunting, plant gathering, and fishing. According to local tribes, native long houses were located up and down the Everett waterfront. Local tribes have communicated to Ecology that the Everett waterfront is a culturally sensitive area. With that in mind, the procedures to be used in the event cultural resources are encountered during Site activities were outlined in the RI/FS Work Plan. Cultural artifacts were not encountered during the RI field activities.

6.2 ANALYTICAL RESULTS

Soil, groundwater, sediment, and stormwater system solids samples collected during the initial RI sampling event were submitted to Fremont Analytical of Seattle, Washington for analysis. Soil, marine sediment and catch basin (trunk line) sediment samples were submitted to Axys Analytical Services of Sidney, British Columbia, for analysis for dioxins/furans. Groundwater samples from the February 22, 2011 lab comparison sampling event and soil, groundwater, and stormwater system solids samples from the supplemental RI sampling events were submitted to Analytical Resources, Inc. (ARI), in Tukwila, WA, for analysis.

6.2.1 QUALITY ASSURANCE

The soil, groundwater, sediment samples, and stormwater system solids samples were analyzed and validated according to the quality control (QC) procedures described in the upland and sediment SAPs, Appendices F and G of the Work Plan, respectively. QC for the project included maintaining a chain-of-custody record for each set of samples submitted to the laboratory, proper storage and preservation of the samples, equipment decontamination, and analysis of QC samples, in accordance with the SAPs. In addition, the analytical data were validated to determine the acceptability of the data for use in adequately characterizing the sediment and groundwater. All of the data were determined to be acceptable for use and no data were rejected, except as described in Section 6.2.1.5.

6.2.1.1 Sample Containers, Preservation, and Storage

Soil, groundwater, and sediment samples submitted to the analytical laboratory for analysis were collected in the appropriate sample container provided by the analytical laboratory. The samples were preserved by cooling to a temperature of 4°centrigrade (C) and as required by the analytical method. The time between sample collection, extraction, and analysis was determined to be within analytical method - specified holding times for all analyses associated with the soil and groundwater samples and within holding times specified in Ecology's sediment sampling and analysis plan (SAP; Ecology 2008a), with the exception of reanalysis for BEHP in groundwater as discussed below in Section 6.2.1.5.

6.2.1.2 Sample Custody

Sample custody was documented by means of a chain-of-custody record, which was initially completed by the sampler and, thereafter, signed by those individuals who accepted custody of the sample. All samples shipped to a laboratory were placed in coolers and the cooler secured with signed custody seals and taped shut with strapping tape.

6.2.1.3 Equipment decontamination

All sampling equipment used (i.e., stainless-steel bowls, stainless-steel spoons, and core tubes) were dedicated and pre-cleaned using a three-step process, which included scrubbing surfaces of the equipment that would be in contact with the sample with a brush and an Alconox solution; rinsing the equipment with tap water; and a final rinse with deionized water.

6.2.1.4 Quality Control Samples

Laboratory QC samples included matrix spike (MS), matrix spike duplicate (MSD), method blanks, and control samples. Note that MSDs were not specifically collected, but were occasionally run by the lab for internal QA purposes. These samples were analyzed at the frequency described in the upland and sediment SAPs. Blind field duplicate samples were collected as follows:

- Blind field duplicate soil samples were collected at G-FA-101, G-FA-101c, G-FA-115, G-GC-105, J-FA-101, M-FA-102j, M-GC-102, M-GC-105, M-GC-107, and N-FA-103B.
- Blind field duplicate groundwater samples were collected at ECI-MW-3, M-FA-104, M-FA-107, and RI-MW-4 during the initial RI sampling events. A blind field duplicate was collected from RI-MW-5 during the October 2011 groundwater sampling event.
- A blind field duplicate sediment sample was collected from A/H-SED-1.
- A blind field duplicate stormwater system solids sample was collected from CB-111.

6.2.1.5 Data Quality Evaluation

An internal data quality evaluation was performed by Landau Associates on all the soil, groundwater, sediment, and stormwater systems solids analytical data collected as part of the RI to determine acceptability of the analytical results. The data quality evaluation conducted included the following review:

- Chain-of-custody records

- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes/laboratory control samples
- Laboratory and field duplicates
- Completeness
- Overall assessment of data quality.

During the initial round of groundwater sampling (December 15, 2010), BEHP was detected by Fremont Analytical in samples collected from four of the eight monitoring wells at concentrations greater than its screening level (2.2 µg/L). The detected concentrations ranged from 13.6 µg/L to 137 µg/L. Given that BEHP is a common laboratory contaminant, a portion of one sample (RI-MW-5) was submitted to ARI for reanalysis; BEHP was not detected in the sample at a concentration greater than the reporting limit of 1 µg/L (note that the re-analysis for BEHP was conducted outside of holding time). The original analysis by Fremont Analytical indicated a concentration of BEHP of 40.5 µg/L in the sample from RI-MW-5. Fremont Analytical subsequently reviewed their sample preparation procedures and identified a piece of plastic tubing in place of copper tubing on an instrument used in the sample preparation. Fremont Analytical reanalyzed the original groundwater samples for SVOCs; BEHP in all the reanalyzed samples was below the reporting limit. The reanalysis was conducted 65 days after the samples were extracted, which is outside of the 40-day holding time. This is not suspected to have impacted the results because the extracts were frozen). Based on the results of the reanalysis, the original SVOC data were rejected and are not presented in data tables or on figures.

The relative percent difference (RPD) between the analytical results for some analytes in the blind field duplicate soil sample pairs was higher than the control limit of 35 percent for seven soil samples, one marine sediment sample, and one stormwater system solids sample. Note that during initial RI field activities, duplicate soil samples were collected after homogenizing the soil, with the exception of samples collected for analysis of VOCs and/or TPH-G which were co-located samples. Therefore, the high RPD is likely related to sample heterogeneity rather than analytical precision. These results were qualified as estimates (J flagged) in the data tables. During the supplemental RI sampling, co-located blind field duplicates for soil were collected from side by side locations. For groundwater, duplicate samples were collected by alternately filling samples containers between the duplicate sample and the regular sample.

Based on the results of the data quality evaluations, analytical results were qualified as estimates, where applicable, and data qualifiers were added to the applicable analytical data tables. Several dioxin/furan concentrations in soil were qualified by the laboratory as estimated maximum possible concentrations (EMPCs). Based on this data quality evaluation, these concentrations were qualified as non-detects (U) at the reported concentrations.

Data validation reports are maintained in Landau Associates' files and are available upon request.

6.3 SOIL QUALITY

Analytical results for soil samples collected during the RI are discussed by area in the following sections. Screening levels for soil are presented in Table 5. A comparison of the soil results for detected compounds to the screening levels is presented in Tables 9 and 10 and exceedances of the soil screening levels are shown on Figure 16. Soil samples were tested for a broad range of constituents. No soil samples exceeded the screening levels for SVOCs (with the exception of cPAHs), dioxins/furans, or VOCs. No soil samples exceeded the screening level for PCBs, except for a sample collected from the Norton Industries property (N-FA-103) that appears to be unrelated to Site releases. Only 5 of 58 soil samples collected from the Site exceeded the cPAHs screening level, including one sample collected from the Norton Industries property (N-FA-102) that appears to be unrelated to Site releases. Soil concentrations that are more than five times the screening levels are highlighted in Table 10 (metals) and on Figure 16 to identify the locations with more highly elevated concentrations relative to the screening levels.

In general, soil contamination was limited to those areas where contamination was anticipated based on existing analytical data and/or observations made during previous investigations, interim actions, or Site historical analyses. Site soil contamination primarily consists of heavy metals (antimony, arsenic, copper, and lead); limited areas of cPAHs; and gasoline-, diesel- and oil-range petroleum hydrocarbon contamination. Gasoline-range petroleum hydrocarbon contamination was detected at location N-FA-103B and PCB and cPAHs contamination were detected at location N-FA-102. The two locations are on the Norton Industries property and detected contamination appears to be unrelated to Site releases as discussed in Section 7.1.1.

The following sections present the analytical results for soil samples collected during the RI. Section 7.1.1 discusses the nature and extent of contamination at the Site and incorporates data for soil remaining from pre-RI soil investigations.

6.3.1 AREA G

The primary focus of the Area G investigation was to delineate the extent of previously detected soil contamination along the northern and western boundaries of Area G, and to characterize soil conditions and the nature of fill material in previously uninvestigated areas. Soil samples were collected from 34 direct-push borings and 6 test pits. Samples were analyzed for a range of compounds as summarized in Table 1.

A comparison of the results to the screening levels, presented in Tables 9 and 10, shows that SVOCs (including cPAHs), PCBs, and VOCs were not detected in Area G soil at concentrations greater than the screening levels. In addition, at 21 of 40 soil sampling locations, no chemical constituent was detected in soil at a concentration greater than the screening levels. Soil concentrations did not exceed the screening levels in any Area G general characterization (GC) soil samples.

Gasoline-range petroleum hydrocarbons were detected in one soil sample (G-FA-101c) at a depth of 3 to 4 ft BGS at a concentration of 680 mg/kg, which is greater than the screening level (100 mg/kg). Gasoline-range petroleum hydrocarbons were not detected in the sample collected from a depth of 6 to 7 ft BGS at G-FA-101c, or in the sample collected from a depth of 3 to 4 ft BGS at boring G-FA-101g, which was advanced approximately 5 ft south of G-FA-101c.

Metals (antimony, arsenic, and lead) were detected at 20 of 40 soil sampling locations in Area G at concentrations exceeding one or more of the screening levels (Table 10). Antimony concentrations exceeding the screening level (32 mg/kg) in Area G soil ranged from 42.2 mg/kg to 303 mg/kg. The arsenic concentrations exceeding the screening level (20 mg/kg) ranged from 20.5 mg/kg to 3,270 mg/kg. The lead concentrations exceeding the screening level (250 mg/kg) ranged from 417 mg/kg to 1,460 mg/kg.

The highest concentrations of metals, and all samples with the collective exceedance of arsenic, antimony and lead, were from soil samples that included an angular, black sand-sized material (logged as "apparent sandblasting media"). Lower levels of arsenic (24.5 mg/kg to 70.0 mg/kg) were detected in most samples of apparent concrete slurry waste material.

Locations with screening level exceedances for metals in soil are shown on Figure 16 and are concentrated in the following three areas where soil contamination was anticipated to be present based on previous investigations and observations:

- Antimony, arsenic, and lead were detected at concentrations that significantly exceeded their soil screening levels along the western boundary of Area G where layers and lenses of black sand-sized material were observed in shallow soil in two soil borings (G-FA-100 and G-FA-105a) and five test pits (G-FA-104 through G-FA-107 and G-FA-109). Note that the test pits identified the occurrence of the black sand-sized material to be discontinuous and of variable thickness. Impacted soil encountered in this area was generally limited to the upper 2 ft of fill material, overlying the hydraulic dredge fill.
- Arsenic (50.8 to 70 mg/kg) was detected at concentrations exceeding the screening levels along the northern leasehold boundary in the vicinity of the stormwater trunk line alignment at locations G-FA-101, G-FA-101a, G-FA-101c, G-FA-101d, G-FA-101e, G-FA-103, G-FA-103c, G-FA-114, G-FA-115a, and G-FA-115c. Soil samples consisting of soft, silt-like material collected from locations G-FA-101, G-FA-101c, G-FA-101e, G-FA-103, G-FA-103c, and G-FA-114 also exhibited elevated pH (10.7 to 12.4), which is indicative of

potential concrete slurry waste material. Impacted soil in this area is generally encountered between 1 and 9 ft BGS.

- Arsenic (24.5 mg/kg to 50.6 mg/kg) was detected at concentrations slightly exceeding the screening level within three former concrete settling basins on the eastern side of the lab/storage building (G-FA-110 through -112). The concrete bottoms of the settling basins were encountered at 5 ft BGS in all three borings. Note that black, angular sand-size material (apparent sand blast media) was not encountered in borings G-FA-110 through -112.

General characterization sampling (GC series borings) in Area G did not exceed any screening levels. Residual soil contamination identified during investigations completed prior to the RI is discussed in Section 7.1.1.

6.3.2 AREA I

Area I was subject to extensive characterization and compliance monitoring sampling prior to and following implementation of the Site interim action (Landau Associates 2010a). As a result, RI soil characterization in Area I was limited to the area along the eastern boundary of the southern half of Area I, west and south of Interim Action Area G-1a. One soil sample was collected for metals analysis from direct-push boring I-FA-100 (note that the sample was inadvertently collected from location I-FA-100 rather than I-FA-101 as indicated in the Work Plan). Metals were detected in the sample at concentrations less than the screening levels. Evidence of impact to soil was not observed during field screening at I-FA-101 or during installation of the shoreline monitoring wells (RI-MW-1 through -3); therefore, soil samples were not collected from these locations for chemical analysis.

Residual soil contamination identified during investigations completed prior to the RI is present along the northern boundary of Area I, near the center of the eastern boundary of Area I, and along the shoreline as described in Section 7.1.1.

6.3.3 AREA J

The Area J soil investigation was focused primarily on characterization of soil in the northern portion of Area J where petroleum hydrocarbon impacts were previously observed and in the area of former sawmill structures including a wood refuse burner and boiler house. In addition, general characterization samples were collected from a previously uninvestigated area in the southeastern portion of Area J. Soil samples for chemical analysis were collected from five direct-push borings. Samples were analyzed for a range of compounds as summarized in Table 1.

A comparison of the results to the screening levels, presented in Tables 9 and 10, shows that chemical constituents [metals, TPH, SVOCs (including cPAHs), PCBs, and dioxins/furans] were not detected in Area J soil at concentrations greater than the screening levels. Evidence of impact to soil was not observed during installation of monitoring well RI-MW-4; therefore, soil samples were not collected for chemical analysis from this location.

One area of residual soil contamination identified during previous investigations is present in the northeastern portion of Area J, as discussed in Section 7.1.1.

6.3.4 AREA M

The primary focus of the Area M soil investigation was to characterize soil in areas of previous industrial and commercial operations (work yards for buildings along West Marine View Drive and the footprint of the former Collins Building following demolition). In addition, general characterization samples were collected from previously uninvestigated areas to evaluate the quality of fill material placed at the Site. Soil samples were collected from 31 direct-push borings. In addition, soil samples were collected during drilling for the installation of monitoring well RI-MW-5 and samples were collected from nine locations in the area of the former Collins Building using hand tools. Samples were analyzed for a range of constituents as summarized in Table 1.

A comparison of the results to the screening levels, presented in Tables 9 and 10, shows that SVOCs (with the exception of cPAHs at four locations) and PCBs were not detected in Area M soil at concentrations greater than the screening levels. At 28 of 41 soil sampling locations, no analytical parameters were detected in soil at a concentration greater than the screening levels. Metals (arsenic, and/or lead) were detected at 11 of 35 soil sampling locations in Area M at concentrations exceeding the screening levels, TPH was detected at 2 locations at concentrations greater than the screening level, and cPAHs were detected at four locations at a concentration greater than the screening level. Locations with exceedances for metals, cPAHs, and TPH in soil are shown on Figure 16. As is shown, impacted soil was identified in five areas within Area M:

- Arsenic (44.6 mg/kg to 76.4 mg/kg) was detected at concentrations greater than the screening levels in the 0 to 1 ft samples from M-GC-102, M-GC-102a, M-GC-102b, and M-GC-102d, located to the east of the sublease building in the northern portion of Area M. Detected concentrations of arsenic were below the screening levels in the 1 to 2 ft samples collected from each of these locations.

- Arsenic (33.3 mg/kg) was detected at a concentration greater than the screening level in the 0 to 1 ft sample from M-GC-107a located to the north of the sublease building in the northern portion of Area M.

- Lead (270 mg/kg to 1,820 mg/kg) and arsenic (30.4 mg/kg 2,440 mg/kg) were detected at concentrations greater than the screening levels in the sample collected from 7 to 7.5 ft BGS at M-FA-102, the sample collected from 4 to 5 ft at M-FA-102h, the sample collected from 6 to 7 ft BGS at M-FA-102i, and the sample collected from 7 to 8 ft BGS at M-FA-102l, located to the south of the former Collins Building. The cPAHs concentrations (0.161 mg/kg to 4.217 mg/kg) at M-FA-102, M-FA-102h, M-FA-102i, and M-FA-102l also exceeded the screening level.

- Arsenic (35.3 mg/kg) was detected at a concentration greater than the soil screening levels in the 0 to 1 ft sample at M-FA-102b, located at the southwestern corner of the former Collins Building.
- Lead (294 mg/kg) was detected at concentrations greater than the screening levels in the 0 to 1 ft sample at M-FA-103, located in the southeastern portion of Area M, near the northwestern corner of the net shed.

No evidence of contamination was observed at these locations during field screening, except for M-FA-102, M-FA-102i, and M-FA-102l where blue-black sand-sized material (apparent sandblast media) was observed in the sample interval. Limited recovery was obtained from this interval at location M-FA-102h. All metals screening level exceedances occurred in General Fill or non-soil materials, and no exceedances were detected in samples collected from hydraulic fill.

Diesel-range (M-GC-105) and heavy oil-range (M-GC-105 and M-FA-105) petroleum hydrocarbons (TPH-Dx) were detected at concentrations greater than the screening levels at two locations within the former Collins Building footprint. At M-GC-105, areas of black, petroleum hydrocarbon-cemented sand and woodchips were observed at the ground surface and extending to a depth of approximately 0.5 ft BGS. Samples collected from the cemented material and the soil immediately below the material (1 to 1.5 ft BGS) exhibited heavy oil concentrations of 34,700 mg/kg and 5,420 mg/kg, respectively, and diesel-range concentrations of 6,100 mg/kg and 872 mg/kg, respectively. TPH was not detected at concentrations greater than the laboratory reporting limits in the sample collected from 4 to 5 ft BGS where hydraulic dredge fill was encountered. At M-FA-105, heavy oil-range petroleum hydrocarbons were detected at a concentration of 2,340 mg/kg in the sample collected from 0 to 1 ft BGS, which slightly exceeds the screening level (2,000 mg/kg). TPH was not detected at concentrations greater than the laboratory reporting limits in the sample collected from 4 to 5 ft BGS at M-FA-105.

An emergency cleanup action was conducted in association with the Craftsman District boatyard expansion to address these petroleum exceedances, as described in 3.3. Following excavation of petroleum impacted soil, nine compliance monitoring samples were collected from the base and sidewalls of the two excavation areas and analyzed for TPH-D and TPH-O. TPH-D and TPH-O were not detected in the samples at concentrations greater than the laboratory reporting limits.

One area of residual soil contamination identified during previous investigations is present in the east central portion of Area M, as discussed in Section 7.1.1.

6.3.5 NORTON INDUSTRIES PROPERTY

Four direct-push soil borings were conducted in two areas of the Norton Industries property, located along the north boundary of the Site, as shown on Figure 8. Two borings (N-FA-100 and N-FA-101) were completed north of Area I where arsenic and copper were detected at concentrations greater than the screening levels during post-interim action compliance monitoring. Two borings (N-FA-

102 and N-FA-103) were completed north of the oil-affected area discovered in 2004 along the northern boundary of Area G during a storm sewer repair project. A second boring (N-FA-103B) was advanced adjacent to N-FA-103 because no recovery was obtained below 8.3 ft in the initial boring; Boring N-FA-103B is not shown on Figure 8, but the boring log is presented in Appendix D. Soil samples were analyzed for a range of compounds as discussed in Section 2.1.4 and summarized in Table 1.

No constituents were detected in the soil samples collected from N-FA_100 or N-FA-101 at concentrations greater than the screening levels. Arsenic (28.3 mg/kg) was detected at a concentration slightly greater than the screening level in the wood debris sample collected from 6 to 7 ft BGS at N-FA-103B.

Detected concentrations of cPAHs (0.789 mg/kg) and total PCBs (3.85mg/kg), were greater than the screening levels at N-FA-102 at a depth of 2 to 3 ft BGS. The vertical extent of contamination was not defined at this location. Gasoline-range petroleum hydrocarbons were detected at a concentration of 413 mg/kg at N-FA-103B at a depth of 6 to 7 ft BGS, which exceeds the screening level (100 mg/kg).

The relationship between screening level exceedances at the Site and Area N property to the north are discussed further in Section 7.1.1, including results of pre-RI investigations conducted along the northern Site boundary as part of the oil-affected area investigation.

6.4 MARINE SEDIMENT QUALITY

Marine sediment quality was evaluated to determine if previous Site activities had impacted sediment quality to an extent that could pose a threat to human health or adversely affect biological resources. To make this determination, the analytical results for the sediment samples were compared to the SMS SQS and CSL cleanup standards. Some of the SQS and CSL values are expressed on a TOC-normalized basis and, therefore, applicable sample results have been organic carbon normalized. Table 11 presents organic carbon-normalized results and Table 12 presents non-organic carbon-normalized (dry-weight) results. Comparison of the marine sediment sample analytical results to the SMS criteria indicates that no concentrations exceed the CSL or SQS criteria.

Two sediment samples (A/H-SED-1 and A/H-SED-4) were analyzed for dioxins and furans. Dioxins and furans were detected in the samples at low concentrations [TEQ = 2.41 nanograms per kilogram (ng/kg) and 1.77 ng/kg, respectively]. Dioxins and furans do not have promulgated SQS and CSL values. However, based on current Ecology draft guidance (Ecology 2012), the cleanup level for dioxins and furans in Puget Sound marine sediment can be established using a range of approaches, with the most conservative approach being the use of the Puget Sound natural background concentration as the cleanup level. The natural background concentration for Puget Sound (inclusive of Port Gardner) has not yet been determined with a high degree of certainty. However, based upon review of the concentrations and overall distribution of both the Site data, as well as the available natural background data throughout

Puget Sound, the Site-specific data reflect levels substantially below generally recognized natural background levels. As a result, dioxins and furans do not appear to be an environmental concern for Site marine sediment.

Reporting limits for six constituents (hexachlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, hexachlorobutadiene, and BBP) exceeded the SMS carbon-normalized criteria in some samples. However the TOC values were within the range typically found in Puget Sound and the dry-weight concentrations for these constituents were below the AETs that are based on dry-weight concentrations. Ecology recommends that, in areas with low TOC values (which results in higher reporting limits), the use of dry-weight AETs be considered along with the organic carbon-normalized criteria.

Ammonia, total sulfides, and TVS results were used to evaluate potential adverse effects on sediment due to high organic content, wood debris, etc. No wood debris was observed during sediment sampling. None of the samples exceeded the threshold of 25 percent wood by weight, as measured by TVS analysis. Although SMS criteria are not promulgated for ammonia and total sulfides, the detected concentrations for these constituents do not appear to be elevated. Based on these data, wood debris does not appear to be a significant environmental concern for Site marine sediment.

Concentrations of TOC ranged from 1.76 to 2.43 percent and are considered typical of Puget Sound sediment.

6.5 GROUNDWATER QUALITY

RI groundwater monitoring was conducted to evaluate Site-wide groundwater quality and flow, to evaluate groundwater quality in focused areas where historical activities and documented releases to Site soil may have impacted groundwater quality, and to evaluate groundwater quality at the point of discharge to surface water. This section presents the RI groundwater quality results. As discussed in Section 4.3, wet season groundwater sampling was conducted in December 2010 and dry season groundwater sampling was conducted in October 2011 as part of the RI. In addition, groundwater samples were collected from selected monitoring wells in February 2011 to further evaluate concentrations of BEHP, mercury, arsenic, and TPH detected during the December 2010 sampling event that appeared to be anomalous.

6.5.1 GROUNDWATER

The groundwater analytical results were compared to the groundwater screening levels presented in Table 4. Analytical results for compounds detected during RI groundwater sampling events are presented in Table 13. Screening level exceedances for dissolved arsenic and dissolved copper are shown on Figures 17 and 18 (copper) and Figure 19 (arsenic), because these are the only constituents with confirmed multiple exceedances of the groundwater screening levels, as discussed below. Note that dissolved arsenic data for four monitoring wells located along the southern boundary of the TC Systems Site to the north are shown on Figure 19; however, the data are not included in the data tables.

cPAHs, and PCBs constituents did not exceed the groundwater screening levels in any of the groundwater samples. 1,1-DCE exceeded its groundwater screening level in one sample from one location (ECI-MW-3), BEHP exceeded its groundwater screening level in two samples from one location (RI-MW-3), petroleum hydrocarbons in the diesel and/or oil ranges exceeded the screening levels in two locations, and a few heavy metals (primarily arsenic and copper) exceeded the screening levels in multiple samples. However, a number of the exceedances either were not reproducible in follow-up sampling or the exceedances were associated with groundwater samples collected from temporary borings instead of established monitoring wells, which may have resulted in analytical results that are biased high. Additional discussion of the RI groundwater data that may not be representative of groundwater quality on a Site-wide basis is presented in the following section.

6.5.1.1 Potentially Unrepresentative Groundwater Analytical Results

There are a number of factors that suggest that many of the groundwater screening level exceedances detected during the first round of RI groundwater monitoring are not representative of Site groundwater quality due to laboratory QC issues, groundwater sampling methods, and possibly other unidentified factors. This conclusion is supported by laboratory reporting narrative, the lack of reproducibility of some results, and the consistent and measurable difference in concentrations for some constituents detected in groundwater samples collected from monitoring wells versus concentrations in samples collected from direct-push borings. Site-wide anomalous groundwater quality results are discussed in this section and localized anomalous results are discussed in the following sections addressing specific Site areas. Groundwater quality results that reflect a Site- wide anomaly are discussed in this section and the results that are anomalous only in a particular area are discussed in the following sections addressing specific Site areas.

As previously discussed, selected groundwater samples collected during the December 2010 sampling event were reanalyzed for SVOCs due to suspected phthalate laboratory contamination issues. The original data were rejected and the results for the reanalysis are presented in this section. In addition, only a single phthalate exceedance (BEHP) occurred in a February 2011 sampling event that was conducted to analyze for a number of constituents that exhibited anomalous results during the December 2010 round of monitoring. This exceedance was repeated during the October 2011 groundwater monitoring event in only one well, RI-MW-3. The BEHP exceedances are discussed further in Section 6.2.1.5

Mercury was detected above the groundwater screening level in a number of monitoring wells and direct-push groundwater samples during the December 2010 round of groundwater sampling. Prior to the RI, mercury was only reported above its detection limit in 1 out of 26 samples (the last reported detection was in 1992) collected between 1989 and 2005. Because mercury had not been detected in any recent groundwater samples previously collected from the Site or the greater North Marina Area, and because mercury has not been detected at significantly elevated concentrations in Site soil, the mercury detections were suspect. To investigate further, five monitoring wells were re-sampled for mercury during the February 2011 groundwater sampling. Mercury was not detected in any of the samples above the reporting limit. Mercury was also not detected above the reporting limit in samples collected from eight monitoring wells and the sump during the October 2011 sampling event. The available data indicate that the first round mercury screening level exceedances are not representative of groundwater quality. The cause of the first round mercury detections are not explained by turbidity or filter contamination as turbidity measurements do not appear to correlate to mercury concentrations and a rinsate blank collected from one of the field filters did not exhibit detectable concentrations of mercury.

Dissolved copper groundwater concentrations exhibited significantly more elevated concentrations in samples collected in the first sampling event from direct-push borings than in samples collected from monitoring wells. Copper concentrations in two of the monitoring wells (RI-MW-1 and P-10) exceeded the copper screening level during the December 2010 round of sampling, yet were below the copper screening level during the October 2011 round of sampling from monitoring wells only (see Figures 16 and 17).

During the December 2010 sampling event, the average dissolved copper concentration for direct-push samples where dissolved copper was detected is 24.7 µg/L compared to 3.4 µg/L in groundwater samples collected from monitoring wells. The three highest dissolved copper groundwater concentrations also correspond to the three highest turbidity readings (see Tables 13 and 14). A similar trend is apparent in dissolved zinc concentrations, although none of the zinc concentrations exceed the screening level. These results support the conclusion that the elevated copper concentrations detected in groundwater samples collected from direct-push borings are an artifact of the sampling process; because the samples were filtered, these elevated concentrations likely result from fine grained particulates that passed through the filter media, poor filter performance, or both.

It is common for concentrations of constituents that partition heavily to soil, such as heavy metals, to exhibit elevated concentrations in wells on the first sampling event following well construction or significant disturbance such as well development due to disturbance of the aquifer matrix. This may be the cause of the elevated concentrations of copper detected in the December 2010 round of sampling that were not observed in the October 2011 round in samples collected from MW-1 and P-10. This conclusion is supported by the analytical results for dissolved arsenic at P-10, which was significantly elevated

(16.7 µg/L) in the December 2010 round of sampling and was well below the arsenic screening level (1.4 µg/L) in the October 2011 round of sampling.

6.5.1.2 Field Parameters

Conductivity, pH, temperature, turbidity, DO, and ORP were measured in all monitoring wells and most direct-push borings from which groundwater samples were collected, as presented in Table 14. Some field parameters were not measured in some of the direct-push boring samples because insufficient water was present.

Conductivity measured in groundwater collected from monitoring wells ranged from 317 to 8,503 micro-Siemens per centimeter (µS/cm). Conductivity measured in groundwater collected from direct-push borings ranged from 362 to 2,472 µS/cm. During the wet season (December 2010) sampling event, conductivity in groundwater samples collected from monitoring wells ranged from 394 to1,975 µS/cm with the highest measurements recorded in the wells closest to the shoreline and generally decreasing with distance from the shoreline. During the dry season (October 2011) sampling event, conductivity in groundwater samples collected from monitoring wells ranged from 1,008 to 8,503 µS/cm and did not show a clear pattern in relation to distance from the shoreline. The wide range in conductivity concentrations and lack of correlation between the conductivity and distance from the shoreline are indicative of a potential malfunctioning conductivity meter and the results may not be representative of Site groundwater.

Groundwater pH ranged from 5.93 to 8.76, but generally fell between 6.2 and 7.5. Turbidity ranged from 1.3 to 178 NTU in monitoring wells and 28.2 to greater than 1,000 NTU in groundwater samples collected from direct-push borings. Turbidity readings for direct-push samples were collected prior to filtration or centrifuging, so the turbidity data are not representative of the samples submitted for analysis.

Groundwater temperature ranged from 9.0 to 12.8 degrees Celsius in groundwater samples collected from monitoring wells and 6.95 to 14.5 degrees Celsius in groundwater samples collected from direct-push borings. Groundwater temperature in groundwater samples collected from monitoring wells during the dry season sampling event (October 2011) were an average of 4.2 degrees higher than temperature recorded during the wet season sampling event (December 2010). Groundwater samples were collected from direct-push borings completed between November 2010 and January 2011. The range in temperature in groundwater samples collected from direct-push borings may result from the influence of the ambient temperature of the temporary sampling equipment or the longer exposure of the groundwater samples to ambient air temperature due to the slower extraction rates associated with some of the direct-push sampling locations.

ORP ranged from -219 to 119 millivolt (mv). However, ORP was negative, indicating reduced groundwater conditions, in all but one sample collected during the December 2010 round of sampling, about half of the groundwater samples collected during the February 2011 sampling, and all but one sample collected during the October 2011 round of sampling. The increase in the number of locations with positive ORP values during the February 2011 sampling is likely due to greater precipitation recharge, which contains higher oxygen concentrations than groundwater.

6.5.1.3 Area G

The purpose of the groundwater investigation in Area G was to characterize post-interim action groundwater quality, evaluate groundwater quality in areas of previous soil exceedances, and to evaluate general groundwater quality within, and downgradient of, operations areas. In Area G, groundwater samples were collected from two direct-push borings (G-GC-100 and G-FA-113), two existing monitoring wells (SEE-EC-3 and P-10), one new monitoring well (RI-MW-7), and a sump within the Ameron manufacturing building. A total of 10 groundwater samples were analyzed for a range of constituents including dissolved metals, TPH, SVOCs, and VOCs, as identified in Table 3.

A comparison of the results to the screening level s, presented in Table 13, shows that TPH, SVOCs, and VOCs were not detected at concentrations greater than the screening level s in Area G. Dissolved arsenic concentrations exceeded the screening level (5 µg/L) in two of the five groundwater samples analyzed for metals (16.7 µg/L at P-10 and 256 µg/L at SEE-EC-3) during the initial round of groundwater sampling. SEE EC-3 was re-sampled for dissolved arsenic during the February 2011 event because of laboratory QA/QC concerns (see discussion in Section 6.5.1.1). The sample exhibited a significantly lower dissolved arsenic concentration of 35.6 µg/L for this round of sampling. Dissolved arsenic concentrations exceeded the screening level in one of the four samples analyzed for metals (34.6 µg/L at SEE-EC-3) during the October 2011 round of sampling, consistent with the concentrations detected during the February 2011 sampling.

SEE-EC-3 is located in the immediate vicinity of deposits of angular black sand (apparent sandblast media), which contains highly elevated arsenic concentrations. The occurrence of the black sand-sized material could affect groundwater quality at SEE-EC-3; however, the black sand appears to be limited to elevations above the water table and there is no evidence that it is leaching, as discussed below. The elevated concentrations of arsenic is more likely due to reduced (low oxygen) groundwater conditions resulting from high organic content in the hydraulic fill and the presence of wood debris deposits observed in the saturated zone in borings in this area. In reduced groundwater chemistry, arsenate ($As+^5$) reduces to the more soluble arsenite ($As+^3$). Reduced groundwater chemistry occurs elsewhere in the North Marina Area and is common in Western Washington, resulting in elevated arsenic groundwater concentrations by mobilizing naturally occurring arsenic in soil.

As shown in Table 14, reduced groundwater conditions were measured at all groundwater monitoring wells sampled during the first round of RI groundwater monitoring, at about half the locations during the February 2011 groundwater monitoring, and at all but one location during the October 2011 round of sampling. The concentration of arsenic at SEE-EC-3 decreased by almost an order of magnitude from the December 2010 to the February 2011 sampling. The lower concentration was confirmed during the October 2011 round of sampling. ORP increased by a similar amount, which is consistent with elevated arsenic concentrations due to reduced groundwater conditions. Regardless of the cause, dissolved arsenic is not migrating a significant distance downgradient from SEE-EC-3, nor does it have much aerial extent, as demonstrated by:

- The low dissolved arsenic concentration in the groundwater sample collected from I-FA-100 (0.984 µg/L), located less than 100 ft downgradient from SEE-EC-3
- The low concentration at I-FA-101 (< 1.0 µg/L), which is downgradient from G-FA-109 (where a substantial layer of the black sand was found)
- The downgradient RI-MW-1 and RI-MW-2 water quality data for dissolved arsenic (<1.0 µg/L and 1.6 µg/L, respectively, during the December 2010 round of sampling; 1.8 µg/L and 0.4 µg/L, respectively, during the October 2011 round of sampling).
- Low or non-detectable concentrations of arsenic in G-GC-100 and RI-MW-7, which are in the vicinity of SEE-EC-3 and the angular black sand occurrence.

Dissolved copper concentrations exceeded the screening level (3.1 µg/L) at G-GC-100 (61.5 µg/L) and at P10 (5.23 µg/L) during the December 2010 round of sampling. As discussed in Section 6.5.1.1, because the groundwater sample at G-GC-100 was collected from a direct-push boring rather than a monitoring well, it is likely the elevated copper concentration is an artifact of the sampling method and not representative of groundwater quality. This is supported by the high turbidity measured in the sample prior to filtration (551 NTU), the observed condition of the groundwater sample at the time of collection (which exhibited a brown tint), and the low concentration of copper (1.4 µg/L) detected in a sample collected from a monitoring well RI-MW-7, which was installed right next to and directly downgradient of G-GC-100 to test this hypothesis. These results indicate that the concentration of copper detected during the initial round of sampling at location G-GC-100 is not representative of Site groundwater quality. Dissolved copper was not detected at a concentration greater than the laboratory reporting limit in the groundwater sample collected from P10 during the October 2011 round of sampling, which is consistent with the results from the initial sampling event at this well in 2004 (<2.0 µg/L).

6.5.1.4 Area I

The purpose of the RI groundwater investigation in Area I was primarily characterization of groundwater quality near its point of discharge to surface water. Groundwater quality samples were also collected to evaluate post-interim action groundwater conditions in the area of observed concrete-like waste material and angular black sand (apparent sandblast media) along the eastern boundary of Area I, and downgradient of current and historical operations in Area G. Samples were collected from three shoreline wells (RI-MW-1 through RI-MW-3) and from two direct-push borings in the eastern portion of Area I (I-FA-100 and I-FA-101).

Groundwater grab samples collected from the borings I-FA-100 and I-FA-101 were analyzed for dissolved metals and VOCs. VOCs were not detected at concentrations greater than the screening level s. Copper and mercury were detected in both of the samples at concentrations greater than the screening level s. The detected concentrations of copper at I-FA-100 and I-FA-101 were 5.75 µg/L and 7.15 µg/L, respectively, which slightly exceed the copper screening level (3.1 µg/L). As described in Section 6.5.1.1, the copper concentrations detected in groundwater samples collected from direct-push borings appear to be biased high and not representative of groundwater quality.

Samples collected from the three shoreline monitoring wells were analyzed for dissolved metals, SVOCs, cPAHs, and VOCs. SVOCs (except for BEHP – see discussion below), cPAHs, and VOCs were not detected at concentrations greater than the screening level s. Copper was detected in shoreline well RI-MW-1 at a concentration of 4.35µg/L, which is slightly greater than the screening level (3.1 µg/L), during the December 2010 round of sampling, and at a concentration of 2.9 µg/L, which is below the screening level, during the October 2011 round of sampling. In both cases, the detected concentrations are less than the concentration of dissolved copper detected in the surface water sample collected in the vicinity of RI-MW-1 (7 µg/L), as discussed in Section 6.6.

Mercury was detected in groundwater samples collected from direct-push borings I-FA-100 and I-FA-101 and each of the shoreline wells at concentrations ranging from 0.133 µg/L to 0.480 µg/L during the December 2010 round of groundwater sampling, which are greater than the screening level (0.1 µg/L). But, mercury was not detected above the reporting limit of 0.02 µg/L during the February 2011 sampling event or the October 2011 round of sampling and, as previously discussed in Section 6.5.1.1, the mercury detections that occurred during the December 2011 round of groundwater monitoring do not appear to be representative of Site groundwater quality.

BEHP was detected in samples from RI-MW-3 at concentrations of 6.8 µg/L and 3.1 µg/L during the February 2011 sampling and October 2011 round of groundwater monitoring, respectively. The detected concentrations are greater than the screening level (2.2 µg/L). However, BEHP was not detected in the sample collected from RI-MW-3 during the December 2010 round of groundwater monitoring. Because BEHP is a common laboratory contaminant, it is possible that the BEHP exceedance in RI-MW-3 is the result of laboratory contamination, particularly since BEHP did not exceed its soil screening level in any soil samples collected at the Site.

6.5.1.5 Area J

RI groundwater quality monitoring was conducted in Area J to characterize post-interim action groundwater quality downgradient of the 1993 MSRC interim action area and interim action area J-3, and to evaluate groundwater quality in the area of former mill structures and in the area to the north of the MSRC building where petroleum hydrocarbons were observed in 2007 during construction associated with the Craftsman District. In addition, general characterization groundwater sampling was conducted in the eastern portion of Area J. Groundwater samples were collected from two monitoring wells (RI-MW-4 and RI-MW-6) and three direct-push borings (J-FA-100, J-FA-102, and J-GC-100).

Samples were analyzed for a range of constituents including TPH, dissolved metals, SVOCs, cPAHs, VOCs, and PCBs, as indicated in Table 3. As is indicated in the applicable RI data tables, SVOCs, cPAHs, VOCs and PCBs were not detected in Area J groundwater samples at concentrations greater than the screening level s.

Copper was detected at three locations at concentrations greater than the screening level (8.45 µg/L to 127 µg/L). All of the copper screening level exceedances occurred in samples collected from direct-push borings, which appear to be biased high and not representative of groundwater quality, as previously discussed. RI-MW-6 was installed directly downgradient of direct-push location J-FA-100, where the highest concentration of copper (127 µg/L) was detected during the initial sampling event. Copper was detected at a concentration of 1.0 µg/L in the sample collected from RI-MW-6.

Lead was detected at J-FA-100 at a concentration of 143 µg/L, which is greater than the screening level of 8.1 µg/L. J-FA-100 is also the location where the highest copper concentration was detected (127 µg/L) in RI groundwater samples, as described above. Lead was detected at a concentration of 0.2 µg/L in the sample collected from RI-MW-6. The highly elevated concentrations of copper and lead detected in the sample collected from J-FA-100, combined with the high turbidity measured (greater than 1,000 NTU), the brown color the sample exhibited at the time of sampling, and the lack of correlation between the sample data collected from direct-push location J-FA-100 and monitoring well RI-MW-6, support the conclusion that the elevated dissolved metals concentrations (with the exception of arsenic as discussed below) are associated with turbidity and are not be representative of groundwater quality.

Arsenic was detected at a concentration of 7.35 µg/L, which is greater than the screening level (5 µg/L) in the sample collected from direct-push location J-FA-100. Arsenic was detected at a similar concentration (9.4 µg/L) in the sample collected from downgradient monitoring well RI-MW-6. As described in Section 6.5.1.3, detection of elevated concentrations of arsenic in groundwater at the Site are likely attributable to reducing conditions, as evidenced by ORP measurements (-191 mv at J-FA-100 and -88.1 mv at RI-MW-6) and the presence of wood fragments in soil at these sample locations. Residual petroleum hydrocarbons in soil in this area, discussed below, may also be contributing to reducing conditions in this area.

Mercury was detected at RI-MW-4 at a concentration of 0.337 µg/L during the December 2010 round of sampling, which is greater than the screening level. Similar to other locations, mercury was below the reporting limit in the February 2011 sampling and October 2011 round of groundwater sampling and the initial mercury exceedance is not considered representative of Site groundwater quality.

TPH was detected at two locations in Area J at concentrations greater than the screening levels during the initial sampling event. Diesel-range and heavy oil-range petroleum hydrocarbons were detected at J-FA-100 at concentrations of 881 µg/L and 2,240 µg/L, respectively, and heavy oil-range petroleum hydrocarbons were detected at RI-MW-4 at a concentration of 1,390 µg/L. The screening level for both diesel-range and heavy oil-range petroleum hydrocarbons is 500 µg/L. Neither sheen nor petroleum hydrocarbon odor were present at either location at the time of sampling. J-FA-100 is located in the vicinity of an area of petroleum impact observed to the north of the former MSRC building during construction associated with the Craftsman District. As noted previously, the sample from J-FA-100 had high turbidity and was brown in color. Thus, the measured TPH concentrations were believed to be due to particles entrained in the sample and not representative of actual groundwater quality, particularly for the less soluble TPH fractions. Monitoring well RI-MW-6 was installed directly downgradient of direct-push location J-FA-100 to test this hypothesis. Diesel- and heavy oil-range petroleum hydrocarbons were not detected in the sample collected from RI-MW-6 at concentrations greater than the laboratory reporting limit. These results help support the hypothesis that the petroleum hydrocarbon exceedance detected at J-FA-100 during the first round of sampling may not be representative of groundwater quality.

RI-MW-4 is located downgradient of the 1993 MSRC interim action area. During the December 2010 sampling event, oil-range petroleum hydrocarbons were detected at a concentration greater than the screening level, even though no evidence of petroleum hydrocarbon contamination was observed during sample collection. A groundwater sample was collected from RI-MW-4 during the February 2011 sampling event. TPH-Dx was not detected in the sample. Diesel- and oil-range petroleum hydrocarbons were also not detected in a sample collected from RI-MW-4 during the October 2011 round of sampling. These results help support the hypothesis that the petroleum hydrocarbon exceedance detected at RI-MW-4 during the first round of sampling may not be representative of groundwater quality.

6.5.1.6 Area M

RI groundwater quality monitoring was conducted in Area M to characterize groundwater quality downgradient of previous operational areas associated with the former mill, manufacturing operations in the Collins Building, and the marine/auto repair-related businesses along West Marine View Drive. In addition, general characterization groundwater sampling was conducted in previously uninvestigated areas located to the north and west of the former Collins Building and in the northeastern corner of the Site. Groundwater samples were collected from two monitoring wells (ECI-MW-3 and RI-MW-5) and nine direct-push borings. Samples were analyzed for a range of constituents including TPH, dissolved metals, SVOCs, cPAHs, VOCs, and PCBs, as indicated in Table 3.

As is indicated in Table 13, SVOCs, cPAHs, and PCBs were not detected in Area M groundwater samples at concentrations greater than the screening level s. A single VOC (1,1-DCE at 12.3 µg/L), exceeded its screening level (3.2 µg/L) at ECI-MW3 during the December 2010 sampling event, but was not detected above laboratory reporting limits during the October 2011 round of sampling. It should also be noted that BEHP exceeded the screening level in monitoring wells ECI-MW-3 and RI-MW-5 in the original analysis prior to those results being rejected due to laboratory contamination (see Section 6.2.1.5). BEHP was not detected at concentrations greater than the laboratory reporting limits in samples collected from either of these wells during the February 2011 sampling or October 2011 round of sampling. These data confirm that the BEHP concentrations detected during the December 2010 round of sampling were not representative of Site groundwater quality.

Arsenic was detected at concentrations greater than the screening level (5 µg/L) at locations M-GC-100 (9.80 µg/L), ECI-MW-3 (18.2 µg/L), and M-FA-104 (6.0 µg/L) in the northern portion of Area M during the first sampling event. The arsenic data from the direct-push sampling is likely biased high as discussed already for the metals analyses in other areas of the Site. Arsenic was detected at a concentration of 65.8 µg/L at ECI-MW-3 during the October 2011 round of sampling, indicating an increase in the concentration of arsenic. The ORP data indicate reducing conditions for the December 2010 (-98.0 mv) and October 2011 (-85.0 mv) sampling events, which is consistent with elevated arsenic concentrations being related to groundwater reducing conditions.

Mercury was detected at concentrations greater than the screening level (0.1 µg/L) at M-GC-103 (1.09 µg/L) and at RI-MW-5 (0.125 µg/L) during the December 2010 round of groundwater sampling. A sample was collected from RI-MW-5 during the February 2011 sampling. The sample was analyzed by ARI for mercury, which was not detected at a concentration greater than the laboratory reporting limit of 0.02 µg/L. Mercury was also not detected at a concentration greater than the laboratory reporting limit during the October 2011 round of sampling. Based on these results, it is concluded that the elevated mercury concentration detected during the first round of monitoring are not representative of groundwater quality.

Copper was detected in a groundwater grab sample collected from direct-push boring M-FA-103 at a concentration of 3.20 µg/L, which is slightly greater than the screening level (3.1 µg/L). Even though the soil sample collected from M-FA-102 contained black sand-sized material (apparent sandblast media) and exhibited a copper concentration of 1,410 mg/kg, and the sample was collected from below the groundwater table, the groundwater dissolved copper concentration in the sample collected from this location was below the reporting limit of 0.5 µg/L. The combination of the dissolved copper groundwater concentration below the reporting limit and the highly elevated copper concentration in a soil sample collected from below the water table at the same location support the conclusion that the elevated concentrations of copper present in Site soil are not causing elevated copper concentrations in groundwater. During the December 2010 and October 2011 rounds of groundwater monitoring, dissolved copper was not detected at concentrations greater than the screening level in samples collected from monitoring wells in Area M.

6.5.1.7 Norton Industries Property

Two groundwater samples were collected from the Norton Industries property. One sample was collected north of Area I (N-FA-100) and one sample was collected from north of Area G (N-FA-102). The samples were analyzed for dissolved metals (N-FA-100) and for TPH, SVOCs, cPAHs, VOCs, and PCBs (N-FA-102). TPH, SVOCs, cPAHs, VOCs, and PCBs were not detected at concentrations greater than the screening level s.

Dissolved copper was detected in the samples at concentrations of 18.3 µg/L (N-FA-100) and 3.60 µg/L (N-FA-102; slightly exceeding the copper screening level of 3.1 µg/L). Dissolved copper has been detected at elevated concentrations (8.22 to 27 µg/L) during the TC Systems RI/FS in samples collected from monitoring wells along the southern and western boundaries of the TC Systems Inc Site (Ecology Facility Site ID 10587741), located to the north of the Site (Stantec 2011). It is noted that the copper concentrations detected as part of the TC Systems RI/FS were from the initial sampling event, and the wells had high turbidity that may have influenced the results. Because copper in groundwater only slightly exceeded its screening level in several wells at the Site, and no exceedances were identified in the 2nd round of groundwater sampling, detected concentrations of copper in groundwater at N-FA-100 and N-FA-101 (located on TC Systems property) do not appear to be attributable to Site releases.

6.6 SURFACE WATER

One surface water sample was collected on October 11, 2011 from the 12th Street Yacht Basin in the vicinity of RI-MW-1 to establish background surface water quality in the shoreline vicinity, and to evaluate whether surface water quality could be affecting groundwater quality in the vicinity of the shoreline. Dissolved arsenic was detected at a concentration of 2 µg/L and dissolved copper was detected at a concentration of 7 µg/L. The detected concentration of dissolved copper exceeds the groundwater screening level for copper and is greater than the concentrations detected in samples collected from any of the Site monitoring wells, including the concentration detected in shoreline monitoring well RI-MW-1 during the initial sampling event (4.35 µg/L). The detected concentration of dissolved copper is also greater than its ambient background concentration of 0.639 µg/L (Ecology 2008b). The results of the surface water sampling indicate that surface water quality could be affecting copper groundwater quality in the vicinity of the shoreline. The detected concentrations of dissolved copper in surface water are not attributable to Site releases and are more likely the result of anti-fouling paints commonly applied to boat hulls. A 2007 study conducted by Ecology documented similar to higher levels of dissolved copper at two Puget Sound marinas located in the Anacortes, Washington area resulting from anti-fouling paint. Inner marina concentrations for dissolved copper ranged from 3.3 µg/L to 12 µg/L at Cap Sante Marina and ranged from 4.7 µg/L to 7.2 µg/L at Skyline Marina as compared to a background concentration of 0.42 µg/L (Ecology 2007). Dissolved copper concentrations were generally progressively lower moving from the inner marina toward the marina entrance.

The detected concentrations of dissolved copper within the Anacortes marinas were attributed by the Ecology report to anti-fouling paints commonly applied to boat hulls. Senate Bill 5436, which was signed into law in May of 2011 and became effective in July of 2011, prohibits the sale of new recreational water vessels with antifouling paint containing copper after January 1, 2018. The bill also prohibits the sale of copper antifouling paint intended for use on recreational water vessels after January 1, 2020. These measures are expected to reduce concentrations of dissolved copper and improve surface water quality in Washington State marinas over time.

Given that only one surface water sample has been collected and analyzed for dissolved copper, it is also possible that the results are anomalous. Additional sampling would be needed to confirm the results. Because the elevated copper concentrations in surface water are not associated with Site releases, additional surface water monitoring should be conducted independently of Site cleanup activities.

6.7 STORMWATER SYSTEM SOLIDS

The stormwater system investigation was focused on the evaluation of stormwater solids collected from areas of the Site with industrial activities. In November 2010, samples were collected from four catch basins or manholes locations along the trunk line and one catch basin location in the vicinity of the new Bayside Marine dry stack storage building that contribute to the trunk line. In addition, solids samples were collected from within the trunk line at three locations north of the Ameron manufacturing building in December 2011 to evaluate whether the quality of stormwater systems solids in the trunk line varied from that in the catch basins. The main trunk line was likely installed circa 1981-1982 (Pinnacle GeoSciences 2010) and is composed primarily of corrugated metal pipe. The main corrugated metal pipe (CMP) trunk line is likely corroded and there have been two incidents of pipe collapse in recent years.

Stormwater system solids from the November 2010 sampling event were analyzed for metals, SVOCs, TPH-Dx, percent solids, and PCBs. In addition, samples collected from catch basins and manholes along the northern Site boundary were analyzed for hexavalent chromium, a constituent possibly associated with Norton Industries. As described in Section 4.5, sub-samples collected from the trunk line during the December 2011 sampling event were composited into a single sample. The composite sample was analyzed for RCRA metals (total and TCLP), SVOCs, TPH-Dx, dioxins/furans, percent solids, and PCBs. Analytical results for stormwater system solids samples are summarized in Table 15.

The quality of solids accumulated in a functioning stormwater collection and conveyance system is not regulated under environmental regulations, other than the proper management for waste disposal purposes. However, since system stormwater discharges to the 12th Street Marina, the analytical results for stormwater system solids samples were evaluated in terms of their potential impact on marine sediment quality, as follows:

- Arsenic (568 mg/kg) and copper (734 mg/kg) were detected in the sample collected from CB 111 at highly elevated concentrations. This is the last catch basin on the trunk line prior to discharge to the 12th Street Marina and receives stormwater from multiple locations.
- Highly elevated concentrations of zinc (up to 5,210 mg/kg) were detected in each of the November 2010 samples (the December 2011 trunk line sample was not analyzed for zinc). The highest zinc concentration was detected at CB-101, which is located to the south of the trunk line in the vicinity of the Bayside Marine building. This elevated concentration could result from drainage from the Bayside Marine dry stack storage building galvanized metal roof, which is routed through CB-101.
- A number of PAHs were detected at elevated concentrations in the sample collected from SD-3, and to a lesser degree in the trunkline composite sample.
- Phthalates were detected in samples from four of the five catch basins and in the trunk line composite sample. Based on the issue with BEHP laboratory contamination identified in Site groundwater samples (see Section 6.1.1. 5), there is a potential that some of the phthalate exceedances are associated with laboratory contamination. BBP was detected in the sample collected from SD-3 (4.75 mg/kg) and in the trunk line composite sample (2.8 mg/kg) at elevated concentrations. BEHP was detected in four catch basins and in the trunk line composite sample at concentrations ranging from 4.43 to 46.7 mg/kg Di-n-octyl phthalate was detected at concentrations ranging from below the reporting limits to up to 6.96 mg/kg (CB101).
- Low concentrations of PCBs were detected in the sample from SD-3 (1.7 mg/kg) and in the trunk line composite sample (0.10 mg/kg).
- Petroleum hydrocarbons in the diesel and oil ranges were detected in the samples from SD-3, SD-4, and SD-7, and in the trunk line composite sample at relatively low concentrations, with the highest concentration of 1,600 mg/kg detected in the trunkline composite sample.
- Dioxins/furans were detected in the trunkline composite sample at a concentration of 15.9 ng/kg.

With the exception of TPH, detected concentrations in the trunkline composite sample were generally similar to or lower than concentrations detected in the stormwater system solids samples collected from catch basins and manholes during the November 2010 sampling event. This supports the conclusion that there has been no historical contaminant loading that was not reflected in the catch basin sampling results.

It is also important to note that the marine sediment quality directly in front of the outfalls shows no evidence of impact from the constituents detected in the stormwater system solids at elevated concentrations, indicating that no significant release of stormwater sediment to marine sediment has occurred.

6.8 PROCESS WASTE SAMPLING

As described in Section 4.6, three composite samples were collected from drying bins located to the east of the Ameron manufacturing building. The samples were analyzed for metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, and zinc) and the results are summarized in Table 10. The analytical results for the bin samples were compared to the soil screening levels, as they are the most applicable screening criteria. Metals were detected in each of the samples at concentrations less than screening levels, with the exception of arsenic in one sample as discussed below.

Arsenic was detected in the composite sample collected from Bin 2 at a concentration of 22.4 mg/kg, which is slightly greater than the screening level (20 mg/kg). At the time of the sampling, Bin 2 contained a small pile of rusted metal debris and underlying soil matrix material, separate from the more typical concrete slurry waste. Because the Work Plan indicated that all distinct materials in the bins were to be included in the composite sample, a sub-sample was collected from soil matrix material (described as brown, gravelly, sandy, silt) underlying the rusted metal debris and included in the composite sample for Bin 2. As a result, the Bin 2 sample may have contained small metal fragments that could have biased the analytical results for metals, including arsenic.

The process waste materials are currently contained and managed under an industrial stormwater permit. Controls are currently in place to prevent stormwater that contacts the waste materials from being released to the environment.

7.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of identified contamination at the Site is discussed in this section based on the results of chemical testing of soil, groundwater, and sediment samples. The Site is divided into upland and the marine areas for discussion purposes.

7.1 UPLAND AREA

The extent of contamination in the upland portion of the Site is discussed in the following sections by media.

7.1.1 SOIL

The extent of soil contamination presented is based on soil samples collected during and prior to the RI and that are representative of soil that remains at the Site following completion of the previously described interim actions and emergency cleanup action. The locations for samples representing soil remaining are shown on Figures 16 and 20 and summarized below.

7.1.1.1 Western Boundary of Area G

Heavy metals (antimony, arsenic, and lead) were detected at concentrations exceeding the screening levels along the western boundary of Area G where black sand-sized material (apparent sandblast media) was observed in two soil borings (G-FA-100 and G-FA-105a) and five test pits (G-FA-104 through G-FA-107 and G-FA-109) completed during the RI. Black sand-sized material and multi-colored apparent concrete waste material were observed in the 2007 Interim Action Area G-1a excavation and elevated concentrations of heavy metals were detected in three soil compliance monitoring samples collected from the G-1a excavation (G1A-100507-S2, -S3, and –B2), located in both Area G and Area I.

Impacted soil encountered in this area is generally limited to the upper 2.5 ft of fill material overlying the hydraulic dredge fill based on test pit observations, sampling conducted in Area G, and observations during the G-1a/Area I cleanup area excavation. The test pits excavated in Area G (G-FA-104 through G-FA-109) identified irregularly occurring seams (2 inches to 2 ft) of the black sand-sized material just below the grass layer within the top 1to 2 ft of ground surface across the unpaved area in the northwest portion of Area G (Figure 20). Compliance monitoring data and field observations from the G-1a excavation indicate that the sandblast waste continued to the east, west, and southwest of the G-1a excavation and the colored concrete extended into Area I to the west. The G1-a excavation extended to a depth of about 5 ft on the east side, but was limited to a depth of about 2.5 ft on the west side by the presence of an electric utility conduit.

Based on available soil data, the western extent of the remaining non-soil materials in Area G-1a generally lie to the east of the crest of the historic soil berm constructed to contain the 1973 hydraulic fill placed in Area I; the berm is shown on Figure 8. This is supported by the lack of apparent concrete waste and/or the black sand-sized materials at RI sample locations I-FA-100 or I-FA-101. Metals were not detected at concentrations greater than the screening levels in the soil sample collected from I-FA-100, which is located directly west of the G-1a excavation area. The eastern extent of contamination in this area is likely bounded by the edge of pavement west of the manufacturing building and the western edge of the lab/storage, pole polishing, and pole finishing buildings. Waste materials were not observed and heavy metals were not detected at concentrations greater than the screening levels in soil samples collected from RI borings advanced in the paved areas west of the manufacturing building (G-GC-100, G-GC-101, G-GC-102) or in soil samples collected from beneath the pole finishing building (G-GC-113 and G-GC-114).

Note that, at the time of the G-1a excavation, the original fence between Area G and Area I had been removed and the excavation appeared to fall within a 10-ft zone between the former fence line and the Ameron leasehold boundary. The occurrence of impacted material straddling the fence line suggests that the contamination originated prior to construction of the fence that separates the two areas, which was constructed between 1981 and 1982 (Appendix A).

7.1.1.2 Former Settling Ponds – Area G

Arsenic (24.5 mg/kg to 50.6 mg/kg) was detected at concentrations exceeding the screening level in soil filling three former concrete settling basins on the eastern side of the lab/storage building (RI borings G-FA-110 through G-FA-112, and pre-RI sample ECI-J-2). Although apparent sand blast media was logged by ECI in the pre-RI test pit sample ECI-J-2 (ECI 1992), no “black sand” blast media was observed in the three RI borings completed into these basins. The concrete bottom depth of the settling basins was encountered at 4.5 to 5 ft BGS in the three RI borings. Contaminated soil is contained at this location within the concrete structures.

7.1.1.3 Northern Site Boundary – Area G

Determining the nature and extent of contamination along the northern Site boundary is complicated by the proximity of the TC Systems site located on Norton Industries property to the north, and the complex relationship between the physical and legal boundaries between the Port and Norton Industries properties (Figures 21 and 22). As described in the Historical Report (Appendix A), there has always been a physical distinction (e.g., grade difference or fence line) separating the area north of the manufacturing building in Area G and the adjoining property to the north (Appendix A). The grade of the

Norton Industries property was historically about 10 ft lower in elevation than the Site grade. The Norton Industries property was filled to the approximate grade of the Site between mid-1977 and mid-1978 and the stormwater trunk line was installed between 1980 and 1982 (Appendix A). The approximate location of the historical grade difference, as interpreted from aerial photographs, is shown on Figures 21 and 22. As indicated on the figures, the historical grade difference was located about 15 ft south of the current fence line that separates the properties. Evidence of the bulkhead that marked the physical boundary between Area G and the property to the north until 1978, when the property to the north was filled to the approximated grade of Area G, was observed in the 1991 exploration ECI-TP-6 (Earth Consultants 1992) where a vertical wall of treated 12x12-inch timbers was found within a few feet of ground surface, extending to the depth of exploration at 8 ft (Figure 21).

During previous investigations and the initial RI sampling, the property line separating Port property from the Norton Industries property to the north was assumed to correspond with the fence line that currently separates Area G from the Norton Industries property to the north. A recent survey performed for Norton Industries shows that the fence line is located about 5 ft north of the property line separating the Port and Norton Industries properties (see Figures 21 and 22). The survey indicates that the trunk line repair conducted in 2004 occurred primarily on the Norton Industries property. For clarity, the distribution of contamination is discussed below relative to the parcel line separating the Port and Norton Industries property shown on Figures 21 and 22, and related to the Site boundary at the end of this section.

Figures 21 and 22 present soil data for samples collected along the northern Site boundary. Arsenic is present at concentrations greater than the screening level in samples collected from different zones within the fill between a depth of 1 and 9 ft along the northern parcel line. The area of impacted fill material extends south to the location of the pavement section placed along the north side of the manufacturing building in approximately 1976 (approximately 30 ft north of the manufacturing building) (Figure 21). Soil borings advanced in this area encountered mixed fill, including white and colored silt-like material with a concrete-like odor, organics and wood debris, concrete chunks, occasional voids, and other fill material. Soil samples consisting of soft, white or green, silt-like material collected from locations G-FA-101, G-FA-101c, G-FA-101e, G-FA-103, G-FA-103c, and G-FA-114, with arsenic concentrations in the range of 28.6 to 65.0 mg/kg (65.0 mg/kg is the average of the detected concentration of arsenic in the primary sample and duplicate sample collected from G-FA-101c), also exhibited elevated pH (11.9 to 12.4), which may be related to concrete slurry waste material. Concrete materials encountered in borings on the Norton Industries property, adjacent to the north boundary, were hard chunks of concrete debris rather than soft silt-like material encountered on Port property. Occasionally, other fill materials in this area contained screening level exceedances for arsenic [e.g., a sample of wood debris in N-FA-103 at 6 to7 ft (28 mg/kg) and a gravel in G-FA-115c at 4 to 7 ft (23.6 mg/kg)].

As shown on Figure 22, organic compounds (including PCBs, TPH, and cPAHs) were detected at concentrations greater than the screening levels in soil samples collected from the Norton Industries property (N-FA-102, N-FA-103, and TC Systems monitoring well MW-7), and in one sample on Port property (gasoline-range petroleum hydrocarbons at G-FA-101c). Organic compounds were not detected at concentrations greater than the screening levels in soil samples collected from nine soil borings south of the property boundary. Note that the log for TC Systems monitoring well MW-7 identifies a moderate petroleum odor from 3.5 to 10 ft BGS, and a sheen from 5 to 10 ft BGS. SVOCs (including cPAHs) and TPH were detected at concentrations greater than the screening levels in soil samples from the upper 3 ft at this location. Soil samples from below 3 ft BGS were not submitted for chemical analysis (Stantec 2011), even though visual evidence of contamination was present in some of the deeper samples.

The physical and chemical differences in the conditions encountered on the Norton Industries and Port properties support the conclusion that the parcel line also represents the site boundary separating these two sites. Apparent concrete slurry waste was only encountered in borings completed on Port property, and PCB and cPAH soil contamination was only encountered on Norton Industries property. As a result of the Site filling history and contaminant occurrence, the parcel boundary separating the Port and Norton Industries property is considered the northern Site boundary for the purposes of this RI/FS.

7.1.1.4 Northern Site Boundary - Area I

Area I was subjected to interim cleanup action that was completed in 2006/2007 as part of the Craftsman District/Bayside Marine redevelopment (Landau Associates 2010a). Following this interim action, a limited occurrence of arsenic was identified along the northern boundary of Area I (Figure 16). At the location of Interim Action I-5, arsenic is present in soil remaining at concentrations exceeding the screening level at three locations (I5-S3D, I5-AC-NWALL A, and I5-AC-NWALL B) and copper and lead are present at concentrations greater than the screening level at one location (I5-AC-NWALL A), as shown on Figure 16. The Area I-5 excavation was limited to the north by the fence separating Port and Norton Industries property. Arsenic was detected at these fence line locations at concentrations ranging from 130 mg/kg to 1,730 mg/kg. Copper and lead were detected at I5-AC-NWALL A at concentrations of 3,070 mg/kg and 2,270 mg/kg, respectively.

The elevated concentrations of metals were associated with a thin (approximately1 ft) layer of colored concrete and black sand waste materials that was observed at the northern boundary of the excavation, which extended to the northern fence line. The thickness of the waste material was observed to decrease rapidly as the excavation progressed toward the northern fence line. The extent of contamination is bounded to the north by N-FA-100 and N-FA-101, which were installed during this RI field work as close as possible to the fence line. The absence of waste material at these locations is consistent with the rapid decrease in affected material to the north observed in Interim Action Area I-5 during the 2006/2007 interim in this area. The extent of contamination was bounded to the south, east, and west by compliance monitoring samples collected following interim actions completed in Area I (Figure 16). Based on the absence of affected material to the north of the fence line, any contamination in this area appears to be very limited in aerial extent. All contaminated soil was removed south of the fence, and the area between the Bayside Marine building and the fence was backfilled with clean soil as part of the construction of the Bayside Marine building.

7.1.1.5 Crushed Rock Fill Under Esplanade

Crushed rock base course material imported as subgrade support in 2006 for the esplanade at the head of the 12th Street channel (western edge of Area I) was determined to contain arsenic exceeding the screening level at concentrations ranging from 29 mg/kg to 126 mg/kg. Accessible portions of the base course material were removed; however, about the western 20 ft of the affected base course material was already covered by the concrete esplanade constructed for public access along the shoreline and, as a result, the affected base course beneath the esplanade was left in place and is contained by this structure (Figure 20). The affected material extends to approximately 1 ft below the concrete. The portion of the imported rock that was removed (470 yd^3) was placed in Area J-3 where long-term containment was planned (while the site was under the VCP) for arsenic- and cPAHs-affected soil and construction debris, as discussed below and in Section 2.2.3.2.

7.1.1.6 Eastern Boundary of Area J (Interim Action Area J-3)

A total of 22 characterization samples (from 12 locations) and 6 compliance monitoring samples were collected from the Area J-3 region during various investigations. Arsenic exceeded its soil screening level in only 4 of the 22 samples tested. Other than a surface soil sample (SS01; described by Kleinfelder as “brown silty-sand, with a trace of gravel and organic material) collected in 1993 that showed high metals concentrations including arsenic at 1,600 mg/kg, the maximum arsenic concentration in Area J-3 was 34 mg/kg identified at station J-GC-6. A total of 15 soil samples were tested for cPAHs; the cPAHs screening level was exceeded in only 2 of the samples at locations J-JC-6 and J-GC-6i. The maximum cPAH detected concentration of 0.56 mg/kg was identified at location J-GC-6i. Although this concentration exceeds the screening level, it is well below the cPAH screening level based on groundwater protection (1.9 mg/kg). It is noted that cPAHs were not detected in RI groundwater samples above the screening level, which is based on a practical quantitation limit of 0.1 µg/L. The outlined area shown on Figure 20 in the northeastern portion of Area J is based on visual observation and represents an expansion of the original interim action area identified as J-3. It is estimated that the affected material extends down to 17 ft BGS and is identifiable by the presence of construction debris containing yellow, red, and orange brick-like fragments, yellow concrete building material, metal, and burned materials. The material is not described in logs as powdery, nor is concrete-like waste material specified in the logs.

Interim action was conducted at Area J-3 during the North Marina Redevelopment interim action conducted in 2006. The purpose of the interim action was to remove metals- (arsenic, lead and antimony) and cPAH-contaminated soil, and buried construction debris encountered within the upper 6 ft to provide a clean soil unit for the installation of utilities constructed during the Craftsman District development. The excavation was not extended farther east to address the J3-S1 exceedance because the sample was collected adjacent to the eastern fence line associated with Area J. Note that the aforementioned fence line separates Area J from Area G. Soil contamination in Area G has been discussed previously in Section 7.1.1.1. Following completion of the interim action in Area J-3,a portion of the fenceline was moved farther west such that some of Area J-3 is now located east of the fenceline.

Explorations in Area J-3 indicate that the affected material remaining following the interim action is similar in appearance to the material removed. Consequently, although many of the characterization and compliance monitoring samples in Area J-3 were collected from the 0- to 6-ft depth interval excavated during the 2006 interim action, the remaining Area J-3 soil is anticipated to be similar in soil quality to that removed. In 2010, RI soil borings J-FA-101 and J-FA-102 were advanced below the covered work area at the north end of the J-MSRC building, west of the J-3 excavation area. Evidence of construction debris was observed at depths ranging from 4.5 to 18.5 ft BGS at J-FA-101. At J-FA-102, organic material was observed at a depth ranging from 7.5 to 10 ft BGS; no samples were recovered from 10 to 14 ft BGS, and concrete was observed at depths ranging from 14 to 18 ft BGS at J-FA-102. Metals and cPAHs were not detected at concentrations greater than the PCLs in samples collected from either location. The sample from J-FA-102 was collected from within the interval where construction debris was encountered. It is noted that the soil sample from J-FA-101 was collected at a depth of 28 to 29 ft BGS and that no samples were collected for analysis from the interval where brick-like fragments were encountered. The purpose of this boring was to evaluate the condition of native soil underlying the fill material. At the time of the field investigation, the native soil interface was incorrectly interpreted to be at approximately 28 ft BGS rather than at approximately 18 ft BGS as shown on the exploration log. Given that exceedances of the soil PCLs for arsenic (4 of 22 samples) and cPAHs (2 of 15 samples) have been sporadic during pre-RI investigations, locations J-FA-101 and J-FA-102 are included as uncertain (question marks) in the outlined area on Figure 20 based on the presence of construction debris at these locations.

As discussed above in Section 7.1.1.5, approximately 470 yd^3 of arsenic-affected crushed rock was removed from the area of the esplanade along the shoreline in Area I and was placed in the eastern portion of Area J-3 as shown in Figure 20. Analytical results for samples collected from the crushed rock identified arsenic at concentrations of up to 126 mg/kg. The crushed rock was placed away from the planned utility alignment for the new Craftsman District development at a depth of approximately 6 ft BGS, at the approximate location shown on Figure 20.

7.1.1.7 Shallow Soil Area M

Shallow soil (0 to 1 ft below the base course or approximately 0 to 2 ft BGS as indicated below) contains detections of arsenic at concentrations greater than the screening level (33 mg/kg to 76 mg/kg) in the following three areas:

- The northern portion of Area M in the Dunlap paved storage yard to the north of the Ameron sublease building along West Marine View Drive (M-GC-107a; 0.5 to 1.5 ft BGS)
- East of the Ameron sublease building in the paved access road/parking area [M-GC-102 (1 to 2 ft BGS), M-GC-102a (0.5 to 1.5 ft BGS), M-GC-102b (0.5 to 1.5 ft BGS), and M-GC-102d (1 to 2 ft BGS)
- Near the southeastern corner of the former Collins Building (M-FA-102b; 0 to 1 ft BGS).

With the exception of soil to the east of the Ameron sublease building, exceedances for arsenic in shallow soil in Area M appear to be isolated occurrences. Soil samples were collected from three locations in the Dunlap storage yard (M-GA-100, M-GC-107, and M-GC-107a) and arsenic was detected at a concentration greater than the screening level in only one of these samples (33 mg/kg at M-GC-107a).

Another isolated hit of arsenic occurred near the southeast corner of the former Collins Building. At this location, arsenic was detected in one shallow soil sample (M-FA-102b) at a concentration greater than the screening level (35 mg/kg). A statistical evaluation was completed to determine compliance with the screening levels for arsenic in the potential exposure area, which is defined as the southern portion of Area M, as shown on Figure G-1 in Appendix G. The data set included results for 23 surface and subsurface soil samples collected from the southern portion of Area M. Sample collected from sample locations M-FA-102, M-FA-102h, M-FA-102i, and M-FA-102l were excluded from the evaluation because black sand-sized material was observed in this area, and the area has been designated as a cleanup action area (see Section 10.0). Based on the statistical evaluation, arsenic concentrations remaining in soil within the southern portion of Area M (including M-FA-102b) comply with the screening level for arsenic. Documentation of the statistical evaluation, including a figure showing the exposure area, the samples included in the evaluation, and the cleanup action area, is presented in Appendix G.

Lead is present at a concentration greater than the screening level in shallow soil (0 to 1 ft below the base course, or 1 to 2 ft BGS) at one location in the southeastern portion of Area M (M-FA-103). No evidence of contamination was observed at these locations during field screening. All metals PCL exceedances occurred in General Fill, and no exceedances were detected in samples collected from hydraulic fill with the exception of M-FA-102b, which was collected from beneath the former Collins Building where hydraulic fill was present at the ground surface. Metals were not detected at concentrations greater than the screening levels in the 1 to 2 ft samples at these locations. In addition, these areas are bounded by explorations in the same area and at similar depth that had no exceedances. A statistical evaluation was completed to determine compliance with the screening levels for lead in surface and subsurface soil in the exposure area defined as the southern portion of Area M (see Figure G-2 in Appendix G). The data set included results for surface and subsurface soil samples collected from the southern portion of Area M, excluding samples where black sand-sized material was observed (M-FA-102, M-FA-102h, M-FA-102i, and M-FA-102l). As described above and in Section 10.0, the area of M-FA-102, M-FA-102h, M-FA-102i, and M-FA-102l has been designated as a cleanup action area. Based on the statistical evaluation, lead concentrations remaining in soil in the southern portion of Area M (including M-FA-103) comply with the screening level for lead when samples containing black sand-sized material are excluded from the analysis. Documentation of the statistical evaluation, including a figure showing the exposure area, the samples included in the evaluation, and the cleanup action area, is presented in Appendix G.

cPAHs are present in soil remaining at concentrations exceeding the screening level at one location (M1-S1) along the northern sidewall of Interim Action Area M-1. The detected concentration of cPAHs at this location is 1 mg/kg. The extent of contamination was bounded in all directions by previous investigations as shown on Figure 16 and this exceedance appears to be an isolated occurrence.

Petroleum hydrocarbons (by EPA Method 418.1) were detected at a concentration greater than the screening level in one surface soil sample (ECI-B-1) collected in 1992 from along the west side of the Ameron sublease building as described in Section 2.2.2.1. ECI (1992) describes the area of affected soil as being very limited. This area has since been developed by Ameron into paved holding bins for concrete slurry waste. RI boring G-FA-113 was advanced as close as practicable to the west and downgradient of ECI-B-1. Evidence of petroleum hydrocarbons was not observed during field screening and petroleum hydrocarbons were not detected in the groundwater sample from this location at concentrations greater than the laboratory reporting limit. This area appears to be very limited in extent based on sampling data and observations made by ECI at the time of the 1992 sampling, as well as the soil and groundwater data collected down gradient during this RI.

Based on the limited vertical extent of contamination, screening level exceedances in shallow soil in Area M may likely be attributable to limited releases associated with activities that occurred prior to Site paving, or possibly to impacted fill material placed for trafficking surfaces.

7.1.1.8 South of Former Collins Building

Heavy metals (arsenic and lead) and cPAHs were detected at concentrations greater than the screening levels at four locations south of the former Collins Building (M-FA-102, M-FA-102h, M-FA-102i, and M-FA-102l). Butyl benzyl phthalate was also detected above its screening level at location M-FA-102. Blue-black sand (apparent sandblast media) and brick fragments were observed at M-FA-102 (7 to 8 ft BGS) and M-FA-102i (6 to 8.5 ft BGS), and apparent sand blast media was observed at M-FA-102l (7 to 8.5 ft BGS). Although evidence of black sand-sized material was not observed during field screening at location M-FA-102h, brick fragments were observed at a depth of approximately 5 ft BGS and no recovery was obtained from 6 to 8 ft BGS at this location. Hydraulic fill was observed at a depth of 8.5 ft BGS at M-FA-102, M-FA-102i, and M-FA-102l, and at a depth of 10.5 ft BGS at M-FA-102h. Chemical constituents were not detected at concentrations greater than the screening levels in the hydraulic fill at M-FA-102, M-FA-102i, or M-FA-102l.

Impacted soil has not been bounded by chemical testing to the south. However, the filling history presented in the Pinnacle GeoSciences historical report (see Figure 4 in the Historical Report – Appendix A) clearly shows that the area to the south and east of the M-FA-102 area was filled in advance of the M-FA-102 area. The figure also documents that a distinct physical separation (probably a bulkhead) was present between the areas prior to the filling of the M-FA-102 area. In addition, aerial photographs indicate that the southern portion of area M was filled and the road to the south of area M (13th Street) was installed between 1947 and 1953. The road was elevated above the ground surface to the north. Three soil borings were advanced along the south side of 13th Street during the 2005 Data Gaps Investigation for the North Marina Redevelopment Site. Exploration logs indicate that the borings were completed to 8 ft BGS and that evidence of contamination (i.e., sand blast material or debris) was not observed. Soil samples from these borings were analyzed for metals and cPAHs. cPAHs were not detected at concentrations greater than the screening levels. Arsenic was detected at a maximum concentration of 270 mg/kg in a sample collected from one sample (L-GC-4b) at a depth of 1.7 to 2.2 ft BGS. Arsenic was not detected in the sample from 2.7 to 3.7 ft BGS at this location. No samples were analyzed from below 3.7 ft BGS (Landau Associates 2005a).

7.1.2 GROUNDWATER

Groundwater quality is evaluated on a Site-wide basis and also at the point of groundwater discharge to the 12th Street Yacht Basin. Only analytical results for samples collected during the RI (post-interim action) were used in the evaluation because these are representative of current Site conditions. As discussed below, groundwater concentrations of several chemicals were detected above the screening level at the Site. However, it is noted that the groundwater detections above the screening level either were not repeated in subsequent samplings, were due to turbidity in grab samples from direct-push borings, are a typical laboratory contaminant, or may be due to natural Site conditions. Discussion of the detections is provided below.

7.1.2.1 Site Wide

As discussed in Section 6.3, dissolved arsenic, dissolved copper, dissolved lead, dissolved mercury, diesel- and oil-range petroleum hydrocarbons, 1,1-DCE, and BEHP were detected in one or more groundwater samples at a concentration greater than the screening levels during the RI. As discussed in Section 6.5.1, analytical results for dissolved mercury and dissolved lead from the first round of groundwater sampling are considered anomalous and lead and mercury are not considered groundwater IHS for the Site.

Diesel- and oil-range petroleum hydrocarbons were detected in the initial round of groundwater sampling, but were not detected at concentrations greater than the screening levels at location MW-4 (as measured in February 2011 and October 2011) or MW-6 (as measured in October 2011). Based on this, the elevated concentrations identified during the initial round of groundwater sampling do not appear to be representative of groundwater quality. However,additional groundwater monitoring will be needed to confirm this so diesel- and oil-range petroleum hydrocarbons are carried forward as groundwater IHS to be addressed in the FS.

A concentration of 1,1-DCE greater than the screening level was detected in the sample collected from ECI-MW-3 during the initial sampling event, but was not detected at a concentration greater than the laboratory reporting limit in the sample collected from this well during the October 2011 sampling event. 1,1-DCE also was not detected in the original 1991 sampling conducted following the well installation. Although it appears that the 1,1-DCE screening level exceedance from the first round of sampling was anomalous based on the groundwater sampling results conducted prior to and after the initial RI, sufficient groundwater monitoring has not been conducted to verify this conclusion. As a result, 1,1-DCE is carried forward as a groundwater IHS for the Site and will be addressed in the FS.

BEHP was detected at concentrations greater than the screening level in two of three samples collected from monitoring well RI-MW-3 during the RI. BEHP was also detected in groundwater at a concentration greater than the screening level in pre-RI sample G-FA-7, which is located upgradient from monitoring well RI-MW-7 (BEHP was not tested for in the groundwater sample collected from RI-MW-7). Although these exceedances of the BEHP groundwater screening level are suspected to be the result of lab contamination, sufficient groundwater quality data have not been collected to confirm this conclusion. As a result, BEHP will be carried forward as an IHS to be addressed in the FS.

Dissolved arsenic is the only constituent with confirmed multiple exceedances of the groundwater screening levels. Detected concentrations of arsenic in groundwater are shown on Figure 19. As discussed in Section 6.5.1, dissolved arsenic concentrations detected in groundwater may be influenced by reducing conditions in groundwater. This conclusion is supported by:

- The inconsistent correlation between locations exhibiting high concentrations of arsenic in soil with corresponding high concentrations in groundwater. However, it is noted that the majority of dissolved arsenic exceedances above the screening level in groundwater occurred in the northern half of the Site, which exhibited most of the arsenic exceedances in soil.
- The wide-spread distribution of organic material, including wood debris, in the shallow aquifer matrix, which typically causes reducing conditions in groundwater (see Section 6.1.1.4).
- The presence of reducing conditions (low to negative ORP values) throughout much of the shallow aquifer.

Based on the considerations above, dissolved arsenic in groundwater is considered an IHS for Site groundwater.

Detected concentrations of dissolved copper in groundwater are shown on Figures 17 and 18. As discussed in Section 6.5.1, dissolved copper in established monitoring wells only exceeded its screening level during the initial round of groundwater monitoring. Copper is carried forward as a groundwater IHS for the Site to confirm that concentrations are below the screening level.

7.1.2.2 Point of Groundwater Discharge to Port Gardner and 12th Street Yacht Basin

Groundwater quality was evaluated at the proposed conditional point of compliance for Site groundwater, (the point of groundwater discharge to surface water in the 12th Street Yacht Basin). As indicated in Table 13, dissolved mercury, dissolved copper, and BEHP are the only constituents that were detected in the shoreline monitoring wells (RI-MW-1 through RI-MW-3) at concentrations greater than the screening levels, and BEHP is the only constituent that was detected at concentrations greater than its screening level in more than one sampling event (February 2011 and October 2011).

As discussed in Section 6.5.1.1, analytical results for dissolved mercury from the first sampling event are considered anomalous. Mercury is not considered a groundwater IHS for the Site. As discussed previously, BEHP was detected at concentrations greater than its screening level at one location (RI-MW-3) during two sampling events. Although it is suspected that BEHP is present as the result of lab contamination, BEHP will be carried forward as an IHS to be addressed in the FS.

Dissolved copper was detected in shoreline well RI-MW-1 at a concentration of 4.35µg/L, which is slightly greater than the screening level (3.1 µg/L), during the December 2010 round of sampling, and at a concentration of 2.9 µg/L, which is below the screening level, during the October 2011 round of sampling. In both cases, the detected concentrations are less than the concentration of dissolved copper detected in the surface water sample collected from the 12th Street Yacht Basin in the vicinity of RI-MW-1 (7 µg/L), which indicates that there is a potential for surface water quality to affect groundwater quality at the Site. As discussed in Section 6.5.1.1, elevated concentrations of metals are often detected in newly installed or recently developed monitoring wells during initial groundwater monitoring events because of elevated turbidity prior to the aquifer matrix having an opportunity to stabilize. Therefore, copper is carried forward as a groundwater IHS for the Site and will be addressed in the FS.

It is also important to note that significant hydrodynamic dispersion occurs between groundwater at the location where it is monitored in vertical monitoring wells as close as practicable to the shoreline and the actual point of groundwater discharge to surface water. At the nearby North Marina West End site, it was determined that the estimated concentration of contaminants at the point of discharge to surface water was 25 times less than the concentration measured in the vertical shoreline well (Ecology 2011). Given that the highest concentration of dissolved copper measured in RI-MW-1 was less than 2 times the screening level and the highest concentration of BEHP measured in RI-MW-3 was about 3 times the screening level, it is reasonable to conclude that, even if the maximum concentrations of dissolved copper and BEHP detected during the RI in the shoreline wells were confirmed, the concentrations at the point of discharge to surface water would be significantly below the screening levels.

These considerations and evaluations support the conclusion that, although Site soil contamination likely had an impact on groundwater quality, the impact for contaminants, other than arsenic, is limited and very local. Any future soil cleanup will only serve to further improve groundwater quality.

7.1.3 STORMWATER SYSTEM SOLIDS

Stormwater system solids are not an affected media regulated under MTCA. However, stormwater system solids have the potential to be released to marine surface water and sediment and as such, were evaluated and considered for potential source control. Analytical results for stormwater system solids indicate that a number of constituents (i.e., heavy metals, PAHs, PCBs, phthalates, TPH, and dioxins/furans) are generally present in stormwater solids within the trunk line and in catch basins along the trunk line at concentrations that would be of concern if discharged to surface water or marine sediment.

None of the constituents present in storm system solids were detected in sediment in the 12th Street Yacht Basin, including samples collected in the vicinity of the outfall, at concentrations above the SQS or CSL values, indicating that upland sources, including stormwater solids, have not impacted sediment quality since the 12th Street Yacht Basin was dredged in 2006. Pre-dredging sediment investigations in the 12th Street Yacht Basin (including the portion of the 12th Street Yacht Basin located south of the Site boundary) found sediment SMS exceedances, although not widespread, of heavy metals, phthalates, and TPH, and slightly elevated concentrations of dioxins/furans.

Because of the potential for stormwater solids to be discharged to surface water and marine sediment, and the potential for the existing trunk line to act as a conduit for release of affected soil or groundwater due to its poor condition, the Port is undertaking a MTCA emergency action to clean out and repair the trunk line. The emergency action plan was presented in a technical memorandum (Landau Associates 2012), and Ecology approved the emergency action in a September 19, 2012 email (Ecology 2012) based on review of the interim action plan. The emergency action is currently underway. Accumulated solids have been removed from the trunk line by jetting, to the extent possible. The Port evaluated the feasibility of slip-lining the trunk line with cured-in-place pipe (CIPP) and determined that this is not a feasible option because of the poor condition of the trunk line. The portion of the trunk-line located west of SD-7 will be decommissioned and bypassed with a parallel replacement line to the north of the existing line through an emergency action. This portion of the trunk line replacement will not be considered an element of the final cleanup action and, consequently, is not addressed in the FS. In contrast, the remaining portion of the trunk line located east of SD-7 runs through contaminated soil, so this portion of the trunk line will be removed and replaced as part of the final cleanup action and is addressed in the FS.

7.1.4 MARINE SEDIMENT

Marine Site sediment did not exceed SMS cleanup standards. As a result, marine sediment is not considered an affected media for the Site.

8.0 CONCEPTUAL SITE MODEL

The conceptual Site model (CSM) was developed based on historic land use, environmental data, and the contaminant fate and transport processes that control the migration of contaminants in the natural environment. A schematic representation of the Site CSM is presented on Figure 23, and the following sections discuss the factors affecting the CSM, including contaminants and sources present at the Site, the nature and extent of contamination, and exposure pathways and receptors.

8.1 CONTAMINANTS AND SOURCES

RI data were evaluated to identify IHS for the Site based on post-interim action conditions. The data used for the evaluation is summarized in Tables 16 and 17, which includes the analytical testing, the number of detections, and the number of samples that exceeded the screening levels. The tables also summarize the constituent frequency of detection, minimum and maximum detected concentrations and reporting limits, and analytes identified as IHS for the RI. IHS identified for Site soil based on the RI results include cPAHs, antimony, arsenic, copper and lead, and gasoline- and diesel-range petroleum hydrocarbons. IHS identified for Site groundwater include dissolved copper, dissolved arsenic, diesel- and oil-range petroleum hydrocarbons, 1,1-DCE, and BEHP.

The primary potential contaminant sources identified for contamination remaining at the Site include: 1) releases from former industrial activities, 2) contaminated fill material, and 3) releases from adjacent industrial operations. Areas where these potential contaminant sources existed and the contaminants associated with each source are described below. It should be noted, however, that many of these potential contaminant sources no longer exist at the Site, either because the activities that may have resulted in a release or spill have ceased or the release (e.g., contaminated soil) has been removed by interim actions conducted at the Site (described in Section 3.2).

- **Commercial/Industrial Releases.** Property owners and their tenants and subtenants conducted a variety of commercial and/or industrial activities at the Site. These activities, and the wastes resulting from these activities (previously discussed in Section 2.2), have released heavy metals, petroleum, and cPAHs to Site media of concern including the stormwater system. Note that the main stormwater trunk line is in poor condition and leaks because it has holes. These holes could provide a conduit for contaminated soil or groundwater from the Site, and the adjacent TC Systems Site to the north (which also drains to the trunk line), to enter the trunk line and discharge to marine surface water in the 12th Street Yacht Basin. As discussed previously in Section 7.1.3, an emergency action has been undertaken to clean out and replace the western portion of the trunk line. Replacement of the eastern portion of the trunk line will be completed as part of the final cleanup action.
- **Fill Material.** Soil containing wood debris and other construction debris (e.g., brick) are described in boring logs as fill material in the northern portion of Area J. In addition, arsenic-affected crushed base course is contained beneath the esplanade along the western boundary of Area I and also in Area J-3. Contaminated fill containing wood debris, black sand, and/or construction debris has also been identified around the storm drain trunk line backfill at the

north boundary of Area G, in the northeaster portion of Area J, and to the south of the former Collins Building in Area M.

- **Adjacent Industrial Releases**. Industrial operations to the north of the Site, such as TC Systems, may have released hazardous substances to soil, groundwater, or the stormwater system. Hazardous substances may have migrated onto the Site via groundwater or may have entered the shared stormwater trunk line and contaminated stormwater sediment, or been released to soil and groundwater in the vicinity of the trunk line.

As described in Section 6.4.1.2, the arsenic groundwater concentrations at the Site may be influenced by wood debris and other organic content present in Site fill (including the hydraulic fill). In addition, surface water quality in the vicinity of the shoreline (i.e., copper) has the potential to affect groundwater quality at the Site in the shoreline vicinity.

8.2 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS.

The impacted media at the Site are soil and groundwater, with Site stormwater solids considered a potential source control issue. As discussed in Section 5.2, potential receptors of Site contaminants are humans and aquatic organisms. The potential human health exposure pathways for Site soil are incidental ingestion and dermal contact with constituents in Site soil, and exposure through inhalation of soil contaminants (as particulates) that have migrated to air as windblown or fugitive dust.

Because Site groundwater is not considered a potential source of drinking water, the only potential for groundwater to impact human health and the environment is future migration of contaminants in groundwater to surface water and direct contact with shallow groundwater during construction activities. Potential receptors for the groundwater to surface water migration pathway include benthic organisms present in sediment affected by Site groundwater and humans who may ingest contaminated fish and benthic organisms.

9.0 DISCUSSION OF CLEANUP STANDARDS

This section develops proposed soil and groundwater cleanup standards for the Site. The proposed soil and groundwater cleanup standards are based on the screening levels developed in Section 5.0, but are only developed for those media and those hazardous substances that exceeded the screening levels in data collected for the RI and determined to be Site IHS. Cleanup standards for sediment are not developed since marine sediment is not considered an affected media for the Site.

9.1 CLEANUP STANDARDS

This section discusses Site cleanup standards for chemical constituents that were determined to be IHS for the Site, as presented in Section 8.1. Affected media consist of soil and groundwater. Cleanup standards consist of: 1) preliminary cleanup levels (PCLs) defined by regulatory criteria that are adequately protective of human health and the environment, and 2) the point of compliance at which the cleanup levels must be met. The proposed cleanup standards developed in this section are used as the basis for developing media-specific remedial action objectives (RAOs) for the cleanup action in the FS (Section 10).

9.1.1 PROPOSED CLEANUP STANDARDS FOR GROUNDWATER

This section develops proposed cleanup standards for groundwater at the Site. Final cleanup standards for groundwater will be selected by Ecology and presented in the Site CAP.

9.1.1.1 Proposed Groundwater Cleanup Levels

The cleanup levels proposed for groundwater and presented in this section will be used to develop, and evaluate the effectiveness of, cleanup action alternatives for the FS. Cleanup levels for groundwater developed under MTCA represent the concentration of IHS that are protective of human health and the environment for identified potential exposure pathways, based on the highest beneficial use (HBU) and the reasonable maximum exposure (RME) for each affected media. The process for developing cleanup levels consists of identifying the HBU and RME for affected media, determining those that represent the greatest risk to human health or the environment, and determining the cleanup levels for the IHS in affected media, as described in Section 5.0.

As discussed in Section 8.1, IHS for Site groundwater are dissolved arsenic, dissolved copper, diesel- and oil-range petroleum hydrocarbons, 1,1-DCE, and BEHP. Proposed cleanup levels for Site groundwater IHS are presented in Table 18. Final cleanup standards for groundwater will be selected by Ecology and presented in the Site CAP.

9.1.1.2 Proposed Groundwater Point of Compliance

Under MTCA, the point of compliance is the point or location on the Site where the cleanup levels must be attained.

The point of compliance for groundwater is typically throughout the Site when groundwater is considered a potential source of potable drinking water. If groundwater discharge to surface water represents the highest beneficial use, MTCA provides for a conditional point of compliance at the point of discharge of groundwater to the surface water receiving body. It is proposed that the downgradient edge of the Site, as close as technically possible to the point of entry of groundwater to surface water at the 12th Street Yacht Basin, will be the conditional point of compliance for Site groundwater. The achievement of groundwater cleanup levels will be measured at the conditional point of compliance using the existing network of groundwater monitoring wells located along the shoreline. Compliance monitoring is discussed further in the FS portion of this document.

9.1.2 PROPOSED CLEANUP STANDARDS FOR SOIL

This section develops proposed cleanup standards for soil at the Site. Final cleanup standards for soil will be selected by Ecology and presented in the Site CAP.

9.1.2.1 Development of Proposed Soil Cleanup Levels

Proposed cleanup levels for soil were developed for hazardous substances determined to be Site IHS in Section 8.1. The proposed cleanup levels for soil were developed to be protective of the potential human receptors at the Site. Because the Site is currently mostly covered with buildings and pavement, and will be following redevelopment, the Site meets the exclusion for a terrestrial ecological evaluation. Soil proposed cleanup levels protective of human health were developed using applicable human health risk assessment procedures specified in WAC 173-340-708. These procedures include development of proposed cleanup levels based on the reasonable maximum exposure to occur at the Site, as described in Section 5.0.

As discussed in Section 8.1, IHS for Site soil are antimony, arsenic, lead, and cPAHs, and gasoline- and diesel-range petroleum. Proposed cleanup levels for Site soil IHS are presented in Table 18.

9.1.2.2 Soil Point of Compliance

The point of compliance for soil in WAC 173-340-740(6) is throughout the site if based on protection of groundwater or to a maximum depth of 15 ft BGS if based on direct contact. MTCA recognizes that for those cleanup actions that involve containment of hazardous substances, the soil cleanup levels will typically not be met throughout the site [WAC 173-340-740(6)(f)]. However, such cleanup actions are considered to comply with cleanup standards if the remedy: 1) is permanent to the maximum extent practicable, 2) is protective of human health, 3) is protective of terrestrial ecological receptors, 4) includes institutional controls to protect the long-term integrity of the containment system, and 5) includes compliance monitoring and periodic reviews to ensure the long-term integrity of the containment system. Any remedial alternatives that include containment as part of the remedy will be evaluated against these criteria in the FS.

10.0 FEASIBILITY STUDY

The purpose of the FS is to develop and evaluate cleanup action alternatives to enable an appropriate cleanup action to be selected for the Site. Specifically, the FS:

- Develops and evaluates cleanup action alternatives that protect human health and the environment
- Presents a preferred cleanup action alternative.

This section presents the information collected and the evaluations conducted to achieve this purpose. The FS is organized into the following sections:

- Section 10.1 identifies remedial action objectives (RAOs) and potentially applicable laws
- Section 10.2 presents a summary of the screening of remedial technologies considered for the FS
- Section 10.3 describes the remedial alternatives
- Section 10.4 describes the evaluation criteria
- Section 10.5 evaluates the remedial alternatives
- Section 10.6 presents the disproportionate cost analysis (DCA)
- Section 10.7 presents the summary and conclusions, including a description of the preferred alternative.

10.1 CLEANUP AREA IDENTIFICATION

Cleanup Action Areas were defined based on areas where proposed soil cleanup levels are exceeded, as shown on Figure 24. Cleanup Areas were labeled consistent with the previous interim action. Each cleanup area is designated by the investigation area label (e.g., G, I, J) followed by a sequential number within each investigation area (e.g., 1, 2, 3, etc.). Cleanup Areas that are an extension of a previous Cleanup Area have a sequential letter appended to the number (e.g., M-1a). The numbers for new cleanup areas are sequential to the numbers used during the interim action to avoid any confusion created by duplicate Cleanup Area designations (e.g., the first Cleanup Area identified in Area I is I-12).

As shown on Figure 24, there are a total of 13 new cleanup areas identified, including:

- Three in Area G (two new areas, one extension of a previous cleanup area)
- Four in Area I (two new and two expansions of previous areas)
- One in area J (an expansion of Cleanup Area J-3)
- Five in Area M (four new and one expansion of a previous area).

Areas I-5a, I-5-b, M-1a, M-4 and M-5 are isolated cleanup areas resulting from a single proposed cleanup level exceedance. Each of these exceedances is bounded by soil sampling locations exhibiting concentrations below the proposed cleanup levels. At all of these locations, either an insufficient number of relevant data are present in the sample vicinity or the concentration is too high (more than twice the cleanup level) to use the provisions of WAC 173-340-740(7) to demonstrate compliance with the cleanup levels. As a result, these locations are identified as isolated cleanup areas for the purposes of the FS, but are not considered of sufficient mass to pose a significant threat to human health or the environment. These areas will utilize caps consisting of Site buildings and paving to protect against direct contact exposure and leaching to groundwater, except under Alternative 1, as described below. Institutional controls will be used to ensure that the capping and containment remain functional and protective.

10.2 INTEGRATION OF SITE CLEANUP WITH FUTURE SITE DEVELOPMENT

As discussed in Section 5.1, the Site is contained within the Port's Craftsman District, which is focused on marine-based services such as boat haul-out and storage, boat maintenance, boating supplies and services, and other marina-oriented services to boaters. The Craftsman District also includes the Port's administrative offices, a restaurant, and other businesses. The recently updated Craftsman District development strategy is illustrated on Figure 25. Although the specific locations of some features could change, the nature of Site use in the Craftsman District will not change.

The Cleanup Areas are also shown on Figure 25 to illustrate the relationship of the Cleanup Areas to the anticipated long-term Site use features. As the figure illustrates, Cleanup Areas fall in parking lots or work areas, or outside the areas planned for active use. As such, Site cleanup, for whatever cleanup technology is selected, does not conflict with Site use under current or anticipated future development scenarios in any of the Cleanup Areas.

10.3 REMEDIAL ACTION OBJECTIVES AND POTENTIALLY APPLICABLE LAWS

RAOs define the goals of the cleanup that must be achieved to adequately protect human health and the environment. RAOs must address all affected media, and a cleanup alternative must achieve all RAOs to be considered a viable cleanup action. RAOs can be either action-specific or media-specific. Action-specific RAOs are not intended to achieve specific chemical criteria. Media-specific RAOs incorporate the proposed cleanup levels (proposed CULs) developed in Section 5.3. Based on the CSM presented in Section 8.0 and the cleanup standards developed in Section 9.0, the action-specific and media-specific RAOs identified for the Site consist of:

- **RAO-1**: Prevent or limit direct human contact with soil containing hazardous substances at concentrations above the direct contact soil CUL.

- **RAO-2**: Prevent contaminated soil containing concentrations of COCs above soil CULs from becoming airborne or waterborne and impacting surface water or sediment (via dust or runoff).
- **RAO-3**: Confirm that groundwater COCs are not discharging to surface water at concentrations that could adversely affect aquatic organisms.
- **RAO-4**: Prevent or limit direct human contact with shallow groundwater containing hazardous substances at concentrations above the CUL.

Each of these RAOs can be achieved through removal or treatment of the contaminated soil, or by preventing exposure to the contaminated soil through containment and institutional controls in conjunction with groundwater compliance monitoring. Each of the cleanup action alternatives described in Section 10.3 achieve the above RAOs and meet all of the MTCA threshold requirements (described in Section 10.4.1); each alternative is, therefore, reasonable for initial consideration as a cleanup alternative under MTCA. The degree to which each cleanup action alternative meets the threshold requirements and other requirements listed in WAC 173-340-360(2) will be determined by applying the specific evaluation criteria identified in MTCA (see Section 10.4).

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 applicable or relevant and appropriate requirements (ARARs). The starting point for ARARs is the MTCA CULs and regulations that address implementation of a cleanup under MTCA (Chapter 173.105D RCW; Chapter 173-340 WAC). Other potential ARARs include the following:

- Washington State SMS (Chapter 173-204 WAC)
- EPA National Recommended Water Quality Criteria – Section 304 Clean Water Act
- EPA Water Quality Standards (National Toxics Rule) – 40 CFR 131
- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 RCW).
- Washington Water Pollution Control Act (Chapter 90.48 RCW) and the implementing regulations, Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC)
- Washington Hazardous Waste Management Act and the implementing regulations, Dangerous Waste Regulations (Chapter 173-303 WAC) and the federal Resource Conservation and Recovery Act [RCRA; 40 CFR 261), to the extent that any dangerous wastes are discovered or generated during the cleanup action
- The federal Clean Water Act, with respect to in-water work associated with dredging or sediment capping
- Washington's Shoreline Management Act, with respect to construction activities conducted near the shoreline during the cleanup action

- Endangered Species Act, due to the listing of Puget Sound chinook, coastal/Puget Sound bull trout, and certain species of rockfish.
- Washington Clean Air Act (Chapter 70.94 WAC)
- Occupational Safety and Health Act (OSHA), 29 CFR Subpart 1910.120
- Washington Industrial Safety and Health Act (WISHA).

10.4 SCREENING OF REMEDIAL TECHNOLOGIES

The purpose of the FS is to develop and evaluate cleanup action alternatives to enable an appropriate cleanup action to be selected for the Site. Cleanup action alternatives are an assemblage of one or more cleanup activities that, taken as a whole, will achieve all the RAOs for the Site. This section discusses the breadth of remedial technologies considered for implementation and identifies the remedial technologies that are carried forward for development of the cleanup action alternatives in Section 10.3.

10.4.1 REMEDIAL TECHNOLOGY SCREENING

The following remedial technologies or response actions were screened for consideration in development of cleanup action alternatives for the Site and were compared to the applicable RAOs.

10.4.1.1 Capping/Containment

Capping and containment prevents or limits potential human exposure to contaminated soil and migration of soil via erosion or mechanical disturbance by covering contaminated soil with a physical barrier. The use of pavement and buildings for capping also minimizes the potential for airborne or waterborne dust transport to the waterway. Capping would also limit the potential for infiltration through affected soil and minimize groundwater discharge to surface water.

Capping and containment would be achieved by maintaining existing pavement and buildings as cover over the areas of contaminated soil, and by placing new pavement as part of the cleanup action for future redevelopment.

Capping and containment would achieve all four RAOs. To ensure that the RAOs continue to be met, this technology would be paired with institutional controls (see Section 10.2.1.2 below). Because most of the Site is currently developed and covered in paved parking lots, roadways, and buildings, or is planned for redevelopment with additional impermeable surfaces, this is a practical alternative and is carried forward for further evaluation in Section 10.3.

10.4.1.2 Institutional Controls

Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action that may result in exposure to hazardous substances. Institutional controls may include physical measures, such as fences, documented use restrictions such as deed restrictions or restrictive covenants, maintenance requirements, or educational programs. For this Site, institutional controls would include restrictive covenants limiting activities that could lead to potential human contact with hazardous substances, and, if paired with capping/containment, would include requirements for inspections and maintenance of the cap to achieve RAO-1, RAO-2, and RAO-4, and maintain compliance with RAO-3. Use of institutional controls is carried forward for additional evaluation in Section 10.3 as it would likely be paired with capping and containment to provide additional assurance that a capping and containment alternative remains viable in the long term.

10.4.1.3 Excavation/Disposal

Excavation and offsite disposal of contaminated soil is a permanent solution for the Site. Excavation could achieve all RAOs at the Site. Multiple Site buildings and Site infrastructure limit the practicability of complete removal of contaminated soil. The presence of shallow groundwater is also a complicating factor when considering complete soil removal. Because excavation has the potential to permanently address all the RAOs, it is carried forward for additional evaluation in Section 10.3.

10.4.1.4 Stabilization

Stabilization technology is a process that reduces the leachability (by decreasing solubility or mobility) or toxicity of a hazardous substance through chemical processes to prevent migration of contaminants and/or exposure to contaminants in a given medium. Stabilization can be performed *in situ* to prevent leaching to groundwater or to reduce direct contact risks for human or terrestrial ecological receptors, or *ex situ* to treat a waste so that it can be disposed of as a non-hazardous waste (i.e., so that it passes TCLP testing). Stabilization of metal-contaminated soil can be accomplished through addition of agents such as phosphate or activated carbon that bind or complex the contaminants in the soil and prevent leaching, or addition of products such as cement, cement kiln dust, fly ash, and lime that change the pH of the soil and consequently reduce leachability. Based on previous investigation and laboratory data, if contaminants are leaching from Site soil to groundwater it appears to be limited and localized. Additionally, if leaching is occurring it is not occurring at a rate that would result in the contaminated media being classified as a hazardous waste. During the RI, TCLP analysis was performed on the two soil samples exhibiting the highest detected concentrations of total arsenic and lead [G-FA-100(0-1) and G-FA-109 (0.5-1)]. Black sand-sized material was observed in both of these samples. Arsenic and lead were not detected at concentrations greater than the laboratory detection limits in sample G-FA-100 and were detected at concentrations of 0.443 mg/L and 0.222 mg/L for arsenic and lead, respectively, in sample G-FA-109. The detected concentrations are well below the dangerous waste criteria of 5.0 mg/L for arsenic and lead. Therefore, stabilization would provide no benefit at this Site and is not considered further in this FS.

10.4.1.5 Solidification

Solidification is similar to stabilization in that it is performed to reduce the mobility of a contaminant or risk of direct contact, but typically involves physical or chemical processes that encapsulate, entomb, or otherwise trap the contaminant in a solid medium. Examples of solidification include: 1) vitrification that uses an electric current, a direct-fired kiln, or other heat source to melt soil to immobilize and/or destroy organic contaminants or incorporate inorganic contaminants within the vitrified glass and crystalline mass, and 2) combining and incorporating contaminated soil or other earthen materials with asphalt or cement/concrete mixes. Solidification can be applied as either an *in situ* or *ex situ* technology; also, *in situ* applications can be limited by utilities and other structures that can limit access or can be damaged by the treatment process. Similar to stabilization, because leaching or other migration of contaminated media appears to be limited, solidification would provide no apparent benefit at the Site and is, therefore, not considered further in this FS.

10.4.1.6 Thermal Desorption

Thermal desorption was considered as a possible treatment technology for soil contaminated with organic compounds. However, the only organic contamination identified at the Site is a single exceedance of diesel-range petroleum hydrocarbon contamination (ECI-B-1) identified as a very localized area of soil contamination in 1992. Petroleum hydrocarbon contamination has been encountered near the Area G north Site boundary on the TC Systems site at location N-FA-103. In addition, petroleum contamination was encountered within fill during repair of the stormwater trunk line in this area in 2005. As such, although not encountered during the RI above screening levels, petroleum contamination could exist in localized areas within the Area G northern boundary. But, where detected above the screening levels near the Area G north Site boundary, TPH contamination has been associated with exceedances by other COCs that are not effectively treated by thermal desorption, such as heavy metals and cPAHs. Based on these considerations, thermal desorption is not considered an effective treatment technology for the Site and is not considered further in this FS.

10.4.1.7 Groundwater Extraction and Treatment

Groundwater extraction and treatment was considered as a potential treatment technology for addressing contaminated groundwater. Groundwater extraction and treatment is most commonly used to contain or prevent the further migration of groundwater contamination, often in combination with a groundwater cutoff wall or other physical containment that supplements groundwater extraction in maintaining containment and in minimizing the amount of groundwater that requires extraction and treatment.

Of the chemicals that exceeded groundwater screening levels at the Site, arsenic had the most exceedances (8 locations) which were concentrated in the Site’s northern half. Dissolved arsenic exceeded its screening level by more than 2 times at 3 locations (P-10, SEE-EC-3, and ECI-MW-3). Locations SEE-EC-3 and ECI-MW-3 had dissolved arsenic concentrations greater than 5 times the screening level. However, across the entire Site, only 3 locations out of 20 had arsenic concentrations that exceeded the screening level by 2 times. As such, the highest dissolved arsenic concentrations at the Site appear to be limited and localized. Based on this, groundwater contamination in this area, and elsewhere on the Site, is too localized and low in concentration to warrant use of groundwater extraction and treatment for Site cleanup. Additionally, wells with dissolved arsenic concentrations 2 times the screening level are over 250 ft from the shoreline where concentrations of dissolved arsenic at 3 shoreline wells are below the screening level. This indicates that groundwater treatment and extraction, or any other groundwater containment technology, is not needed to achieve groundwater cleanup standards. Based on these considerations, groundwater extraction and treatment is not considered an effective or necessary treatment technology for the Site and is not considered further in this FS.

10.4.1.8 Groundwater Compliance Monitoring

Groundwater compliance monitoring will be conducted to ensure that groundwater cleanup standards are achieved and maintained. It’s noted that most groundwater IHS were only detected above the PCLs during a single monitoring event; arsenic concentrations detected above its groundwater PCL are likely influenced in part by reducing conditions in groundwater, and groundwater at the proposed conditional point of compliance did not exceed any of the groundwater PCLs, except for two minor exceedances of BEHP in MW-3 (a typical laboratory contaminant), and a single exceedance of copper at MW-1. A sufficient number of rounds of groundwater compliance monitoring were not conducted during the RI to verify that all PCLs have been achieved at the proposed conditional point of compliance. As a result, additional rounds of groundwater compliance monitoring will be carried forward in Section 10.3.

10.5 DESCRIPTION OF REMEDIAL ALTERNATIVES

This section provides a detailed evaluation of the remedial technologies considered applicable at the Site and packages these technologies into four Site-wide remedial alternatives. The development of the remedial alternatives addresses the applicable RAOs, the type and magnitude of contamination in given areas, and any unique aspects of each identified area of contamination such as the proximity to building foundations, existing infrastructure, and/or existing surface features that currently act as a cap over contaminated soil. As indicated in Section 10.1, distinct areas where contamination is present that are addressed by the remedial alternatives have been given alphanumeric Cleanup Area designations based on the area of the Site where they are located, as identified on Figure 24. Note that the final remedy is considered to include the previous interim actions (see Section 3.2) in addition to the remedial alternative below that is ultimately selected. As a result, the interim action cleanup areas are also shown on the figures showing the remedial alternatives for the Site.

A description of these alternatives is presented below. Within each alternative is a discussion of the conceptual approach, how the alternative meets the RAOs, and a cost estimate for implementation of the alternative. All cost estimates presented in this FS are considered preliminary and are provided for the purposes of comparison between alternatives and identification of the order of magnitude of likely costs. A 30 percent contingency has been included in the estimate for each alternative. Cost estimates should not be considered as a bid or quote for services or as an engineers estimate. A more detailed breakdown of the cost estimates and associated assumptions for each alternative are provided in Appendix H. These cost estimates are intended solely for use as a basis for comparison of costs between alternatives and were prepared using general cost estimating techniques, rule-of-thumb estimates, and from experience with similar tasks, equipment, and materials. Costs do not include specific quotes from subcontractors, vendors, or suppliers and should not be considered a quote or bid for services. An updated cost estimate will be developed for the selected cleanup action during the design phase.

10.5.1 ALTERNATIVE 1: SITE-WIDE REMEDIAL EXCAVATION

Alternative 1 is the most permanent alternative that, to the degree practical, excavates and disposes of soil with contaminant concentrations above the cleanup standards from all areas of the Site where soil contamination is known to be present above the proposed CULs.

10.5.1.1 Remedial Excavation and Offsite Disposal

Excavation of contaminated soil would include the following twelve areas as shown on Figure 26:

- Isolated cleanup areas resulting from a single proposed cleanup level exceedance (Area I-5a, I5-b, M-1a, M-4, and M-5)

- Arsenic-affected crushed rock base-course fill beneath the waterfront concrete esplanade on the west side of Area I (Area I-12; existing containment area)
- Contaminated soil (arsenic and cPAHs), construction debris, and arsenic-affected crushed rock beneath asphalt paving in the area northeast of the Waterfront Center building at the north end of Area J (Area J-3a; existing containment area); this excavation would include removal of clean overburden from previously excavated areas)
- Arsenic-, antimony-, and lead-containing fill soil (identified as an angular black sand) beneath the partially gravel-paved, northwest portion of Area G, west of the Ameron Pole Polishing/Pole Finishing Building along the boundary between Area I and Area G (Area G-1b)
- Arsenic-containing fill soil beneath asphalt paving along the northern property line and around the trunk line at the north end of Area G (Area G-2
- Arsenic-containing fill soil in the former settling basins at the east end of the Ameron Pole Polishing Building in the west-central portion of Area G (Area G-3)
- Arsenic-containing soil immediately beneath asphalt paving east of the Ameron sublease building in the northern portion of Area M (Area M-3)
- Arsenic-, BBP-, lead-, and cPAH-containing fill soil in the southern end of Area M (Area M-2; M-FA-102 vicinity). This area is defined for the purposes of this FS by the historical alignment of 13th Street to the south, and by clean RI sampling locations to the north, east, and west.

The assumed lateral limits of each excavation (for cost estimating purposes) are shown on Figure 26. The depth of contamination in these various areas range from less than 1 ft to approximately 17 ft BGS. The excavation limits will be refined during the design-phase of the cleanup action and confirmed through compliance monitoring conducted during cleanup construction. For cost estimating purposes, it was assumed that the trunk line would be replaced between catch basins SD-5 and the point where the SD-8 lateral connects to the trunk line as part of the cleanup action in Area G-2. As previously indicated, the trunk line between the SD-8 lateral connection and CB110 is being replaced as part of an emergency action being conducted by the Port and will not be part of the final cleanup action. Therefore, costs associated with replacement of the trunk line to the west of the SD-8 lateral are not included. In addition, cleanup of Area G-1b is being proposed as part of an emergency action associated with replacement of the damaged SD-8/SD-9 storm drain lateral. Additional details regarding the emergency actions will be provided in the CAP.

Based on the assumed horizontal and vertical excavation limits, approximately 19,500 cubic yards (yd^3) of soil would be excavated as part of Alternative 1, including about 5,300 yd^3 of clean overburden soil. Alternative 1 would remove most soil above the PCLs, although some contaminated soil will remain beneath buildings if removal threatens the stability of the structure, in particular contaminated soil in the vicinity of the Waterfront Center building, which requires excavation beneath the awning at the north end of the building.

Paving materials would be segregated and transported to a construction debris disposal or recycling facility. Contaminated soil would be transported to a Subtitle D disposal facility (assuming none of the soil is designated as a dangerous waste). Clean structural fill would be placed and compacted in the excavation areas and the areas would be repaved to match existing conditions. For cost estimating purposes, it was assumed that approximately 170 soil confirmation samples would be collected during or after excavations for performance and compliance monitoring purposes.

The remedial excavation described above would achieve all of the RAOs except RAO-4. Excavation achieves RAO-1 and RAO-2 by removing soil with contaminant concentrations above human direct contact CULs, and helps insure that RAO-3 is achieved by minimizing stormwater infiltration through affected soil. Institutional controls would still be needed for RAO-4 to insure construction workers do not come into contact with contaminated shallow groundwater or any residual soil contamination, and to ensure that any extracted groundwater is properly managed.

10.5.1.2 Institutional Controls

Institutional controls would be used to ensure that construction workers do not come into contact with contaminated shallow groundwater or any residual soil if all contaminated soil cannot be removed from one or more of the cleanup areas. This would include documentation through a restrictive covenant to identify health and safety requirements for activities where contaminated soil or groundwater may be encountered, and the implementation of a soil and groundwater management plan (SGMP) that would specify the procedures for testing and management of soil and groundwater encountered during future intrusive activities. The SGMP would also address the required soil testing and management requirements for intrusive activities outside areas of known contamination. Implementing institutional controls would achieve RAO-4 by preventing or properly controlling and planning for human direct contact with contaminants in residual soil and groundwater with concentrations above human direct contact CULs.

10.5.1.3 Groundwater Compliance Monitoring

As discussed in Section 10.2.1.6, additional rounds of groundwater compliance monitoring will be collected to verify that all PCLs have been achieved at the proposed conditional point of compliance. As a result, groundwater compliance monitoring will be conducted to verify that groundwater cleanup standards are achieved and maintained.

For the purposes of this FS, groundwater compliance monitoring is assumed to consist of four rounds of groundwater quality monitoring for one year for selected constituents at locations where compliance with cleanup levels needs to be verified, and at all shoreline wells to verify that cleanup levels are being achieved at the conditional point of compliance for the Site. The following wells will be monitored for the constituents indicated:

- RI-MW-1 – dissolved arsenic, dissolved copper
- RI-MW-2 – dissolved arsenic, dissolved copper
- RI-MW-3 – dissolved arsenic, dissolved copper, BEHP
- RI-MW-4 – diesel- and oil-range petroleum hydrocarbons
- RI-MW-6 – dissolved arsenic, diesel- and oil-range petroleum hydrocarbons
- RI-MW-7 – BEHP
- P-10 – dissolved arsenic, dissolved copper
- SEE-EC-3 – dissolved arsenic
- ECI-MW-3 – dissolved arsenic, 1,1-DCE.

10.5.1.4 Estimated Cost and Schedule

The estimated cost to implement Alternative 1 is $5,500,000 as summarized in Table 19. The total estimated cost of Site remediation for Alternative 1, including the $2,000,000 previous interim action work (see Section 3.2), would be $7,500,000. It is anticipated that the design, permitting, excavation, and filling of the remedial excavations would take approximately 2 years to complete.

10.5.2 ALTERNATIVE 2: REMEDIAL EXCAVATION IN FUTURE REDEVELOPMENT AREAS AND CONTAINMENT

Alternative 2 includes the excavation and disposal of soil with contaminant concentrations above the proposed CULs from those areas of the Site that have not yet been redeveloped consistent with the Port's Master Plan. Although the Port is currently updating its master plan for the North Marina area, its current development strategy is consistent with the existing Port Master Plan that identifies the Site as part of the Craftsman District, as described in Section 10.2. This alternative leaves contaminated soil in place in areas of the Site that have recently been redeveloped or are not anticipated to undergo any future redevelopment. These areas will utilize existing caps consisting of Site buildings and paving to cap and contain soil contamination. Institutional controls will be used to ensure that the capping and containment remain functional and protective.

Under this alternative, soil with metals concentrations significantly greater than the PCLs would be left in place in two areas of the Site. Area I-13 is located in an area that has been redeveloped as part of the Craftsman District; contaminated soil was removed in this area (Interim Action Area G-1a), but soil removal was limited due to the presence of utilities serving the current Bayside Marina building to the north. Further excavation in this area is not practicable due to the presence of utilities. Area M-2 is also located in an area that has been redeveloped by the Port. Excavation of impacted material in this area would require removal of significant redevelopment improvements, utilities, and a significant quantity of clean overburden to access the contaminated soil, and would require dewatering and shoring.

10.5.2.1 Remedial Excavation and Offsite Disposal

As described above, excavation of contaminated soil would be performed only in those areas of the Site that have not yet been redeveloped by the Port (i.e., most of Area G, the northern portion of Area M, and the Norton Industries property north of Area I). These include the following five areas:

- Isolated cleanup areas resulting from a single proposed cleanup level exceedance (Areas I-5a, I-5b, M-1a, M-4, and M-5)
- Arsenic-, antimony-, and lead-containing fill soil (identified as angular black sand) in the northwest portion of Area G and west of the Ameron Pole Polishing/Pole Finishing Building along the boundary between Area I and Area G (Area G-1b).
- Arsenic-containing fill soil beneath asphalt paving along the northern property line and around the trunk line at the north end of Area G (Area G-2).
- Arsenic-contaminated soil in the former settling basins at the east end of the Ameron Pole Polishing Building in the west-central portion of Area G (Area G-3).
- Arsenic-contaminated soil beneath asphalt paving east of the Ameron sublease building in the northern portion of Area M (Area M-3).

The assumed lateral limits of each excavation (for cost estimating purposes) are shown on Figure 27. The depth of contamination ranges from less than 1 ft in fill beneath pavement east of the Ameron sublease building to as deep as approximately 10 ft BGS in the fill along the north property line in Area G. For cost estimating purposes, it was assumed that the trunk line would be replaced between catch basins SD-5 and the SD-8 lateral connection to the trunk-line as part of the cleanup action in Area G-2. The excavation limits will be refined during the design-phase of the cleanup action and confirmed through compliance monitoring conducted during cleanup construction.

Based on the assumed horizontal and vertical excavation limits shown on Figure 27, approximately 6,000 yd^3 of soil would be excavated. Similar to Alternative 1, overlying clean paving materials would be disposed of or recycled at a construction debris facility and contaminated soil would be disposed of at a Subtitle D disposal facility. Clean structural fill would be placed and compacted in the excavation areas and the area repaved with asphalt.

For cost estimating purposes, it was assumed that 90 soil confirmation samples would be collected during or after excavations for performance and compliance monitoring purposes.

Similar to Alternative 1, the remedial excavation would achieve RAO-1 to RAO-3 for those areas where contaminated soil was removed.

10.5.2.2 Containment and Institutional Control

The areas of the Site with soil concentrations exceeding the soil CULs that have recently been redeveloped and are not anticipated to undergo any future redevelopment (i.e., Areas I and J and the southern portion of Area M) will use existing surface features (e.g., paved parking areas and buildings) to act as a cap and containment system. Note that an area in the northeast portion of Area J-3a (between the current fence line and the southern portion of the pole-finishing building) is not currently paved, but will be paved as part of site redevelopment. Institutional controls would be used to ensure the maintenance of the cap and ensure that construction workers properly manage, and are adequately protected against, contaminated groundwater and soil encountered during any future intrusive activities. This would include periodic inspections, documentation through a restrictive covenant to prevent unauthorized disturbance of the cap, health and safety requirements for intrusive activities, requirements for replacement and repair of the cap in the event that disturbance of the cap is necessary, and testing and proper disposal procedures for soil or groundwater generated during construction, facilitated through the development and application of a Site SGMP.

Maintaining a capped containment system and institutional controls would achieve all of the RAOs. Capping and containment achieves RAO-1 and RAO-2 by maintaining a physical barrier above soil with contaminant concentrations above human direct contact CULs, and achieves RAO-3 by maintaining a low-permeability surface that would continue to prevent stormwater infiltration that could cause migration or leaching from soil that could potentially impact Site groundwater. Implementing institutional controls would achieve RAO-4 by preventing or properly controlling and planning for human contact with contaminants with concentrations above human direct contact CULs.

10.5.2.3 Groundwater Compliance Monitoring

Groundwater compliance monitoring would consist of the same activities as Alternative 1, as described in Section 10.3.1.3.

10.5.2.4 Estimated Cost and Schedule

The estimated cost to implement Alternative 2 is $2,260,000, as summarized in Table 19. The total estimated cost of Site remediation for Alternative 2, including the previous interim action work (see Section 3.2), would be $4,260,000. It is anticipated that the design, permitting, excavation, and filling of the remedial excavations would take approximately 12 to 18 months to complete.

10.5.3 ALTERNATIVE 3: CONTAINMENT WITH FOCUSED EXCAVATION

Alternative 3 includes excavation of the contaminated soil in areas that are subject to future redevelopment and that pose a potential threat of discharge to marine surface water and sediment. Other areas of contaminated soil and groundwater would be addressed through containment with institutional controls to achieve the RAOs for the Site.

Based on analytical data and field observations of the corresponding samples, the area where the soil concentrations are most elevated is in the western portion of Area G (Area G-1b), where the soil contains black, angular sand-sized material (apparent sandblast media) with high metals concentrations is located. In addition, the contaminated soil in this area is exposed at the ground surface and has the potential for direct human contact and to be discharged to marine surface water via stormwater discharge to the trunk line located along the north Site boundary. The contamination in Area G-1b is generally limited to soil from the ground surface to approximately 2.5 ft BGS. This area is the only area sampled during the RI where a Site IHS (arsenic) is present at concentrations greater than 10 times the PCL. This material also has elevated concentrations of antimony and lead that exceed the PCLs. The presence of metals at concentrations significantly higher than the PCLs in this unpaved area of the Site increases the potential for direct contact exposure and presents a potential for future leaching to groundwater.

Although the IHS concentrations are not as high as in Cleanup Area G-1b, Cleanup Area G-2, (located along the north Site boundary) contains soft, colored, silt-like material (apparent concrete slurry waste) containing arsenic at concentrations up to 109 mg/kg (about 5 times the PCL) immediately adjacent to the stormwater trunk line along the northern property boundary that discharges to the 12th Street Marina. Because the trunk line represents a potential conduit for migration of contaminants to the Puget Sound and may be impacting groundwater quality, removal of this material is included in Alternative 3.

The limits of Cleanup Area G-2 are defined by the property/Site boundary to the north and the alignment of the northern edge of the pavement section placed north of the manufacturing building in 1976 (See Figure 21). The depth of excavation is estimated to be an average of 7.5 ft BGS. Due to the known degraded condition of the trunk line, the trunk line would be replaced between the SD-8 lateral connection and catch basin SD-5as part of the cleanup action in Area G-2.

The concentration of arsenic in these two Cleanup Areas, the potential for human direct contact (Cleanup Area G-1b), and potential contaminant migration to Puget Sound (Cleanup Area G-2) provide a compelling priority for focused removal of soil in these two Cleanup Areas. As previously indicated, Cleanup Area G-1b is proposed for clean up as an emergency action in conjunction with replacement of the damaged SD-8/SD-9 storm drain lateral. In addition, removal of soil in cleanup area G-3 is included in this alternative because the planned future development includes active use of this area and the impacted soil is likely to be encountered during redevelopment.

10.5.3.1 Focused Remedial Excavation and Offsite Disposal

The assumed lateral limits of each excavation (for cost estimating purposes) are shown on Figure 28. Most of the contaminated soil in Area G-1b is present in the upper 2 ft. However, this excavation will be extended vertically and laterally until the CULs are achieved or existing pavement or buildings are encountered, or further excavation threatens the stability of an existing structure. This area is proposed for clean up as part of an emergency action associated with replacement of the SD-8/SD-9 storm drain lateral. The occurrence of the angular black sand can be visually ascertained in the field. Once it is believed to be removed, the cleanup will be confirmed through compliance monitoring.

The contaminated soil in Area G-2 varies, but is estimated to extend to an average of 7.5 ft BGS. The lateral limits of this excavation will be limited by the property line to the north and to the northern boundary of the 1976 pavement section to the south. An additional round of investigation will be performed to better delineate the extent of contamination in Area G-2. Additional perimeter borings will be completed to better delineate the south and west limits of Area G-2, and to confirm that soil below the area paved in 1976 was not contaminated by historic Site activities. The results of this investigation will be integrated into the DCAP. A contingency plan will also be in place to address other types of wastes (based on field screening) encountered during the excavation.

The trunk line straddles the property/Site boundary separating the Site from the TC Systems site. Implementation of the Alternative 3 in Area G-2 may require concurrent and coordinated cleanup on the adjacent T C Systems site.

The contaminated soil in Area G-3 is contained within former concrete-lined settling ponds. Compliance samples cannot be collected from this area as the soil was placed directly atop the concrete, instead, following removal of the soil, the concrete ponds will be broom swept clean.

Based on the assumed horizontal and vertical excavation limits, approximately 5,480 yd^3 of soil would be excavated as part of Alternative 3. This volume would be refined following completion of the additional investigation described above. The contaminated soil would be disposed of at a Subtitle D disposal facility.

For cost estimating purposes, it was assumed that approximately 65 soil confirmation samples would be collected during or after excavations for performance and compliance monitoring purposes.

Similar to Alternative 1, the remedial excavation would achieve RAO-1 to RAO-3 for those areas where contaminated soil was removed.

10.5.3.2 Containment and Institutional Controls

The other areas of the Site with soil exceeding the CULs are currently paved and will rely on existing surface features (e.g., asphalt pavement and buildings) to act as a surface cap and containment system. Note that an area in the northeast portion of Area J-3a (between the current fence line and the southern portion of the pole-finishing building) is not currently paved, but will be paved as part of site redevelopment. Institutional controls will be used to ensure the integrity of the cap, including periodic inspections, mandatory maintenance of the cap, and documentation through a restrictive covenant to prevent unauthorized disturbance of the cap and mandatory health and safety procedures, soil and groundwater management procedures, and specifications for replacement and repair of the cap in the event that disturbance of the cap is necessary.

Similar to Alternative 2, maintaining the capped containment system in conjunction with institutional controls would achieve all of the RAOs by maintaining a physical barrier to direct contact, preventing waterborne or airborne contamination from entering surface water, limiting stormwater infiltration and groundwater discharge, and preventing or properly managing future intrusive activities through implementation of a Site SGMP.

10.5.3.3 Groundwater Compliance Monitoring

Groundwater compliance monitoring would consist of the same activities as Alternative 1, as described in Section 10.3.1.3.

10.5.3.4 Alternative 3 Total Cost Estimate and Schedule

The estimated present worth to implement Alternative 3 is $1,900,000, as summarized in Table 19. The total estimated cost of Site remediation for Alternative 3, including the previous interim actions (see Section 3.2), would be $3,900,000. It is anticipated that the design, permitting, excavation, and filling of the remedial excavations would take approximately 12 to 18 months to complete.

10.5.4 ALTERNATIVE 4: SITE-WIDE CAPPING AND CONTAINMENT

Alternative 4 consists of capping those areas at the Site with contaminated soil that are currently unpaved (i.e., the area along the western portion of Area G) to prevent direct contact and entrainment in surface water runoff and to limit stormwater water infiltration, and providing for ongoing protective measures so that the integrity of capping in both the existing and newly paved areas are maintained. Institutional controls would be used to ensure that the capping and containment remain functional and protective.

10.5.4.1 Containment and Institutional Controls

The contaminated areas of the Site that are not currently paved would be paved with asphalt or concrete paving (shown on Figure 29). The newly paved areas along with existing paved parking areas and buildings would be utilized as a cap and containment system. Institutional controls would be used to ensure the integrity of the cap, including periodic inspections and maintenance of the cap, and documentation through: 1) a restrictive covenant to prevent unauthorized disturbance of the cap or contact with contaminated media without health and safety procedures, 2) a SGMP, and 3) specifications for replacement and repair of the cap in the event that disturbance of the cap is necessary.

Similar to Alternatives 2 and 3, maintaining the capping and containment system and implementing institutional controls would achieve all of the RAOs by maintaining a physical barrier to direct contact; prevent airborne or stormwater entrainment of affected soil; reduce infiltration and groundwater discharge; and provide an administrative means for controlling any potential disturbance of the containment areas, and preventing or properly managing human contact with contaminants with concentrations above human direct contact CULs.

10.5.4.2 Groundwater Compliance Monitoring

Groundwater compliance monitoring would consist of the same activities as Alternative 1, as described in Section 10.3.1.3.

10.5.4.3 Alternative 4 Total Cost Estimate and Schedule

The estimated cost to implement Alternative 4 is $380,000, as summarized in Table 19. The total final estimated cost of site remediation, including the previous interim action work (see Section 3.2), would be $2,380,000. It is anticipated that the design, permitting, and implementation of Alternative 4 would take approximately 3 to 6 months to complete.

10.6 FEASIBILITY STUDY EVALUATION CRITERIA

MTCA requires that cleanup alternatives be compared to a number of criteria 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 cleanup alternatives developed. Consistent with MTCA, the cleanup alternative was evaluated with respect to compliance with threshold requirements, permanence, and restoration timeframe as discussed in Sections 10.4.1 (Threshold Requirements) through 10.4.3 (Requirement for a Reasonable Restoration Timeframe). Public participation is also a requirement as discussed in Section 10.4.4. MTCA specifies preferences for remedial technologies that minimize the amount of untreated hazardous substances remaining at a site, which is discussed in Section 10.4.2 (Requirement for Permanent Solution to the Maximum Extent Practicable).

10.6.1 MODEL TOXICS CONTROL ACT THRESHOLD REQUIREMENTS

As specified in WAC 173-340-360(2), all cleanup actions are required to meet the following threshold requirements:

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

It is assumed that compliance with MTCA cleanup standards will ensure protection of human health and the environment and that any cleanup action performed in accordance with the requirements of MTCA will be in compliance with applicable state and federal laws. Compliance monitoring is a component of all cleanup alternatives.

10.6.2 REQUIREMENT FOR PERMANENT SOLUTION TO THE MAXIMUM EXTENT PRACTICABLE

WAC 173-340-200 defines a permanent solution as one in which cleanup standards can be met without further action being required at the original site or any other site involved with the cleanup action, other than the approved disposal site of any residue from the treatment of hazardous substances. Ecology recognizes that permanent solutions may not be practicable for all sites and provides criteria for determining whether a cleanup action is permanent to the "maximum extent practicable" in WAC 173-340-360(3)(f). These criteria include:

- ***Overall protectiveness*** of human health and the environment, including the degree to which existing risks are reduced, the time required to reduce the existing risks and attain cleanup standards, risks from implementation, and improvement of overall environmental quality.
- ***Permanence***, as the degree of reduction in toxicity, mobility, and volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.
- ***Cost***, including capital costs and operation and maintenance costs.
- ***Long-term effectiveness***, including the degree of certainty that the alternative will be successful, long-term reliability, the magnitude of residual risk, and the effectiveness of controls required to manage treatment residues and remaining waste.
- ***Management of short-term risks***, including the protection of human health and the environment associated with the alternative during construction and implementation

- ***Implementability***, including consideration of whether the alternative is technically possible, availability of necessary offsite facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions.
- ***Consideration of public concerns***, including the extent to which the alternative addresses such concerns. This process includes identifying and addressing concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site.

Ecology provides a procedure referred to as a disproportionate cost analysis [DCA; WAC 173-340-360(3)(e)] to determine whether a cleanup action is permanent to the maximum extent practicable. The purpose of the DCA is to determine if the incremental increase in cost of a cleanup alternative over that of a lower cost alternative is justified by the incremental increase in benefits to human health and the environment. If the incremental increase in costs is determined to be disproportionate to the benefits, the more expensive alternative is considered impracticable and the lower cost alternative is determined to be permanent to the maximum extent practicable. This process provides a mechanism for balancing the permanence of the cleanup action with its costs, while ensuring that human health and the environment are adequately protected.

10.6.3 REQUIREMENT FOR A REASONABLE RESTORATION TIMEFRAME

WAC 173-340-360(4)(b) specifies that the following factors be considered when determining whether a cleanup action provides for a reasonable restoration timeframe:

- Potential risks to human health and the environment
- Practicability of achieving a shorter restoration timeframe
- Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site
- Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site
- Availability of alternative water supplies
- Likely effectiveness and reliability of institutional controls
- Ability to control and monitor migration of hazardous substances from the site
- Toxicity of the hazardous substances at the site
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions.

10.6.4 REQUIREMENT FOR CONSIDERATION OF PUBLIC CONCERNS

Consideration of public concerns is an important part of the site cleanup process under MTCA (see WAC 173-340-600). Ecology will publish a notice in the Site Register when the draft RI/FS report is received [WAC 173-340-515(4)(d)]. There will be a formal public review and comment period of 30 days for the draft RI/FS report, during which time comments from the public may be submitted. Those comments will be considered and addressed as applicable in the final FS and/or CAP.

10.7 EVALUATION OF ALTERNATIVES

This section provides an evaluation of the cleanup alternatives with respect to the MTCA criteria as discussed in Section 10.4 (FS Evaluation Criteria). The evaluation of each cleanup alternative against the MTCA criteria is summarized in Table 20 and presented in the following sections.

As previously discussed in Section 10.0, all cleanup action alternatives achieve the applicable RAOs presented in Section 10.1. Additionally, each alternative meets all of the MTCA threshold requirements, as discussed in Section 10.5.1 below. As a result, each alternative is considered a viable cleanup alternative under MTCA.

10.7.1 THRESHOLD REQUIREMENTS

The following sections identify how each cleanup alternative complies with the threshold requirements.

10.7.1.1 Protection of Human Health and the Environment

Alternatives 1 through 4 protect human health and the environment through removal of contaminated soil and disposal at an offsite licensed disposal facility, and/or maintenance (and installation as necessary) of a protective cap and implementation of institutional controls, including a SGMP, to prevent potential human direct contact. They also limit any potential for airborne or waterborne transport of affected soil to surface water or marine sediment, and reduce stormwater infiltration and groundwater discharge.

10.7.1.2 Compliance with Cleanup Standards

Through the various cleanup technologies employed, and achievement of the applicable RAOs (Section 10.1), Alternatives 1 through 4 all comply with MTCA soil cleanup standards by achieving or maintaining proposed CULs at the identified points of compliance or through implementation of institutional controls.

10.7.1.3 Compliance with State and Federal Laws

Through compliance with identified ARARs (Section 10.1) and compliance with MTCA regulations, Alternatives 1 through 4 all comply with state and federal laws.

10.7.1.4 Provisions for Compliance Monitoring

Compliance monitoring requirements [WAC 173-340-410(1)] include protection monitoring (during construction, operation, and maintenance of the cleanup action), performance monitoring (to confirm progress of the cleanup action), and confirmation monitoring (to confirm the cleanup action has been attained and the long-term effectiveness of the cleanup action).

Protection monitoring would be provided for Alternatives 1 through 4 through appropriate health and safety protocols outlined under a Site-specific health and safety plan. The excavation components of Alternatives 1 through 3 include onsite observations and soil sampling for both performance and confirmation monitoring. The inspection and maintenance of institutional controls provides performance monitoring for Alternatives 2 through 4, and possibly Alternative 1 if all contaminated soil cannot be removed from the J-3 area; and confirmation monitoring is provided through any sampling performed as required under the 5-year review process. All alternatives include groundwater compliance monitoring to provide both performance and confirmation monitoring.

10.7.2 REQUIREMENT FOR A REASONABLE RESTORATION TIMEFRAME

MTCA identifies a number of factors to be considered when establishing a reasonable restoration timeframe, as described in Section 10.4.3 (Requirement for a Reasonable Restoration Timeframe). A cleanup action is considered to have achieved restoration once cleanup standards have been met. An evaluation of the cleanup alternatives with regard to achieving a reasonable restoration timeframe is presented in Table 20 and is discussed below, except that the practicability of achieving a shorter restoration timeframe is addressed as part of the DCA evaluation presented in Section 10.6.

Restoration timeframe estimates are interpreted to begin at the initiation of remediation work, assuming all permitting and/or Site access components have been completed. All four cleanup alternatives are anticipated to achieve restoration in a reasonable timeframe and range from approximately 6 to 18 months.

Alternative 1 is estimated to achieve cleanup standards following excavation and disposal of accessible contaminated soil at the Site, and implementation of institutional controls for groundwater. If it is determined that significant contamination remains beneath buildings or other inaccessible locations, institutional controls for soil may need to be negotiated for the Site, and a SGMP would be implemented Site-wide to address the testing and proper management procedures for soil or groundwater generated during future intrusive activities. This remedy is estimated to take up to 18 months to complete.

Alternatives 2 and 3 are estimated to achieve cleanup standards following excavation and disposal of soils from specific areas of contamination and implementation of institutional controls in containment areas. These remedies are estimated to take 12 to 18 months to complete.

Alternative 4 relies solely on containment and institutional controls for compliance with the cleanup regulations. Achievement of cleanup standards is considered complete upon construction of the cap and implementation of the institutional controls. This remedy is estimated to take no more than 6 months to complete, with ongoing inspection and monitoring.

10.7.3 PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

As described in Section 10.4.2 (Requirement for Permanent Solution to the Maximum Extent Practicable), MTCA requires that cleanup actions be permanent to the maximum extent practicable, and identifies a number of criteria to evaluate whether this requirement is achieved. This section provides a comparison of the cleanup alternatives to the permanence criteria. The criteria are summarized in Section 10.4.2. The evaluation of practicability is addressed in Section 10.6 (Disproportionate Cost Analysis).

10.7.3.1 Overall Protectiveness

As indicated in Section 10.4.2, overall protectiveness of human health and the environment is a measure of the degree to which existing risks are reduced, the time required to reduce existing risks at the Site and attain cleanup standards, the onsite and offsite risks resulting from implementation, and the improvement of overall environmental quality. All four alternatives for the Site are protective of human health and the environment and reduce the risk of direct contact to human receptors and the potential risk of leaching to groundwater through a combination of contaminated soil removal and/or capping/containment and implementation of institutional controls.

The overall protectiveness of all the alternatives is relatively high. Protectiveness increases with each alternative where more contaminated soil is removed because potential future exposure risks are decreased if institutional controls do not adequately work. However, the removal of contaminated soil provides limited benefit to overall protectiveness because:

- Most of the contaminant mass was removed during the interim action (see Section 10.6.1.1),
- Leaching to groundwater at the Site, if it is occurring, is limited and localized
- Capping existing potential direct contact exposure areas and implementing institutional controls greatly reduces the risk of direct exposure (provided the institutional controls are properly implemented).

Additionally, Alternatives 1 through 3 have the potential to temporarily increase onsite and offsite risks; they have the potential of spreading contaminated soil during construction through windblown or mechanically spread dust or dirt, or spills during transportation. However, these risks can be appropriately managed through proper design, implementation, and monitoring.

10.7.3.2 Permanence

As indicated in Section 6.1.2, permanence is the degree of reduction in toxicity, mobility, and volume of hazardous substances, including the adequacy of the alternative in destruction, reduction, or elimination of hazardous substances. All four alternatives provide a moderate degree of permanence through removal of soil contamination and/or installation and maintenance of permanent physical barriers between contaminated soil and potential receptors, thereby reducing potential mobility of the contaminants. Alternative 1 is considered the most permanent because it removes the most contamination from the Site and Alternative 4 the least permanent because it relies solely on containment. None of the alternatives permanently reduce the toxicity or volume of hazardous substances; they only contain the contaminants on site or at an offsite engineered solid waste landfill.

10.7.3.3 Cost

As indicated in Section 10.3, costs include capital costs as well as operation and maintenance costs. Itemized cost estimates for each of the cleanup alternatives are provided in Appendix H. Estimated costs are summarized as follows:

- Alternative 1 (Site-Wide Remedial Excavation) – $5,500,000 ($7,500,000 including the interim action)
- Alternative 2 (Remedial Excavation in Future Redevelopment Areas and Containment) – $2,230,000 ($4,230,000 including the interim action)
- Alternative 3 (Containment With Focused Remedial Excavation) – $1,900,000 ($3,900,000 including the interim action)
- Alternative 4 (Site-Wide Capping and Containment) – $380,000 ($2,380,000 including the interim action).

These estimated cleanup costs are consistent with an order of magnitude cost estimate. These costs are used as the cost basis for the DCA presented in Section 10.6.3.

10.7.3.4 Long-Term Effectiveness

As indicated in Section 10.4.2, long-term effectiveness includes the degree of certainty that the alternative will be successful, long-term reliability, the magnitude of residual risk, and the effectiveness of controls required to manage treatment residues and remaining waste. All four of the alternatives are expected to be effective over the long term as they all have a relatively high certainty in the success and reliability of removing and/or preventing risk of exposure to human receptors.

Under WAC 3-340-360(3)(e)(iv), MTCA indicates that the “following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; onsite or offsite disposal in an engineered line and monitored facility; onsite isolation or containment with attendant engineering controls; and institutional controls and management.” By this standard, all the alternatives rely on cleanup action components with moderate long-term effectiveness. However, among the alternatives under consideration, Alternative 1 has a relatively high certainty of success in comparison to the others because it relies on offsite disposal as the primary mechanism for compliance with the cleanup standards. Using the MTCA guidance, Alternatives 2, 3, and 4 are considered to be progressively less effective in the long term due to the use of proportionally less contaminant removal and more reliance on containment and institutional controls to achieve the cleanup standards.

10.7.3.5 Management of Short-Term Risks

As indicated in Section 10.4.2, management of short-term risks includes the protection of human health and the environment associated with the alternative during construction and implementation. The degree of short-term risk of the four alternatives varies somewhat due to the difference between the construction and/or implementation of the alternatives. However, the ability to manage those risks for the four alternatives is relatively high.

The short-term risks associated with excavation, which is included in varying quantities in Alternatives 1 through 3, are moderate, although manageable. The risks are primarily related to the potential for airborne or waterborne releases during excavation and transport, potential accidents, worker exposure to hazardous substances during excavation of contaminated soil, damaging utilities or other infrastructure, and the transport of contaminated soil for treatment or disposal. Alternative 1 carries the highest short-term risk with Alternatives 2, 3, and 4 having progressively less short-term risk related to these factors. These risks are manageable with proper health and safety procedures, planning, identification and management of underground utilities, and careful monitoring during excavation. Paving for the Site cap carries some construction-related risks, but there are virtually no short-term risks associated with institutional controls; therefore, short term risks associated with Alternative 4 are very low and manageable.

10.7.3.6 Technical and Administrative Implementability

As indicated in Section 10.4.2, implementability includes consideration of whether the alternative is technically possible; availability of necessary offsite facilities, services and materials; administrative and regulatory requirements; scheduling; size; complexity; monitoring requirements; access for construction operations and monitoring; and integration with existing facility operations and other current or potential remedial actions. The challenges related to implementability of the four alternatives vary somewhat due to differences between the construction and/or implementation techniques, how Site conditions specifically impact those techniques, and different permitting and Site access requirements.

Alternative 1 has moderate technical challenges related to excavations beneath existing new infrastructure (e.g., the esplanade) that are minimized by excavation of only future redevelopment areas (Alternative 2) or focused excavations (Alternative 3). However, Alternatives 1, 2, and 3 all have some general technical challenges related to excavation in a busy commercial area, in relatively restrictive construction areas, and with many underground utilities. Alternative 4 has negligible technical challenges.

Alternatives 2, 3, and 4 have similar administrative challenges related to developing and establishing institutional controls. Alternatives 1, 2, and 3 each have minor challenges related to obtaining grading/public works permits.

10.8 DISPROPORIONATE COST ANALYSIS

As discussed in Section 10.4.2, MTCA regulations for remedy selection include the requirement to use permanent solutions to the maximum extent practicable. MTCA defines permanent cleanup actions as those in which cleanup standards are met without further action being required. MTCA specifies that the evaluation of whether a cleanup action uses permanent solutions to the maximum extent practicable be based on a disproportionate cost analysis (DCA) consistent with the requirements of WAC 173-340-360(3)(e). In that analysis, cleanup alternatives are arranged from most to least permanent based on the criteria specified in WAC 173-340-360(3)(f).

The DCA then compares the relative environmental benefits of each alternative against those provided by the most permanent alternative evaluated. Costs are disproportionate to benefits if the incremental cost of the more permanent alternative exceeds the incremental benefits achieved by the lower cost alternative [WAC 173-340-360(3)(e)(i)]. Alternatives that exhibit disproportionate costs are considered “impracticable.” Where the benefits of two alternatives are equivalent, MTCA specifies that the least costly alternative shall be selected [WAC 173-340-360(3)(e)(ii)(C)].

The DCA is shown below, using the information provided in Section 10.5 and Table 19. The benefits of each alternative are ranked under the criteria of the DCA [WAC 173-340-360(3)(f)] in Section 10.4.2. The costs are then compared against these benefits and the relationship between the costs and benefits determined in Section 10.6.2. This analysis then defines which alternative is permanent to the maximum extent practicable.

Relative rankings for the alternatives were determined by assigning a value on a scale from 1 to 10, where 10 is the highest benefit/value, for each criterion, multiplying each value by a weighting factor, and summing the weighted values to determine an overall alternative benefit ranking score. Weighting factors are based on Ecology guidance and Ecology-accepted weighting factors that have been used for similar sites. The six evaluation criteria and associated weighting factors are:

- Overall protectiveness: 30 percent
- Permanence: 20 percent
- Long-term effectiveness: 20 percent
- Short-term risk management: 10 percent
- Implementability: 10 percent
- Considerations of public concerns: 10 percent.

10.8.1 COMPARATIVE EVALUATION OF ALTERNATIVES

The DCA is based on a comparative analysis of the alternatives against the six evaluation criteria. Relative rankings of each alternative for the six criteria are discussed below and summarized in Table 19. The following provides the comparative evaluation of the alternatives.

10.8.1.1 Overall Protectiveness

Alternative 1 is ranked highest for protectiveness with a score of 10 based on the relative certainty that protectiveness will be maintained by Site-wide removal of contaminated soil and because potential future exposure risks are negligible (as opposed to the other alternatives where the potential to exposure increases if institutional controls are not adequately effective). Alternatives 2, 3, and 4 are given scores of 8, 7, and 5, respectively, based on the total mass of contaminants in soil removed from the Site, and the extent to which protectiveness relies on capping and institutional controls. These rankings are based on the evaluation presented in Appendix I, which provides a comparison of contaminant mass removal (focused on IHS metals) under the four alternatives, including the contaminant mass removed during the interim action. The mass removals were determined using average contaminant concentrations in each of the interim action and final cleanup areas (based on interim action and RI sampling data) and the total mass of soil removed during the interim action or planned for removal under the remedial alternatives. Based on this evaluation, the total mass removal of contaminants (IHS metals) under each Alternative is as follows:

- Alternative 1: ≈100% of total contaminant mass; ≈100% of remaining contaminant mass
- Alternative 2: ≈92% of total contaminant mass; ≈63% of remaining contaminant mass
- Alternative 3: ≈92% of total contaminant mass; ≈62% of remaining contaminant mass
- Alternative 4: ≈79% of total contaminant mass; 0% of remaining contaminant mass.

10.8.1.2 Permanence

Each of the four alternatives equally reduces the mobility of contamination at the Site through removal of soil contamination and/or construction and maintenance of permanent physical barriers between contaminated soil and potential receptors. None of the alternatives permanently reduce the toxicity or volume of hazardous substances; they only contain the contaminants on site or at an offsite engineered solid waste landfill. However, the permanence of each alternative with respect to the Site is dependent on the amount and magnitude of contaminated soil removed from the Site. Therefore Alternatives 1, 2, 3, and 4 were given permanence score of 9, 7, 6, and 4, respectively.

10.8.1.3 Long-Term Effectiveness

Long-term effectiveness includes the degree of certainty that the alternative will be successful, long-term reliability, the magnitude of residual risk, and the effectiveness of controls required to manage treatment residues and remaining waste. All four of the alternatives are expected to be effective over the long term as they all have a relatively high certainty in the success and reliability of removing and/or preventing risk of exposure to human or ecological receptors. However, per WAC 3-340-360(3)(e)(iv), “offsite disposal in an engineered, lined, and monitored facility” has a higher degree of long-term effectiveness than “onsite isolation or containment with attendant engineering controls; and institutional controls and management.” Therefore, Alternative 1 is given the highest long-term effectiveness score of 8 because it relies on offsite disposal as the primary mechanism for compliance with the cleanup standards. Because Alternatives 2, 3, and 4 each, in order, use proportionally less excavation and more reliance on capping/containment and institutional controls to achieve the cleanup standards, they are given scores of 7, 6, and 5, respectively.

10.8.1.4 Management of Short-Term Risks

The short-term risks for excavation-related activities become progressively smaller for Alternatives 1 through 3 (thus resulting in progressively higher scores), due to the smaller quantity of excavation and restoration that would respectively be performed. Also, Alternative 1 includes a significant amount of excavation adjacent to buildings and beneath building awnings/covered areas, which requires the addition of shoring and associated risks. Therefore, Alternatives 1, 2, and 3 are given short-term risk scores of 5, 8, and 9 respectively. Short-term risks associated with Alternative 4 are considered negligible because there is only limited construction related to capping (paving) and contaminated soil would be minimally disturbed; therefore, it is given a score of 10.

10.8.1.5 Technical and Administrative Implementability

Because of its technical challenges related to excavations beneath and proximate to existing new infrastructure (e.g., the esplanade and Site buildings) and associated shoring design and implementation, Alternative 1 is given the lowest score of 6. Excavations only in future redevelopment areas (Alternative 2) or in focused areas of contamination (Alternative 3) have fewer technical challenges related to construction around buildings and infrastructure. However, Alternatives 2 and 3 also have comparable administrative challenges related to developing and establishing institutional controls. Alternatives 1, 2, and 3 also have minor challenges related to obtaining grading/public works permits. Based on these various technical and administrative challenges, Alternatives 2 and 3 are given scores of 8 and 9, respectively. Although Alternative 4 includes no excavation, paving of the currently uncapped contaminated soil at the Site would require a similar amount of construction activities as for Alternative 3; therefore, Alternative 4 would have equivalent technical challenges as Alternative 3. Alternative 4 would also have similar administrative challenges as Alternatives 2 and 3 related to developing and establishing institutional controls. Therefore, Alternative 4 is also given a score of 9.

10.8.1.6 Consideration of Public Concerns

Public concerns regarding the cleanup alternatives are not yet known, but will be solicited and responded to during the draft RI/FS public comment period. For the purposes of this FS, all alternatives are given a ranking of 10 for consideration of public concerns, based on the assumption that the public's primary concern is that the Site be cleaned up consistent with MTCA requirements rather than having a preference (or concern) for a specific remedy. The evaluation of alternatives against the Consideration of Public Concerns criterion is subject to change based on public comments received on this document.

10.8.2 COMPARISON OF OVERALL BENEFITS (RELATIVE BENEFIT SCORES)

Based on receiving the highest score in the areas of overall protectiveness, Alternative 1 has the highest weighted overall benefit score. The four alternatives received similar scores for the other categories of permanence, long-term effectiveness, management of short-term risk, and implementability. The rank and relative benefit scores for each alternative are presented in Table 19, and are as follows:

- Alternative 1 Relative Benefit Score: 8.5
- Alternative 2 Relative Benefit Score: 7.8
- Alternative 3 Relative Benefit Score: 7.5
- Alternative 4 Relative Benefit Score: 6.2.

10.8.3 CONCLUSIONS AND SUMMARY OF THE DISPROPORTIONATE COST ANALYSIS

As required by MTCA for remedy selection, the costs and benefits associated with the evaluated remedial alternatives are compared using a DCA. The DCA compares the relative environmental benefits of each alternative against those provided by the most permanent alternative evaluated. Costs are disproportionate to benefits if the incremental cost of the most permanent alternative exceeds the incremental degree of benefits achieved over a lower cost alternative [WAC 173-340-360(3)(e)(i)]. Alternatives that exhibit such disproportionate costs are considered "impracticable." Where the benefits of two alternatives are equivalent, MTCA specifies that the lower cost alternative shall be selected [WAC 173-340-360(3)(e)(ii)(C)].

The estimated alternative costs summarized in Section 10.5.3.3, and the benefits presented in Section 10.6.1, are summarized for each alternative in Table 19. Table 19 also summarizes the overall benefits and costs for each alternative using the relative benefit score developed for each alternative in Section 10.6.1. Figure 30 provides a graphical comparison between the costs of each alternative and the relative benefits, using the costs developed in Appendix H and benefit rankings developed in Table 19. A comparison of the relative cost to benefit ratios between the alternatives is also shown on Figure 30. Additionally, Figure 31 illustrates the relative cost of each remedial alternative against the total percentage of contaminant mass that would be removed under each.

Because the DCA indicates that Alternative 1 (Site-Wide Remedial Excavation) yields the greatest overall benefit of the four alternatives evaluated for the Site, it is considered the most permanent. Because Alternative 1 is the most permanent alternative, the relative benefits and costs for the other alternatives are compared to Alternative 1 to determine which alternative is permanent to the maximum extent practicable. As shown on Figure 24, Alternative 1 has a cost to benefit ratio of 8.8.

Alternative 2 (Remedial Excavation in Future Development Areas and Containment) has only a slightly lower overall benefits score than Alternative 1 (approximately 8 percent lower); however, the cost is approximately $3.27 million or 44 percent less as compared to Alternative 1 (60 percent less if only future costs are considered). Alternative 2 has a cost to benefit ratio of 5.5. Therefore, the incremental cost increase for Alternative 1 is considered substantial and disproportionate to its incremental increase in benefits (as illustrated by having the highest cost to benefit ratio) and Alternative 1 is considered impracticable and eliminated from further consideration.

The overall benefits score for Alternative 3 (Containment with Focused Remedial Excavation) is only slightly lower than that of Alternative 2 (approximately 6 percent), and the cost for Alternative 3 is significantly less, approximately $0.4 million or 9 percent less, than Alternative 2 (16 percent less if only future costs are considered). Alternative 3 has a cost to benefit ratio of 5.2. Therefore, the incremental cost increase for Alternative 2 is considered substantial and disproportionate to its incremental increase in benefits (as illustrated by having the second-highest cost to benefit ratio). Consequently, Alternative 2 is also considered impracticable and is eliminated from further consideration.

Alternative 4 (Site-Wide Capping and Containment) has the most significant incremental reduction in benefit (27 percent lower than Alternative 3) of the four alternatives. The estimated cost for Alternative 4 is about $1.5 million less than Alternative 3, which is 40 percent less than the cost for Alternative 3 (80 percent less if only future costs are considered). This results in Alternative 4 having slightly significantly lower cost to benefit ratio (3.8), than Alternative 3. Although the incremental increase in cost for Alternative 3 over Alternative 4 may be considered significant, it is not considered disproportionate relative to the increase in benefit. Therefore, Alternative 3 is considered the FS alternative that is permanent to the maximum extent practicable under WAC 173-340-360 (3) (f) (i).

10.9 FEASIBILITY STUDY SUMMARY AND CONCLUSIONS

The Site RI (including supplemental RI) defined and documented physical characteristics, source areas, the nature and extent of impacted media, and the migration pathways for contaminants. Data from the RI were used in the FS process to develop and evaluate remedial alternatives for the Site.

The FS developed remedial alternatives for the Site to clean up contaminated media delineated in the RI, evaluated the alternatives against criteria defined by MTCA, provided a comparative analysis of the alternatives to determine the relative environmental benefits of each, and compared the relative benefits of each against their costs to determine the alternative that uses the most permanent solutions to the maximum extent practicable.

10.9.1 PREFERRED ALTERNATIVE

The preferred alternative for the Site is Alternative 3 (Containment with Focused Remedial Excavation). Alternative 3 consists of the following elements:

- Containment.
- Inspection and maintenance of impermeable surfaces over areas of soil contamination.
- Institutional controls, including a SGMP, to ensure cap is not breached and construction workers are not exposed to contaminated media without proper management and precautions.
- Focused remedial excavation of hot spot areas. Offsite disposal of excavated material at an appropriately permitted solid waste management facility.
- Groundwater compliance monitoring.

10.9.2 IMPLEMENTATION OF SITE CLEANUP

The selected cleanup action will be presented in the Site CAP, which will describe the cleanup action and specify cleanup standards and compliance monitoring requirements. Following public review of the CAP, the cleanup will progress in a series of implementation phases, including engineering and design, permitting, construction, development and filing of institutional controls, and long-term compliance monitoring and maintenance (as applicable).

11.0 USE OF THIS REPORT

This RI/FS report has been prepared for the exclusive use of the Port of Everett and the Washington State Department of Ecology for specific application to the North Marina Ameron/Hulbert Site located in Everett, Washington. The use of this report by others or for another project is at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This report has been prepared under the supervision and direction of the undersigned. If you have any questions or comments regarding this report, please contact us at (425) 778-0907.

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Data Source: ESRI 2008

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig1-Vicinity Map.mxd 1/25/2013

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North Marina Ameron/Hulbert Site Everett, Washington	**Vicinity Map**	Figure 1

Legend

- 🟫 Approximate North Marina Ameron/Hulbert Site Boundary
- 🟪 North Marina Boundary

Note

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

0 200 400

Scale in Feet

Data Source: 2011 Google Earth Pro Image; Snohomish County Assessor

North Marina Ameron/Hulbert Site RI/FS Report Everett, Washington	**North Marina Ameron/Hulbert Site Plan**	Figure 2

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig2-Site Plan.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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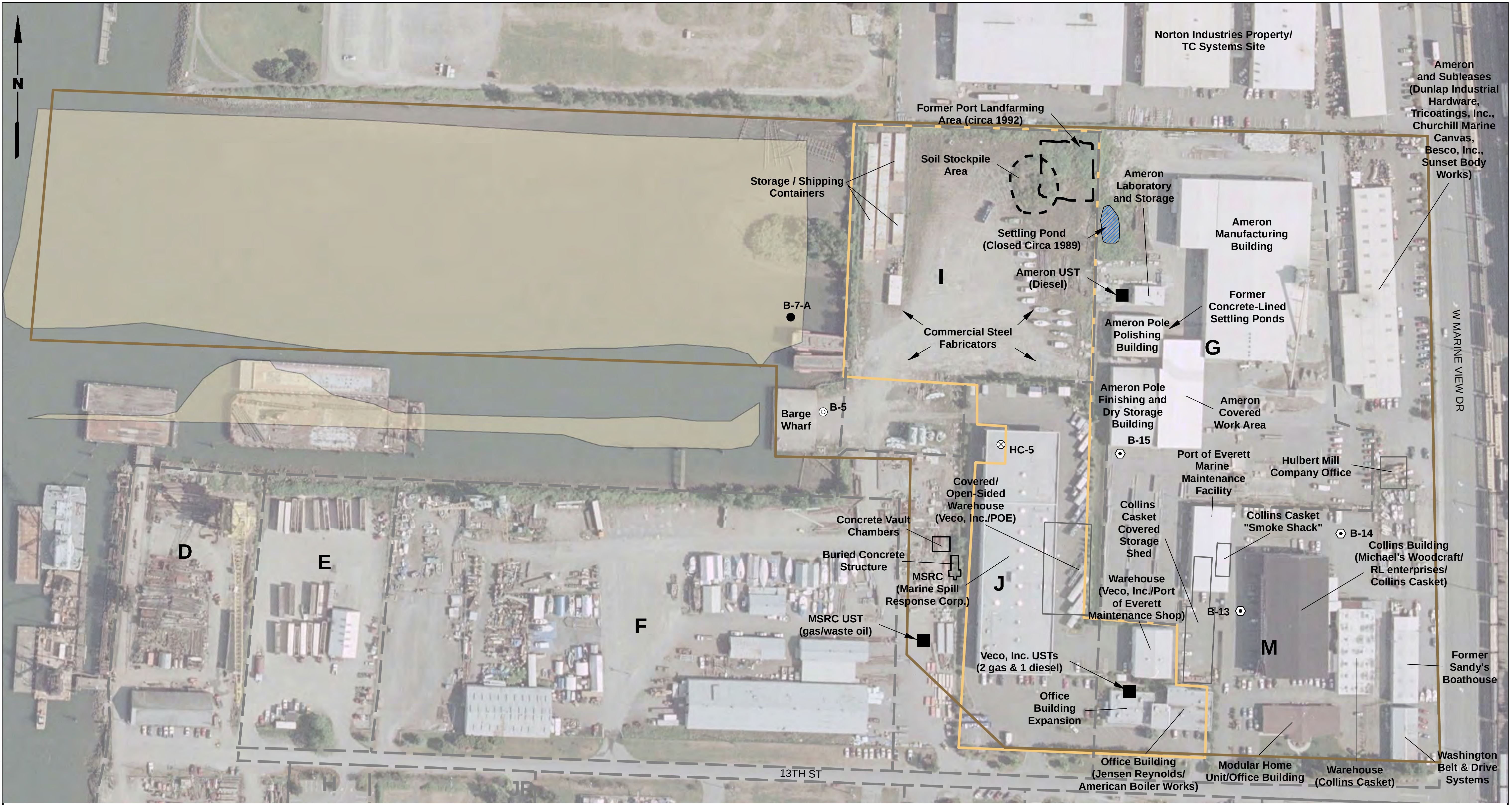

Legend

● Hart Crowser Report 12-3-2003 Closed-Ended Test Pile	⊙ Approximate Geotechnical Boring Location (Landau Associates - 2005)	J — Investigation Area Designation and Boundary	▭ Approximate North Marina Ameron/Hulbert Site Boundary
⊗ Approximate Geotechnical Boring Location (Hart Crowser - 1992)	◎ Approximate Geotechnical Boring Location (Dames & Moore - 1975)	▭ Approximate Dredging Area of 12th Street Yacht Basin	▭ Former Jensen-Reynolds Leasehold

0 160 320

Scale in Feet

Data Source: Google Earth (2003 Image)

Note

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

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North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Pre-Interim Action Site Features

Figure
3

G:\Projects\1147\029\500\640\2012 RIFS Report\Fig3-Pre-interim Action Features.mxd 10/23/2013

Legend

J ▬	Investigation Area Designation and Boundary
▭	Approximate North Marina Ameron/Hulbert Site Boundary
🟨	Riparian and Intertidal Habitat Bench
⬚	Boatyard Expansion

0 160 320

Scale in Feet

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

Data Source: Google Earth Pro (2011 Image)

G:\Projects\1470\029\500\640\2012 RIFS Report\Fig4-Current Site Features.mxd 10/23/2013

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North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Current Site Features

Figure
4

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig5-Sediment and CatchBasin Locations.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

◎ Sediment Sampling Locations

○ Samples Archived for Potential Laboratory Analysis

● Catch Basin Sediment Sample Location (11/24/2010)

● Trunk Line Sediment Sample Location (12/22/2011)

⊙ Landau Associates Sediment Sampling Locations (2009)

⊙ SAIC Sediment Sample Location (2009)

○— Catch Basin and Piping

▭ Approximate Ameron/Hulbert Site Boundary

G - Area Designation

▩ Asphalt Berms

▥ Trench Drains

Notes

1. Data for the storm system alignment was obtained from a variety of sources including Reid Middleton plans dated 1996, information provided by Aspect Consulting, plans provided by the Port of Everett and a binding site plan for Norton Industries dated 1992.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 150 300

Scale in Feet

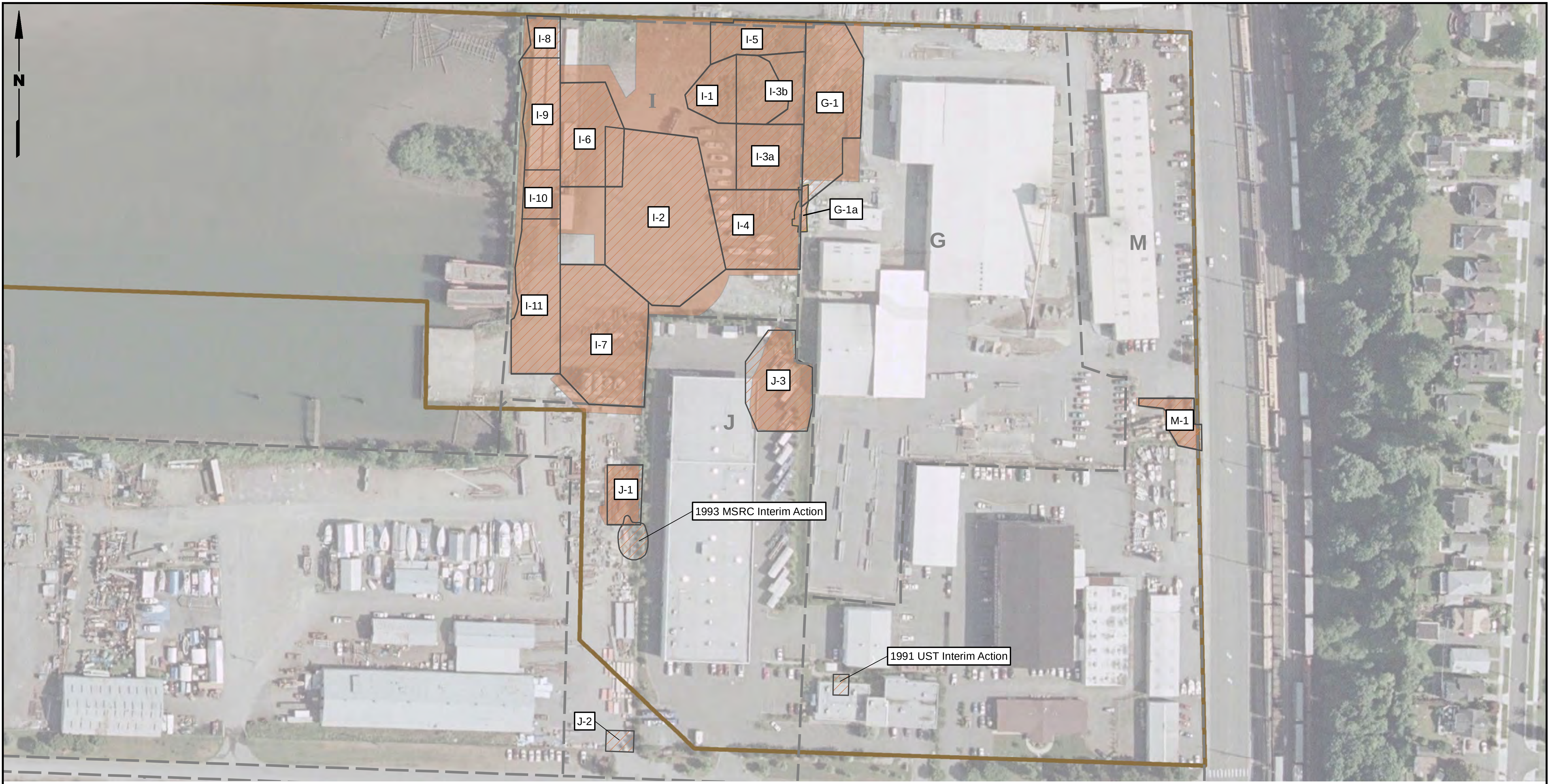
Data Source: Google Earth Pro (2011 Image)

Landau Associates

North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Storm System Layout and Sediment and Catch Basin Sample Locations

Figure
5



Legend

▨ Planned Interim Action Areas

🟧 Areas Excavated (2005-2007)

⌐¬ G - Area Designation

▭ Approximate North Marina Ameron/Hulbert Site Boundary

0 140 280
Scale in Feet

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

Data Source: 6/19/2002 Google Earth Image

North Marina Ameron/Hulbert Site RI/FS Report Everett, Washington	**Interim Action Areas**	Figure 6

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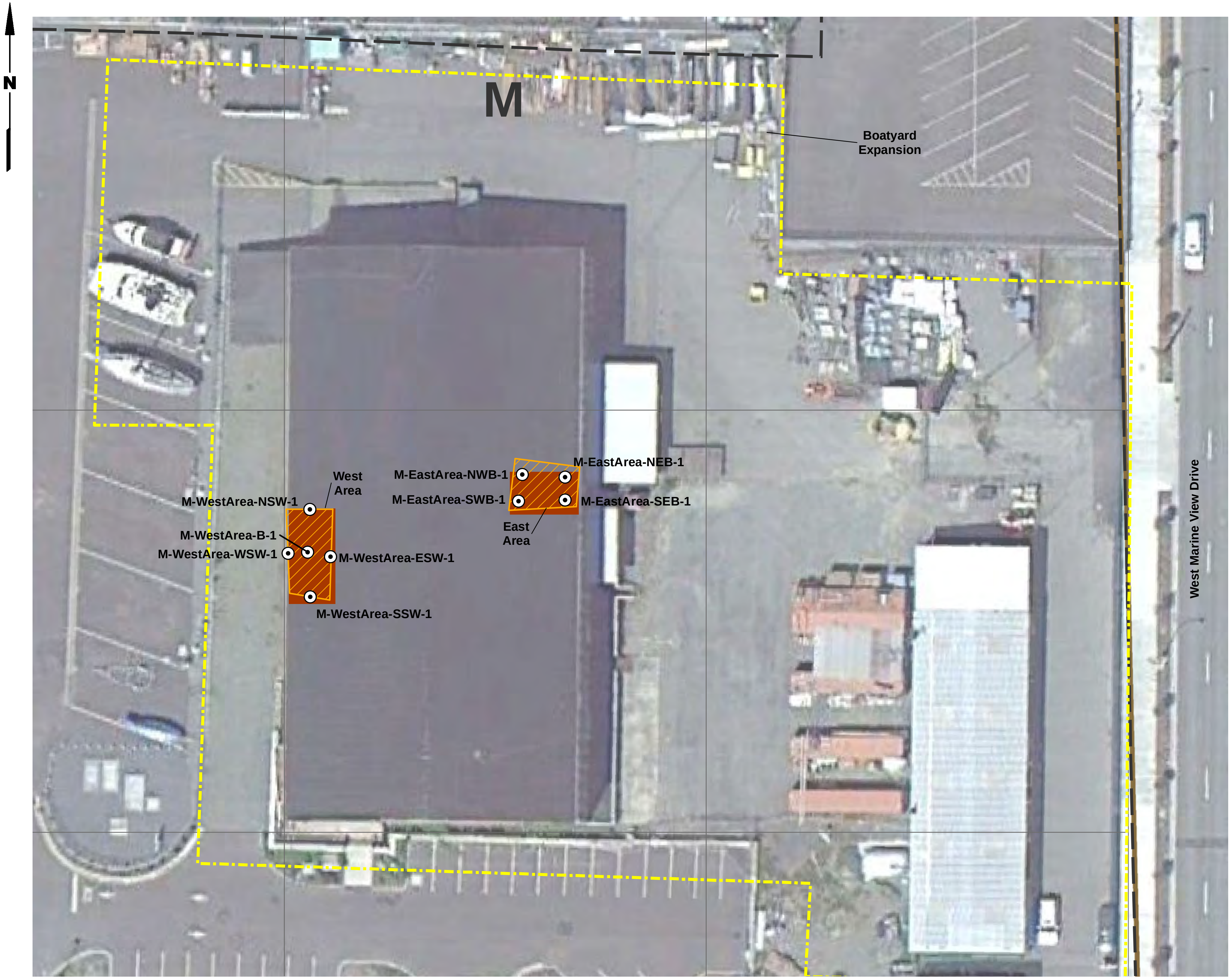
Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig6-Planned Interim Action Areas.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

⊙ Excavation Soil Sample Location

▨ Cleanup Areas

■ Planned Cleanup Areas

⬚ Boatyard Expansion

▭ Approximate Ameron/Hulbert Site Boundary

⌐ M - Area Designation

Note

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

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig7-EmergencyActionAreas.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Data Source: Google Earth Pro (2011 Image)

0 40 80

Scale in Feet

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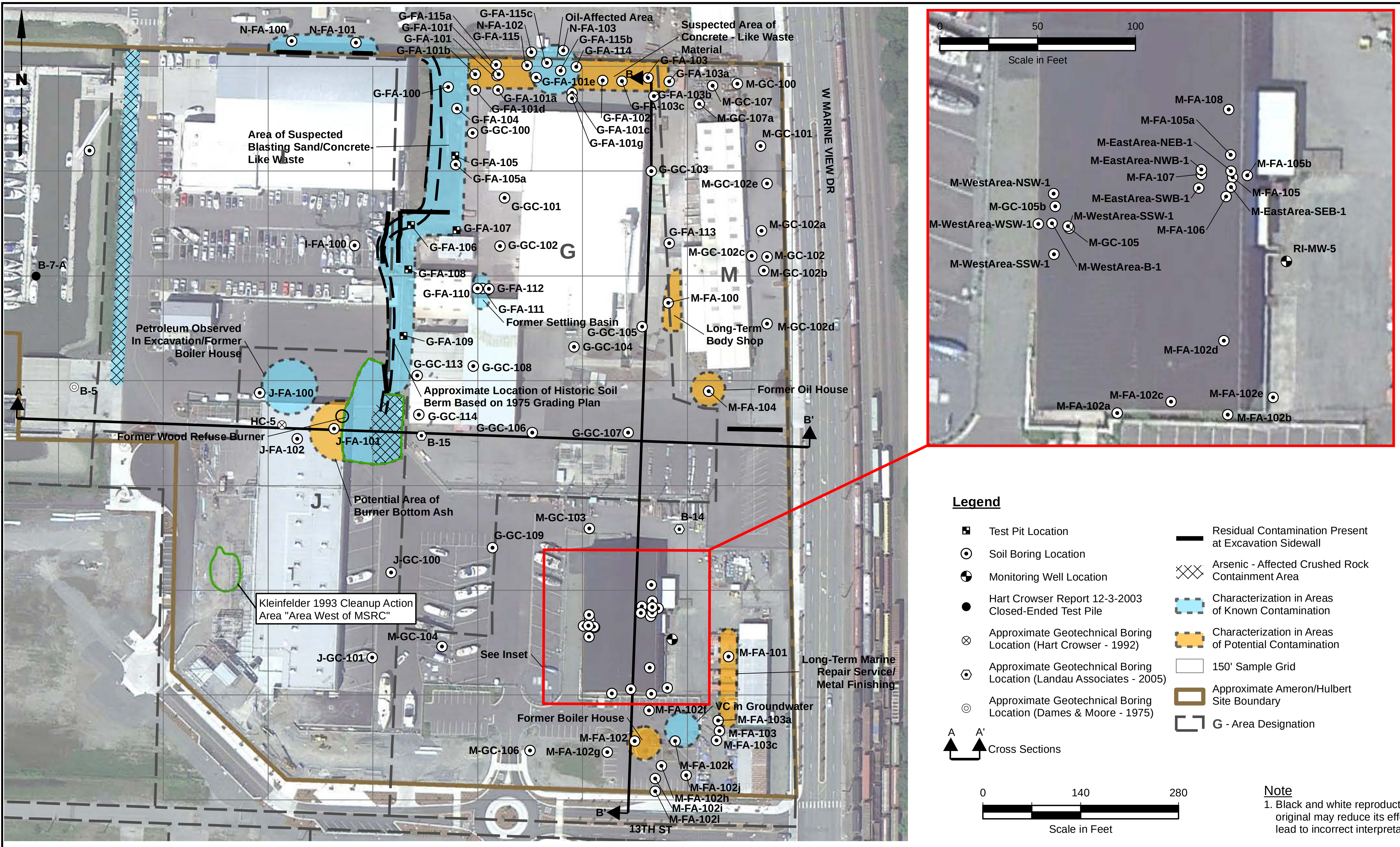
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

2011 Emergency Action Cleanup Areas and Compliance Monitoring Sample Locations

Figure
7



Legend

- ◘ Test Pit Location
- ⊙ Soil Boring Location
- ◐ Monitoring Well Location
- ● Hart Crowser Report 12-3-2003 Closed-Ended Test Pile
- ⊗ Approximate Geotechnical Boring Location (Hart Crowser - 1992)
- ⊙ Approximate Geotechnical Boring Location (Landau Associates - 2005)
- ◎ Approximate Geotechnical Boring Location (Dames & Moore - 1975)
- A A' Cross Sections
- ▬ Residual Contamination Present at Excavation Sidewall
- ▨ Arsenic - Affected Crushed Rock Containment Area
- 🟦 Characterization in Areas of Known Contamination
- 🟧 Characterization in Areas of Potential Contamination
- ☐ 150' Sample Grid
- ▭ Approximate Ameron/Hulbert Site Boundary
- G - Area Designation

0 140 280
Scale in Feet

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

G:\Projects\147\029\500\640\2012 RIFS Report\Fig8-SoilSampleLocations.mxd 12/20/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Data Source: Google Earth Pro (2011 Image)

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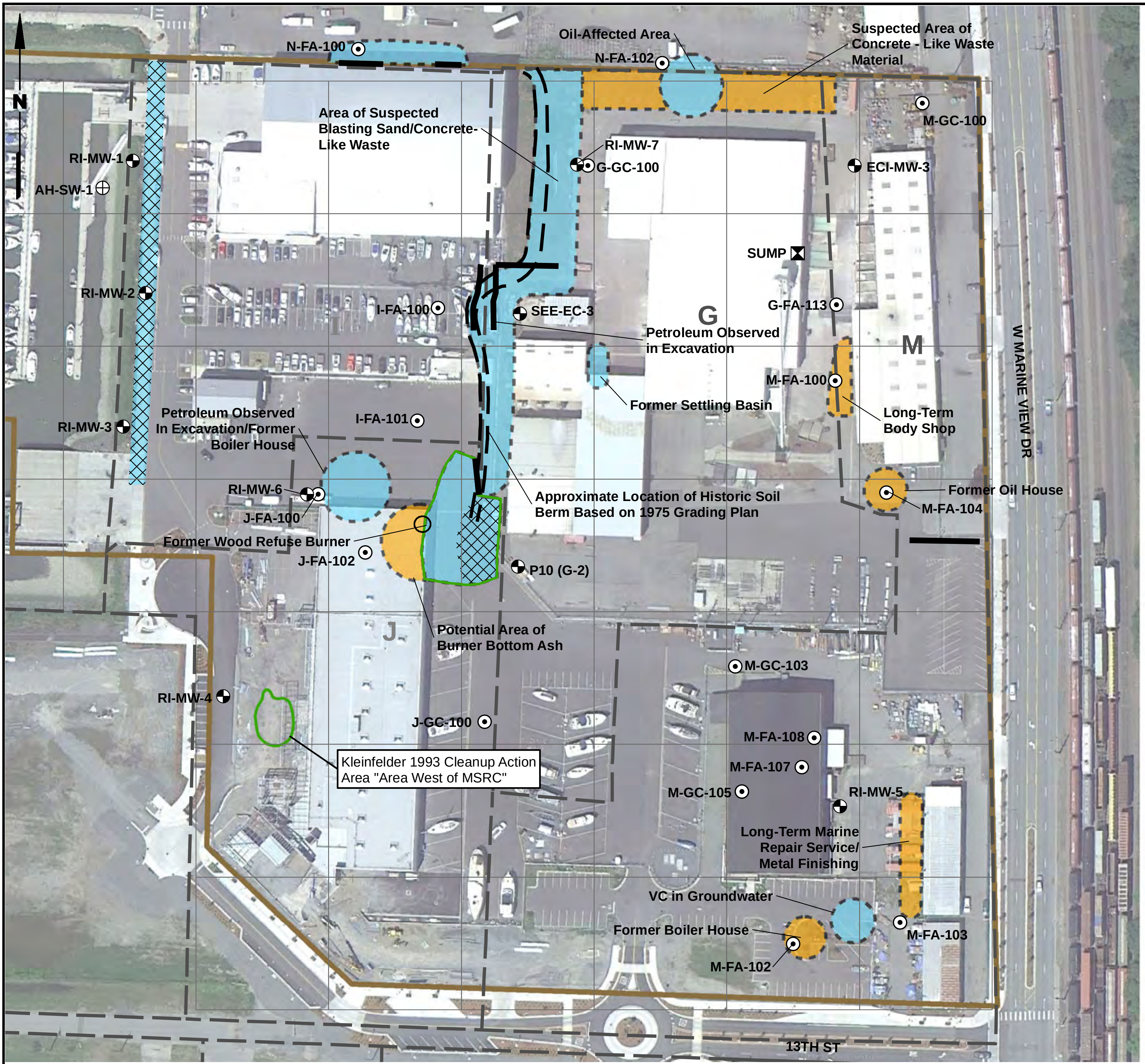
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

RI Soil Sample Locations

Figure
8



Legend

◐	Groundwater Monitoring Well Locations
⊙	Groundwater Borehole Sample Location
⊕	Surface Water Sample Location
☒	Sump Sample Location
▬	Residual Contamination Present at Excavation Sidewall
▨	Arsenic - Affected Crushed Rock Containment Area
🟦	Characterization in Areas of Known Contamination
🟧	Characterization in Areas of Potential Contamination
☐	150' Sample Grid
🟫	Approximate Ameron/Hulbert Site Boundary
⌐ ¬	G - Area Designation

0 140 280

Scale in Feet

Note

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

Data Source: Google Earth Pro (2011 Image)

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig9-GroundwaterSampleLocations.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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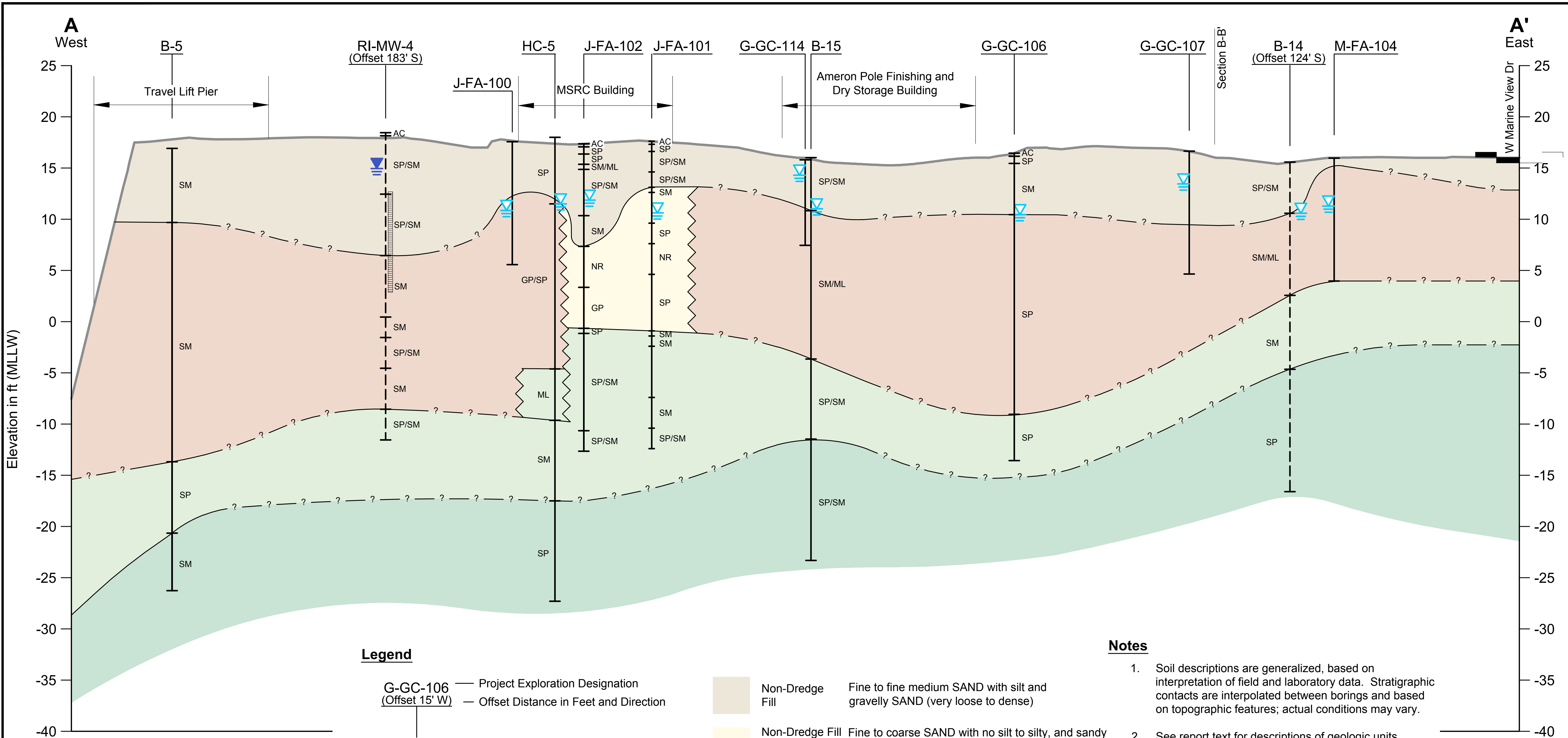
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

RI Groundwater and Surface Water Sample Locations

Figure
9



Legend

G-GC-106 — Project Exploration Designation
(Offset 15' W) — Offset Distance in Feet and Direction
Top of Exploration
Groundwater Level (Measured)
Groundwater Level (At time of drilling)
GM — Unified Soils Classification Symbol
Soil Type Contact
? — Inferred Geologic Contact
Well Screen Interval (If Installed)
Bottom of Exploration

▨	Non-Dredge Fill	Fine to fine medium SAND with silt and gravelly SAND (very loose to dense)
▨	Non-Dredge Fill with Debris Materials	Fine to coarse SAND with no silt to silty, and sandy coarse gravel, with brick, concrete-like material, timber, and wood debris (loose to medium dense)
▨	Hydraulic Fill	Fine to fine medium SAND with silt to trace silt and silty fine SAND to fine sandy SILT with shell fragments (loose to medium dense and soft to medium stiff)
▨	Marine Sediment	Fine SAND with silt to silty fine SAND and fine sandy SILT to clayey SILT (very loose to medium dense and very soft to medium stiff)
▨	Glacial/ Interglacial Sediment	Fine to medium SAND with silt to trace silt and clayey SILT (medium dense to very dense and medium stiff to hard)

Notes

1. Soil descriptions are generalized, based on interpretation of field and laboratory data. Stratigraphic contacts are interpolated between borings and based on topographic features; actual conditions may vary.
2. See report text for descriptions of geologic units.
3. For Cross Section location, see the RI Soil Sample Locations, Figure 3.
4. Dashed borings are projected >100ft from cross section line.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 80 160
Horizontal Scale: 1: = 80'
Vertical Scale: 1" = 10'

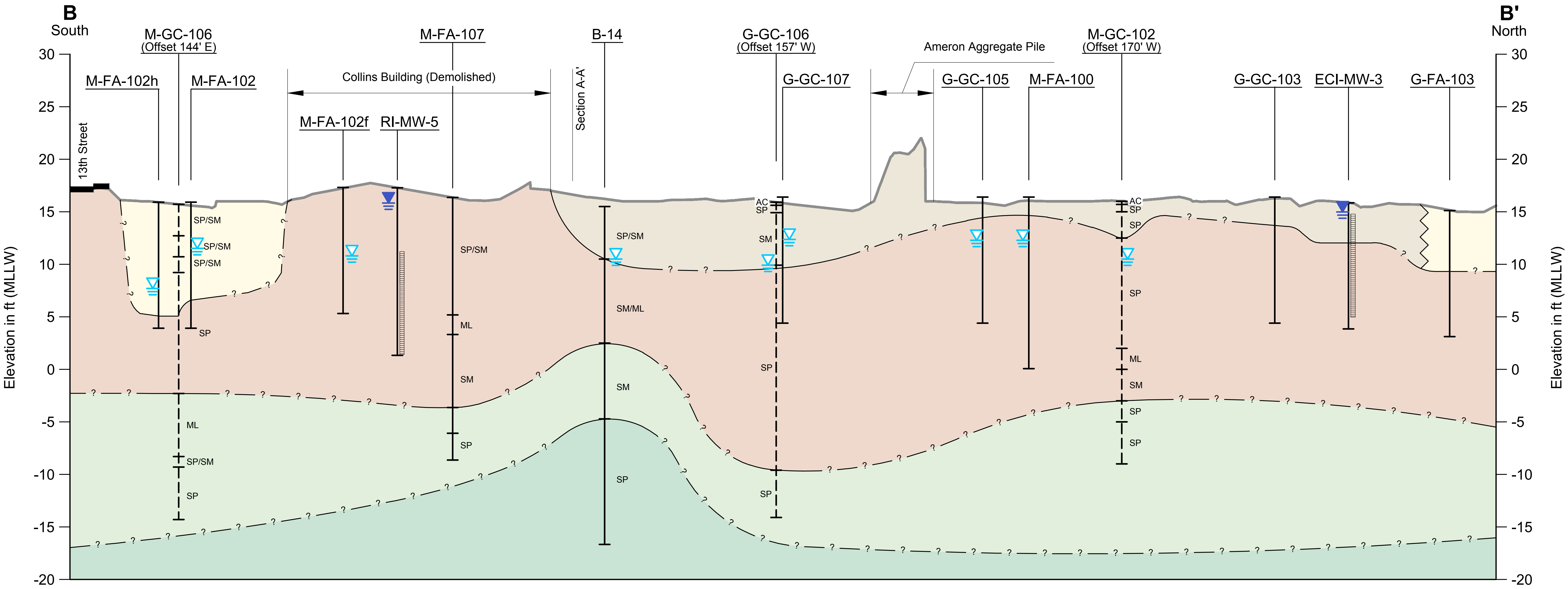
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Geologic Cross Section A-A'

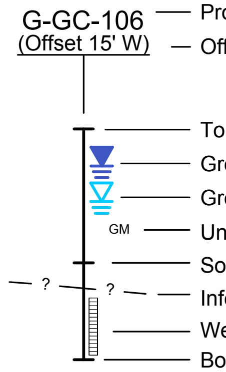
Figure
10

LANDAU ASSOCIATES

LANDAU ASSOCIATES, INC. | V:\147\029\500\613 AH\Sections A & B.dwg (A) "Figure 10" 1/25/2013



Legend


G-GC-106 — Project Exploration Designation
(Offset 15' W) — Offset Distance in Feet and Direction
Top of Exploration
Groundwater Level (Measured)
Groundwater Level (At time of drilling)
GM — Unified Soils Classification Symbol
Soil Type Contact
? — Inferred Geologic Contact
Well Screen Interval (If Installed)
Bottom of Exploration

🟫	Non-Dredge Fill	Fine to fine medium SAND with silt and gravelly SAND (very loose to dense)
🟨	Non-Dredge Fill with Debris Materials	Fine to coarse SAND with no silt to silty, and sandy coarse gravel, with brick, concrete-like material, timber, and wood debris (loose to medium dense)
🟫	Hydraulic Fill	Fine to fine medium SAND with silt to trace silt and silty fine SAND to fine sandy SILT with shell fragments (loose to medium dense and soft to medium stiff)
🟩	Marine Sediment	Fine SAND with silt to silty fine SAND and fine sandy SILT to clayey SILT (very loose to medium dense and very soft to medium stiff)
🟩	Glacial/ Interglacial Sediment	Fine to medium SAND with silt to trace silt and clayey SILT (medium dense to very dense and medium stiff to hard)

Notes

1. Soil descriptions are generalized, based on interpretation of field and laboratory data. Stratigraphic contacts are interpolated between borings and based on topographic features; actual conditions may vary.
2. See report text for descriptions of geologic units.
3. For Cross Section location, see the RI Soil Sample Locations, Figure 3.
4. Dashed borings are projected >100ft from cross section line.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 80 160
Horizontal Scale: 1: = 80'
Vertical Scale: 1" = 10'

LANDAU ASSOCIATES, INC. | V:\147\029\500\613 AH\Sections A & B.dwg (A) "Figure 11" 1/25/2013

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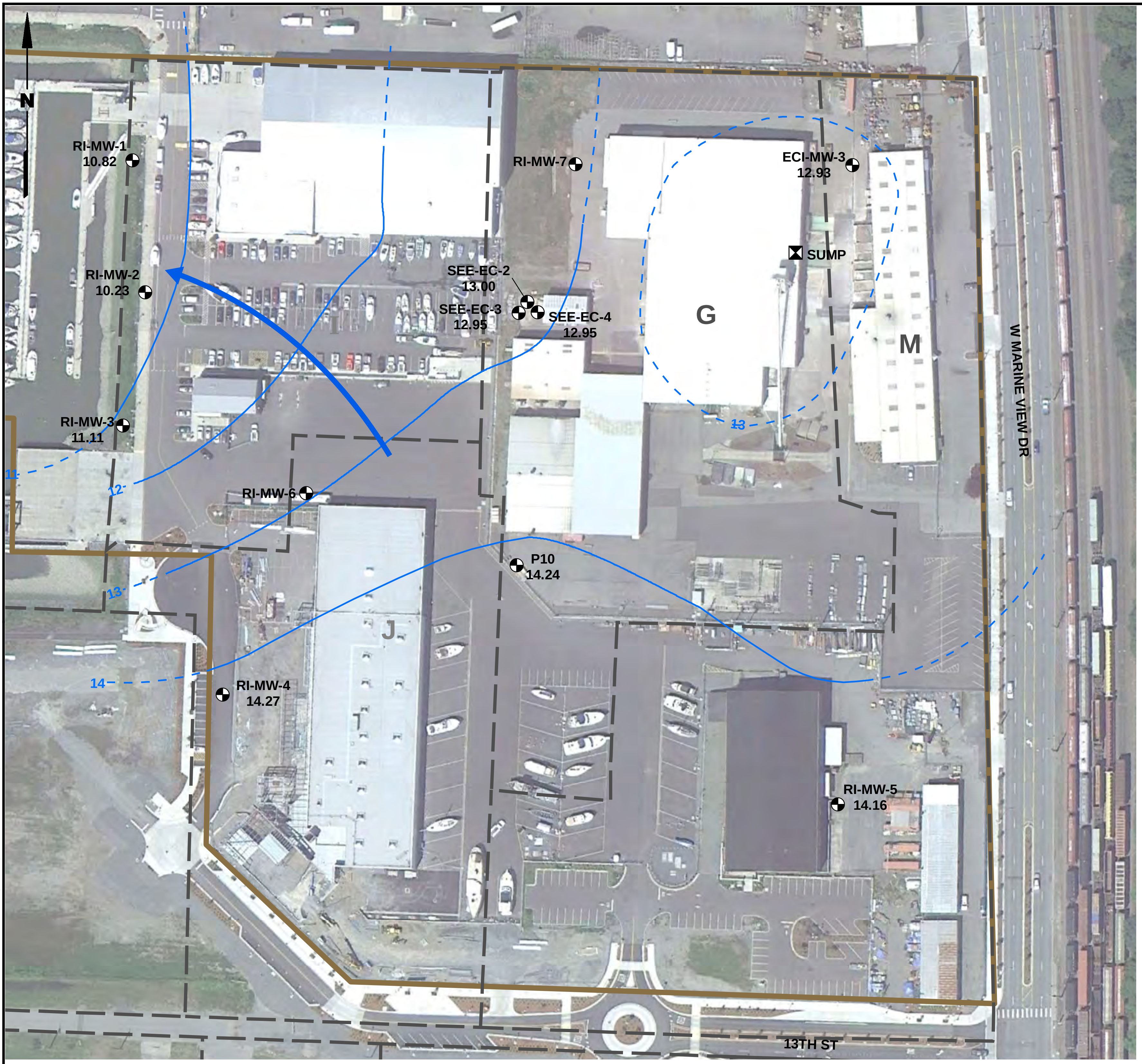
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Geologic Cross Section B-B'

Figure
11



Legend

- ● RI-MW-5 14.16 Groundwater Sample Location and Elevation (ft)
- ☒ Concrete Settling Basin Sump
- — Groundwater Elevation Contour (ft MLLW)
- ▭ Approximate Ameron/Hulbert Site Boundary
- ⌐┐ G - Area Designation
- ← Estimated Direction of Groundwater Flow

0 140 280

Scale in Feet

Note

1. RI-MW-6 and RI-MW-7 were installed in October 2011 and are not included in contours.
2. Groundwater monitoring data recorded on 1/19/2011 between 15:00 and 15:45.
3. All water level data used in commutation of groundwater contours except SEE-EC-2 and SEE-EC-4.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig12-GWElevationHighTide.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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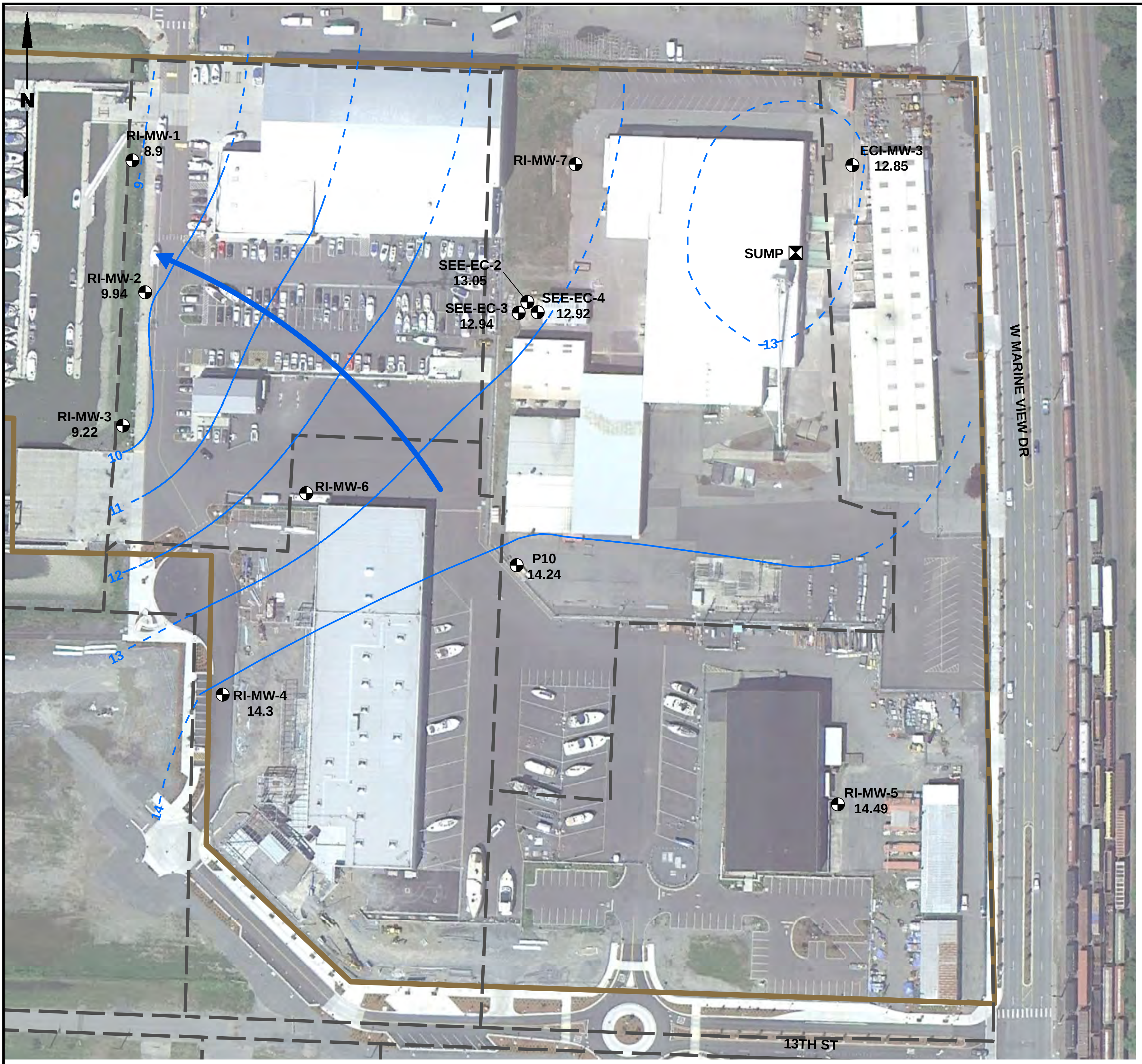
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Elevation Contour Map - High Tide January 19, 2011

Figure
12



Legend

● RI-MW-5 14.49 Groundwater Sample Location and Elevation (ft)

☒ Concrete Settling Basin Sump

— Groundwater Elevation Contour (ft MLLW)

▭ Approximate Ameron/Hulbert Site Boundary

⌐¬ G - Area Designation

← Estimated Direction of Groundwater Flow

0 140 280

Scale in Feet

Note

1. RI-MW-6 and RI-MW-7 were installed in October 2011 and are not included in contours.
2. Groundwater monitoring data recorded on 1/19/2011 between 10:10 and 11:00.
3. All water level data used in commutation of groundwater contours except SEE-EC-2 and SEE-EC-4.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig13-GWElevationIntermediateTide.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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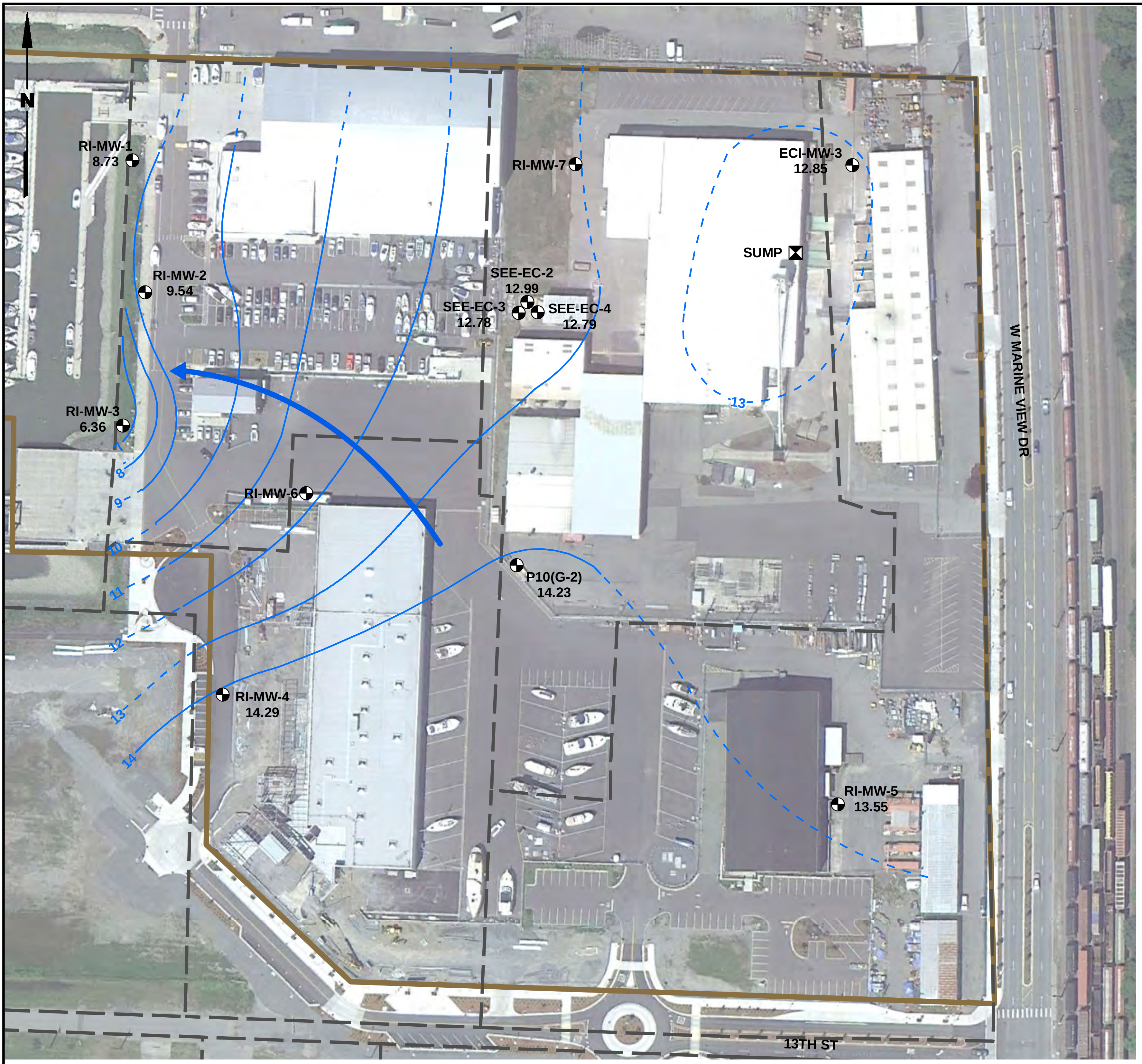
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Elevation Contour Map - Intermediate Tide January 19, 2011

Figure
13



Legend

● RI-MW-5 13.55 Groundwater Sample Location and Elevation (ft)

☒ Concrete Settling Basin Sump

— Groundwater Elevation Contour (ft MLLW)

▭ Approximate Ameron/Hulbert Site Boundary

⌐ ¬ G - Area Designation

← Estimated Direction of Groundwater Flow

0 140 280
Scale in Feet

Note

1. RI-MW-6 and RI-MW-7 were installed in October 2011 and are not included in contours.
2. Groundwater monitoring data recorded on 2/22/2011 between 13:00 and 14:00.
3. All water level data used in commutation of groundwater contours except SEE-EC-2 and SEE-EC-4.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig14-GWElevationLowTide.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Elevation Contour Map - Low Tide February 22, 2011

Figure
14

Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig15-GWElevationLowTideOct2011.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

● RI-MW-5 13.55	Groundwater Sample Location and Elevation (ft)
☒	Concrete Settling Basin Sump
—	Groundwater Elevation Contour (ft MLLW)
▭	Approximate Ameron/Hulbert Site Boundary
⌐ ¬	G - Area Designation
←	Estimated Direction of Groundwater Flow

0 140 280

Scale in Feet

Note
1. Groundwater monitoring data recorded on 10/11/2011 between 10:15 and 16:30.
2. All water level data used in commutation of groundwater contours except SEE-EC-2 and SEE-EC-4.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

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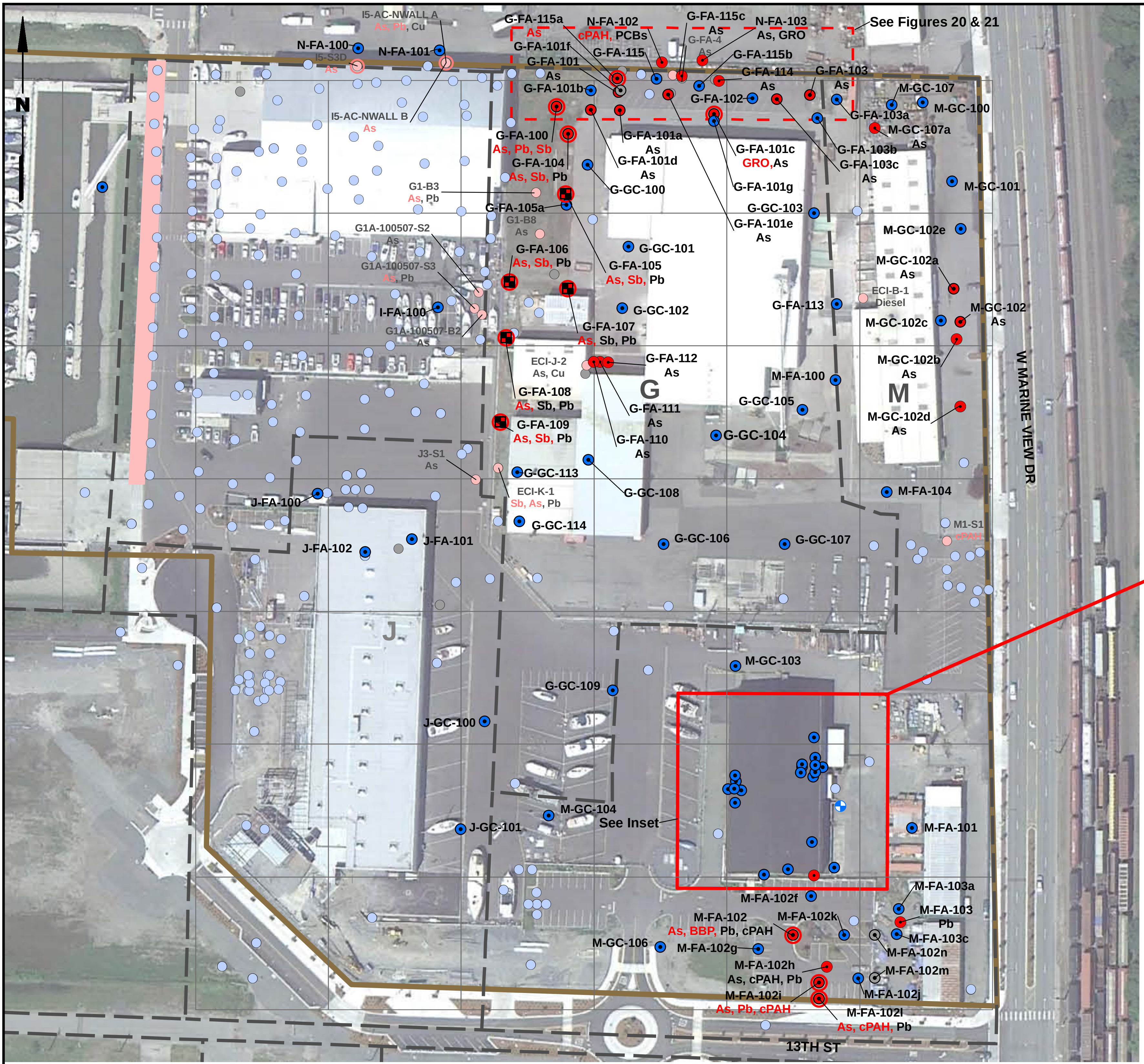
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Elevation Contour Map - Low Tide October 11, 2011

Figure
15



Inset Shows Pre-Emergency Cleanup Action Conditions. Primary Figure Shows Post-Emergency Action Conditions.

Legend

- ○ Soil Sample with a Concentration Greater than 5x the Preliminary Screening Level
- ● Soil Sample Exceeded Preliminary Screening Level - Represents Soil Remaining
- ● Soil Sample Below Preliminary Screening Level
- ◐ Monitoring Well
- ▣ Test Pit
- ● Previous Soil Sample Exceeded Preliminary Screening Level - Constituent that exceeds is noted below sample name - Represents Soil Remaining
- ● Previous Soil Sample Below Preliminary Screening Levels - Represents Soil Remaining
- ● Previous Soil Sample Locations with No Analytical Data
- ☐ 150' Sample Grid
- ▭ Approximate Ameron/Hulbert Site Boundary
- ⌐ G - Area Designation
- 🟥 Area of Arsenic-Affected Crushed Rock (No Analytical Data Available for Crushed Rock Remaining in this Area)

0 140 280

Scale in Feet

Data Source: Google Earth Pro (2011 Image)

Notes

1. As = Arsenic; Cu = Copper; CPAH = Carcinogenic polycyclic aromatic hydrocarbons; Pb = Lead; GRO = Gasoline-Range Organics; DRO = Diesel-Range Organics; BBP = Benzyl Butyl Phthalate; PCBs = Polychlorinated Biphenyls; Sb = Antimony.
2. Analytes in red text are present at a concentration greater than 5x the Preliminary Screening Level.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

G:\Projects\1470\029\500\064\02012 RIFS Report\Fig16-AnalyticalResultsSoil.mxd 1/17/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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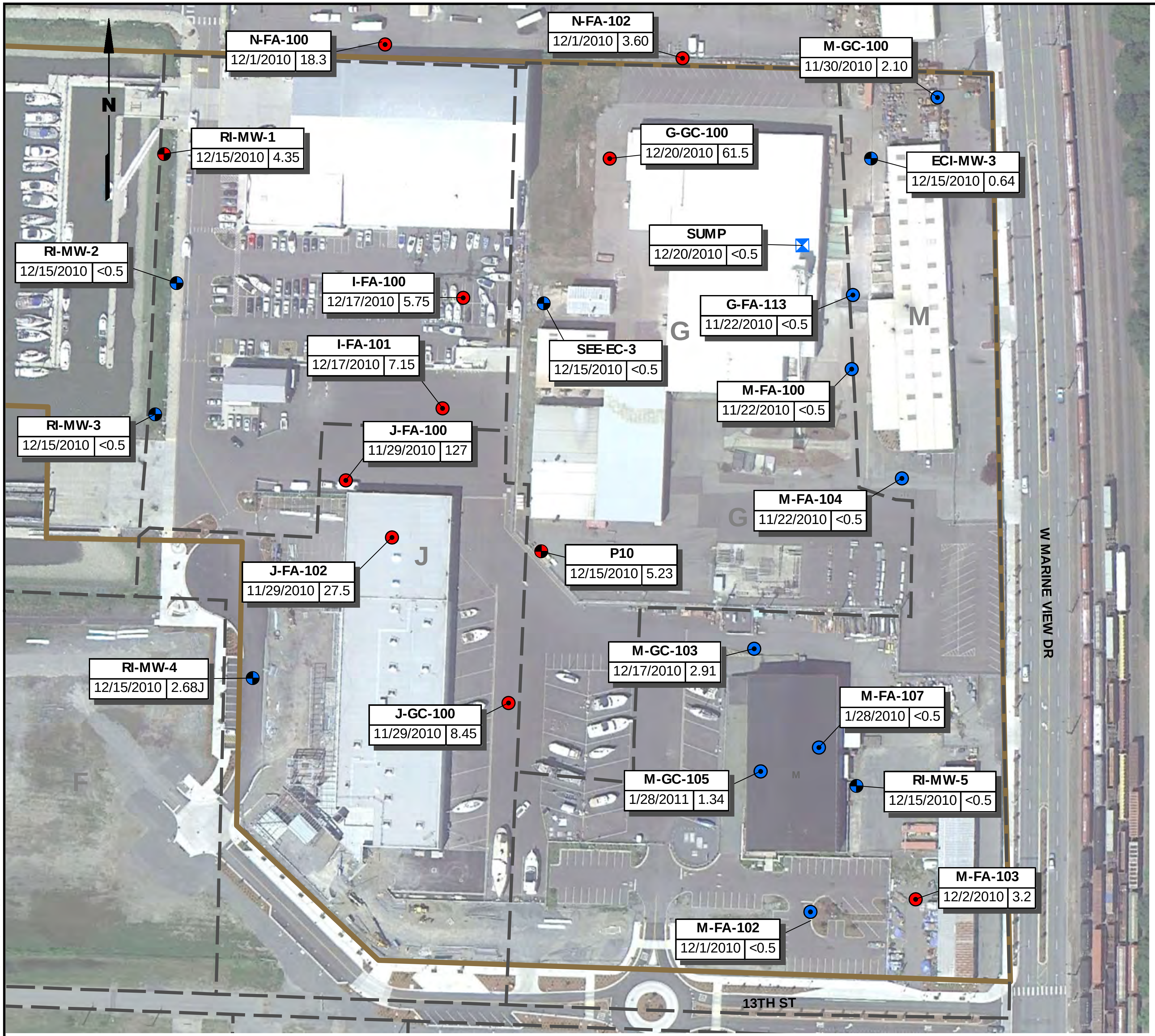
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Soil Analytical Results

Figure
16



Legend

◐ Monitoring Well

⊙ Soil Boring

🔴 Groundwater Sample Exceeds Preliminary Screening Level (3.1 µg/L) - (Only exceedances in dissolved concentrations are shown).

🔵 Groundwater Sample Does Not Exceed Preliminary Screening Level For Copper

▭ Approximate North Marina Ameron/Hulbert Site Boundary

G - Area Designation

0 150 300

Scale in Feet

Note
1. **Black** text indicates RI well or boring groundwater sampling locations.
2. All results shown in µg/L.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

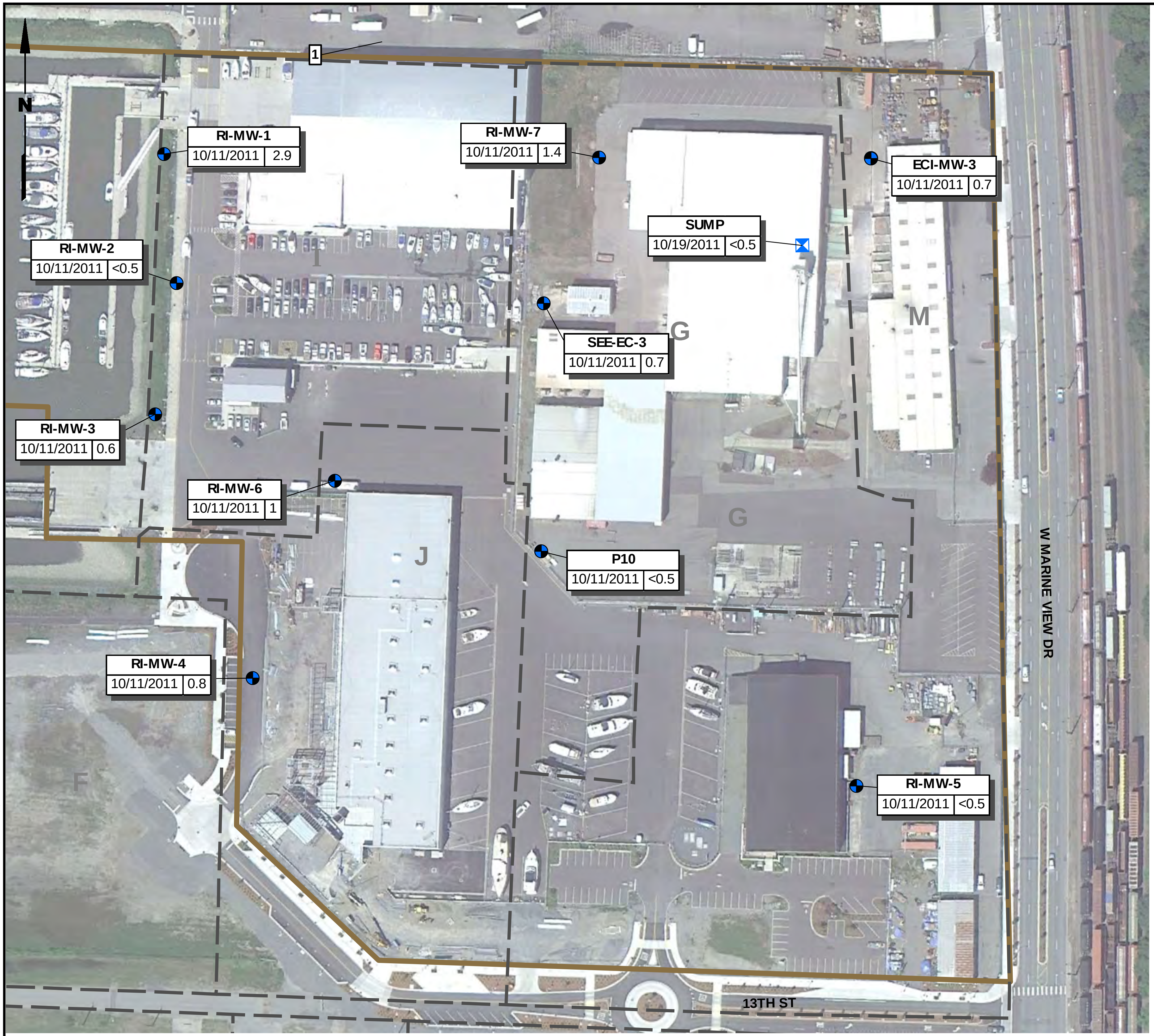
G:\Projects\147\029\500\640\2012 RIFS Report\Fig17-CopperResultsGW.mxd 10/23/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

LANDAU ASSOCIATES

North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Analytical Results for Dissolved Copper November 2010 - January 2011

Figure
17



Y:\Projects\147029\Mapdocs\Ameron Hulbert Site\2012 RIFS Report\Fig18-CopperResultsGWDry.mxd 1/25/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

◕	Monitoring Well
●	Groundwater Sample Does Not Exceed Preliminary Screening Level For Copper
▭	Approximate North Marina Ameron/Hulbert Site Boundary
⌐	G - Area Designation

0 140 280

Scale in Feet

Notes
1. During the October 2011 groundwater sampling event, samples were collected only from monitoring wells. No groundwater grab samples were collected.
2. All results shown in µg/L.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

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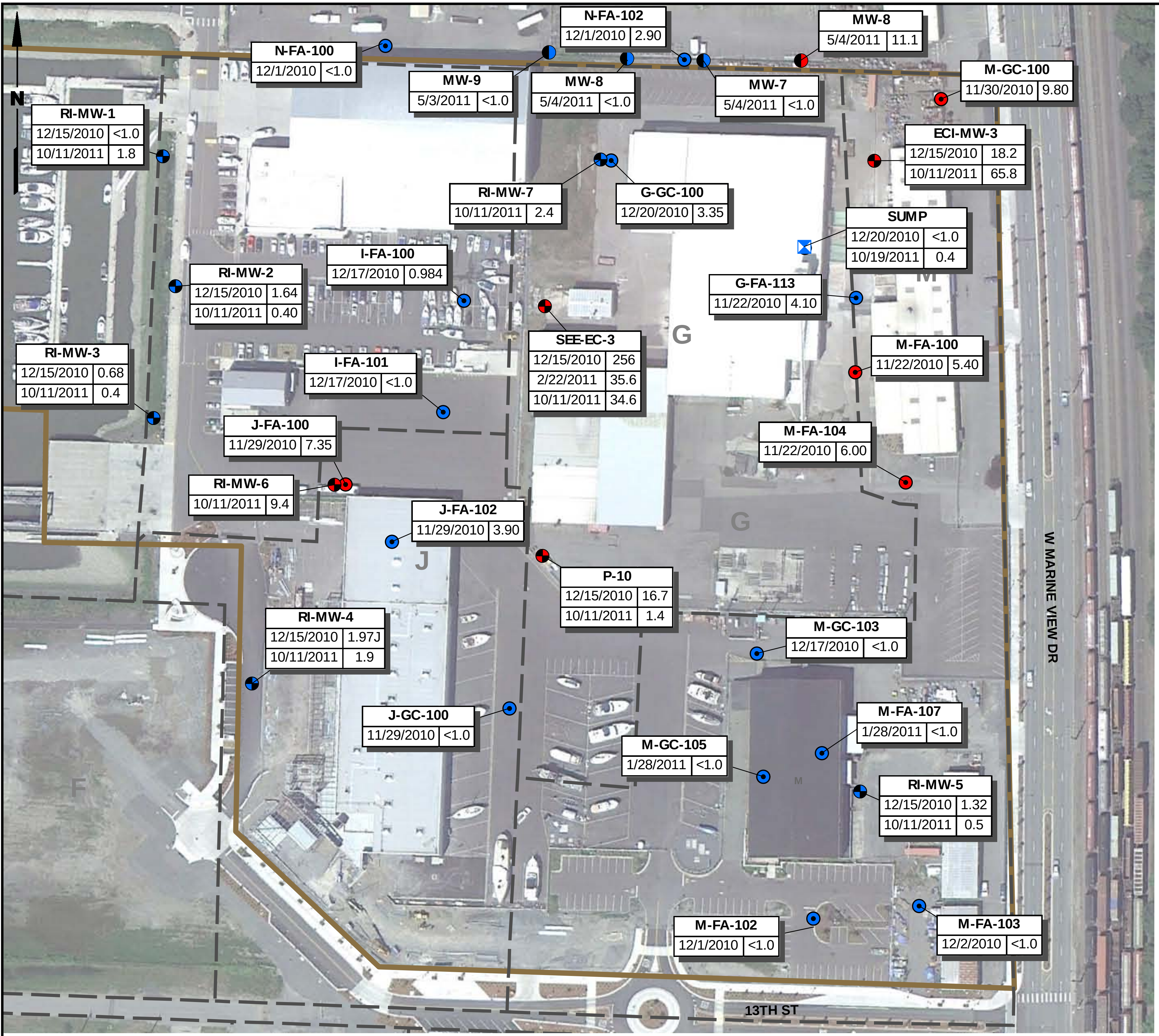
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Groundwater Analytical Results for Dissolved Copper October 2011

Figure 18



G:\Projects\147\029\500\640\2012 RIFS Report\Fig19-ArsenicResultsGW.mxd 12/20/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

⊕	Monitoring Well
⊙	Soil Boring
◐	TC Systems Monitoring Well
●	Groundwater Sample Exceeds Preliminary Screening Level (5 µg/L) - (Only exceedances in dissolved concentrations are shown).
●	Groundwater Sample Does Not Exceed Preliminary Screening Level for Arsenic
▭	Approximate North Marina Ameron/Hulbert Site Boundary
⌐¬	G - Area Designation

0 140 280

Scale in Feet

Notes
1. **Black** text indicates RI well or boring groundwater sampling locations.
2. All results shown in (µg/L)
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Google Earth Pro (2011 Image)

LANDAU ASSOCIATES

North Marina Ameron/Hulbert Site RI/FS Report Everett, Washington	**Groundwater Analytical Results for Dissolved Arsenic**	Figure 19

G:\Projects\147\029\500\640\2012 RIFS Report\Fig20-MaxDepthsExceedances.mxd 12/19/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

- ● Soil Sample with Maximum Depth of Exceedance: 0 - 1 ft
- ● Soil Sample with Maximum Depth of Exceedance: > 1 - 4.0 ft
- ● Soil Sample with Maximum Depth of Exceedance:> 4 ft
- ⊙ RI Soil Sample Below Preliminary Screening Levels - Represents Soil Remaining
- ◐ RI Location with No Analytical Results
- ■ Test Pit Sample with Maximum Depth of Exceedance: 0 - 1 ft
- ■ Test Pit Sample with Maximum Depth of Exceedance: > 1 - 4.0 ft
- ■ Test Pit Sample with Maximum Depth of Exceedance:> 4 ft
- ● Previous Soil Sample Below Preliminary Screening Levels - Represents Soil Remaining
- ● Previous Soil Sample Locations with No Analytical Data
- ▨ Arsenic - Affected Crushed Rock Containment Area (0-6 ft BGS)
- ⌐¬ Approximate Area of Construction Debris with Occasional Exceedances for As and cPAH Overlain by 4-13 ft of Clean Fill
- ☐ 150' Sample Grid
- ▭ Approximate Ameron/Hulbert Site Boundary
- ⌐¬ G - Area Designation

0 140 280

Scale in Feet

Data Source: Google Earth Pro (2011 Image)

Notes

1. As = Arsenic; Cu = Copper; CPAH = Carcinogenic polycyclic aromatic hydrocarbons; Pb = Lead; GRO = Gasoline-Range Organics; DRO = Diesel-Range Organics; BBP = Benzyl Butyl Phthalate; PCBs = Polychlorinated Biphenyls; Sb = Antimony.
2. Depths listed indicate depth below pavement and base coarse where applicable.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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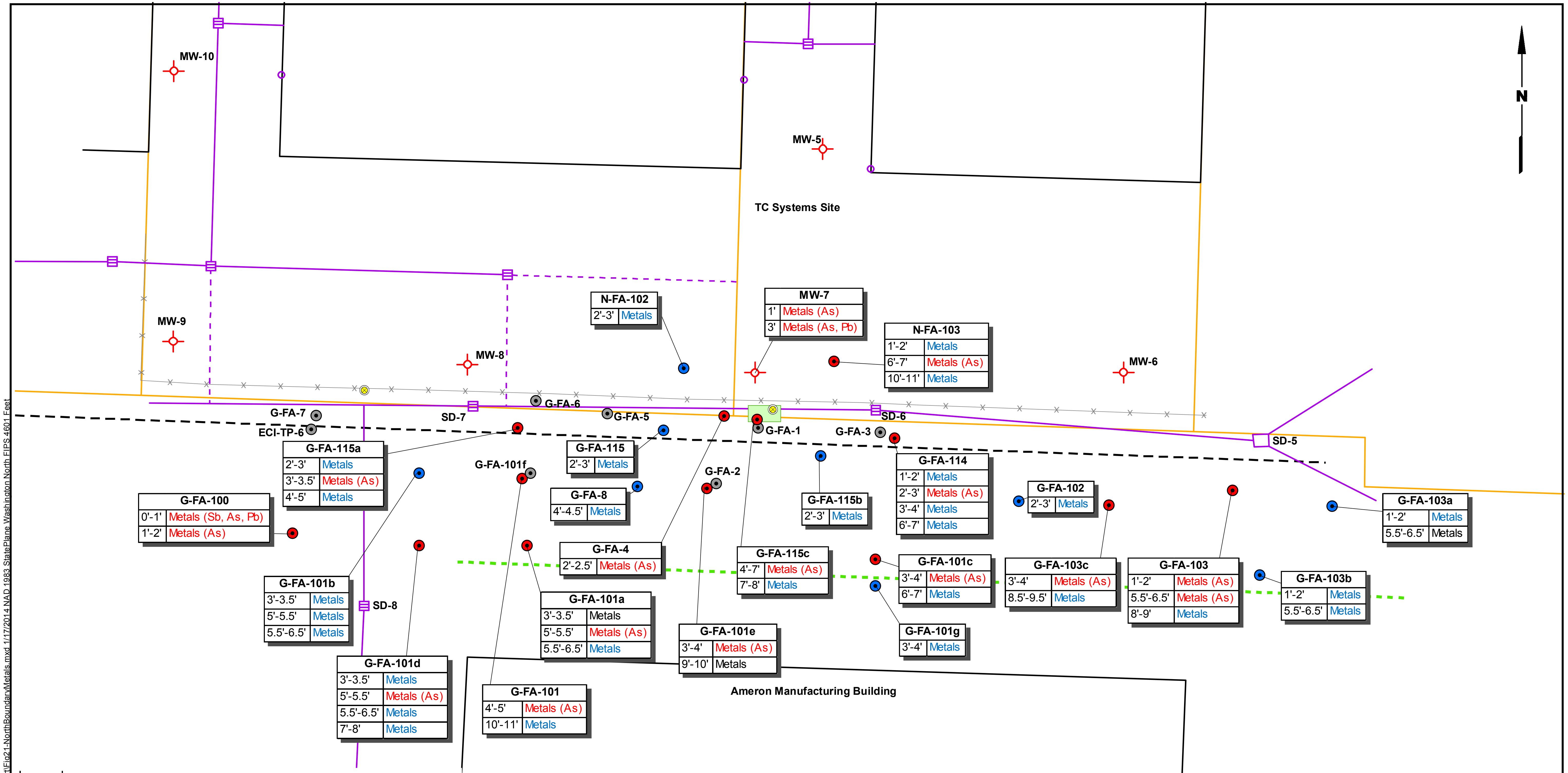
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Soil Analytical Results - Depth of Remaining Impacted Soil

Figure
20



Legend

- 🔴 Soil Sample Exceeded Preliminary Screening Level
- 🔵 Soil Sample Below Preliminary Screening Level
- ● Soil Sample Locations with No Analytical Data
- ⌖ TC Systems Wells
- ⊗ Manhole (Paved Over)
- 🟩 Approximate Location of Oil-Affected Area Excavation
- - - 1976 Pavement Line (Approximate)
- — Building
- x Chain Link Fence
- — Storm Line (Current Alignment)
- - - Storm Line (Historical Alignment)
- — Parcel Line
- — — Approximate Location of Historical Grade Difference (Interpreted from aerial photos dated 9/13/73 & 4/11/80)

Notes

1. Red text indicates an exceedance.
   Blue text indicates an analyte was detected below the screening level.
   Black text indicates parameter was tested for, but not detected.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60
Scale in Feet

Data Source: Topographic and Boundary Survey for TC Systems Site
Prepared by Otak Incorporated dated May 10, 2011; Google Earth Pro

G:\Projects\147\029\500\640\2012 RIFS Report\Fig21-NorthBoundaryMetals.mxd 1/17/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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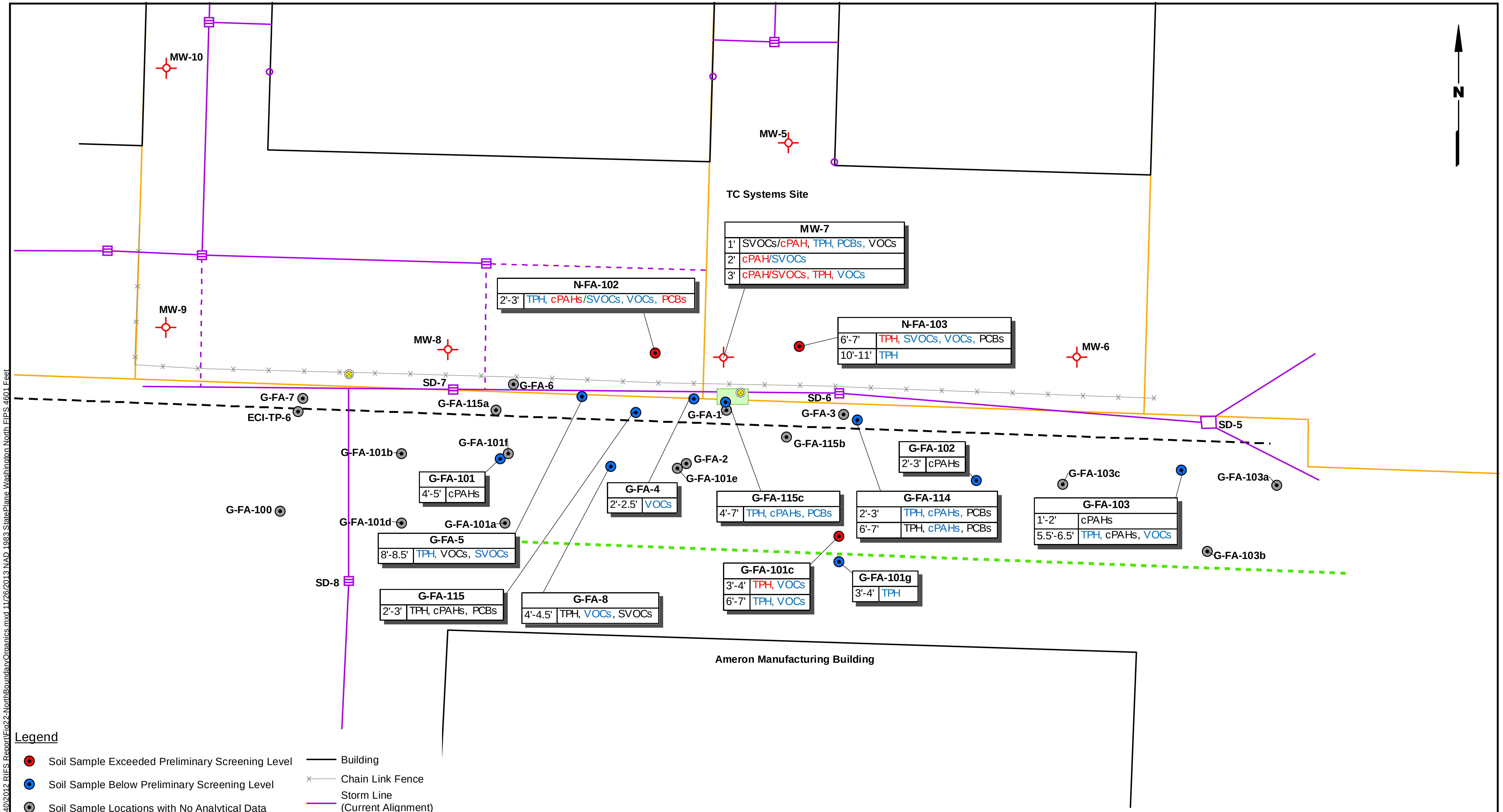
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Soil Analytical Results for Metals North Property Boundary

Figure 21



G:\Projects\147\029\500\640\2012 RIFS Report\Fig22-NorthBoundaryOrganics.mxd 11/26/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

- ● Soil Sample Exceeded Preliminary Screening Level
- ● Soil Sample Below Preliminary Screening Level
- ● Soil Sample Locations with No Analytical Data
- ⌖ TC Systems Wells
- ⊗ Manhole (Paved Over)
- 🟩 Approximate Location of Oil-Affected Area Excavation
- - - 1976 Pavement Line (Approximate)
- — Building
- ×— Chain Link Fence
- — Storm Line (Current Alignment)
- - - Storm Line (Historical Alignment)
- — Parcel Line
- - - Approximate Location of Historical Grade Difference (Interpreted from aerial photos dated 9/13/73 & 4/11/80)

Notes
1. Red text indicates an exceedance.
   Blue text indicates an analyte was detected below the screening level.
   Black text indicates parameter was tested for, but not detected.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 25 50

Scale in Feet

Data Source: Topographic and Boundary Survey for TC Systems Site Prepared by Otak Incorporated dated May 10, 2011; Google Earth Pro

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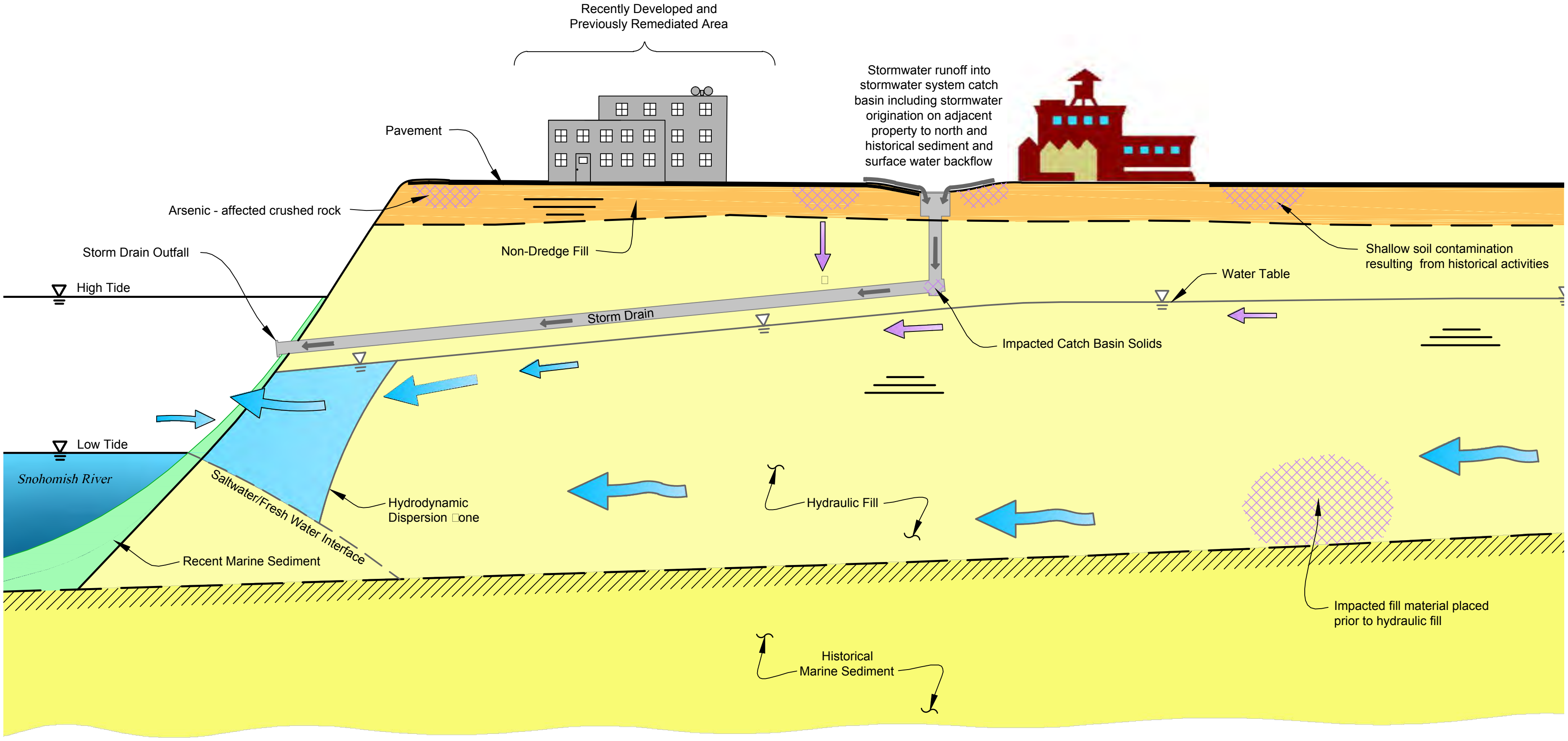
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Soil Analytical Results for Organics North Property Boundary

Figure
22



Legend

▽	Water Table
▼	Tidally Influenced Water Level
▨	Impacted Soil
☰	Wood Debris
←	Groundwater Flow Direction
←	Potential Transport of Contaminants (See Note 2)

Notes:

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. Arsenic present in groundwater due to reduced groundwater chemistry.

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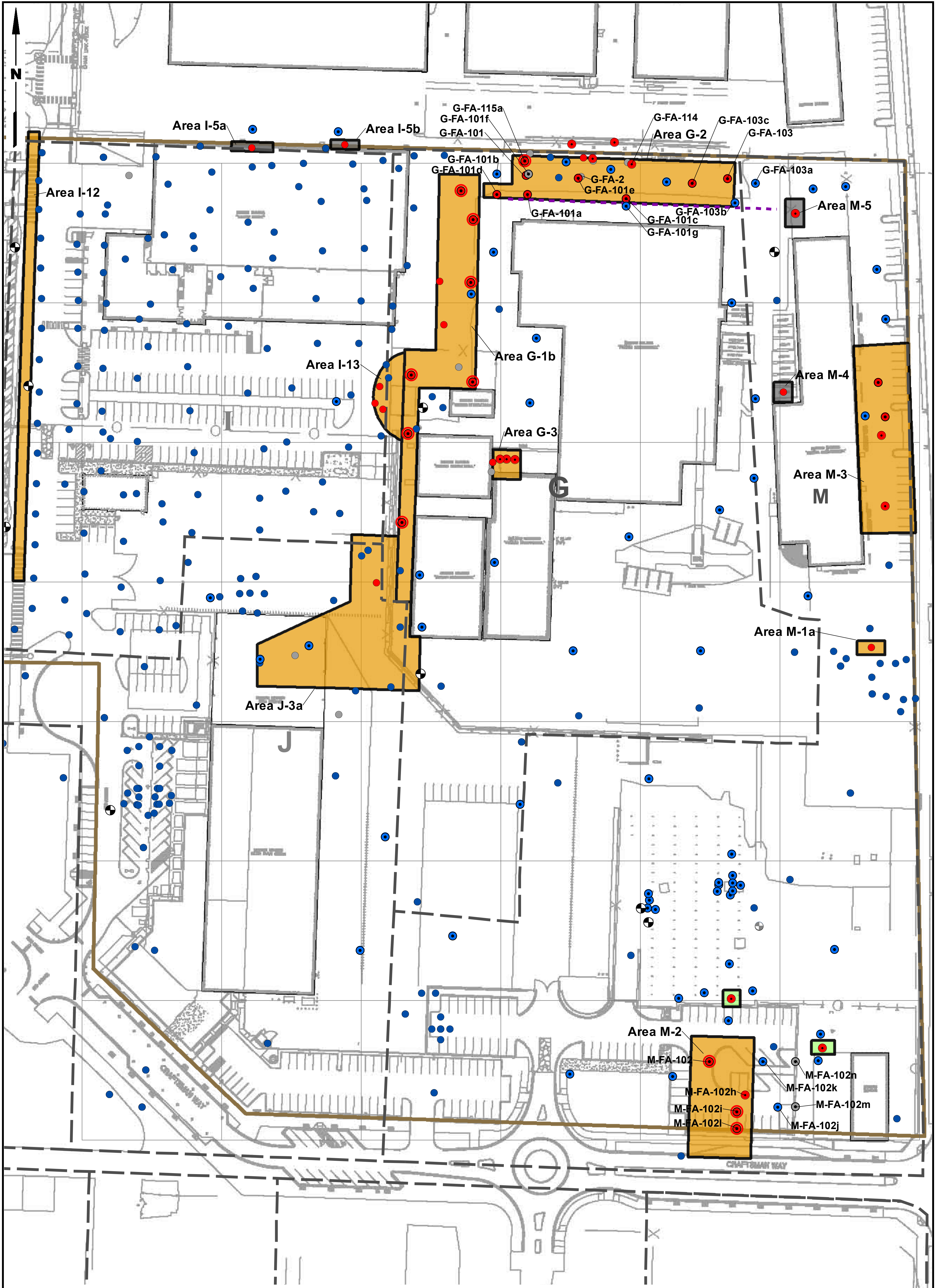
North Marina Ameron-Hulbert Site
RI/FS Report
Everett, Washington

Conceptual Site Model

Figure
23

G:\Projects\147\029\500\640\2012 RIFS Report\Fig24-CleanupAreaDesignations.mxd 1/17/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

○ Soil Sample with a Concentration Greater than 5x the Preliminary Screening Level

● Soil Sample Exceeded Preliminary Screening Level - Represents Soil Remaining

● Soil Sample Below Preliminary Screening Level

◐ Monitoring Well to be Included in Compliance Monitoring

● Previous Soil Sample Exceeded Preliminary Screening Level - Represents Soil Remaining

● Previous Soil Sample Below Preliminary Screening Levels - Represents Soil Remaining

---- 1976 Pavement Line (Approximate)

🟧 Cleanup Areas

⬛ Isolated Cleanup Areas to be Addressed Under Soil Management Plan

🟩 Isolated Cleanup Areas Addressed Using Statistical Compliance

0 100 200

Scale in Feet

Note

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

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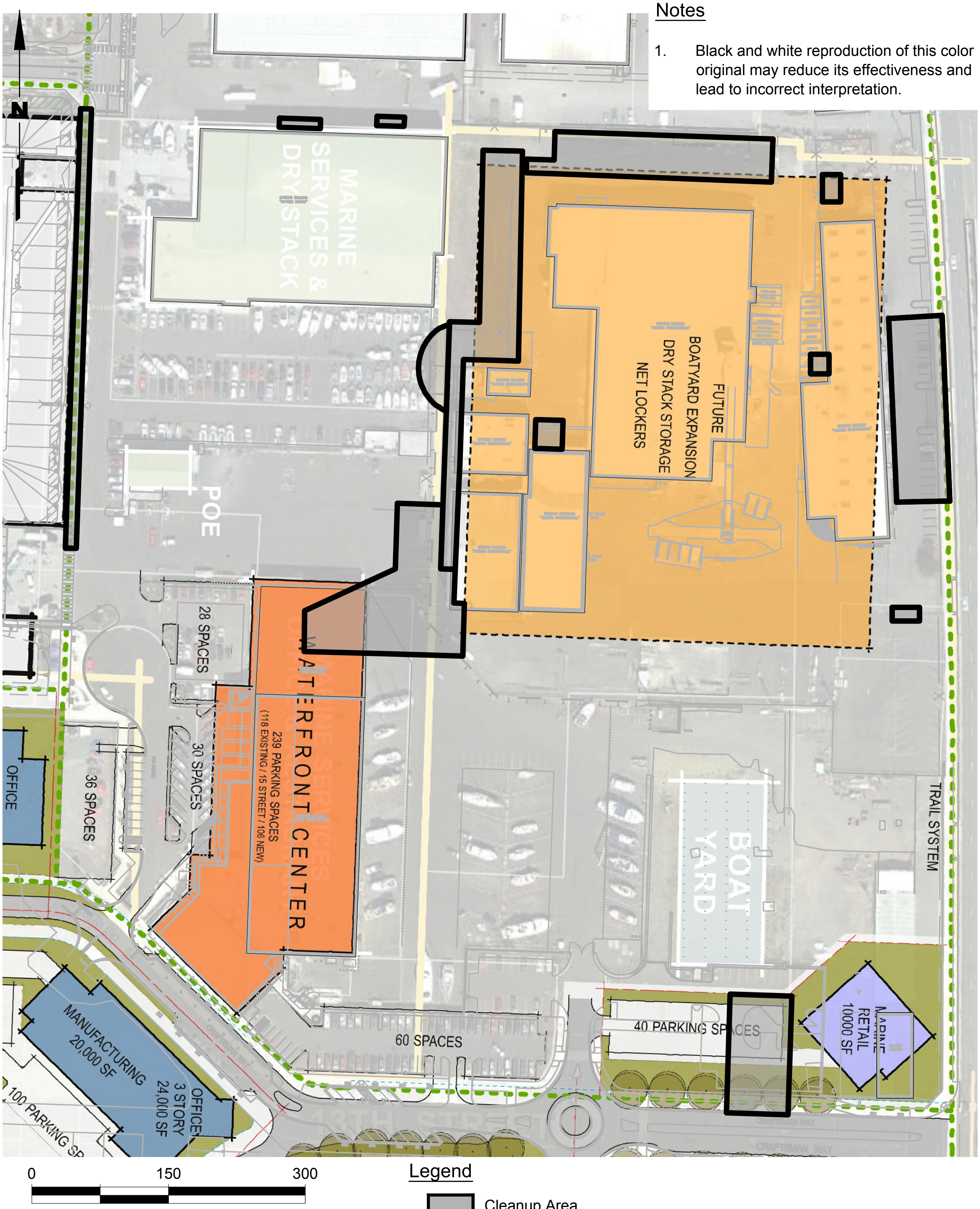
North Marina Ameron/Hulbert Site
Supplemental RI/FS Work Plan
Everett, Washington

Cleanup Area Designations

Figure
24

Notes

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



Legend

▨ Cleanup Area

Source: Port of Everett 2012

LANDAU ASSOCIATES, INC. | G:\Projects\147\029\500\640\2012 RIFS Report\overlay.dwg (A) "Figure 25" 11/26/2013

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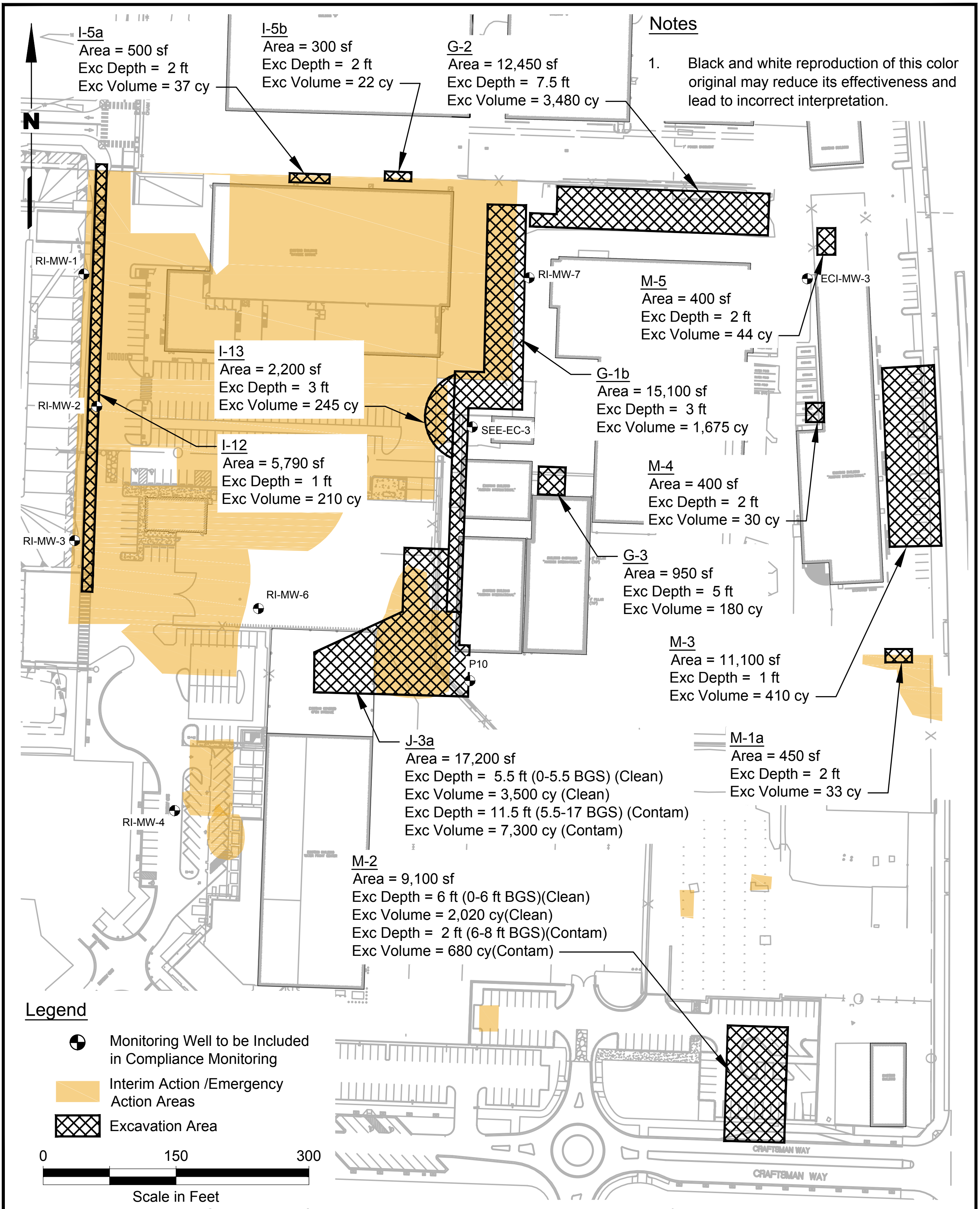
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Relationship of Cleanup Areas to Planned Future Development

Figure
25



Notes

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

Source: Port of Everett 2012, PND Engineers, Inc 2012, David Evans & Associates, Inc 2004

LANDAU ASSOCIATES, INC. | G:\Projects\1470\029\500\640\2012 RIFS Report\Alternatives.dwg (A) "Figure 26" 11/26/2013

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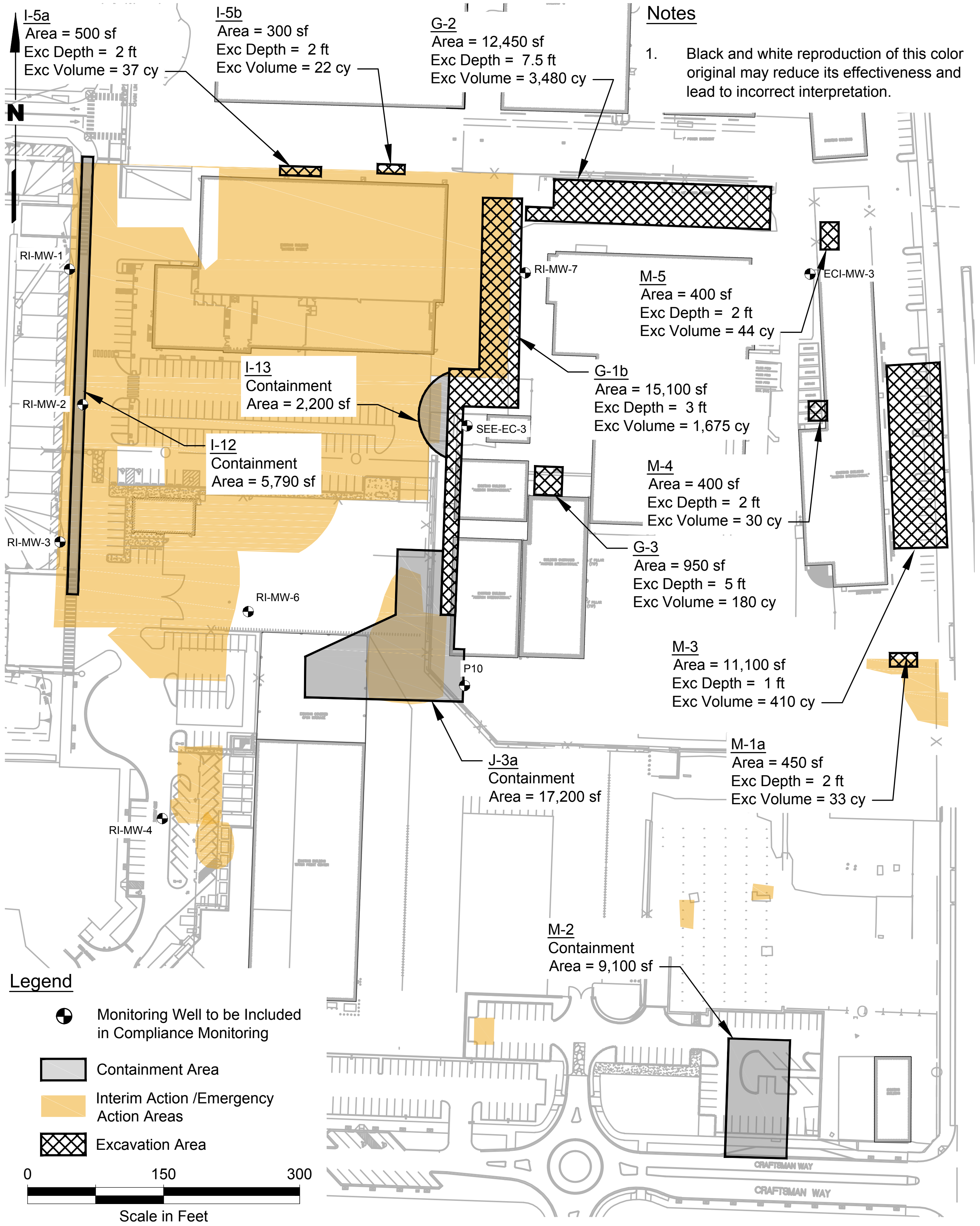
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Alternative 1
Site Wide Remedial Excavation

Figure
26



Notes

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

Legend

●	Monitoring Well to be Included in Compliance Monitoring
▒	Containment Area
🟧	Interim Action /Emergency Action Areas
▩	Excavation Area

Source: Port of Everett 2012, PND Engineers, Inc 2012, David Evans & Associates, Inc 2004

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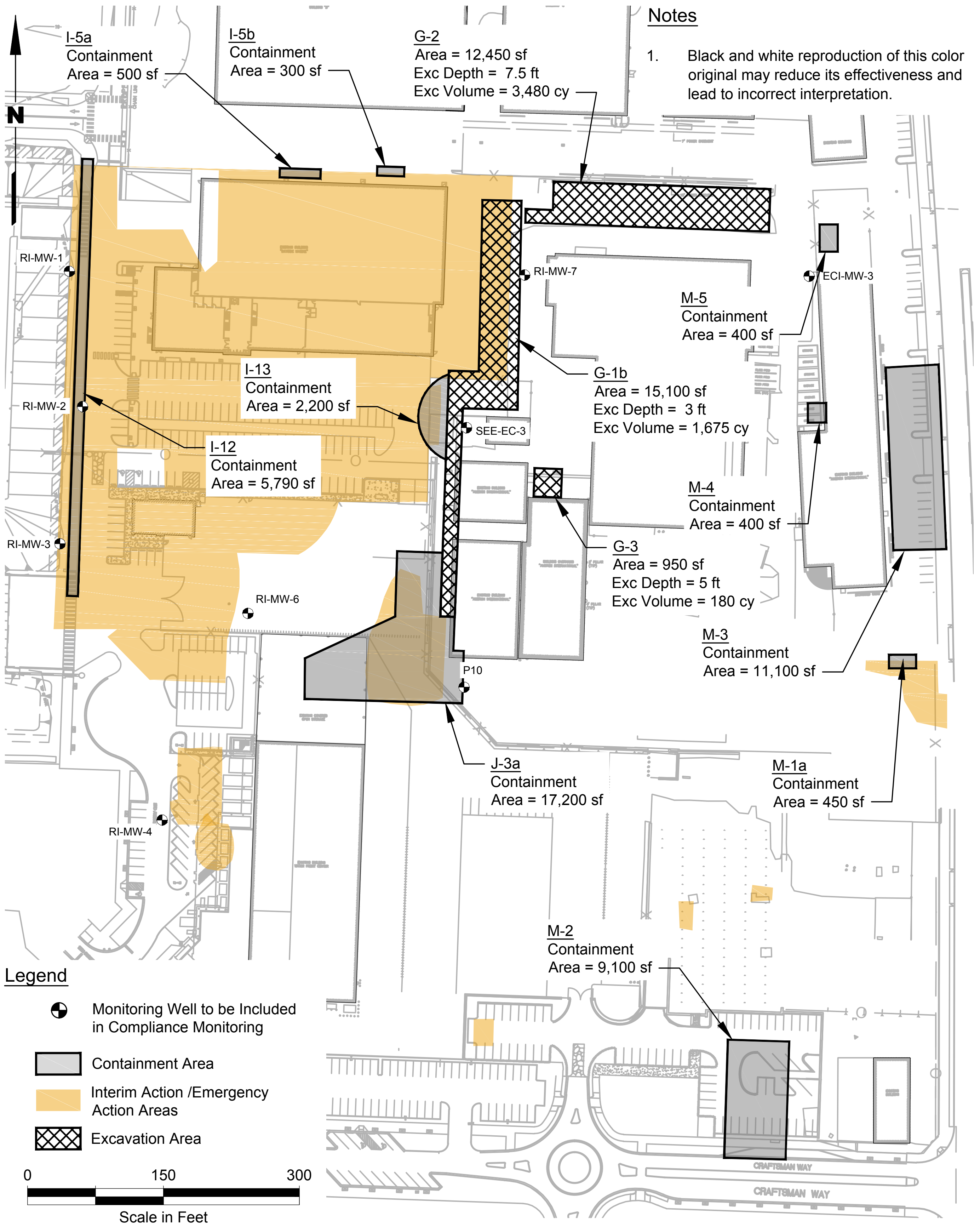
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Alternative 2
Containment With Focused Remedial Excavation

Figure
27

LANDAU ASSOCIATES, INC. | G:\Projects\147\029\500\640\2012 RIFS Report\Alternatives.dwg (A) "Figure 27" 11/26/2013



Notes

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

Source: Port of Everett 2012, PND Engineers, Inc 2012, David Evans & Associates, Inc 2004

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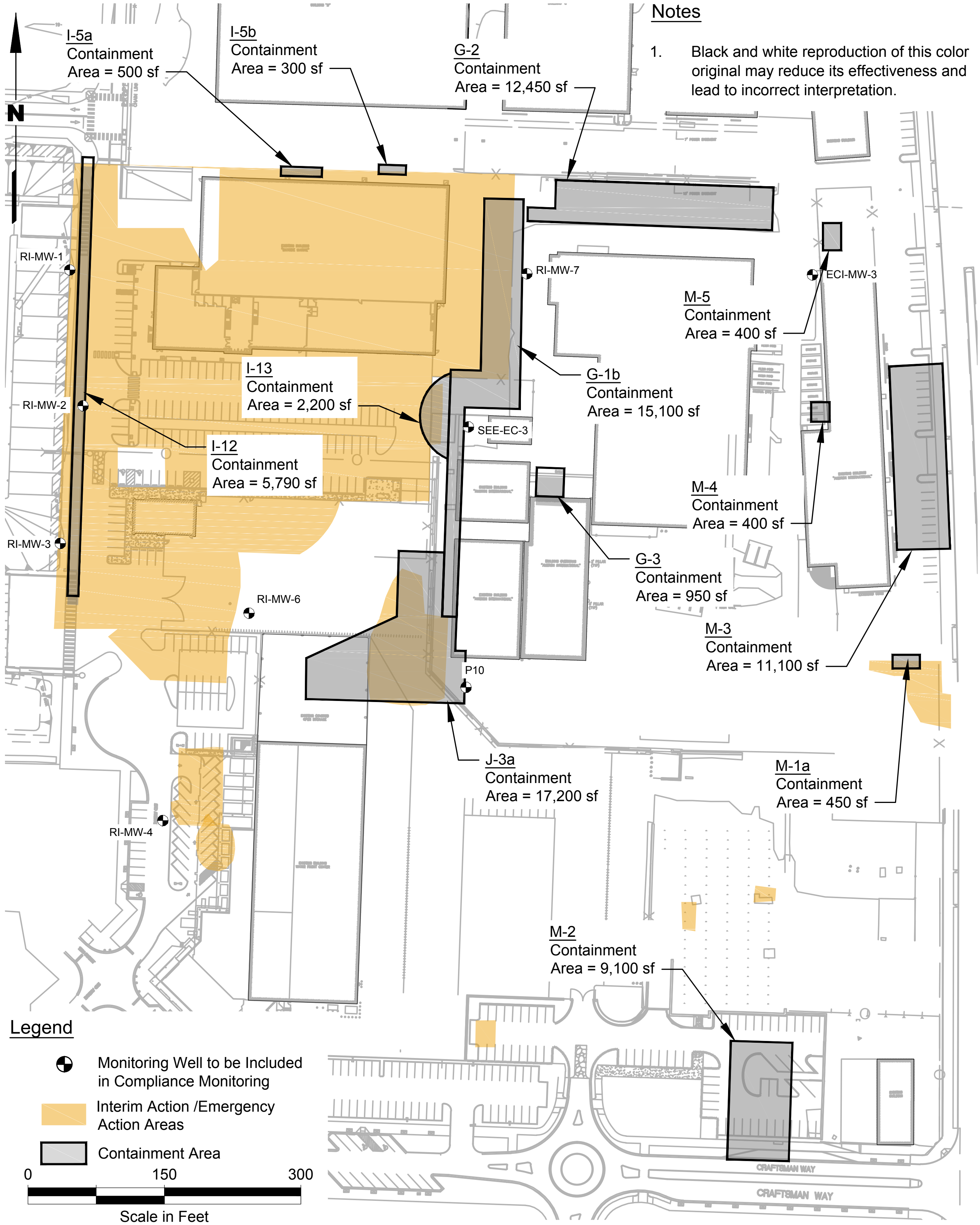
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Alternative 3
Containment with
Focused Remedial Excavation

Figure
28



Notes

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

Legend

◐	Monitoring Well to be Included in Compliance Monitoring
🟧	Interim Action /Emergency Action Areas
▭	Containment Area

0 150 300

Scale in Feet

Source: Port of Everett 2012, PND Engineers, Inc 2012, David Evans & Associates, Inc 2004

LANDAU ASSOCIATES, INC. | G:\Projects\1470029\500\640\2012 RIFS Report\Alternatives.dwg (A) "Figure 29" 11/26/2013

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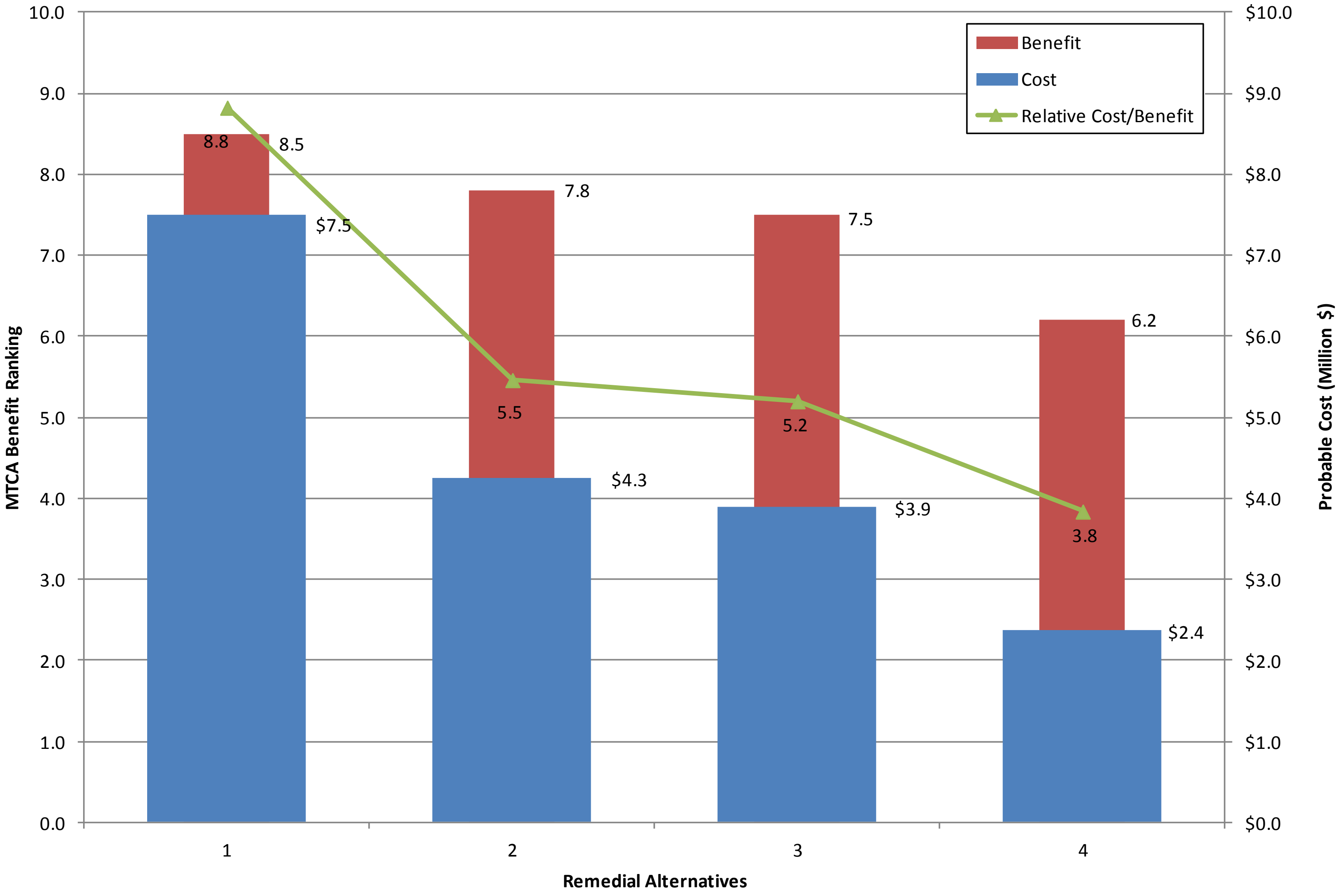
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Alternative 4
Site Wide Capping And Containment

Figure
29

Source: \\edmdata01\projects\147\029\500\FileRm\R\RI-FS Rpt\Public Review Dr\Tables\Public Review Dr A-H RI-FS Rpt_Tb 19.xlsx



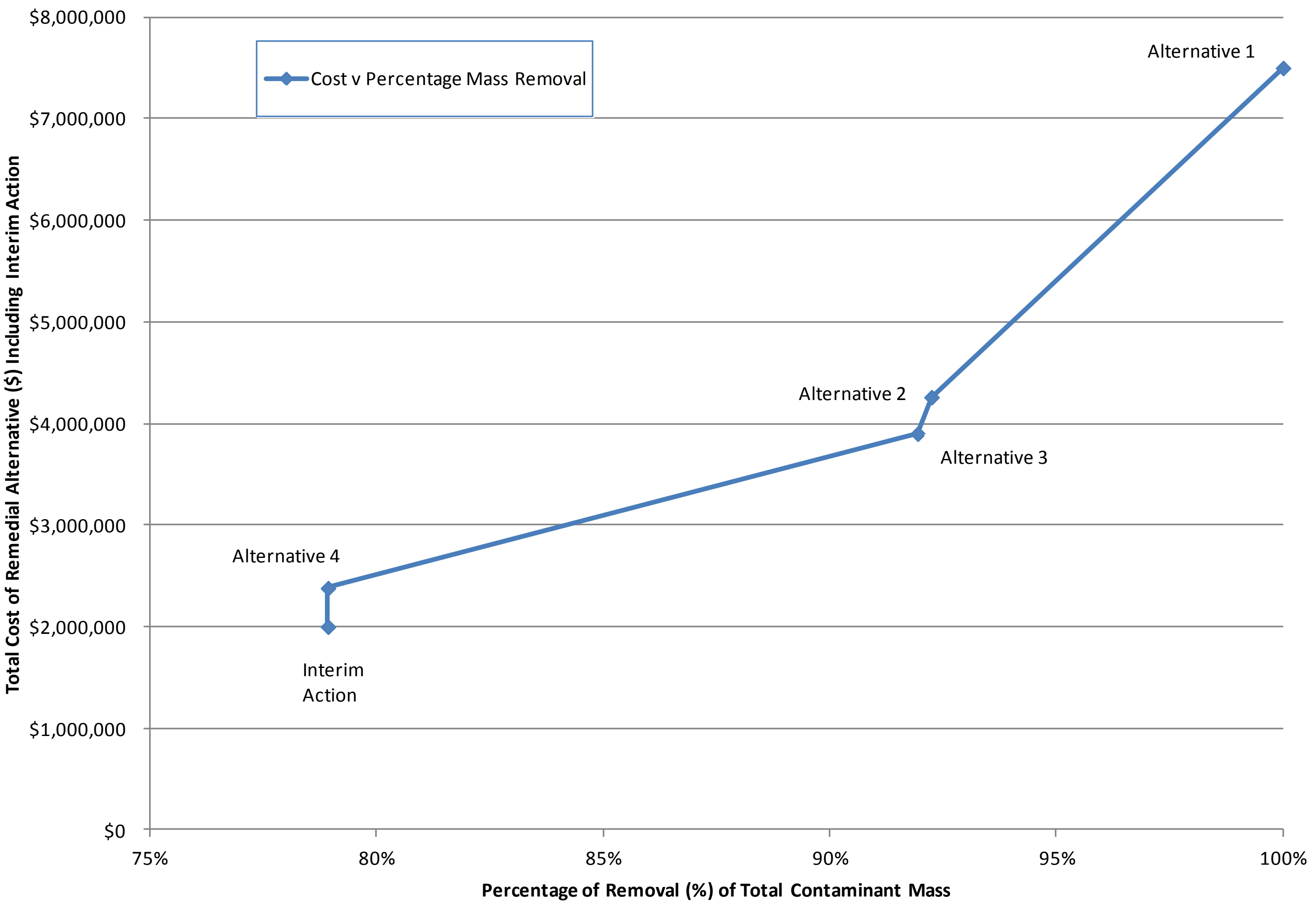
North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Disproportionate Cost Analysis (Relative Cost/Benefit Ratio)

Figure
30

Landau Associates

Source: \\edmdata01\projects\147\029\500\FileRm\R\RI-FS Rpt\Public Review Dr\Appendices\App I\Backup Files\mass removal calcs_122712_AppI_rev111813.xlsx



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North Marina Ameron/Hulbert Site
RI/FS Report
Everett, Washington

Cost of Remedial Alternatives Compared to Contaminant Mass Removal (Total Mass)

Figure
31

TABLE 1
SUMMARY OF PREVIOUS INTERIM ACTIONS
NORTH MARINA AMERON/HULBERT SITE RI/FS

Interim Action Area	Indicator Hazardous Substances (IHS)		Interim Cleanup Action Conducted			Compliance Monitoring Conducted Following Interim Cleanup Action?	
	Soil	Groundwater	Soil (a)		Groundwater	Soil	Groundwater
Investigation Area G							
G-1	Arsenic, Lead	Arsenic, Copper	Soil Removal	2,701	Source Removal	Yes	No
Investigation Area I							
I-1	Arsenic	--	Soil Removal	563	--	Yes	--
I-2	Arsenic	--	Soil Removal	7,965	--	Yes	--
I-3a	Arsenic, Lead, Copper	--	Soil Removal	3,654	--	Yes	--
I-3b	Arsenic, Lead, Copper	--	Soil Removal	-- (b)	--	Yes	--
I-4	Arsenic, Lead, Copper	--	Soil Removal	778	--	Yes	--
I-5	Arsenic, Copper	Copper	Soil Removal	3,813	--	Yes	--
I-6	Arsenic, cPAHs	--	Soil Removal	3,237	--	Yes	--
I-7	Arsenic	Copper	Soil Removal	2,495	--	Yes	--
I-8	Arsenic, Copper	--	Soil Removal	3,263	--	Yes	--
I-9	Arsenic, Copper, cPAHs	--	Soil Removal	-- (c)	--	Yes	--
I-10	Arsenic, Copper	--	Soil Removal	-- (c)	--	Yes	--
I-11	Arsenic, Copper, cPAHs	--	Soil Removal	-- (c)	--	Yes	--
Investigation Area J							
J-1	Arsenic	--	Soil Removal	553	--	Yes	--
J-3	Arsenic, Copper, cPAHs	--	Soil Removal	2,563	--	Yes	--
MSRC Interim Action (1993)	Petroleum Hydrocarbons	--	Soil Removal	966	Source Removal	Yes	Yes
Investigation Area M							
M-1	cPAHs	Arsenic	Soil Removal	396	--	Yes	--
UST Interim Action (1991)	Petroleum Hydrocarbons	--	Soil Removal	50 (d)	Source Removal	Yes	Yes

UST = underground storage tank
cPAHs = carcinogenic polycyclic aromatic hydrocarbons

(a) Value presented is tons of soil removed.
(b) Soil mass for Areas I-3a and I-3b not separately tallied. Soil mass presented for Area I-3a represents entire Area I-3.
(c) Soil mass for Areas I-8 through I-11 not separately tallied. Soil mass presented for Area I-8 represents entire mass for these areas.
(d) Excavated volume presented in cubic yards. Soil mass not available.

TABLE 2
SOIL CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Depth Range (BGS)	Date Collected	Area ID	Sample Type	Metals	PAH	cPAHs	PCBs	TPH-Gx	TPH-Dx	TPH-HCID	BTEX	SVOCs	VOCs	Dioxins / Furans	pH	TOC
G-FA-100 (0-1)	(0-1)	11/30/2010	G	Boring	X												
G-FA-100 (1-2)	(1-2)	11/30/2010	G	Boring	X												
G-FA-101 (4-5)	(4.5-5.5)	11/30/2010	G	Boring	X		X									X	
G-FA-101 (10.5-11.5)	(10.5-11.5)	11/30/2010	G	Boring	X												
G-FA-101a (3-3.5)	(3-3.5)	5/29/2013	G	Boring	X												
G-FA-101a (5-5.5)	(5-5.5)	5/29/2013	G	Boring	X												
G-FA-101a (5.5-6.5)	(5.5-6.5)	5/29/2013	G	Boring	X												
G-FA-101b (3-3.5)	(3-3.5)	5/29/2013	G	Boring	X												
G-FA-101b (5-5.5)	(5-5.5)	5/29/2013	G	Boring	X												
G-FA-101b (5.5-6.5)	(5.5-6.5)	5/29/2013	G	Boring	X												
G-FA-101c (3-4)	(3-4)	5/29/2013	G	Boring	X				X	X				X		X	
G-FA-101c (6-7)	(6-7)	5/29/2013	G	Boring	X				X	X				X		X	
G-FA-101d (3-3.5)	(3-3.5)	5/29/2013	G	Boring	X												
G-FA-101d (5-5.5)	(5-5.5)	5/29/2013	G	Boring	X												
G-FA-101d (5.5-6.5)	(5.5-6.5)	5/29/2013	G	Boring	X												
G-FA-101d (7-8)	(7-8)	5/29/2013	G	Boring	X												
G-FA-101e (9-10)	(9-10)	5/29/2013	G	Boring	X											X	
G-FA-101g (3-4)	(3-4)	5/29/2013	G	Boring	X						X						
G-FA-102 (2-3)	(3-4)	11/30/2010	G	Boring	X		X									X	
G-FA-103 (1-2)	(1-2)	11/30/2010	G	Boring	X		X									X	
G-FA-103 (5.5-6.5)	(5.5-6.5)	11/30/2010	G	Boring	X		X		X					X		X	
G-FA-103 (8-9)	(8-9)	11/30/2010	G	Boring	X												
G-FA-103a (1-2)	(1-2)	5/29/2013	G	Boring	X												
G-FA-103a (5.5-6.5)	(5.5-6.5)	5/29/2013	G	Boring	X												
G-FA-103b (1-2)	(1-2)	5/29/2013	G	Boring	X												
G-FA-103b (5.5-6.5)	(5.5-6.5)	5/29/2013	G	Boring	X												
G-FA-103c (3-4)	(3-4)	5/29/2013	G	Boring	X											X	
G-FA-103c (8.5-9.5)	(8.5-9.5)	5/29/2013	G	Boring	X												
G-FA-104 (0-1)	(0-1)	12/6/2010	G	Test Pit	X												
G-FA-104 (1-2)	(1-2)	12/6/2010	G	Test Pit	X												
G-FA-105 (0.3-0.8)	(0.3-0.8)	12/6/2010	G	Test Pit	X												
G-FA-105 (1-2)	(1-2)	12/6/2010	G	Test Pit	X												
G-FA-105A (2-3)	(2-3)	12/9/2012	G	Boring	X												

TABLE 2
SOIL CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Depth Range (BGS)	Date Collected	Area ID	Sample Type	Metals	PAH	cPAHs	PCBs	TPH-Gx	TPH-Dx	TPH-HCID	BTEX	SVOCs	VOCs	Dioxins / Furans	pH	TOC
G-FA-106 (1-1.2)	(1-1.2)	12/6/2010	G	Test Pit	X												
G-FA-106 (1-1.5)	(1-1.5)	12/6/2010	G	Test Pit	X												
G-FA-106 (3-3.5)	(3-3.5)	12/6/2010	G	Test Pit	X											X	
G-FA-107 (0-1)	(0-1)	12/6/2010	G	Test Pit	X		X										
G-FA-107 (1-2)	(1-2)	12/6/2010	G	Test Pit	X												
G-FA-108A (0-1)	(0-1)	12/6/2010	G	Test Pit	X												
G-FA-108B (0-1)	(0-1)	12/6/2010	G	Test Pit	X												
G-FA-108 (1-2)	(1-2)	12/6/2010	G	Test Pit	X												
G-FA-109 (0.5-1)	(0.5-1)	12/6/2010	G	Test Pit	X												
G-FA-109 (1-2)	(1-2)	12/6/2010	G	Test Pit	X												
G-FA-110 (3.5-4.5)	(3.5-4.5)	12/20/2010	G	Boring	X												
G-FA-111 (2-3)	(2-3)	12/20/2010	G	Boring	X												
G-FA-112 (3-4)	(3-4)	12/20/2010	G	Boring	X												
G-FA-113 (0-1)	(1-2)	11/22/2010	G	Boring	X		X										
G-FA-113 (2-3)	(3-4)	11/22/2010	G	Boring	X		X			X							
G-FA-114 (1-2)	(2-3)	12/9/2011	G	Boring	X												
G-FA-114 (2-3)	(3-4)	12/9/2011	G	Boring	X		X	X		X	X					X	
G-FA-114 (3-4)	(4-5)	12/9/2011	G	Boring	X												
G-FA-114 (6-7)	(7-8)	12/9/2011	G	Boring	X		X	X			X						
G-FA-115 (2-3)	(3-4)	12/9/2011	G	Boring	X		X	X			X						
G-FA-115A (2-3)	(2-3)	12/9/2011	G	Boring	X												
G-FA-115A (3-3.5)	(3-3.5)	12/9/2011	G	Boring	X											X	
G-FA-115A (4.5-5.5)	(4.5-5.5)	12/9/2011	G	Boring	X												
G-FA-115B (2-3)	(3-4)	12/9/2011	G	Boring	X											X	
G-FA-115C (4-7)	(5-8)	12/9/2011	G	Boring	X		X	X		X	X						
G-FA-115C (7-8)	(8-9)	12/9/2011	G	Boring	X												
G-GC-100 (0-1)	(1.5-2.5)	12/20/2010	G	Boring	X		X			X							
G-GC-100 (1-2)	(2.5-3.5)	12/20/2010	G	Boring	X												
G-GC-101 (0-1)	(0.2-1.2)	12/20/2010	G	Boring	X		X										
G-GC-102 (0-1)	(1.5-2.5)	12/20/2010	G	Boring	X		X										
G-GC-103 (0-1)	(0.2-1.2)	12/20/2010	G	Boring	X		X										
G-GC-103 (7-8)	(7.2-8.2)	12/20/2010	G	Boring													X
G-GC-104 (0-1)	(0.2-1.2)	12/20/2010	G	Boring	X		X			X							

TABLE 2
SOIL CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Depth Range (BGS)	Date Collected	Area ID	Sample Type	Metals	PAH	cPAHs	PCBs	TPH-Gx	TPH-Dx	TPH-HCID	BTEX	SVOCs	VOCs	Dioxins / Furans	pH	TOC
G-GC-105 (0-1)	(1-2)	11/22/2010	G	Boring	X			X					X				
G-GC-106 (0-1)	(1-2)	11/22/2010	G	Boring	X		X										
G-GC-107 (0-1)	(1-2)	11/22/2010	G	Boring	X		X										
G-GC-108 (0-1)	(0.2-1.2)	12/20/2010	G	Boring	X		X										
G-GC-109 (0-1)	(1-2)	11/29/2010	G	Boring	X								X				
G-GC-113 (0-1)	(0-1)	12/9/2011	G	Boring	X		X										
G-GC-114 (0-1)	(0-1)	12/9/2011	G	Boring	X		X										
I-FA-100 (2-3)	(3-4)	12/17/2010	I	Boring	X												
RI-MW-2 (10-11)	(10-11)	12/8/2010	I	Monitoring Well													X
J-FA-100 (4-5)	(5-6)	11/29/2010	J	Boring	X			X		X			X				
J-FA-101 (27-28)	(28-29)	11/29/2010	J	Boring	X		X			X					X		
J-FA-102 (13-14)	(14-15)	11/29/2010	J	Boring	X		X										
J-FA-102 (18-19)	(19-20)	11/29/2010	J	Boring	X												
J-GC-100 (0-1)	(1-2)	11/29/2010	J	Boring	X		X										
J-GC-101 (0-1)	(1-2)	11/29/2010	J	Boring	X		X										
M-FA-100 (0-1)	(1-2)	11/22/2010	M	Boring	X		X										
M-FA-101 (0-1)	(0-1)	12/17/2010	M	Boring	X												
M-FA-101 (1-2)	(1-2)	12/17/2010	M	Boring	X												
M-FA-102 (7-7.5)	(7-7.5)	12/1/2010	M	Boring	X			X					X				
M-FA-102 (9-10)	(9-10)	12/1/2010	M	Boring	X		X										
M-FA-102a (0-1)	(0-1)	3/18/2011	M	Boring	X												
M-FA-102b (0-1)	(0-1)	3/18/2011	M	Boring	X					X							
M-FA-102c (0-1)	(0-1)	3/19/2011	M	Boring	X					X							
M-FA-102d (0-1)	(0-1)	3/20/2011	M	Boring	X					X							
M-FA-102e (0-1)	(0-1)	3/21/2011	M	Boring	X					X							
M-FA-102F (7-8)	(8-9)	12/8/2011	M	Boring	X		X										
M-FA-102G (7-8)	(8-9)	12/8/2011	M	Boring	X		X										
M-FA-102H (4-5)	(5-6)	12/8/2011	M	Boring	X		X										
M-FA-102i (6-7)	(6-7)	5/30/2013	M	Boring	X		X										
M-FA-102i (9-10)	(9-10)	5/30/2013	M	Boring	X		X										
M-FA-102j (5-6)	(5-6)	5/30/2013	M	Boring	X		X										
M-FA-102j (7.5-8)	(7.5-8)	5/30/2013	M	Boring	X		X										
M-FA-102k (5-6)	(5-6)	5/30/2013	M	Boring	X		X										

TABLE 2
SOIL CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Depth Range (BGS)	Date Collected	Area ID	Sample Type	Metals	PAH	cPAHs	PCBs	TPH-Gx	TPH-Dx	TPH-HCID	BTEX	SVOCs	VOCs	Dioxins / Furans	pH	TOC
M-FA-102k (7-7.5)	(7-7.5)	5/30/2013	M	Boring	X		X										
M-FA-102k (9-10)	(9-10)	5/30/2013	M	Boring	X		X										
M-FA-102l (7-8)	(7-8)	5/30/2013	M	Boring	X		X										
M-FA-102l (9-10)	(9-10)	5/30/2013	M	Boring	X		X										
M-FA-103 (0-1)	(1-2)	12/2/2010	M	Boring	X												
M-FA-103 (1-2)	(2-3)	12/2/2010	M	Boring	X												
M-FA-103a (0-1)	(0-1)	3/18/2011	M	Boring	X												
M-FA-103C (0-1)	(1-2)	12/8/2011	M	Boring	X												
M-FA-104 (0-1)	(0.5-1.5)	11/22/2010	M	Boring	X		X			X							
M-FA-105 (0-1)	(0-1)	1/28/2011	M	Boring	X			X		X	X		X				
M-FA-105 (4-5)	(4-5)	1/28/2011	M	Boring						X							
M-FA-105a (0-1)	(0-1)	3/18/2011	M	Boring						X							
M-FA-105b (0-1)	(0-1)	3/18/2011	M	Boring						X							
M-FA-106 (0-1)	(0-1)	1/28/2011	M	Boring		X		X			X						
M-FA-107 (0-1)	(0-1)	1/28/2011	M	Boring		X		X			X						
M-FA-108 (0-1)	(0-1)	1/28/2011	M	Boring		X		X			X						
M-GC-100 (0-1)	(1-2)	11/30/2010	M	Boring	X			X					X				
M-GC-101 (0-1)	(1-2)	11/30/2010	M	Boring	X		X										
M-GC-102 (0-1)	(1-2)	11/30/2010	M	Boring	X		X										
M-GC-102 (1-2)	(2-3)	11/30/2010	M	Boring	X												
M-GC-102 (6-7)	(7-8)	11/30/2010	M	Boring													X
M-GC-102A (0-1)	(0.5-1.5)	12/8/2011	M	Boring	X												
M-GC-102A (1-2)	(1.5-2.5)	12/8/2011	M	Boring	X												
M-GC-102B (0-1)	(0.5-1.5)	12/8/2011	M	Boring	X												
M-GC-102B (1-2)	(0.5-1.5)	12/8/2011	M	Boring	X												
M-GC-102C (0-1)	(0.5-1.5)	12/8/2011	M	Boring	X												
M-GC-102D (0-1)	(1-2)	12/8/2011	M	Boring	X												
M-GC-102D (1-2)	(2-3)	12/8/2011	M	Boring	X												
M-GC-102E (0-1)	(0.5-1.5)	12/8/2011	M	Boring	X												
M-GC-103 (0-1)	(1-2)	12/17/2010	M	Boring	X		X										
M-GC-104 (0-1)	(1.5-2.5)	12/2/2010	M	Boring	X		X										
M-GC-105 (0-0.2)	(0-0.2)	1/29/2011	M	Boring	X			X		X	X		X				
M-GC-105 (0.5-1.5)	(0.5-1.5)	1/29/2011	M	Boring						X							

TABLE 2
SOIL CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Depth Range (BGS)	Date Collected	Area ID	Sample Type	Metals	PAH	cPAHs	PCBs	TPH-Gx	TPH-Dx	TPH-HCID	BTEX	SVOCs	VOCs	Dioxins / Furans	pH	TOC
M-GC-105 (4-5)	(4-5)	1/29/2011	M	Boring						X							
M-GC-105b (0-1)	(0-1)	3/18/2011	M	Boring	X (a)												
M-GC-106 (0-1)	(0-1)	12/2/2010	M	Boring	X		X										
M-GC-107 (0-1)	(0-1)	12/8/2011	M	Boring	X		X			X	X			X			
M-GC-107 (1-2)	(1-2)	12/8/2011	M	Boring	X												
M-GC-107A (0-1)	(0.5-1.5)	12/9/2011	M	Boring	X												
M-GC-107A (1-2)	(1.5-2.5)	12/9/2011	M	Boring	X												
N-FA-100 (0-1)	(0.3-1.3)	12/1/2010	M	Boring	X												
N-FA-100 (1-2)	(1.3-2.3)	12/1/2010	N	Boring	X												
N-FA-101 (3-4)	(3-4)	12/1/2010	N	Boring	X											X	
N-FA-101 (4-5)	(4-5)	12/1/2010	N	Boring	X												
N-FA-102 (2-3)	(2-3)	12/1/2010	N	Boring	X			X		X			X	X			
N-FA-103 (1-2)	(1.3-2.3)	12/1/2010	N	Boring	X												
N-FA-103B (6-7)	(6.3-7.3)	12/1/2010	N	Boring	X			X	X	X			X	X			
N-FA-103B (10-11)	(10.3-11.3)	12/1/2010	N	Boring	X				X								
RI-MW-5 (0-1)	(0-1)	12/7/2010	M	Monitoring Well	X		X										
AH-BIN1	(0-1)	12/9/2011	G	Grab	X												
AH-BIN2	(0-1)	12/9/2011	G	Grab	X												
AH-BIN5	(0-1)	12/9/2011	G	Grab	X												

BGS = below ground surface
PAH = polycyclic aromatic hydrocarbons
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
TPH = total petroleum hydrocarbons
Gx = gasoline
Dx = diesel

HCID = hydrocarbon identification analysis
BTEX = benzene, toluene, ethylbenzene, and xylenes
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
TOC = total organic carbon

(a) Sample M-GC-105b (0-1) Metals analyzed for Toxicity Characteristic Leaching Procedure (TCLP) only

TABLE 3
GROUNDWATER CHARACTERIZATION SAMPLE ANALYSIS GRID
NORTH MARINA AMERON/HULBERT SITE RI/FS

Sample Name	Date Collected	Area ID	Sample Type	Dissolved Metals	Hexavalent Chromium	cPAHs	TPH-Gx TPH-Dx	TPH-HCID	SVOCs	VOCs	PCBs
ECI-MW-3	12/15/2010	M	Monitoring Well	X	X	X			X	X	
ECI-MW-3	2/22/2011	M	Monitoring Well						X (BEHP)		
ECI-MW-3	10/11/2011	M	Monitoring Well	X	X	X			X	X	
G-FA-113	11/22/2010	G	Boring	X				X		X	
G-GC-100	12/20/2010	G	Boring	X			X (Gx, Dx)			X	
I-FA-100	12/17/2010	I	Boring	X						X	
I-FA-101	12/17/2010	I	Boring	X						X	
J-FA-100	11/29/2010	J	Boring	X		X	X (Dx)	X	X	X	X
J-FA-102	11/29/2010	J	Boring	X				X		X	
J-GC-100	11/29/2010	J	Boring	X						X	
M-FA-100	11/22/2010	M	Boring	X				X		X	
M-FA-102	12/1/2010	M	Boring	X		X		X	X	X	X
M-FA-103	12/2/2010	M	Boring	X				X		X	
M-FA-104	11/22/2010	M	Boring	X				X		X	
M-FA-107	1/28/2011	M	Boring	X				X		X	
M-FA-108	1/28/2011	M	Boring					X		X	
M-GC-100	11/30/2010	M	Boring	X		X		X	X	X	
M-GC-103	12/17/2010	M	Boring	X						X	
M-GC-105	1/28/2011	M	Boring	X			X (Dx)	X		X	
N-FA-100	12/1/2010	N	Boring	X						X	
N-FA-102	12/1/2010	N	Boring	X		X		X	X	X	X
P10 (G-2)	12/15/2010	G	Monitoring Well	X						X	
P10 (G-2)	10/11/2011	G	Monitoring Well	X						X	
RI-MW-1	12/15/2010	I	Monitoring Well	X		X			X	X	
RI-MW-1	2/22/2011	I	Monitoring Well	X (Hg)					X (BEHP)		
RI-MW-1	10/11/2011	I	Monitoring Well	X		X			X	X	
RI-MW-2	12/15/2010	I	Monitoring Well	X		X			X	X	
RI-MW-2	2/22/2011	I	Monitoring Well	X (Hg)							
RI-MW-2	10/11/2011	I	Monitoring Well	X		X			X	X	
RI-MW-3	12/15/2010	I	Monitoring Well	X		X			X	X	
RI-MW-3	2/22/2011	I	Monitoring Well	X (Hg)					X (BEHP)		
RI-MW-3	10/11/2011	I	Monitoring Well	X		X			X	X	
RI-MW-4	12/15/2010	J	Monitoring Well	X		X	X (Dx)	X	X	X	
RI-MW-4	2/22/2011	J	Monitoring Well	X (Hg)			X (Dx)				
RI-MW-4	10/11/2011	J	Monitoring Well	X		X	X (Dx)	X	X	X	
RI-MW-5	12/15/2010	M	Monitoring Well	X		X		X	X	X	
RI-MW-5	2/22/2011	M	Monitoring Well	X (Hg)					X (BEHP)		
RI-MW-5	10/11/2011	M	Monitoring Well	X		X		X	X	X	
RI-MW-6	10/11/2011	J	Monitoring Well	X (As, Cu, Pb)			X (Dx)				
RI-MW-7	10/11/2011	G	Monitoring Well	X (As, Cu)							
SEE-EC-3	12/15/2010	G	Monitoring Well	X						X	
SEE-EC-3	2/22/2011	G	Monitoring Well	X (As)							
SEE-EC-3	10/11/2011	G	Monitoring Well	X						X	
SUMP	12/20/2010	G	SUMP	X		X	X (Dx)	X	X	X	
SUMP	10/19/2011	G	SUMP	X		X	X (Gx, Dx)		X	X	

Hg = silver
As = arsenic
Pb = lead
Cu = copper
Dx = diesel
Gx = gasoline

BEHP = Bis 2-Ethylhexyl phthalate
TPH = total petroleum hydrocarbons
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
PCBs = polychlorinated biphenyls
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
HCID = hydrocarbon identification analysis

TABLE 4
GROUNDWATER PRELIMINARY SCREENING LEVELS FOR DETECTED CONSTITUENTS (1)
RI/FS WORK PLAN - NORTH MARINA AMERON/HULBERT SITE RI/FS

			State and Federal ARARs (2)								MTCA B Equation (2)				
Analyte	Potable Groundwater Levels (2, 3)		Federal Marine Chronic Aquatic Life Clean Water Act Section 304		Federal Marine Chronic Aquatic Life NTR 40 CFR 131		State Marine Chronic Aquatic Life Washington WQS Ch. 173-201A		Federal Human Health Consumption of Organisms Clean Water Act Section 304	Federal Human Health Consumption of Organisms NTR 40 CFR 131	Human Health MTCA Method B Surface Water Equation 173-340-730		Practical Quantitation Limit (4)	Preliminary Screening Level (5)	
VOLATILES (µg/L)															
1,1,1-Trichloroethane	---		NA		NA		NA		NA	NA	930,000	nc	1	930,000	
cis-1,2-Dichloroethene	16		NA		NA		NA		NA	NA	NA		1	16	
1,2-Dichloroethane	---		NA		NA		NA		37	99	59	c	1	37	
Benzene	---		NA		NA		NA		51	71	23	c	1	51	(a)
Ethylbenzene	---		NA		NA		NA		2,100	29000	6,900	nc	1	2,100	
m,p-Xylene	1600		NA		NA		NA		NA	NA	NA		1	1600	
o-Xylene	1600		NA		NA		NA		NA	NA	NA		1	1600	
Xylenes	1600		NA		NA		NA		NA	NA	NA		1	1600	
Toluene	---		NA		NA		NA		15,000	200000	19,000	nc	1	15,000	
Vinyl Chloride	---		NA		NA		NA		2.4	530	3.7	c	1	2.4	
1,2,4-Trimethylbenzene	15		NA		NA		NA		NA	NA	NA		1	15	
1,3,5-Trimethylbenzene	80		NA		NA		NA		NA	NA	NA		1	80	
Acetone	7200		NA		NA		NA		NA	NA	NA		1	7200	
Chloroform	--		NA		NA		NA		470	470	6,900	nc	0.35	470	(a)
Methylene Chloride	--		NA		NA		NA		590	1600	960	c	1.5	590	
1,1-Dichloroethene	--		NA		NA		NA		7,100	3.2	23,000	nc	1	3.2	
SEMIVOLATILES (µg/L)															
bis(2-Ethylhexyl)phthalate	--		NA		NA		NA		2.2	5.9	3.6	c	1	2.2	
Di-n-butylphthalate	--		NA		NA		NA		4,500	12,000	2,900	nc	2	2,900	
Diethylphthalate	--		NA		NA		NA		44,000	120,000	28,000	nc	2	28,000	
1-Methylnaphthalene	1.5		NA		NA		NA		NA	NA	NA	c	1	1.5	
2-Methylnaphthalene	32		NA		NA		NA		NA	NA	NA	nc	1	32	
TOTAL PETROLEUM HYDROCARBONS (mg/L)															
Gasoline range	0.8	(b)	NA		NA		NA		NA	NA	NA		0.1	0.8	
Diesel range	0.5	(b)	NA		NA		NA		NA	NA	NA		0.1	0.5	
Oil range	0.5	(b)	NA		NA		NA		NA	NA	NA		0.25	0.5	
METALS (µg/L)															
Antimony	--		NA		NA		NA		640	4,300	1,037	nc	1	640	
Arsenic	5	(c)	36	(d)	36	(d)	36	(d)	0.14	0.14	0.098	c	0.2	5	(c)
Beryllium	--		NA		NA		NA		NA	NA	273	nc	1	273	
Cadmium	---		8.8	(d)	9.3	(d)	9.3	(d)	NA	NA	41	nc	0.2	8.8	
Total Chromium (e)	--		NA		NA		NA		NA	NA	240,000	nc	1	240,000	
Chromium VI	--		50		50		50		NA	NA	490	nc	4	50	
Copper	---		3.1	(d)	2.4		3.1	(d)	NA	NA	2,800	nc	1	3.1	
Lead	---		8.1	(d)	8.1	(d)	8.1	(d)	NA	NA	NA		1	8.1	
Mercury	---		0.94	(d)	0.025		0.025		0.3	0.15	NA		0.1	0.1	(f)
Nickel	---		8.2		8.2		8.2		4,600	4600	1100	nc	2	8.2	
Silver	---		NA		NA		NA		NA	NA	26,000	nc	5.4	26,000	
Selenium	---		71		71		71		4200	NA	2700	nc	0.5	71	
Thallium	---		NA		NA		NA		0.5	6.3	0.22	nc	0.5	0.5	
Zinc	---		81	(d)	81	(d)	81	(d)	26,000	NA	17,000	nc	1	81	

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RI/FS WORK PLAN - NORTH MARINA AMERON/HULBERT SITE RI/FS

		State and Federal ARARs (2)					MTCA B Equation (2)				
Analyte	Potable Groundwater Levels (2, 3)	Federal Marine Chronic Aquatic Life Clean Water Act Section 304	Federal Marine Chronic Aquatic Life NTR 40 CFR 131	State Marine Chronic Aquatic Life Washington WQS Ch. 173-201A	Federal Human Health Consumption of Organisms Clean Water Act Section 304	Federal Human Health Consumption of Organisms NTR 40 CFR 131	Human Health MTCA Method B Surface Water Equation 173-340-730		Practical Quantitation Limit (4)	Preliminary Screening Level (5)	
PAHs (µg/L)											
Acenaphthene	---	NA	NA	NA	990	NA	640	nc	5	640	
Fluorene	---	NA	NA	NA	5,300	14,000	3,500	nc	1	3,500	
Benzo(a)anthracene	---	NA	NA	NA	0.018	0.031	0.3	c	0.1	0.1	(f)
Benzo(a)pyrene	---	NA	NA	NA	0.018	0.031	0.03	c	0.1	0.1	(f)
Benzo(b)fluoranthene	---	NA	NA	NA	0.018	0.031	0.3	c	0.1	0.1	(f)
Benzo(k)fluoranthene	---	NA	NA	NA	0.018	0.031	3.0	c	0.1	0.1	(f)
Chrysene	---	NA	NA	NA	0.018	0.031	30	c	0.1	0.1	(f)
Dibenz(a,h)anthracene	---	NA	NA	NA	0.018	0.031	0.03	c	0.1	0.1	(f)
Indeno(1,2,3-cd)pyrene	---	NA	NA	NA	0.018	0.031	0.3	c	0.1	0.1	(f)
Naphthalene	---	NA	NA	NA	NA	NA	4,900	nc	0.1	4,900	
cPAH TEQ	---	NA	NA	NA	NA	NA	NA		--	0.1	(f)
PCBs (µg/L)											
Aroclor 1248	---	NA	NA	NA	NA	NA	NA		0.01	--	(f)
Aroclor 1254	---	NA	0.03	NA	NA	NA	0.0017		0.01	0.01	(f)
Aroclor 1260	---	NA	0.03	NA	NA	NA	NA		0.01	0.03	(f)
Total PCBs	---	0.03	0.03	0.03	0.000064	0.00017	0.00017		0.01	0.01	(f)

NA = Preliminary Screening Level not available.
NTR = National Toxics Rule
WQS = Water Quality Standard
ARAR = Applicable or Relevant and Appropriate Requirements
CLARC = Cleanup Screening Levels and Risk Calculation
MTCA = Model Toxics Control Act

"c" = Cleanup Screening Level based on a 1E-06 cancer risk level.
"nc" = Cleanup Screening Level based on a hazard quotient of 1.
PQL = Practical Quantitation Limits.
PCBs = polychlorinated biphenyls
PAHs = polycyclic aromatic hydrocarbons
cPAH = carcinogenic polycyclic aromatic hydrocarbon

TEQ = toxic equivalency quotient
CFR
mg/L = milligrams per liter
µg/L = micrograms per liter
WAC = Washington Administrative Code
Shaded value = Basis for proposed Preliminary Screening Level.

"---" = A potable groundwater Preliminary Screening Level was not provided because an applicable surface water Cleanup Screening Level was identified.

(a) Cleanup Screening Level deferred to federal ARAR because it is considered sufficiently protective of human health for carcinogens as described in WAC 173-340-730(3) andoin Figure 3 of Ecology's Focus on Developing Surface Water Cleanup Standards Under MTCA (rev. April 2005).
(b) Due to the absence of published ARARs or a MTCA B Cleanup Screening Level, the MTCA A potable groundwater Cleanup Screening Level was selected.
(c) Ecology's potable groundwater Method A Cleanup Screening Level for arsenic is based on background concentrations of this metal in groundwater (WAC 173-340-900; Table 720-1). As such, the proposed Cleanup Screening Level for arsenic of 5 µg/L is based on the MTCA Method A level for potable groundwater.
(d) The surface water Cleanup Screening Level is based on the dissolved fraction.
(e) Cleanup Screening Level for total chromium is defered to chromium (III) Cleanup Screening Levels because no metal plating or other activities associated with chromium (VI) occurred at the Site.
(f) The proposed Cleanup Screening Levels is based on the PQL.

Notes:
1. Where available, groundwater Cleanup Screening Levels are based on protection of marine surface water. Groundwater at the site discharges into Port Gardner and is non-potable.
2. Unless otherwise noted, all federal and state ARARs and MTCA B Cleanup Screening Levels for surface water were identified from Ecology's online CLARC database (https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx).
3. Potable groundwater levels were used for screening purposes in absence of applicable surface water levels. Unless other wise noted, the minimum level between state and federal ARARs and MTCA Method B was selected.
4. PQLs based on analytical method reporting limits.
5. Cleanup Screening Level based on lowest water quality standard or PQL or background, indicated by shading, except as noted otherwise.

TABLE 5
SOIL CLEANUP LEVELS FOR DETECTED CONSTITUENTS
INTERIM ACTION REPORT
NORTH MARINA AMERON/HULBERT SITE RI/FS

Analyte	Groundwater PCL (µg/L) (1)	MTCA Protection of Groundwater as Surface Water (2)	MTCA Method B Direct Contact (3)	Background (4)	Practical Quantitation Limit (5)	Preliminary Screening Level (6)
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
Gasoline range	--	--	30/100 (a,b)	--	5.0	30/100 (b)
Diesel range	--	--	2,000 (a)	--	10.0	2,000
Oil range	--	--	2,000 (a)	--	10.0	2,000
Mineral oil	--	--	4,000 (a)	--	10.0	4,000
Benzene	51 (c)	0.29	18.0 (d)	--	0.05	0.29
Toluene	15,000 (e)	110	6,400 (f)	--	0.03	110
Ethyl Benzene	2,100 (e)	18.0	8,000 (f)	--	0.05	18
m,p-Xylene	1,600 (g)	15 (h)	16,000 (f)	--	0.06	16,000 (m)
o-Xylene	1,600 (g)	15 (h)	16,000 (f)	--	0.04	16,000 (m)
Xylenes, Total	1,600 (g)	15 (h)	16,000 (f)	--	--	16,000 (m)
METALS (mg/kg)						
Aluminum	--	55,000 (i)	80,000 (f)	33,000	6.4	55,000 (i)
Antimony	640 (e)	580	32 (f)	--	3.8	32
Arsenic	5.0 (k)	2.9	20 (k)	7	5.0	20 (k)
Barium	2,000	1,650	16,000 (f)	--	0.30	1,650
Beryllium	273 (l)	4,300	160 (f)	0.6	0.10	160
Boron	--	--	16,000 (f)	--	0.71	16,000
Cadmium	8.8 (e)	1.2	80 (f)	1	0.20	80 (m)
Calcium	--	--	--	--	--	-- (n)
Chromium	240,000 (l)	1x10^{b} (o)	120,000 (f)	48	0.60	120,000
Cobalt	--	--	23 (i)	--	0.39	23
Copper	3.1 (e)	1.4	3,000 (f)	36	1.0	3,000 (m)
Iron	--	--	56,000 (f)	36,000	3.1	56,000 (f)
Lead	8.1 (e,j)	1,620	250 (p)	24	2.0	250 (p)
Manganese	--	--	11,000	1,200	0.1	11,000
Mercury	0.10 (u)	0.10	24 (f)	0.07	0.05	24 (m)
Nickel	8.2	11	1,600 (f)	48	2.5	1,600 (m)
Selenium	71	7.4	400 (f)	--	6.4	400 (m)
Silicon	--	--	--	--	5.7	--
Silver	26,000	4,400	400 (f)	--	0.64	400 (m)
Sodium	--	--	--	--	6.6	-- (n)
Sulfur	--	--	--	--	--	--
Thallium	0.47	0.67	0.8 (f)	--	5.9	5.9
Vanadium	--	--	560 (f)	--	0.63	560
Zinc	81 (e,j)	101	24,000 (f)	85	0.60	24,000 (m)
SVOCs (mg/kg)						
4-Methylphenol	--	--	400 (f)	--	0.23	400
Benzoic acid	64,000 (g)	260	320,000	--	1.70	320,000
Di-n-Octyl phthalate	--	--	---	--	0.19	---
Fluorene	3,500 (e)	553	3,200 (f)	--	0.20	553
Phenanthrene	26,000 (q)	12,000	24,000	--	0.20	12,000
Anthracene	26,000 (l)	12,000	24,000 (f)	--	0.14	12,000
Fluoranthene	90 (l)	89	3,200 (f)	--	0.06	89
Pyrene	2,600 (l)	3,600	2,400 (f)	--	0.15	2,400
Di-n-butylphthalate	2,900	100	8,000 (f)	--	0.33	100
bis(2-Ethylhexyl)phthalate	2.2 (e)	4.9	71 (d)	--	0.27	4.9
Butylbenzylphthalate	8.2	2.3	530 (d)	--		530 (m)
Carbazole	--	--	--	--		--
Dimethylphthalate	1,100,000	5,100	--	--		5,100
1,4-Dichlorobenzene	190	3.1	--	--		3.1
o-Dinitrobenzene	1.6	--	8.0 (f)	--		8.0
1-Methylnaphthalene	1.5	--	35	--		35
Phenol	560,000	2,500	24,000	--		2,500
di(2-Ethylhexyl)adipate	73	--	830 (d)	--		830
PAHs (mg/kg)						
Acenaphthene	640	66	4,800 (f)	--	0.02	66
Naphthalene	4,900 (l)	140	1,600 (f)	--	0.02	140
2-Methylnaphthalene	32	--	320 (f)	--	0.02	320
Benzo(g,h,i)perylene	--	--	--	--	0.02	--
Benzo(a)anthracene	0.10 (u)	0.72	TEQ (r)	--	0.02	TEQ (r)
Chrysene	0.10 (u)	0.80	TEQ (r)	--	0.02	TEQ (r)
Benzo(b)fluoranthene	0.10 (u)	2.5	TEQ (r)	--	0.02	TEQ (r)
Benzo(k)fluoranthene	0.10 (u)	2.5	TEQ (r)	--	0.02	TEQ (r)
Benzo(a)pyrene	0.10 (u)	1.9	0.14 (c)	--	0.02	0.14
Indeno(1,2,3-cd)pyrene	0.10 (u)	6.9	TEQ (r)	--	0.02	TEQ (r)
Dibenz(a,h)anthracene	0.10 (u)	3.6	TEQ (r)	--	0.02	TEQ (r)
cPAH TEQ	0.10	--	0.14	--	--	0.14 (m)
PCBs (mg/kg)						
Aroclor-1248	--	--	--		0.04	Total PCBs
Aroclor-1254	0.01 (u)	0.02	0.50 (d)	--	0.04	Total PCBs (t)
Aroclor-1260	0.03 (j)	-- (s)	0.50 (d)	--	0.04	Total PCBs
Total PCBs	0.01 (u)	--	0.5 / 1.0 (a)	--	0.04	1.0 (t)

TABLE 5
SOIL CLEANUP LEVELS FOR DETECTED CONSTITUENTS
INTERIM ACTION REPORT
NORTH MARINA AMERON/HULBERT SITE RI/FS

Analyte	Groundwater PCL (µg/L) (1)	MTCA Protection of Groundwater as Surface Water (2)	MTCA Method B Direct Contact (3)	Background (4)	Practical Quantitation Limit (5)	Preliminary Screening Level (6)
Dioxins/Furans (ng/kg)						
Dioxins/Furans TEQ	0.00001	540	11	5.2	--	11
TBT (µg/kg)						
Butyl Tin Trichloride	--	--	--	--	0.12	--
Dibutyl Tin Dichloride	--	--	--	--	--	--
Dibutyl Tin Ion	--	--	--	--	0.08	--
Tributyl Tin Chloride	--	--	--	--	0.03	--
TBT as TBT Ion	0.01	7,400	23,400	--	4	7,400
VOCs (mg/kg)						
1,1-Dichloroethane	--	--	16,000 (f)	--	0.002	16,000
Trichloroethene	30 (e)	0.20	11 (d)	--	0.002	0.20
Sec-Butylbenzene	--	--	--	--	0.002	--
Acetone	7,200 (g)	29	72,000 (f)	--	0.005	29
Methyl Ethyl Ketone	4,800	--	48,000 (f)	--	0.003	48,000
1,1,1-Trichloroethane	930,000 (l)	7,400	160,000 (f)	--	0.005	7,400
Tetrachloroethene	3.30 (e,c)	0.04	1.9 (d)	--	0.004	1.9 (m)
Methylene Chloride	590	2.6	130 (d)	--	0.007	2.6
1,2,4-Trimethylbenzene	15 (i)		62 (i)	--	0.002	62
1,3,5-Trimethylbenzene	80 (g)	--	800 (f)	--	0.004	800
Isopropylbenzene	800 (g)	--	8,000 (f)	--	0.002	8,000
n-Propylbenzene	800 (g)	--	8,000 (f)	--	0.002	8,000
4-Isopropyltoluene	--	--	--	--	0.002	--
n-Butylbenzene	1,800 (i)	--	3,900 (i)	--	0.002	3,900

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
ng/kg = nanograms per kilogram
PCL = preliminary cleanup level
MTCA = Model Toxics Control Act
-- = Soil criteria not established.

SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
PCBs = polychlorinated biphenyls
PAHs = polycyclic aromatic hydrocarbons
TBT = tributyl tin

Shaded value = selected as proposed preliminary screening level.
TEQ = Toxicity Equivalency Quotient. TEQ is based on individual Toxicity Equivalency Factors (TEFs) of benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene.

(a) MTCA direct contact cleanup level/federal Toxics Substance Control Act (TSCA; 40 CFR Part 761.61) cleanup standard for high occupancy areas.
(b) MTCA Method A Cleanup Screening Level is 30 mg/kg when benzene is present and 100 mg/kg when benzene is not present.
(c) Selected surface water ARAR used for calculation of soil Cleanup Screening Level protective of groundwater is based on the federal criteria because it is considered sufficiently protective of human health for carcinogens as described in WAC 173-340-740(3).
(d) MTCA Method B soil standard formula value based on criteria as a carcinogen.
(e) EPA National Recommended Water Quality Criteria - Section 304 Clean Water Act.
(f) MTCA Method B soil standard formula value based on criteria as a non-carcinogen.
(g) Potable groundwater levels were used for screening purposes in absence of applicable surface water levels. Unless other wise noted, the minimum level between state and federal ARARs and MTCA Method B was selected.
(h) Based on protection of drinking water.
(i) Based on EPA national rick-based screening level, April 2009 (http://www.epa.gov/region09/superfund/prg/index.html)
(j) EPA Water Quality Standards (National Toxics Rule) - 40 CFR 131
(k) The MTCA Method A soil Cleanup Screening Level for unrestricted land use and MTCA Method A cleanup level for potable water were used for arsenic because it was established based on adjustment for background. From Responsiveness Summary for the Amendments to the Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC. 1991.
(l) MTCA Method B Surface Water Equation (Standard Fomula Values)
(m) Proposed Cleanup Screening Level is the Method B direct human contact Cleanup Screening Level. Empirical evidence, based on groundwater analytical results, indicate that current concentrations of constituent in soil are protective of groundwater and, therefore, need only be compared to Cleanup Screening Levels protective of direct human contact.
(n) Cleanup levels are not needed for iron, magnesium, calcium, potassium, and sodium because they are essential nutrients.
(o) Calculated Cleanup Screening Level is greater than 100% of constituent.
(p) MTCA Method A soil Cleanup Screening Level based on preventing unacceptable blood lead levels.
(q) No criteria available for phenanthrene. Therefore, as requested by Ecology, anthracene was used as a surrogate.
(r) As requested by Ecology a TEQ will be computed for each sample containing carcinogenic PAHs above reporting limits and compared to the benzo(a)pyrene Cleanup Screening Level in accordance with WAC 173-340-708(8)(e).
(s) No cleanup level protective of groundwater was calculated using Ecology's three-phase partitioning model due to lack of available Henry's law constant.
(t) Selected cleanup standard is based on the federal criteria because it represents an acceptable risk less than 1x10-5, consistent with WAC 173-340-740(3)(b)(i).
(u) Preliminary cleanup level based on practical quantitation limit.

Notes:
(1) Preliminary groundwater cleanup level based on Table 3.
(2) MTCA Method B values based on protection of marine surface water using MTCA equation 747-1 (February 2001), unless otherwise noted.
(3) MTCA Method B standard formula values based on direct contact (Ecology's CLARC, accessed) unless otherwise noted.
(4) From Ecology's Natural Background Soil Metals Concentrations in Puget Sound (1994). Used 90th percentile for Puget Sound unless noted otherwise. Background for dioxins/furans from Ecology's Natural Background for Dioxinx/Furans in Washington Soil (2010).
(5) Practical quantitation limits (PQLs) based on the laboratory reporting limit.
(6) Preliminary Cleanup Screening Level based on lowest soil criteria corrected for PQL and background, as indicated by shading, unless otherwise noted.

TABLE 6
SEDIMENT REGULATORY LEVELS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	SMS Cleanup Screening Level Criteria (a)	SMS Marine Sediment Quality Standards (b)	SMS Dry Weight Equivalent (c)	CSL Dry Weight Equivalent (c)	Dredged Material Management Program 1998 Screening Level
Conventionals (%)					
Total organic carbon	10 (d)	10 (d)	10 (d)	10 (d)	---
Total volatile solids	25 (e)	25 (e)	25 (e)	25 (e)	---
Metals	**(mg/kg - dry weight)**	**(mg/kg - dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(mg/kg - dry weight)**
Antimony	---	---	---	---	150
Arsenic	93	57	57	93	57
Cadmium	6.7	5.1	5.1	6.7	5.1
Chromium	270	260	260	270	---
Copper	390	390	390	390	390
Lead	530	450	450	530	450
Mercury	0.59	0.41	0.41	0.59	0.41
Nickel	---	---	---	---	140
Silver	6.1	6.1	6.1	6.1	6.1
Zinc	960	410	410	960	410
Organotins (Bulk)	**(µg/kg dry weight)**				
TBT as TBT ion	73 (f)	---	---	---	---
TBT as Tin ion	30 (f)	---	---	---	---
Organotins (Pore Water)	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	
TBT as TBT ion	0.05	0.15	0.05 (e)	0.05 (e)	---
TBT as Tin ion	0.02	0.06	---	---	---
PCBs	**(mg/kg -OC)**	**(mg/kg -OC)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**
Total PCBs	65	12	130	1000	130
Pesticides					**(µg/kg dry weight)**
Total DDT	---	---	---	---	6.9
Aldrin	---	---	---	---	10
Chlordane	---	---	---	---	10
Dieldrin	---	---	---	---	10
Heptachlor	---	---	---	---	10
Lindane	---	---	---	---	10
VOCs (mg/kg)					
Ethylbenzene	---	---	---	---	10
Tetrachloroethene	---	---	---	---	57
Total xylenes	---	---	---	---	40
Trichloroethene	---	---	---	---	160
LPAHs	**(mg/kg -OC)**	**(mg/kg -OC)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**
Naphthalene	170	99	2100	2100	2100
Acenaphthylene	66	66	1300	1300	560
Acenaphthene	57	16	500	500	500
Fluorene	79	23	540	540	540
Phenanthrene	480	100	1500	1500	1500
Anthracene	1200	220	960	960	960
2-Methylnaphthalene	64	38	670	670	670
Total LPAH	780	370	5200	5200	5200
HPAHs	**(mg/kg -OC)**	**(mg/kg -OC)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**
Fluoranthene	1200	160	1700	2500	1700
Pyrene	1400	1000	2600	3300	2600
Benzo(a)anthracene	270	110	1300	1600	1300
Chrysene	460	110	1400	2800	1400
Total benzofluoranthenes	450	230	3200	3600	3200
Benzo(a)pyrene	210	99	1600	1600	1600
Indeno(1,2,3-cd)pyrene	88	34	600	690	600
Dibenzo(a,h)anthracene	33	12	230	230	230
Benzo(g,h,i)perylene	78	31	670	720	670
Total HPAH	5300	960	12000	17000	12000

TABLE 6
SEDIMENT REGULATORY LEVELS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	SMS Cleanup Screening Level Criteria (a)	SMS Marine Sediment Quality Standards (b)	SMS Dry Weight Equivalent (c)	CSL Dry Weight Equivalent (c)	Dredged Material Management Program 1998 Screening Level
Misc. SVOCs	**(mg/kg -OC)**	**(mg/kg -OC)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**
1,2-Dichlorobenzene	2.3	2.3	35	50	35
1,3-Dichlorobenzene	---	---	---	---	170
1,4-Dichlorobenzene	9	3.1	110	110	110
1,2,4-Trichlorobenzene	1.8	0.81	31	51	31
Hexachlorobenzene	2.3	0.38	22	70	22
Dimethylphthalate	53	53	71	160	1400
Diethylphthalate	110	61	200	1200	1200
Di-n-butylphthalate	1700	220	1400	5100	5100
Butylbenzylphthalate	64	4.9	63	900	970
bis(2-ethylhexyl)phthalate	78	47	1300	3100	8300
Di-n-octylphthalate	4500	58	6200	6200	6200
Dibenzofuran	58	15	540	540	540
Hexachlorobutadiene	6.2	3.9	11	120	29
Hexachloroethane	---	---	---	---	1400
n-Nitroso-di-phenylamine	11	11	28	40	28
Misc. SVOCs	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**	**(µg/kg dry weight)**
Phenol	1200	420	420	1200	420
2-Methylphenol	63	63	63	63	63
4-Methylphenol	670	670	670	670	670
2,4-Dimethylphenol	29	29	29	29	29
Pentachlorophenol	690	360	360	690	400
Benzyl alcohol	73	57	57	73	57
Benzoic acid	650	650	650	650	650

µg/L = micrograms per liter
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
OC = organic carbon
-- = not measured
HPAH = higher molecular weight polycyclic aromatic hydrocarbons
LPAH = lower molecular weight polycyclic aromatic hydrocarbons
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
PCBs = polychlorinated biphenyls
TBT = tributyl tin
DDT = dichlorodiphenyltrichloroethane
SMS = Sediment Management Standards

(a) Marine sediment cleanup screening criteria set forth in WAC 173-204-520, unless otherwise indicated.
(b) Marine sediment quality standards set forth in WAC 173-204-320, unless otherwise indicated.
(c) Dry weight equivalent criteria are based on the Puget Sound Apparent Effect Threshold Values (Barrick et al. 1988)
(c) Total Volatile Solids screening levels based on SMS Clarification Paper published by Ecology (Kendall and Michelsen 1997).
(d) Total Volatile Solids screening level based on SMS Clarification Paper published by Ecology and PSDDA.
(e) Ecology, 1996, SMS technical information memorandum: testing reporting, and evaluation of tributyltin data in PSDAA and SMS programs.

TABLE 7
SOIL ANALYTICAL RESULTS FOR CONVENTIONALS
NORTH MARINA AMERON/HULBERTSITE RI/FS

	Preliminary Screening Level	G-FA-101 (4-5) 01201-1/CHM110201-6 11/30/2010	G-FA-101C (3-4) WS16 05/29/2013	Dup 0f G-FA-101C (3-4) G-FA-201C WS16C 05/29/2013	G-FA-101C (6-7) WS16B 05/29/2013	G-FA-101E (3-4) WS16D 05/29/2013	G-FA-102 (2-3) CHM101201-1/CHM110201-6 11/30/2010	G-FA-103 (1-2) CHM101201-1 11/30/2010	G-FA-103 (5.5-6.5) CHM101201-1 11/30/2010	G-FA-103C (3-4) WS17P 05/29/2013	G-FA-106 (3-3.5) CHM101220-4/CHM110201-6 12/6/2010	G-GC-103 (7-8) CHM101220-07 12/20/2010	M-GC-102 (6-7) CHM101201-1 11/30/2010	N-FA-101 (3-4) CHM101202-16/CHM110201-6 12/1/2010	RI-MW-2 (10-11) CHM101208-9 12/8/2010
CONVENTIONALS															
Total Organic Carbon (%) (Method 9060A)												**1.34**	**0.0968** J		**0.802**
pH		11.9 J	**12.36**	**12.27**	**7.89**	**12.08**	10.7 J	11.9	11.9	**12.36**	8.26 J	--	--	8.73 J	--

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Bold = Detected compound.

TABLE 8
MONITORING WELL GROUNDWATER ELEVATIONS
NORTH MARINA AMERON-HULBERT
SITE RI/FS

		1/19/2011 (1500-1545) High Tide		1/19/2011 (1010-1100) Intermediate Tide		2/22/2011 (1300-1400) Low Tide		10/11/2011 (1015-1045) Low Tide	
Well ID	**TOC Elevation**	**Measured DTW (ft)**	**GW Elevation (ft)**	**Measured DTW (ft)**	**GW Elevation (ft)**	**Measured DTW (ft)**	**GW Elevation (ft)**	**Measured DTW (ft)**	**GW Elevation (ft)**
RI-MW-1	17.23	6.41	10.82	8.33	8.9	8.50	8.73	8.72	8.51
RI-MW-2	17.66	7.43	10.23	7.72	9.94	8.12	9.54	8.44	9.22
RI-MW-3	18.07	6.96	11.11	8.85	9.22	11.71	6.36	11.49	6.58
RI-MW-4	18.1	3.83	14.27	3.80	14.3	3.81	14.29	5.95	12.15
RI-MW-5	15	0.84	14.16	0.51	14.49	1.45	13.55	2.72	12.28
RI-MW-6	17.42	--	--	--	--	--	--	4.87	12.55
RI-MW-7	15.05	--	--	--	--	--	--	4.36	10.69
ECI-MW-3	15.07	2.14	12.93	2.22	12.85	2.22	12.85	2.95	12.12
P10(G-2)	15.86	1.62	14.24	1.62	14.24	1.63	14.23	1.44	14.42
SEE-EC-2	16.67	3.67	13.00	3.62	13.05	3.68	12.99	--	--
SEE-EC-3	16.48	3.53	12.95	3.54	12.94	3.70	12.78	5.1	11.38
SEE-EC-4	16.49	3.54	12.95	3.57	12.92	3.70	12.79	--	--

TOC = Top of Casing (2" diameter PVC well casing)
DTW = Depth to Water
-- = not measured
ft = feet
GW = groundwater

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	G-FA-101 (4-5) CHM101201-1/CHM110201-6 11/30/2010	Dup of G-FA-101 (4-5) G-FA-201 (4-5) CHM101201-1 11/30/2010	G-FA-101C (3-4) WS16A/WU28A 05/29/2013	Dup 0f G-FA-101C (3-4) G-FA-201C WS16C 05/29/2013	G-FA-101C (6-7) WS16B/WU73A 05/29/2013	G-FA-101G (3-4) WT95A/WU28B 05/29/2013	G-FA-102 (2-3) CHM101201-1/CHM110201-6 11/30/2010	G-FA-103 (1-2) CHM101201-1 11/30/2010	G-FA-103 (5.5-6.5) CHM101201-1 11/30/2010	G-FA-107 (0-1) CHM101208-9 12/6/2010	G-FA-113 (0-1) CHM101202-4 11/22/2010	G-FA-113 (2-3) CHM101122-2 11/22/2010
NWTPH-HCID (mg/kg)													
Diesel-Range Organics (DRO)	2,000						20 UJ						
Diesel (Fuel Oil)	2,000						50 UJ						
Heavy Oil Range Organics	2,000						**>100** J						
NWTPH-Dx (mg/kg)													
Diesel-Range Organics (DRO)	2,000			**2800**		**25**	**54**						
Heavy Oil Range Organics	2,000			**140**		**40**	**190**						
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)													
Aromatic Hydrocarbons													
C8-C10													
C10-C12													
C12-C16													
C16-C21													
C21-C34													
Aliphatic Hydrocarbons													
C8-C10													
C10-C12													
C12-C16													
C16-C21													
C21-C34													
NWTPH-Gx (mg/kg)													
Gasoline-Range Organics (GRO)	30/100			**680** J	**640** J	9.3 U				**87.0** J			
Gasoline	30/100									5.0 U			
SEMIVOLATILES (mg/kg)													
Method SW8270													
Naphthalene	140												
2-Methylnaphthalene	320												
Fluorene	550												
Phenanthrene	12,000												
Di-n-butylphthalate	100												
Fluoranthene	89												
Pyrene	2,400												
Benzyl Butyl phthalate	2.3												
bis (2-Ethylhexyl) adipate	830												
Benzo(a)anthracene	TEQ												
Chrysene	TEQ												
bis (2-Ethylhexyl) phthalate	4.9												
Benzo(b)fluoranthene	TEQ												
Benzo(k)fluoranthene	TEQ												
Benzo(a)pyrene	0.14												
Indeno(1,2,3-cd)pyrene	TEQ												
Benzo(g,h,i)perylene													
cPAH TEQ	0.14												

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	G-FA-101 (4-5) CHM101201-1/CHM110201-6 11/30/2010	Dup of G-FA-101 (4-5) G-FA-201 (4-5) CHM101201-1 11/30/2010	G-FA-101C (3-4) WS16A/WU28A 05/29/2013	Dup 0f G-FA-101C (3-4) G-FA-201C WS16C 05/29/2013	G-FA-101C (6-7) WS16B/WU73A 05/29/2013	G-FA-101G (3-4) WT95A/WU28B 05/29/2013	G-FA-102 (2-3) CHM101201-1/CHM110201-6 11/30/2010	G-FA-103 (1-2) CHM101201-1 11/30/2010	G-FA-103 (5.5-6.5) CHM101201-1 11/30/2010	G-FA-107 (0-1) CHM101208-9 12/6/2010	G-FA-113 (0-1) CHM101202-4 11/22/2010	G-FA-113 (2-3) CHM101122-2 11/22/2010
PAHs (mg/kg)													
Method SW8270SIM													
Benzo(a)anthracene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	**0.046** J	**0.0456** J	0.05 U
Chrysene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	0.05 U	**0.0450** J	0.05 U
Benzo(b)fluoranthene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	**0.047** J	0.05 U	0.05 U
Total Benzofluoranthenes													
Benzo(a)pyrene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	**0.046** J	0.05 U	0.05 U
Indeno(1,2,3-cd)pyrene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	**0.0546**	**0.0453** J	0.05 U
Dibenz(a,h)anthracene	TEQ	0.05 U	0.05 U					0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
cPAH TEQ	0.14	ND	ND					ND	ND	ND	**0.06** J	**0.01** J	ND
VOLATILES (mg/kg)													
Method SW8260B													
Methylene Chloride	2.6									0.03 U			
Acetone	29												
1,1-Dichloroethane	16,000									0.02 U			
Trichloroethene	0.2									0.03 U			
Toluene	110									0.02 U			
1,3,5-Trimethylbenzene	800									**0.0836** J			
1,2,4-Trimethylbenzene	62									**0.359** J			
sec-Butylbenzene										**0.0323**			
n-Butylbenzene	3,900									**0.0969** J			
Naphthalene	140									**0.520** J			
PCBs (mg/kg)													
Method SW8082													
Aroclor 1248													
Aroclor 1254													
Total PCBs	1												
DIOXIN/FURANS (pg/g)													
Method 1613													
OCDD													
TOTAL TETRA-DIOXINS													
TOTAL HEPTA-DIOXINS													
TOTAL (TEQ ND=0)	5.2												
TOTAL (TEQ ND=1/2 DL)	5.2												

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	G-FA-114 (2-3) UA77C 12/09/2011	G-FA-114 (6-7) UA77D 12/09/2011	G-FA-115 (2-3) UA77E 12/09/2011	Dup of G-FA-115 (2-3) G-FA-501 (2-3) UA77K 12/09/2011	G-FA-115C (4-7) UA78E 12/09/2011	G-GC-100 (0-1) CHM101220-07 12/20/2010	G-GC-101 (0-1) CHM101220-07 12/20/2010	G-GC-102 (0-1) CHM101220-07 12/20/2010	G-GC-103 (0-1) CHM101220-07 12/20/2010	G-GC-104 (0-1) CHM101220-07 12/20/2010	G-GC-105 (0-1) CHM101122-2 11/22/2010	Dup of G-GC-105 (0-1) G-GC-205 (0-1) CHM101122-2 11/22/2010	G-GC-106 (0-1) CHM101122-2 11/22/2010
NWTPH-HCID (mg/kg)														
Diesel-Range Organics (DRO)	2,000	**>50**	50 U	50 U		**>50**								
Diesel (Fuel Oil)	2,000													
Heavy Oil Range Organics	2,000	100 U	100 U	100 U		**>100**								
NWTPH-Dx (mg/kg)														
Diesel-Range Organics (DRO)	2,000	**420**				**100**								
Heavy Oil Range Organics	2,000	**30**				**240**								
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)														
Aromatic Hydrocarbons														
C8-C10														
C10-C12														
C12-C16														
C16-C21														
C21-C34														
Aliphatic Hydrocarbons														
C8-C10														
C10-C12														
C12-C16														
C16-C21														
C21-C34														
NWTPH-Gx (mg/kg)														
Gasoline-Range Organics (GRO)	30/100													
Gasoline	30/100													
SEMIVOLATILES (mg/kg)														
Method SW8270														
Naphthalene	140											0.1 U	0.1 U	
2-Methylnaphthalene	320											0.1 U	0.1 U	
Fluorene	550											0.1 U	0.1 U	
Phenanthrene	12,000											0.1 U	0.1 U	
Di-n-butylphthalate	100											**1.22** J	**0.721** J	
Fluoranthene	89											0.1 U	0.1 U	
Pyrene	2,400											0.1 U	0.1 U	
Benzyl Butyl phthalate	2.3											0.1 U	0.1 U	
bis (2-Ethylhexyl) adipate	830											0.1 U	0.1 U	
Benzo(a)anthracene	TEQ											0.08 U	0.08 U	
Chrysene	TEQ											0.08 U	0.08 U	
bis (2-Ethylhexyl) phthalate	4.9											0.1 U	0.1 U	
Benzo(b)fluoranthene	TEQ											0.08 U	0.08 U	
Benzo(k)fluoranthene	TEQ											0.08 U	0.08 U	
Benzo(a)pyrene	0.14											0.08 U	0.08 U	
Indeno(1,2,3-cd)pyrene	TEQ											0.08 U	0.08 U	
Benzo(g,h,i)perylene												0.08 U	0.08 U	
cPAH TEQ	0.14											ND	ND	

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	G-FA-114 (2-3) UA77C 12/09/2011	G-FA-114 (6-7) UA77D 12/09/2011	G-FA-115 (2-3) UA77E 12/09/2011	Dup of G-FA-115 (2-3) G-FA-501 (2-3) UA77K 12/09/2011	G-FA-115C (4-7) UA78E 12/09/2011	G-GC-100 (0-1) CHM101220-07 12/20/2010	G-GC-101 (0-1) CHM101220-07 12/20/2010	G-GC-102 (0-1) CHM101220-07 12/20/2010	G-GC-103 (0-1) CHM101220-07 12/20/2010	G-GC-104 (0-1) CHM101220-07 12/20/2010	G-GC-105 (0-1) CHM101122-2 11/22/2010	Dup of G-GC-105 (0-1) G-GC-205 (0-1) CHM101122-2 11/22/2010	G-GC-106 (0-1) CHM101122-2 11/22/2010
PAHs (mg/kg)														
Method SW8270SIM														
Benzo(a)anthracene	TEQ	**0.017**	0.0047 U	0.0049 U		**0.035**	0.05 U	**0.0594**	0.05 U	0.05 U	0.05 U			0.05 U
Chrysene	TEQ	**0.03**	**0.0063**	0.0049 U		**0.056**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U
Benzo(b)fluoranthene	TEQ						0.05 U	**0.109**	0.05 U	0.05 U	0.05 U			0.05 U
Total Benzofluoranthenes		**0.03**	**0.0083**	0.0049 U		**0.07**								
Benzo(a)pyrene	TEQ	**0.012**	0.0047 U	0.0049 U		**0.041**	0.05 U	**0.0991**	0.05 U	0.05 U	0.05 U			0.05 U
Indeno(1,2,3-cd)pyrene	TEQ	0.012 U	0.0047 U	0.0049 U		**0.024**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U
Dibenz(a,h)anthracene	TEQ	0.012 U	0.0047 U	0.0049 U		**0.009** M	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U
cPAH TEQ	0.14	**0.017**	**0.00146**	ND		**0.0554** M	ND	**0.12**	ND	ND	ND			ND
VOLATILES (mg/kg)														
Method SW8260B														
Methylene Chloride	2.6													
Acetone	29													
1,1-Dichloroethane	16,000													
Trichloroethene	0.2													
Toluene	110													
1,3,5-Trimethylbenzene	800													
1,2,4-Trimethylbenzene	62													
sec-Butylbenzene														
n-Butylbenzene	3,900													
Naphthalene	140													
PCBs (mg/kg)														
Method SW8082														
Aroclor 1248		0.032 U	0.032 U	0.031 U	0.031 U	**0.054**						0.1 U	0.1 U	
Aroclor 1254		0.032 U	0.032 U	0.031 U	0.031 U	**0.052**						0.1 U	0.1 U	
Total PCBs	1	ND	ND	ND	ND	**0.106**						ND	ND	
DIOXIN/FURANS (pg/g)														
Method 1613														
OCDD														
TOTAL TETRA-DIOXINS														
TOTAL HEPTA-DIOXINS														
TOTAL (TEQ ND=0)	5.2													
TOTAL (TEQ ND=1/2 DL)	5.2													

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

									Dup of J-FA-101 (27-28)					
	Preliminary	G-GC-107 (0-1)	G-GC-108 (0-1)	G-GC-109 (0-1)	G-GC-113 (0-1)	G-GC-114 (0-1)	J-FA-100 (4-5)	J-FA-101 (27-28)	J-FA-201 (27-28)	J-FA-102 (13-14)	J-GC-100 (0-1)	J-GC-101 (0-1)	M-FA-100 (0-1)	M-FA-102b (0-1)
	Screening	CHM101122-2	CHM101220-07	CHM101201-1	UA77G	UA78A	CHM101201-1	CHM101201-1/L15821-1	L15821-2	CHM101201-1	CHM101201-1	CHM101201-1	CHM101122-2	SO09D/SO96A
	Level	11/22/2010	12/20/2010	11/29/2010	12/09/2011	12/09/2011	11/29/2010	11/29/2010	11/29/2010	11/29/2010	11/29/2010	11/29/2010	11/22/2010	03/18/2011
NWTPH-HCID (mg/kg)														
Diesel-Range Organics (DRO)	2,000													
Diesel (Fuel Oil)	2,000													
Heavy Oil Range Organics	2,000													
NWTPH-Dx (mg/kg)														
Diesel-Range Organics (DRO)	2,000						20 U	20 U						**30**
Heavy Oil Range Organics	2,000													**40**
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)														
Aromatic Hydrocarbons														
C8-C10														
C10-C12														
C12-C16														
C16-C21														
C21-C34														
Aliphatic Hydrocarbons														
C8-C10														
C10-C12														
C12-C16														
C16-C21														
C21-C34														
NWTPH-Gx (mg/kg)														
Gasoline-Range Organics (GRO)	30/100													
Gasoline	30/100													
SEMIVOLATILES (mg/kg)														
Method SW8270														
Naphthalene	140			0.1 U			0.1 U							
2-Methylnaphthalene	320			0.1 U			0.1 U							
Fluorene	550			0.1 U			0.1 U							
Phenanthrene	12,000			0.1 U			0.1 U							
Di-n-butylphthalate	100			1.44 U			0.656 U							
Fluoranthene	89			0.1 U			0.1 U							
Pyrene	2,400			0.1 U			0.1 U							
Benzyl Butyl phthalate	2.3			0.1 U			0.1 U							
bis (2-Ethylhexyl) adipate	830			0.1 U			0.1 U							
Benzo(a)anthracene	TEQ			0.08 U			0.08 U							
Chrysene	TEQ			0.08 U			0.08 U							
bis (2-Ethylhexyl) phthalate	4.9			0.1 U			0.1 U							
Benzo(b)fluoranthene	TEQ			0.08 U			0.08 U							
Benzo(k)fluoranthene	TEQ			0.08 U			0.08 U							
Benzo(a)pyrene	0.14			0.08 U			0.08 U							
Indeno(1,2,3-cd)pyrene	TEQ			0.08 U			0.08 U							
Benzo(g,h,i)perylene				0.08 U			0.08 U							
cPAH TEQ	0.14			ND			ND							

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	G-GC-107 (0-1) CHM101122-2 11/22/2010	G-GC-108 (0-1) CHM101220-07 12/20/2010	G-GC-109 (0-1) CHM101201-1 11/29/2010	G-GC-113 (0-1) UA77G 12/09/2011	G-GC-114 (0-1) UA78A 12/09/2011	J-FA-100 (4-5) CHM101201-1 11/29/2010	J-FA-101 (27-28) CHM101201-1/L15821-1 11/29/2010	Dup of J-FA-101 (27-28) J-FA-201 (27-28) L15821-2 11/29/2010	J-FA-102 (13-14) CHM101201-1 11/29/2010	J-GC-100 (0-1) CHM101201-1 11/29/2010	J-GC-101 (0-1) CHM101201-1 11/29/2010	M-FA-100 (0-1) CHM101122-2 11/22/2010	M-FA-102b (0-1) SO09D/SO96A 03/18/2011
PAHs (mg/kg)														
Method SW8270SIM														
Benzo(a)anthracene	TEQ	0.05 U	0.05 U		**0.039**	0.077 U		0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
Chrysene	TEQ	0.05 U	0.05 U		**0.21**	**0.3**		0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
Benzo(b)fluoranthene	TEQ	0.05 U	0.05 U					0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
Total Benzofluoranthenes					**0.094**	**0.077**								
Benzo(a)pyrene	TEQ	0.05 U	0.05 U		**0.041**	**0.082**		0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
Indeno(1,2,3-cd)pyrene	TEQ	0.05 U	0.05 U		0.039 U	0.077 U		0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
Dibenz(a,h)anthracene	TEQ	0.05 U	0.05 U		0.039 U	0.077 U		0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	
cPAH TEQ	0.14	ND	ND		**0.056**	**0.093**		ND		ND	ND	ND	ND	
VOLATILES (mg/kg)														
Method SW8260B														
Methylene Chloride	2.6													
Acetone	29													
1,1-Dichloroethane	16,000													
Trichloroethene	0.2													
Toluene	110													
1,3,5-Trimethylbenzene	800													
1,2,4-Trimethylbenzene	62													
sec-Butylbenzene														
n-Butylbenzene	3,900													
Naphthalene	140													
PCBs (mg/kg)														
Method SW8082														
Aroclor 1248							0.1 U							
Aroclor 1254							0.1 U							
Total PCBs	1						ND							
DIOXIN/FURANS (pg/g)														
Method 1613														
OCDD								**8.07**	**10.9**					
TOTAL TETRA-DIOXINS								0.36 UJ	**1.50** J					
TOTAL HEPTA-DIOXINS								**1.23** J	**2.43** J					
TOTAL (TEQ ND=0)	5.2							**0.00242**	**0.00327**					
TOTAL (TEQ ND=1/2 DL)	5.2							**0.571**	**0.673**					

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-FA-102c (0-1) SP04B 3/28/2011	M-FA-102d (0-1) SP04C 3/28/2011	M-FA-102e (0-1) SP04D 3/28/2011	M-FA-102F (7-8) UA75C 12/08/2011	M-FA-102G (7-8) UA75B 12/08/2011	M-FA-102H (4-5) UA75A 12/08/2011	M-FA-102 (7-7.5) CHM101202-16 12/1/2010	M-FA-102 (9-10) CHM101213-7 12/1/2010	M-FA-104 (0-1) CHM101122-2 11/22/2010	M-FA-105 (0-1) CHM110202-5/CHM110131-4 1/28/2011	M-FA-105a (0-1) SO09A 03/18/2011	M-FA-105b SO09B 03/18/2011
NWTPH-HCID (mg/kg)													
Diesel-Range Organics (DRO)	2,000										50 U		
Diesel (Fuel Oil)	2,000										**D**		
Heavy Oil Range Organics	2,000										**D**		
NWTPH-Dx (mg/kg)													
Diesel-Range Organics (DRO)	2,000	**6.0**	**22**	**5.4**							**153**	**33**	5.6 U
Heavy Oil Range Organics	2,000	**12**	**75**	**11**							**2340**	**260**	**44**
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)													
Aromatic Hydrocarbons													
C8-C10											**38.5** J		
C10-C12											**2.97** J		
C12-C16											**18.0** J		
C16-C21											**104** J		
C21-C34											**597** J		
Aliphatic Hydrocarbons													
C8-C10											**30.1** J		
C10-C12											**3.66** J		
C12-C16											**23.5** J		
C16-C21											**370** J		
C21-C34											**1200** J		
NWTPH-Gx (mg/kg)													
Gasoline-Range Organics (GRO)	30/100												
Gasoline	30/100												
SEMIVOLATILES (mg/kg)													
Method SW8270													
Naphthalene	140							0.1 U			0.1 U		
2-Methylnaphthalene	320							0.1 U			0.1 U		
Fluorene	550							0.1 U			0.1 U		
Phenanthrene	12,000							**0.260**			0.1 U		
Di-n-butylphthalate	100							0.501 U			0.1 U		
Fluoranthene	89							**0.501**			0.1 U		
Pyrene	2,400							**0.420**			0.1 U		
Benzyl Butyl phthalate	2.3							**14.1**			0.1 U		
bis (2-Ethylhexyl) adipate	830							0.1 U			0.1 U		
Benzo(a)anthracene	TEQ							**0.140**			0.08 U		
Chrysene	TEQ							**0.230**			0.08 U		
bis (2-Ethylhexyl) phthalate	4.9							**0.330**			**0.141**		
Benzo(b)fluoranthene	TEQ							**0.340**			0.08 U		
Benzo(k)fluoranthene	TEQ							**0.280**			0.08 U		
Benzo(a)pyrene	0.14							**0.130**			0.08 U		
Indeno(1,2,3-cd)pyrene	TEQ							**0.180**			0.08 U		
Benzo(g,h,i)perylene								**0.140**			0.08 U		
cPAH TEQ	0.14							**0.226**			ND		

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-FA-102c (0-1) SP04B 3/28/2011	M-FA-102d (0-1) SP04C 3/28/2011	M-FA-102e (0-1) SP04D 3/28/2011	M-FA-102F (7-8) UA75C 12/08/2011	M-FA-102G (7-8) UA75B 12/08/2011	M-FA-102H (4-5) UA75A 12/08/2011	M-FA-102 (7-7.5) CHM101202-16 12/1/2010	M-FA-102 (9-10) CHM101213-7 12/1/2010	M-FA-104 (0-1) CHM101122-2 11/22/2010	M-FA-105 (0-1) CHM110202-5/CHM110131-4 1/28/2011	M-FA-105a (0-1) SO09A 03/18/2011	M-FA-105b SO09B 03/18/2011
PAHs (mg/kg)													
Method SW8270SIM													
Benzo(a)anthracene	TEQ				**0.024**	0.013 U	**0.094**		0.05 UJ	0.05 U			
Chrysene	TEQ				**0.031**	**0.12**	**0.095**		0.05 UJ	0.05 U			
Benzo(b)fluoranthene	TEQ								0.05 UJ	0.05 U			
Total Benzofluoranthenes					**0.046**	**0.1**	**0.19**						
Benzo(a)pyrene	TEQ				**0.034**	**0.051**	**0.12**		0.05 UJ	0.05 U			
Indeno(1,2,3-cd)pyrene	TEQ				**0.015**	**0.026**	**0.086**		**0.150** J	0.05 U			
Dibenz(a,h)anthracene	TEQ				**0.0049** M	0.013 U	**0.026**		0.05 UJ	0.05 U			
cPAH TEQ	0.14				**0.043** M	**0.065**	**0.161**		**0.015** J	ND			
VOLATILES (mg/kg)													
Method SW8260B													
Methylene Chloride	2.6												
Acetone	29												
1,1-Dichloroethane	16,000												
Trichloroethene	0.2												
Toluene	110												
1,3,5-Trimethylbenzene	800												
1,2,4-Trimethylbenzene	62												
sec-Butylbenzene													
n-Butylbenzene	3,900												
Naphthalene	140												
PCBs (mg/kg)													
Method SW8082													
Aroclor 1248								0.1 U			0.1 U		
Aroclor 1254								0.1 U			0.1 U		
Total PCBs	1							ND			ND		
DIOXIN/FURANS (pg/g)													
Method 1613													
OCDD													
TOTAL TETRA-DIOXINS													
TOTAL HEPTA-DIOXINS													
TOTAL (TEQ ND=0)	5.2												
TOTAL (TEQ ND=1/2 DL)	5.2												

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-FA-105 (4-5) CHM110207-1 1/28/2011	M-FA-106(0-1) CHM110131-4 1/28/2011	M-FA-107 (0-1) CHM110131-4 1/28/2011	M-FA-108 (0-1) CHM110131-4 1/28/2011	M-GC-100 (0-1) CHM101201-1 11/30/2010	M-GC-101 (0-1) CHM101201-1 11/30/2010	M-GC-102 (0-1) CHM101201-1 11/30/2010	Dup of M-GC-102 (0-1) M-GC-202 (0-1) CHM101201-1 11/30/2010	M-GC-103 (0-1) CHM101217-8 12/17/2010	M-GC-104 (0-1) CHM101202-16 12/2/2010	M-GC-105 (0-0.2) CHM110131-4/CHM110202-5 1/29/2011	Dup of M-GC-105 (0-0.2) M-GC-10502 (0-0.2) CHM110131-4/CHM110202-5 1/29/2011
NWTPH-HCID (mg/kg)													
Diesel-Range Organics (DRO)	2,000		50 U	50 U	50 U							50 U	50 U
Diesel (Fuel Oil)	2,000		50 U	50 U	50 U							**D**	**D**
Heavy Oil Range Organics	2,000		100 U	100 U	100 U							**D**	**D**
NWTPH-Dx (mg/kg)													
Diesel-Range Organics (DRO)	2,000	20 U										**6100**	
Heavy Oil Range Organics	2,000	50 U										**34700**	
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)													
Aromatic Hydrocarbons													
C8-C10													
C10-C12													
C12-C16													
C16-C21													
C21-C34													
Aliphatic Hydrocarbons													
C8-C10													
C10-C12													
C12-C16													
C16-C21													
C21-C34													
NWTPH-Gx (mg/kg)													
Gasoline-Range Organics (GRO)	30/100												
Gasoline	30/100												
SEMIVOLATILES (mg/kg)													
Method SW8270													
Naphthalene	140					0.1 U						**0.179**	**0.123**
2-Methylnaphthalene	320					0.1 U						**0.0901** J	**0.0690** J
Fluorene	550					0.1 U						0.1 U	0.1 U
Phenanthrene	12,000					0.1 U						**0.0850** J	**0.187** J
Di-n-butylphthalate	100					0.746 U						0.1 U	0.1 U
Fluoranthene	89					0.1 U						**0.118**	**0.170**
Pyrene	2,400					0.1 U						**0.285**	**0.282**
Benzyl Butyl phthalate	2.3					0.1 U						0.1 U	0.1 U
bis (2-Ethylhexyl) adipate	830					0.1 U						**0.232**	**0.198**
Benzo(a)anthracene	TEQ					0.08 U						0.08 U	0.08 U
Chrysene	TEQ					0.08 U						0.08 U	0.08 U
bis (2-Ethylhexyl) phthalate	4.9					0.1 U						0.1 U	0.1 U
Benzo(b)fluoranthene	TEQ					0.08 U						0.08 U	0.08 U
Benzo(k)fluoranthene	TEQ					0.08 U						0.08 U	0.08 U
Benzo(a)pyrene	0.14					0.08 U						0.08 U	0.08 U
Indeno(1,2,3-cd)pyrene	TEQ					0.08 U						0.08 U	0.08 U
Benzo(g,h,i)perylene						0.08 U						0.08 U	0.08 U
cPAH TEQ	0.14					ND						ND	ND

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-FA-105 (4-5) CHM110207-1 1/28/2011	M-FA-106(0-1) CHM110131-4 1/28/2011	M-FA-107 (0-1) CHM110131-4 1/28/2011	M-FA-108 (0-1) CHM110131-4 1/28/2011	M-GC-100 (0-1) CHM101201-1 11/30/2010	M-GC-101 (0-1) CHM101201-1 11/30/2010	M-GC-102 (0-1) CHM101201-1 11/30/2010	Dup of M-GC-102 (0-1) M-GC-202 (0-1) CHM101201-1 11/30/2010	M-GC-103 (0-1) CHM101217-8 12/17/2010	M-GC-104 (0-1) CHM101202-16 12/2/2010	M-GC-105 (0-0.2) CHM110131-4/CHM110202-5 1/29/2011	Dup of M-GC-105 (0-0.2) M-GC-10502 (0-0.2) CHM110131-4/CHM110202-5 1/29/2011
PAHs (mg/kg)													
Method SW8270SIM													
Benzo(a)anthracene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
Chrysene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
Benzo(b)fluoranthene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
Total Benzofluoranthenes													
Benzo(a)pyrene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
Indeno(1,2,3-cd)pyrene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
Dibenz(a,h)anthracene	TEQ		0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		
cPAH TEQ	0.14		ND	ND	ND		ND	ND	ND	ND	ND		
VOLATILES (mg/kg)													
Method SW8260B													
Methylene Chloride	2.6												
Acetone	29												
1,1-Dichloroethane	16,000												
Trichloroethene	0.2												
Toluene	110												
1,3,5-Trimethylbenzene	800												
1,2,4-Trimethylbenzene	62												
sec-Butylbenzene													
n-Butylbenzene	3,900												
Naphthalene	140												
PCBs (mg/kg)													
Method SW8082													
Aroclor 1248			0.1 U	0.1 U	0.1 U	0.1 U						0.1 U	0.1 U
Aroclor 1254			0.1 U	0.1 U	**0.125**	0.1 U						0.1 U	0.1 U
Total PCBs	1		ND	ND	**0.125**	ND						ND	ND
DIOXIN/FURANS (pg/g)													
Method 1613													
OCDD													
TOTAL TETRA-DIOXINS													
TOTAL HEPTA-DIOXINS													
TOTAL (TEQ ND=0)	5.2												
TOTAL (TEQ ND=1/2 DL)	5.2												

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-GC-105 (0.5-1.5) CHM110207-1 1/29/2011	M-GC-106 (0-1) CHM101202-16 12/2/2010	M-GC-107 (0-1) UA77A 12/08/2011	Dup of M-GC-107 (0-1) M-GC-500 (0-1) UA77B 12/08/2011	N-FA-102 (2-3) CHM101202-16 12/1/2010	N-FA-103B (6-7) CHM101202-16 12/1/2010	Dup of N-FA-103B (6-7) N-FA-203B (6-7) CHM101202-16 12/1/2010	N-FA-103B (10-11) CHM101213-7 12/1/2010	RI-MW-5 (0-1) CHM101208-9 12/7/2010
NWTPH-HCID (mg/kg)										
Diesel-Range Organics (DRO)	2,000			**>50**	**>50**					
Diesel (Fuel Oil)	2,000									
Heavy Oil Range Organics	2,000			**>100**	**>100**					
NWTPH-Dx (mg/kg)										
Diesel-Range Organics (DRO)	2,000	**872**		**240**	**190**	**167**	**78.5**	**103**		
Heavy Oil Range Organics	2,000	**5420**		**1900**	**1600**					
EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)										
Aromatic Hydrocarbons										
C8-C10										
C10-C12										
C12-C16										
C16-C21										
C21-C34										
Aliphatic Hydrocarbons										
C8-C10										
C10-C12										
C12-C16										
C16-C21										
C21-C34										
NWTPH-Gx (mg/kg)										
Gasoline-Range Organics (GRO)	30/100						**280** J	**413** J	**10.1**	
Gasoline	30/100						5.0 U	5.0 U	5.0 U	
SEMIVOLATILES (mg/kg)										
Method SW8270										
Naphthalene	140					**0.430** J	0.1 U			
2-Methylnaphthalene	320					**0.246**	0.1 U			
Fluorene	550					**0.246**	0.1 U			
Phenanthrene	12,000					**1.26** J	0.1 U			
Di-n-butylphthalate	100					**9.89** J	1.5 U			
Fluoranthene	89					**1.29** J	0.1 U			
Pyrene	2,400					**1.32** J	0.1 U			
Benzyl Butyl phthalate	2.3					0.1 U	0.1 U			
bis (2-Ethylhexyl) adipate	830					0.1 U	0.1 U			
Benzo(a)anthracene	TEQ					**0.492** J	0.08 U			
Chrysene	TEQ					**0.830** J	0.08 U			
bis (2-Ethylhexyl) phthalate	4.9					**0.461**	**0.331**			
Benzo(b)fluoranthene	TEQ					**0.983** J	0.08 U			
Benzo(k)fluoranthene	TEQ					**1.01** J	0.08 U			
Benzo(a)pyrene	0.14					**0.492** J	0.08 U			
Indeno(1,2,3-cd)pyrene	TEQ					**0.492** J	0.08 U			
Benzo(g,h,i)perylene						**0.399** J	0.08 U			
cPAH TEQ	0.14					**0.798** J	ND			

TABLE 9
SOIL ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	M-GC-105 (0.5-1.5) CHM110207-1 1/29/2011	M-GC-106 (0-1) CHM101202-16 12/2/2010	M-GC-107 (0-1) UA77A 12/08/2011	Dup of M-GC-107 (0-1) M-GC-500 (0-1) UA77B 12/08/2011	N-FA-102 (2-3) CHM101202-16 12/1/2010	N-FA-103B (6-7) CHM101202-16 12/1/2010	Dup of N-FA-103B (6-7) N-FA-203B (6-7) CHM101202-16 12/1/2010	N-FA-103B (10-11) CHM101213-7 12/1/2010	RI-MW-5 (0-1) CHM101208-9 12/7/2010
PAHs (mg/kg)										
Method SW8270SIM										
Benzo(a)anthracene	TEQ		**0.0800**	**0.038**	**0.039**					0.05 U
Chrysene	TEQ		**0.196**	**0.12**	**0.1**					0.05 U
Benzo(b)fluoranthene	TEQ		**0.178**							0.05 U
Total Benzofluoranthenes				**0.15**	**0.12**					
Benzo(a)pyrene	TEQ		**0.0978**	**0.058**	**0.053**					0.05 U
Indeno(1,2,3-cd)pyrene	TEQ		**0.0445** J	**0.018**	**0.018**					0.05 U
Dibenz(a,h)anthracene	TEQ		0.05 U	0.017 U	**0.013** M					0.05 U
cPAH TEQ	0.14		**0.13** J	**0.080**	**0.073** M					ND
VOLATILES (mg/kg)										
Method SW8260B										
Methylene Chloride	2.6			**0.016** J	**0.007** J	0.03 U	0.03 U	0.03 U		
Acetone	29			0.0062 UJ	**0.017** J					
1,1-Dichloroethane	16,000			0.0012 U	0.0014 U	**0.0346**	0.02 U	0.02 U		
Trichloroethene	0.2			0.0012 U	0.0014 U	**0.0408**	0.03 U	0.03 U		
Toluene	110			**0.0019**	0.0014 U	0.02 U	0.02 U	0.02 U		
1,3,5-Trimethylbenzene	800			0.0012 U	0.0014 U	0.02 U	0.02 U	0.02 U		
1,2,4-Trimethylbenzene	62			0.0012 U	0.0014 U	0.02 U	**0.0456**	0.02 U		
sec-Butylbenzene				0.0012 U	0.0014 U	0.02 U	0.02 U	0.02 U		
n-Butylbenzene	3,900			0.0012 U	0.0014 U	0.02 U	0.02 U	0.02 U		
Naphthalene	140			0.0062 U	0.0071 U	0.03 U	**0.0634**	**0.0498**		
PCBs (mg/kg)										
Method SW8082										
Aroclor 1248						0.1 U	0.1 U			
Aroclor 1254						**3.85**	0.1 U			
Total PCBs	1					**3.85**	ND			
DIOXIN/FURANS (pg/g)										
Method 1613										
OCDD										
TOTAL TETRA-DIOXINS										
TOTAL HEPTA-DIOXINS										
TOTAL (TEQ ND=0)	5.2									
TOTAL (TEQ ND=1/2 DL)	5.2									

mg/kg = milligrams per kilogram
pg/g = picogram per gram
TEQ = Toxic Equivalency Quotient
cPAH = carcinogenic polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
ND = Not Detected
D = Indicates detection at or above the listed reporting limit
U = Indicates the compound was undetected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
M = Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match.
Bold = Detected compound.
Boxed value indicates exceedance of preliminary screening level.

TABLE 10
SOIL ANALYTICAL RESULTS FOR METALS
NORTH MARINA AMERON/HULBERT SITE RI/FS

TOTAL METALS (mg/kg)
Method SW6020/EPA200.8/SW7471A

	Depth Below			Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	pH
	Ground Surface		Preliminary Screening Level:	32	20	80	120,000	3,000	250	24	24,000	
G-FA-100(0-1)[1]	0-1	CHM101202-16	11/30/2010	272	3270	4.50	94.5	1330	1460	0.20 U	5750	
G-FA-100 (1-2)	1-2	CHM101201-1	11/30/2010	2.37	21.8	0.20 U	34.9	38.0	8.81	0.20 U	44.6	
G-FA-101 (4-5)[2]	4.5-5.5	CHM101201-1/CHM110201-6	11/30/2010	9.38	58.4	0.213	146	62.8	30.1	0.20 U	98.0	11.9 J
Dup of G-FA-101 (4-5)[2]	4.5-5.5	CHM101201-1	11/30/2010	9.95	70.0	0.221	177	71.2	33.8	0.20 U	123	
G-FA-101 (10-11)	10.5-11.5	CHM101213-7	11/30/2010		11.2			28.2				
G-FA-101A	3-3.5	WS17M	05/29/2013		5 U							
G-FA-101A	5-5.5	WS17N	05/29/2013		24							
G-FA-101A	5.5-6.5	WT95B	05/29/2013		11							
G-FA-101B	3-3.5	WS16J	05/29/2013		6							
G-FA-101B	5-5.5	WS16K	05/29/2013		18							
G-FA-101B	5.5-6.5	WS16L	05/29/2013		8							
G-FA-101C[2]	3-4	WS16A/WU28A	05/29/2013		50							12.27
Dup of G-FA-101C[2]	3-4	WS16C	05/29/2013		80							12.36
G-FA-101C	6-7	WS16B/WU73A	05/29/2013		9							
G-FA-101D	3-3.5	WS16M	05/29/2013		7							7.89
G-FA-101D	5-5.5	WS16N	05/29/2013		73							
G-FA-101D	5.5-6.5	WS17K	05/29/2013		9							
G-FA-101D	7-8	WS17L	05/29/2013		14							
G-FA-101E[2]	3-4	WS16D	05/29/2013		60							12.08
G-FA-101E	9-10	WS16I	05/29/2013		7 U							
G-FA-101G	3-4	WT95A/WU28B	05/29/2013		10							
G-FA-102 (2-3)	3-4	CHM101201-1/CHM110201-6	11/30/2010	0.824	8.81	0.20 U	38.5	27.5	8.74	0.20 U	41.9	10.7 J
G-FA-103 (1-2)[2]	1-2	CHM101201-1	11/30/2010	7.80	50.8	0.269	28.7	58.8	72.4	0.20 U	132	11.9
G-FA-103 (5.5-6.5)[2]	5.5-6.5	CHM101201-1	11/30/2010	10.5	62.5	0.308	35.6	81.1	75.7	0.20 U	139	11.9
G-FA-103 (8-9)	8-9	CHM101213-7	11/30/2010		7.71			27.8				
G-FA-103A	1-2	WS16E	05/29/2013		13							
G-FA-103A	5.5-6.5	WS16F	05/29/2013		6 U							
G-FA-103B	1-2	WS16G	05/29/2013		16							
G-FA-103B	5.5-6.5	WS16H	05/29/2013		9							
G-FA-103C[2]	3-4	WS17P	05/29/2013		43.6 J							12.36
G-FA-103C	8.5-9.5	WS17O	05/29/2013		12							
G-FA-104 (0-1)[1]	0-1	CHM101208-9	12/6/2010	171	714	1.97	77.0	714	594	0.20 U	2580	
G-FA-104 (1-2)	1-2	CHM101220-4	12/6/2010	2.10	13.1			25.2	11.5			
G-FA-105 (0.3-0.8)[1]	0.3-0.8	CHM101208-9	12/6/2010	303	1210	3.25	60.2	1030	996	0.20 U	4020	
G-FA-105 (1-2)	1-2	CHM101220-4	12/6/2010	24.1	177			95.5	85.8			
G-FA-105A (2-3)	2-3	UA78G	12/09/2011	0.2 U	3.8			22.4	3.9			
G-FA-106 (1-1.2)[1]	1-1.2	CHM101208-9	12/6/2010	237	1120	3.66	21.3	1380	946	0.20 U	3540	
G-FA-106 (1-1.5)[1]	1-1.5	CHM101208-9	12/6/2010	11.7	50.9	1.34	32.4	44.1	39.0	0.20 U	245	
G-FA-106 (3-3.5)	3-3.5	CHM101220-4/CHM110201-6	12/6/2010	5.08	4.54			16.9	4.96			8.26 J
G-FA-107 (0-1)[1]	0-1	CHM101208-9	12/6/2010	127	521	1.82	93.9	423	417	0.20 U	2240	
G-FA-107 (1-2)	1-2	CHM101220-4	12/6/2010	0.20 U	3.07			12.1	3.62			
G-FA-108A (0-1)	0-1	CHM101208-9	12/6/2010	127	556	1.65	53.6	477	501	0.20 U	2220	
G-FA-108B (0-1)	0-1	CHM101208-9	12/6/2010	42.2	150	1.19	85.2	204	132	0.20 U	1090	
G-FA-108 (1-2)	1-2	CHM101220-4	12/6/2010	0.672	3.87			19.9	13.8			
G-FA-109 (0.5-1)[1]	0.5-1	CHM101208-9	12/6/2010	297	1310	3.84	36.4	1420	1060	0.20 U	4130	

TABLE 10
SOIL ANALYTICAL RESULTS FOR METALS
NORTH MARINA AMERON/HULBERT SITE RI/FS

						TOTAL METALS (mg/kg) Method SW6020/EPA200.8/SW7471A						
	Depth Below			Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	pH
	Ground Surface	**Preliminary Screening Level:**		**32**	**20**	**80**	**120,000**	**3,000**	**250**	**24**	**24,000**	
G-FA-109 (1-2)	1-2	CHM101220-4	12/6/2010	**7.46**	**20.5**			**33.5**	**28.3**			
G-FA-110 (3.5-4.5)[2]	3.5-4.5	CHM101220-07	12/20/2010	**1.05**	**50.6**	**0.387**	**463**	**540**	**13.5**	0.20 U	**473**	
G-FA-111 (2-3)[2]	2-3	CHM101220-07	12/20/2010	**0.674**	**29.0**	0.20 U	**176**	**196**	**12.4**	0.20 U	**241**	
G-FA-112 (3-4)[2]	3-4	CHM101220-07	12/20/2010	**1.58**	**24.5**	**0.333**	**29.6**	**33.9**	**20.8**	0.20 U	**113**	
G-FA-113 (0-1)	1-2	CHM101202-4	11/22/2010	0.20 U	**1.97**	0.20 U	**21.5**	**18.0**	**6.34**	0.20 U	**26.2**	
G-FA-113 (2-3)	3-4	CHM101122-2	11/22/2010	0.20 U	**9.82**	0.20 U	**53.6**	**20.1**	**26.4**	0.20 U	**98.9**	
G-FA-114 (1-2)	2-3	UB70D	12/09/2011		**12.9**			**33.1**				
G-FA-114 (2-3)[2]	3-4	UA77C	12/09/2011	0.3 U	**28.6**			**46.3**	**10.7**			12.21
G-FA-114 (3-4)	4-5	UB70G	12/09/2011		**3.6**			**23.4**				
G-FA-114 (6-7)	7-8	UA77D	12/09/2011		**3.2**			**23.9**				
G-FA-115 (2-3)	3-4	UA77E	12/09/2011		**5.9**			**29.3**				
G-FA-115A (2-3)	2-3	UB70E	12/09/2011		**6.3**			**26.6**				
G-FA-115A (3-3.5)[2]	3-3.5	UA77F	12/09/2011	**0.7**	**109**			**104**	**73.8**			8.49
G-FA-115A (4.5-5.5)	4.5-5.5	UB70F	12/09/2011		**10.4**			**23.6**				
G-FA-115B (2-3)	3-4	UA77P	12/09/2011	0.2 U	**4.4**			**21.2**	**4.5**			8.43
G-FA-115C (4-7)	5-8	UA78E	12/09/2011		**23.6**			**99.1**				
G-FA-115C (7-8)	8-9	UB70H	12/09/2011		**12.6**			**65.7**				
G-GC-100 (0-1)	1.5-2.5	CHM101220-07	12/20/2010	0.20 U	**3.42**	0.20 U	**19.8**	**38.7**	**7.58**	0.20 U	**42.4**	
G-GC-100 (1-2)	2.5-3.5	CHM110104-5	12/20/2010					**16.7**				
G-GC-101 (0-1)	0.2-1.2	CHM101220-07	12/20/2010	**0.262**	**5.94**	0.20 U	**22.9**	**15.9**	**8.90**	0.20 U	**61.4**	
G-GC-102 (0-1)	1.5-2.5	CHM101220-07	12/20/2010	0.20 U	**3.82**	0.20 U	**23.6**	**18.1**	**6.21**	0.20 U	**42.7**	
G-GC-103 (0-1)	0.2-1.2	CHM101220-07	12/20/2010	0.20 U	**3.24**	0.20 U	**23.2**	**15.9**	**5.09**	0.20 U	**46.8**	
G-GC-104 (0-1)	0.2-1.2	CHM101220-07	12/20/2010	0.20 U	**3.72**	0.20 U	**20.0**	**13.2**	**7.82**	**0.228**	**43.6**	
G-GC-105 (0-1)	1-2	CHM101122-2	11/22/2010	0.20 U	**7.66**	0.20 U	**46.4**	**31.0**	**11.2**	0.20 U	**99.9**	
Dup of G-GC-105 (0-1)	1-2	CHM101122-2	11/22/2010	0.20 U	**7.69**	0.20 U	**58.7**	**33.4**	**12.3**	0.20 U	**93.9**	
G-GC-106 (0-1)	1-2	CHM101122-2	11/22/2010	0.20 U	**5.79**	0.20 U	**46.1**	**20.2**	**5.46**	0.20 U	**69.2**	
G-GC-107 (0-1)	1-2	CHM101122-2	11/22/2010	**0.734**	**12.6**	0.20 U	**54.7**	**35.2**	**20.9**	0.20 U	**121**	
G-GC-108 (0-1)	0.2-1.2	CHM101220-07	12/20/2010	0.20 U	**1.77**	0.20 U	**21.2**	**10.5**	**3.70**	0.20 U	**36.5**	
G-GC-109 (0-1)	1-2	CHM101201-1	11/29/2010	0.20 U	**2.46**	0.20 U	**12.4**	**15.8**	**2.76**	0.20 U	**21.3**	
G-GC-113 (0-1)	0-1	UA77G	12/09/2011	0.2 UJ	**13.1** J	0.1 U	**42.6** J	**26.3** J	**5.6**	0.02 U	**54**	
G-GC-114 (0-1)	0-1	UA78A	12/09/2011	0.2 U	**17.4**	0.1 U	**52.6**	**28.1**	**4.1**	0.02 U	**65**	
I-FA-100 (2-3)	3-4	CHM101217-8	12/17/2010	0.20 U	**17.8**	**0.571**	**84.3**	**57.3**	**11.6**	**0.198** J	**135**	
J-FA-100 (4-5)	5-6	CHM101201-1	11/29/2010	0.20 U	**7.34**	0.20 U	**30.7**	**16.0**	**3.14**	0.20 U	**33.3**	
J-FA-101 (27-28)	28-29	CHM101201-1/L15821-1	11/29/2010	0.20 U	**6.43**	0.20 U	**35.5**	**15.5**	**4.68**	0.20 U	**36.3**	
J-FA-102 (13-14)	14-15	CHM101201-1	11/29/2010	**1.03**	**5.86**	**0.204**	**44.2**	**101**	**16.0**	0.20 U	**23.5**	
J-FA-102 (18-19)	19-20	CHM101213-7	11/29/2010					**18.0**				
J-GC-100 (0-1)	1-2	CHM101201-1	11/29/2010	0.20 U	**5.33**	0.20 U	**31.6**	**20.7**	**5.67**	0.20 U	**37.6**	
J-GC-101 (0-1)	1-2	CHM101201-1	11/29/2010	0.20 U	**3.49**	0.20 U	**18.6**	**17.7**	**3.13**	0.20 U	**27.6**	
M-FA-100 (0-1)	1-2	CHM101122-2	11/22/2010	0.20 U	**8.88**	0.20 U	**81.7**	**34.8**	**17.9**	0.20 U	**119**	
M-FA-101 (0-1)	0-1	CHM101217-8	12/17/2010	0.20 U	**5.76**	**0.428**	**65.0**	**54.1**	**18.3**	0.20 U	**128**	
M-FA-101 (1-2)	1-2	CHM101230-2	12/17/2010					**9.26** J				
M-FA-102 (7-7.5)[1]	7-7.5	CHM101202-16	12/1/2010	**10.5**	**290**	**2.04**	**52.8**	**1410**	**270**	0.20 U	**4700**	
M-FA-102 (9-10)	9-10	CHM101213-7	12/1/2010		**5.64**			**18.9**	**3.36**			
M-FA-102a (0-1)	0-1	SO09E	03/18/2011	0.2 U	**5.4**	**0.2**	**28.5**	**21.6**	**8**	0.02 U	**41**	
M-FA-102b (0-1)	0-1	SO09D/SO96A	03/18/2011	**0.3**	**35.3**	**0.5**	**43.0**	**124**	**73**	**0.08**	**188**	

TABLE 10
SOIL ANALYTICAL RESULTS FOR METALS
NORTH MARINA AMERON/HULBERT SITE RI/FS

TOTAL METALS (mg/kg)
Method SW6020/EPA200.8/SW7471A

	Depth Below Ground Surface			Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	pH
		Preliminary Screening Level:		**32**	**20**	**80**	**120,000**	**3,000**	**250**	**24**	**24,000**	
M-FA-102b (1-2)	1-2	SP04A	3/28/2011		**14.3**							
M-FA-102c (0-1)	0-1	SP04B	3/28/2011		**4.1**							
M-FA-102d (0-1)	0-1	SP04C	3/28/2011		**6.4**							
M-FA-102e (0-1)	0-1	SP04D	3/28/2011		**3.0**							
M-FA-102F (7-8)	8-9	UA75C	12/08/2011	0.3 U	**10.0**			**36.5**	**9.4**			
M-FA-102G (7-8)	8-9	UA75B	12/08/2011	0.2 U	**10.3**			**24.2**	**9.9**			
M-FA-102H (4-5)	5-6	UA75A	12/08/2011	**0.8** J	**30.4**			**564**	**328**			
M-FA-102I[1]	6-7	WS17D	05/30/2013		**2440**				**1820**			
M-FA-102I	9-10	WS17E	05/30/2013		**9**				**4**			
M-FA-102J	5-6	WS17I/WS68A	05/30/2013		**8**				**11** J			
Dup of M-FA-102J	5-6	WS17H	05/30/2013		**10**				**22** J			
M-FA-102J	7.5-8	WS17A	05/30/2013		**7**				3 U			
M-FA-102K	5-6	WS17F	05/30/2013		**16**				**28**			
M-FA-102K	7-7.5	WS17G	05/30/2013		6 U				2 U			
M-FA-102K	9-10	WS17J	05/30/2013		6 U				2 U			
M-FA-102L[1]	7-8	WS17B	05/30/2013		**1450**				**1070**			
M-FA-102L	9-10	WS17C	05/30/2013		**9**				**3**			
M-FA-103a (0-1)	0-1	SO09F	03/18/2011					**119**	**127**			
M-FA-103 (0-1)	1-2	CHM101202-16	12/2/2010	**1.34**	**3.06**	**0.341**	**33.5**	**52.1**	**294**	0.20 U	**45.8**	
M-FA-103 (1-2)	2-3	CHM110121-6	12/2/2010					**13.4**	**3.22**			
M-FA-103C (0-1)	1-2	UA75D	12/08/2011		**2.1**			**11.4**	**48.8**			
M-FA-104 (0-1)	0.5-1.5	CHM101122-2	11/22/2010	0.20 U	**8.44**	0.20 U	**45.1**	**23.8**	**26.5**	0.20 U	**103**	
M-FA-105 (0-1)	0-1	CHM110202-5/CHM110131-4	1/28/2011	0.20 U	**4.67**	**0.365**	**25.1**	**24.4**	**11.6**	**0.123**	**89.3**	
M-GC-100 (0-1)	1-2	CHM101201-1	11/30/2010	0.20 U	**1.87**	0.20 U	**20.8**	**10.2**	**5.50**	0.20 U	**25.2**	
M-GC-101 (0-1)	1-2	CHM101201-1	11/30/2010	**2.46**	**12.3**	0.20 U	**25.8**	**23.2**	**30.3**	0.20 U	**43.2**	
M-GC-102 (0-1)	1-2	CHM101201-1	11/30/2010	**9.44** J	**58.0**	**0.250**	**31.6**	**73.0** J	**54.5**	0.20 U	**125**	
Dup of M-GC-102 (0-1)	1-2	CHM101201-1	11/30/2010	**14.8** J	**76.4**	**0.315**	**25.1**	**111** J	**75.0**	0.20 U	**129**	
M-GC-102 (1-2)	2-3	CHM101213-7	11/30/2010		**3.43** J			**14.8**				
M-GC-102A (0-1)	0.5-1.5	UA76B	12/08/2011		**60.7**			**81.1**				
M-GC-102A (1-2)	1.5-2.5	UB54A	12/08/2011		**3.2**			**18.1**				
M-GC-102B (0-1)	0.5-1.5	UA75E	12/08/2011		**44.6**			**87.5**				
M-GC-102B (1-2)	1.5-2.5	UB70B	12/08/2011		**3.1**			**17.7**				
M-GC-102C (0-1)	0.5-1.5	UA76A	12/08/2011		**6.2**			**23.2** J				
M-GC-102D (0-1)	1-2	UB70A	12/08/2011		**53.2** J			**75.3**				
M-GC-102D (1-2)	2-3		12/08/2011		**3.5**			**18.9**				
M-GC-102E (0-1)	0.5-1.5	UB54B	12/08/2011		**2.5**			**16.0**				
M-GC-103 (0-1)	1-2	CHM101217-8	12/17/2010	0.20 U	**8.66**	0.20 U	**54.0**	**35.1**	**7.68**	0.20 U	**107**	
M-GC-104 (0-1)	1.5-2.5	CHM101202-16	12/2/2010	**0.772**	**7.52**	0.20 U	**25.9**	**20.8**	**7.62**	0.20 U	**78.7**	
M-GC-105 (0-0.2)	0-0.2	CHM110131-4/CHM110202-5	1/29/2011	**9.96** J	**5.24**	**0.470**	**46.9**	**25.4**	**128**	**1.21**	**216**	
Dup of M-GC-105 (0-0.2)	0-0.2	CHM110131-4/CHM110202-5	1/29/2011	**3.59** J	**5.87**	**0.434**	**54.7**	**21.0**	**138**	**1.07**	**223**	
M-GC-106 (0-1)	0-1		12/2/2010	**0.319**	**6.51**	0.20 U	**26.0**	**17.2**	**8.95**	0.20 U	**54.1**	
M-GC-107 (1-2)	1-2	UB70C	12/08/2011		**2.4**			**15.3**				
M-GC-107 (0-1)	0-1	UA77A	12/08/2011	0.2 U	**14.1**	**0.5**	**34.1**	**37.1**	**33.0**	**0.05**	**360**	
Dup of M-GC-107 (0-1)	0-1	UA77B	12/08/2011	0.2 U	**16.2**	**0.5**	**38.5**	**42.2**	**33.8**	0.02 U	**360**	
M-GC-107A (0-1)	0.5-1.5	UB70I	12/09/2011		**33.3**			**46.1**				

TABLE 10
SOIL ANALYTICAL RESULTS FOR METALS
NORTH MARINA AMERON/HULBERT SITE RI/FS

				TOTAL METALS (mg/kg) Method SW6020/EPA200.8/SW7471A								
	Depth Below Ground Surface			Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	pH
			Preliminary Screening Level:	**32**	**20**	**80**	**120,000**	**3,000**	**250**	**24**	**24,000**	
M-GC-107A (1-2)	1.5-2.5		12/09/2011		**3.1**			**13.9**				
N-FA-100 (0-1)	0.3-1.3	CHM101202-16	12/1/2010	**0.648**	**5.69**	0.20 U	**22.8**	**45.8**	**51.5**	0.20 U	**76.3**	
N-FA-100 (1-2)	1.3-2.3	CHM101213-7	12/1/2010					**17.4**				
N-FA-101 (3-4)	3-4	CHM101202-16/CHM110201-6	12/1/2010	**0.312**	**7.57**	0.20 U	**31.3**	**152**	**21.3**	0.20 U	**61.0**	8.73 J
N-FA-101 (4-5)	4-5	CHM101213-7	12/1/2010					**30.3**				
N-FA-102 (2-3)	2-3	CHM101202-16	12/1/2010	**1.48**	**8.89**	**0.431**	**34.5**	**50.7**	**114**	0.20 U	**231**	
N-FA-103 (1-2)	1.3-2.3	CHM101213-7	12/1/2010					**18.9**	**2.09**			
N-FA-103B (6-7)	6.3-7.3	CHM101202-16	12/1/2010	**2.86**	**28.3**	**0.460**	**94.3**	**194**	**58.7**	0.20 U	**86.8**	
N-FA-103B (10-11)	10.3-11.3	CHM101213-7	12/1/2010		**5.56**			**27.9**				
RI-MW-5 (0-1)	0-1	CHM101208-9	12/7/2010	**2.09**	**4.38**	0.20 U	**36.8**	**19.4**	**6.15**	0.20 U	**69.8**	
AH-BIN1		UA78J	12/09/2011	0.3 U	**11.2**	**0.2**	**355**	**148**	**18.4**	0.03 U	**204**	
AH-BIN2		UA78K	12/09/2011	0.5 U	**22.4**	**0.3**	**88**	**120**	**44.3**	0.05 U	**312**	
AH-BIN5		UA78L	12/09/2011	0.5 U	**17.8**	**0.2**	**108**	**94**	**32.2**	0.06 U	**240**	

mg/kg = milligrams per kilogram
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
Bold = Detected compound.
Boxed value indicates exceedance of preliminary cleanup level.
Shaded box indicates the detected concentration is greater than 5 times the preliminary cleanup level.

Notes:
1. Black sand-sized material (apparent sandblast media)
2. Apparent concrete slurry waste

TABLE 11
SEDIMENT ANALYTICAL RESULTS - ORGANIC CARBON NORMALIZED
AMERON/HULBERT RI/FS
PORT OF EVERETT

	SMS Criteria			Dup of A/H-SED-1 (0-10 CM)							
	Sediment Quality Standard (a)	Cleanup Screening Level (b)	A/H-SED-1 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-10 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-2 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-3 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-4 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-5 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-6 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-7 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-8 (0-10 CM) CHM101210-10 12/10/2010
TOTAL METALS (mg/kg)											
Method SW6020											
Arsenic	57	93	**8.54**	**8.69**	**8.92**	**7.71**	**7.91**	**11.2**	**6.95** J	**10.5**	**8.79**
Cadmium	5.1	6.7	**0.332**	**0.411**	**0.390**	**0.367**	**0.337**	**0.430**	**0.174** J	**0.599**	**0.353**
Chromium	260	270	**35.5**	**39.9**	**39.5**	**36.4**	**33.9**	**43.6**	**23.2** J	**46.7**	**38.2**
Copper	390	390	**36.5**	**38.9**	**38.2**	**31.6**	**32.2**	**43.1**	**24.2** J	**44.1**	**37.0**
Lead	450	530	**9.64**	**10.6**	**10.2**	**9.30**	**8.94**	**11.4**	**6.24** J	**12.1**	**9.50**
Mercury	0.41	0.59	0.20	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Zinc	410	960	**80.0**	**113**	**89.8**	**85.3**	**89.0**	**107**	**36.8** J	**130**	**96.0**
SEMIVOLATILES											
Method SW8270											
PAHs (mg/kg OC) (c)											
Naphthalene	99	170	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Acenaphthylene	66	66	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Acenaphthene	16	57	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Fluorene	23	79	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Phenanthrene	100	480	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Anthracene	220	1200	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
2-Methylnaphthalene	38	64	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
LPAH (d, e)	370	780	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Fluoranthene	160	1200	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Pyrene	1000	1400	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Benzo(a)anthracene	110	270	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Chrysene	110	460	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Benzo(b)fluoranthene	None	None	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Benzo(k)fluoranthene	None	None	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Total Benzofluoranthenes (d, f)	230	450	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Benzo(a)pyrene	99	210	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Indeno(1,2,3-cd)pyrene	34	88	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Dibenz(a,h)anthracene	12	33	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
Benzo(g,h,i)perylene	31	78	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
HPAH (d, g)	960	5300	4.2	3.8 U	3.9 U	4.4 U	4.5 U	3.3 U	3.3 U	3.6 U	3.5 U
SVOCs (mg/kg OC) (c)											
1,2-Dichlorobenzene	2.3	2.3	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
1,3-Dichlorobenzene	None	None	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
1,4-Dichlorobenzene	3.1	9	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
1,2,4-Trichlorobenzene	0.81	1.8	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Hexachlorobenzene	0.38	2.3	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Dimethylphthalate	53	53	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Diethylphthalate	61	110	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Di-n-butylphthalate	220	1700	5.2	**27.0**	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	**52.4**
Benzyl Butyl phthalate	4.9	64	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
bis (2-Ethylhexyl) phthalate	47	78	5.2	**10.8**	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	**10.0**
Di-n-octyl phthalate	58	4500	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Dibenzofuran	15	58	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Hexachlorobutadiene	3.9	6.2	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
N-Nitrosodiphenylamine	11	11	26.0	23.7 U	24.6 U	27.8 U	28.4 U	20.6 U	20.6 U	22.7 U	22.0 U
SVOCs (mg/kg)											
Phenol	420	1200	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Methylphenol (o-cresol)	63	63	0.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Methylphenol (p-cresol)	670	670	0.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,4-Dimethylphenol	29	29	0.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pentachlorophenol	360	690	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Benzyl Alcohol	57	73	0.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzoic Acid	650	650	0.2	0.2 U	0.20 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
PCBs (d) (mg/kg OC) (c)											
Method SW8082											
Aroclor 1016	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1221	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1232	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1242	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1248	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1254	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Aroclor 1260	--	--	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U
Total PCBs	12	65	5.2	4.7 U	4.9 U	5.6 U	5.7 U	4.1 U	4.1 U	4.5 U	4.4 U

TABLE 11
SEDIMENT ANALYTICAL RESULTS - ORGANIC CARBON NORMALIZED
AMERON/HULBERT RI/FS
PORT OF EVERETT

	SMS Criteria			Dup of A/H-SED-1 (0-10 CM)							
	Sediment Quality Standard (a)	Cleanup Screening Level (b)	A/H-SED-1 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-10 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-2 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-3 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-4 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-5 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-6 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-7 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-8 (0-10 CM) CHM101210-10 12/10/2010
CONVENTIONALS											
Total Organic Carbon (%) (SW9060A)	10 (h)	10 (h)	1.92	2.11	2.03	1.80	1.76	2.43	2.43	2.20	2.27
Total Solids (%) (EPA160.3)	--	--	45.43	44.60	47.30	52.77	51.45	43.92	45.53	44.88	46.86
Total Volatile Solids (%) (EPA1684)	25 (h)	25 (h)	5.56	7.16	5.43	5.54	7.22	5.77	6.85	7.40	7.67
Ammonia (mg/kg)	--	--	**10.1**	**8.72**	**8.67**	**8.76**	**5.24**	**10.8**	**8.09**	**11.0**	**8.62**
Sulfide (mg/kg)	--	--	2.5	2.5 U	**1.51** J	2.5 U	**1.96** J	2.5 U	**0.973** J	**2.53**	2.5 U

U = Indicates the compound was undetected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Bold = Detected compound.
(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) All organic data (except phenols, benzyl alcohol, and benzoic acid) are normalized to total organic carbon; this involves dividing the dry weight concentration of the constituent by the fraction of total organic carbon present.
(d) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:
  (i) Where chemical analyses identify an undetected value for every individual compound/isomer, then the single highest detection limit shall represent the sum of the respective compounds/isomers.
  (ii) Where chemical analyses detect one or more individual compounds/isomers, only the detected concentrations will be added to represent the group sum.
(e) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds listed.
(f) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.
(g) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.
(h) DMMP clarification paper and SMS technichal information memorandum: Management of Wood Waste Under Dredged Material Management Program and the SMS Cleanup Program.

TABLE 12
SEDIMENT ANALYTICAL RESULTS - NON-ORGANIC CARBON NORMALIZED (DRY WEIGHT)
NORTH MARINA AMERON/HULBERT SITE RI/FS

	SQS Dry Weight Equivalent	CSL Dry Weight Equivalent	A/H-SED-1 (0-10 CM) CHM101210-10/L15869-2 12/10/2010	Dup of A/H-SED-1 (0-10 CM) A/H-SED-10 (0-10 CM) CHM101210-10/L15869-4 12/10/2010	A/H-SED-2 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-3 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-4 (0-10 CM) CHM101210-10/L15869-1 12/10/2010	A/H-SED-5 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-6 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-7 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-8 (0-10 CM) CHM101210-10 12/10/2010
TOTAL METALS (mg/kg)											
Method SW6020											
Antimony			0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Arsenic	57	93	**8.54**	**8.69**	**8.92**	**7.71**	**7.91**	**11.2**	**6.95** J	**10.5**	**8.79**
Cadmium	5.1	6.7	**0.332**	**0.411**	**0.390**	**0.367**	**0.337**	**0.430**	**0.174** J	**0.599**	**0.353**
Chromium	260	270	**35.5**	**39.9**	**39.5**	**36.4**	**33.9**	**43.6**	**23.2** J	**46.7**	**38.2**
Copper	390	390	**36.5**	**38.9**	**38.2**	**31.6**	**32.2**	**43.1**	**24.2** J	**44.1**	**37.0**
Lead	450	530	**9.64**	**10.6**	**10.2**	**9.30**	**8.94**	**11.4**	**6.24** J	**12.1**	**9.50**
Mercury	0.41	0.59	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Zinc	410	960	**80.0**	**113**	**89.8**	**85.3**	**89.0**	**107**	**36.8** J	**130**	**96.0**
PCBs (mg/kg)											
Method SW8082											
Aroclor 1016			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1221			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1232			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1242			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1248			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1254			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1260			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Total PCBs	0.13	1.0	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
SEMIVOLATILES (mg/kg)											
Method SW8270											
Aniline			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Phenol	0.42	1.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bis(2-chloroethyl)ether			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Chlorophenol			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,3-Dichlorobenzene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,4-Dichlorobenzene	0.11	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichlorobenzene	0.035	0.05	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzyl Alcohol	0.057	0.073	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Bis(2-chloroisopropyl)ether			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-Methylphenol (o-cresol)	0.063	0.063	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Hexachloroethane			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
N-Nitroso-di-n-propylamine			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Methylphenol (p-cresol)	0.67	0.67	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
3-Methylphenol (m-cresol)			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nitrobenzene			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Isophorone			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-Nitrophenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4-Dimethylphenol	0.029	0.029	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Bis(2-chloroethoxy)methane			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,4-Dichlorophenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trichlorobenzene	0.031	0.051	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Naphthalene	2.1	2.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Chloroaniline			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Hexachlorobutadiene	0.011	0.12	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Chloro-3-methylphenol			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Methylnaphthalene	0.67	0.67	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1-Methylnaphthalene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Hexachlorocyclopentadiene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,4,6-Trichlorophenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-Trichlorophenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Chloronaphthalene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-Nitroaniline			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dinitrobenzene			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acenaphthylene	1.3	1.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,3-Dinitrobenzene			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dimethylphthalate	0.071	0.16	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,6-Dinitrotoluene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dinitrobenzene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	0.5	0.5	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
3-Nitroaniline			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2,4-Dinitrophenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dibenzofuran	0.54	0.54	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,4-Dinitrotoluene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Nitrophenol			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2,3,4,6-Tetrachlorophenol			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2,3,5,6-Tetrachlorophenol			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Fluorene	0.54	0.54	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

TABLE 12
SEDIMENT ANALYTICAL RESULTS - NON-ORGANIC CARBON NORMALIZED (DRY WEIGHT)
NORTH MARINA AMERON/HULBERT SITE RI/FS

	SQS Dry Weight Equivalent	CSL Dry Weight Equivalent	A/H-SED-1 (0-10 CM) CHM101210-10/L15869-2 12/10/2010	Dup of A/H-SED-1 (0-10 CM) A/H-SED-10 (0-10 CM) CHM101210-10/L15869-4 12/10/2010	A/H-SED-2 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-3 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-4 (0-10 CM) CHM101210-10/L15869-1 12/10/2010	A/H-SED-5 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-6 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-7 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-8 (0-10 CM) CHM101210-10 12/10/2010
4-Chlorophenyl phenyl ether			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Diethylphthalate	0.2	1.2	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,6-Dinitro-2-methylphenol			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
N-Nitrosodiphenylamine	0.028	0.04	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Azobenzene			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4-Bromo phenyl phenyl ether			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Hexachlorobenzene	0.022	0.07	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pentachlorophenol	0.36	0.69	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Phenanthrene	1.5	1.5	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	0.96	0.96	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Carbazole			0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Di-n-butylphthalate	1.4	5.1	0.1 UJ	**0.569**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	**1.19**
Fluoranthene	1.7	2.5	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pyrene	2.6	3.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzyl Butyl phthalate	0.063	0.9	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
bis (2-Ethylhexyl) adipate			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(a)anthracene	1.3	1.6	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Chrysene	1.4	2.8	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
bis (2-Ethylhexyl) phthalate	1.3	3.1	0.1 U	**0.227**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	**0.228**
Di-n-octyl phthalate	6.2	6.2	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(b)fluoranthene			0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Benzo(k)fluoranthene			0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Benzo(a)pyrene	1.6	1.6	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Indeno(1,2,3-cd)pyrene	0.6	0.69	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Dibenz(a,h)anthracene	0.23	0.23	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Benzo(g,h,i)perylene	0.67	0.72	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Benzoic Acid	0.65	0.65	0.2 U	0.2 U	0.20 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CPAH TEQ			0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
CONVENTIONALS											
Total Organic Carbon (%) (SW9060A)			1.92	2.11	2.03	1.80	1.76	2.43	2.43	2.20	2.27
Total Solids (%) (EPA160.3)			45.43	44.60	47.30	52.77	51.45	43.92	45.53	44.88	46.86
Total Volatile Solids (%) (EPA1684)			5.56	7.16	5.43	5.54	7.22	5.77	6.85	7.40	7.67
Ammonia (mg/kg)			**10.1**	**8.72**	**8.67**	**8.76**	**5.24**	**10.8**	**8.09**	**11.0**	**8.62**
Sulfide (mg/kg)			2.5 U	2.5 U	**1.51** J	2.5 U	**1.96** J	2.5 U	**0.973** J	**2.53**	2.5 U
GRAIN SIZE (ASTM D422)											
Percent Finer (Passing)											
Sieve Size / Particle Size (microns)											
3/4" / 19000			100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1/2" / 12500			100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
3/8" / 9500			100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
#4 / 4750			100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
#20 / 850			83.48	87.51	90.60	92.44	91.80	93.55	88.73	86.77	93.16
#40 / 425			70.77	73.18	76.12	81.13	82.07	78.97	73.33	72.39	76.91
#60 / 250			62.42	64.40	68.00	72.55	74.48	70.04	65.59	63.93	68.31
#100 / 150			50.07	54.35	61.53	62.71	55.90	61.59	58.96	57.94	59.35
#200 / 75			22.73	21.48	38.18	34.33	26.40	36.94	36.29	46.93	33.47
#325 / 45			6.56	4.14	10.21	8.15	5.08	9.37	9.70	19.95	8.02
#450 / 34			3.74	1.57	3.93	2.95	2.48	2.75	4.32	9.52	2.62
Percent Retained											
Sieve Size / Particle Size (microns)											
3/4" / 19000			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/2" / 12500			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/8" / 9500			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
#4 / 4750			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
#20 / 850			16.52	12.49	9.40	7.56	8.20	6.45	11.27	13.23	6.84
#40 / 425			12.71	14.33	14.48	11.31	9.73	14.58	15.40	14.38	16.25
#60 / 250			8.35	8.77	8.12	8.58	7.59	8.93	7.74	8.46	8.60
#100 / 150			12.35	10.05	6.48	9.85	18.57	8.45	6.63	5.99	8.96
#200 / 75			27.34	32.87	23.35	28.37	29.50	24.65	22.68	11.01	25.88
#325 / 45			16.16	17.34	27.97	26.19	21.32	27.57	26.59	26.98	25.45
#450 / 34			2.82	2.57	6.28	5.21	2.60	6.62	5.38	10.43	5.40
>#450 / <34			0.65	0.27	2.35	0.99	1.60	1.13	2.28	7.31	1.04

TABLE 12
SEDIMENT ANALYTICAL RESULTS - NON-ORGANIC CARBON NORMALIZED (DRY WEIGHT)
NORTH MARINA AMERON/HULBERT SITE RI/FS

	SQS Dry Weight Equivalent	CSL Dry Weight Equivalent	A/H-SED-1 (0-10 CM) CHM101210-10/L15869-2 12/10/2010	Dup of A/H-SED-1 (0-10 CM) A/H-SED-10 (0-10 CM) CHM101210-10/L15869-4 12/10/2010	A/H-SED-2 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-3 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-4 (0-10 CM) CHM101210-10/L15869-1 12/10/2010	A/H-SED-5 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-6 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-7 (0-10 CM) CHM101210-10 12/10/2010	A/H-SED-8 (0-10 CM) CHM101210-10 12/10/2010
DIOXIN/FURANS (pg/g)											
Method 1613											
2,3,7,8-TCDD			0.493 U	0.535 U			0.49 U				
1,2,3,7,8-PECDD			**0.598**	**0.493**			**0.394**				
1,2,3,4,7,8-HXCDD			0.881 U	**0.938**			**0.724**				
1,2,3,6,7,8-HXCDD			2.57 U	**2.83**			**2.29**				
1,2,3,7,8,9-HXCDD			**2.81**	**3.04**			2.26 U				
1,2,3,4,6,7,8-HPCDD			**49.4**	**50.5**			**41.6**				
OCDD			**504**	**528**			**433**				
2,3,7,8-TCDF			**1.61**	**1.49**			**2.42**				
1,2,3,7,8-PECDF			0.459 U	0.355 U			0.394 U				
2,3,4,7,8-PECDF			**0.536**	0.426 U			0.589 U				
1,2,3,4,7,8-HXCDF			0.615 U	**0.627**			0.573 U				
1,2,3,6,7,8-HXCDF			0.459 U	**0.455**			0.394 U				
1,2,3,7,8,9-HXCDF			0.459 U	0.355 U			0.394 U				
2,3,4,6,7,8-HXCDF			0.459 U	**0.532**			0.394 U				
1,2,3,4,6,7,8-HPCDF			**7.72**	**8.03**			**5.68**				
1,2,3,4,7,8,9-HPCDF			**0.485**	**0.648**			0.394 U				
OCDF			**20.4**	**21.4**			**16.6**				
TOTAL TETRA-DIOXINS			**9.46**	**9.27**			**7.84**				
TOTAL PENTA-DIOXINS			**1.61** J	**5.04** J			**2.44**				
TOTAL HEXA-DIOXINS			**26.5**	**33.3**			**23.7**				
TOTAL HEPTA-DIOXINS			**143**	**145**			**116**				
TOTAL TETRA-FURANS			**5.96**	**6.82**			**4.66**				
TOTAL PENTA-FURANS			**3.91**	**4.82**			**2.8**				
TOTAL HEXA-FURANS			**4.80** J	**10.2** J			**5.73**				
TOTAL HEPTA-FURANS			**21.4**	**22.6**			**15.6**				
TOTAL (TEQ ND=0)			**1.77**	**2.15**			**1.41**				
TOTAL (TEQ ND=1/2 DL)			**2.17**	**2.41**			**1.77**				

pg/g = picograms per gram
mg/kg = milligrams per kilogram
ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency
PCBs = polychlorinatee biphenyls

U = Indicates the compound was undetected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Bold = Detected compound.

TABLE 13
GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

				Dup of ECI-MW-3											
	Preliminary	AH-SW-1*	ECI-MW-3	ECI-MW-302	ECI-MW-3	ECI-MW-3	G-FA-113	G-GC-100	I-FA-100	I-FA-101	J-FA-100	J-FA-102	J-GC-100	M-FA-100	M-FA-102
											CHM101201-1				
	Screening	TR28M	CHM101216-1	CHM101216-1	SK38F	TR28A/TR93A	CHM101122-2	CHM101220-07	CHM101217-8	CHM101217-8	CHM101213-7	CHM101201-1	CHM101201-1	CHM101122-2	CHM101202-16
	Level	10/11/2011	12/15/2010	12/15/2010	02/22/2011	10/11/2011	11/22/2010	12/20/2010	12/17/2010	12/17/2010	11/29/2010	11/29/2010	11/29/2010	11/22/2010	12/1/2010
NWTPH-HCID (µg/L)															
Diesel-Range Organics (DRO)	500										**D**	500 U			
Heavy Oil	500						500 U				**D**	500 U		500 U	500 U
Heavy Oil-Range Organics	500														
NWTPH-Dx (µg/L)															
Diesel-Range Organics (DRO)	500										**881**				
Diesel (Fuel Oil)	500							50 UJ			50 U				
Mineral Oil	500							50 UJ			50 U				
Heavy Oil	500							100 UJ			**2240**				
DISSOLVED METALS (µg/L)															
Method EPA 200.8/SW7470A															
Antimony	640		0.20 U			**0.2**	0.2 U	**0.300**	0.20 U	**0.515**	**13.5**	**2.45**	0.20 U	0.2 U	**1.05**
Arsenic	5	**2**	**18.2**			**65.8**	**4.10**	**3.35**	**0.984**	1.0 U	**7.35**	**3.90**	1.0 U	**5.40**	1.0 U
Cadmium	8.8		0.20 U			0.1 U	0.2 U	0.20 U	0.20 U	**0.270**	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U
Chromium	240,000		**40.2**			**1.4**	**19.9**	**22.1**	**15.0**	**97.5**	**25.8**	**0.424**	**4.55**	**62.4**	**57.7**
Copper	3.1	**7**	**0.642**			**0.7**	0.5 U	**61.5**	**5.75**	**7.15**	**127**	**27.5**	**8.45**	0.5 U	0.5 U
Lead	8.1		1.0 U			0.1 U	1.0 U	1.0 U	1.0 U	1.0 U	**143**	1.0 U	1.0 U	1.0 U	1.0 U
Mercury	0.1		0.10 U			0.02 U	0.10 U	0.10 U	**0.470**	**0.385**	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Zinc	81		1.5 U			4 U	1.5 U	**24.0**	**14.0**	**14.6**	**21.2**	1.5 U	**4.85**	**4.35**	1.5 U
TURBIDITY (NTU) (EPA 180.1)															
SEMIVOLATILES (µg/L)															
Method SW8270/SW8270D															
Acenaphthene	640		0.5 U	0.5 U		1.0 U					1.0 U				0.5 U
Diethylphthalate	28000		1.0 U	1.0 U		1.0 U					**5.52**				1.0 U
Fluorene	3,500		0.5 U	0.5 U		1.0 U					1.0 U				0.5 U
Phenanthrene			0.5 U	0.5 U		1.0 U					1.0 U				0.5 U
Di-n-Butylphthalate	2900		0.360 UJ	0.440 UJ		1.0 U					**3.92**				1.0 U
bis(2-Ethylhexyl)phthalate	2.2		0.5 UJ	0.5 UJ	1.0 U	1.0 U					1.0 U				0.5 U
1-Methylnaphthalene	1.5		0.5 U	0.5 U		1.0 U					1.0 U				0.5 U
cPAHs (µg/L)															
Method SW8270D-SIM															
Chrysene	30		0.10 U	0.10 U		0.10 U					**0.160**				0.10 U
cPAH TEQ	0.1		ND	ND		ND					**0.0016**				ND
VOLATILES (µg/L)															
Method SW8260B/C															
Carbon Disulfide			NA			0.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	3.2		**12.3**			0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane			1.0 U			**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	16		1.0 U			0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	15,000		1.0 U			0.2 U	**1.65**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	2,100		1.0 U			0.2 U	**6.22**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
n-Butylbenzene			1.0 U			0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Naphthalene	4,900		4.0 U			0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Total Xylenes	1,600		1.0 U			NA	**17.7**	1.0 U	**1.55**	**1.35**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

TABLE 13
GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary	M-FA-103	M-FA-104	Dup of M-FA-104 M-FA-204	M-FA-107	Dup of M-FA-107 M-FA-10702	M-FA-108	M-GC-100	M-GC-103	M-GC-105	N-FA-100	N-FA-102	P10 (G-2)	P10 (G-2)	RI-MW-1
	Screening	CHM101202-16	CHM101122-2	CHM101122-2	CHM110131-4	CHM110131-4	CHM110131-4	CHM101201-1	CHM101217-8	CHM110131-4 CHM110202-5	CHM101202-16	CHM101202-16	CHM101216-1	TR28B/TR93B	CHM101216-1
	Level	12/2/2010	11/22/2010	11/22/2010	1/28/2011	1/28/2011	1/28/2011	11/30/2010	12/17/2010	1/28/2011	12/1/2010	12/1/2010	12/15/2010	10/11/2011	12/15/2010
NWTPH-HCID (µg/L)															
Diesel-Range Organics (DRO)	500				500 U	500 U	500 U	500 U		500 U					
Heavy Oil	500	500 U	500 U	500 U	500 U	500 U	500 U	500 U		500 U		500 U			
Heavy Oil-Range Organics	500				500 U	500 U	500 U			**D**					
NWTPH-Dx (µg/L)															
Diesel-Range Organics (DRO)	500														
Diesel (Fuel Oil)	500									50 U					
Mineral Oil	500									50 U					
Heavy Oil	500									**150**					
DISSOLVED METALS (µg/L)															
Method EPA 200.8/SW7470A															
Antimony	640	0.2 U	0.2 U	0.2 U	**0.176** J	**0.138** J		**0.250**	0.20 U	**0.857**	0.2 U	**2.25**	0.20 U	0.2 U	0.20 U
Arsenic	5	1.0 U	**6.00**	**5.55**	1.0 U	1.0 U		**9.80**	1.0 U	1.0 U	1.0 U	**2.90**	**16.7**	**1.4**	1.0 U
Cadmium	8.8	0.2 U	0.2 U	0.2 U	0.2 U	0.20 U		0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.1 U	0.20 U
Chromium	240,000	**11.9**	**35.8**	**40.4**	**13.6** J	**8.97** J		**14.7**	**7.32**	**17.3**	**100**	**39.5**	**27.4**	1 U	**36.2**
Copper	3.1	**3.20**	0.5 U	0.5 U	0.50 U	0.50 U		**2.10**	**2.91**	**1.34**	**18.3**	**3.60**	**5.23**	0.5 U	**4.35**
Lead	8.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.07**	0.1 U	**1.19**
Mercury	0.1	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U		0.10 U	**1.09**	0.10 U	0.10 U	0.10 U	0.10 U	0.02 U	**0.296**
Zinc	81	1.5 U	1.5 U	1.5 U	**2.89**	**2.65**		1.5 U	**14.1**	**13.9**	1.5 U	1.5 U	**2.29**	4 U	**4.99** J
TURBIDITY (NTU) (EPA 180.1)															
SEMIVOLATILES (µg/L)															
Method SW8270/SW8270D															
Acenaphthene	640							1.0 U				0.5 U			0.5 U
Diethylphthalate	28000							2.0 U				1.0 U			1.0 U
Fluorene	3,500							1.0 U				0.5 U			0.5 U
Phenanthrene								1.0 U				0.5 U			0.5 U
Di-n-Butylphthalate	2900							2.0 U				**1.84** J			1.04 U
bis(2-Ethylhexyl)phthalate	2.2							1.0 U				**1.60**			0.5 UJ
1-Methylnaphthalene	1.5							1.0 U				0.5 U			0.5 U
cPAHs (µg/L)															
Method SW8270D-SIM															
Chrysene	30							0.10 U				0.10 U			0.10 U
cPAH TEQ	0.1							ND				ND			ND
VOLATILES (µg/L)															
Method SW8260B/C															
Carbon Disulfide		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	NA
1,1-Dichloroethene	3.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
1,1-Dichloroethane		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
cis-1,2-Dichloroethene	16	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.03**	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
Toluene	15,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
Ethylbenzene	2,100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
n-Butylbenzene		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	1.0 U
Naphthalene	4,900	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	**1.52** J	4.0 U	0.5 U	4.0 U
Total Xylenes	1,600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NA	1.0 U

TABLE 13
GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary Screening Level	RI-MW-1	RI-MW-1	RI-MW-2	RI-MW-2	RI-MW-2	RI-MW-3	RI-MW-3	RI-MW-3	RI-MW-4	Dup of RI-MW-4 RI-MW-402	RI-MW-4	RI-MW-4	RI-MW-5	RI-MW-5
										CHM101230-5	CHM101230-5				
		SK38A	TR28C/TR93C	CHM101216-1	SK38B	TR28D/TR93D	CHM101216-1	SK38C	TR28E/TR93E	CHM101216-1	CHM101216-1	SK38D	TR28F/TR93F	CHM101216-1	SK38E
		02/22/2011	10/11/2011	12/15/2010	02/22/2011	10/11/2011	12/15/2010	02/22/2011	10/11/2011	12/15/2010	12/15/2010	02/22/2011	10/11/2011	12/15/2010	02/22/2011
NWTPH-HCID (µg/L)															
Diesel-Range Organics (DRO)	500												500 U		
Heavy Oil	500									500 U	**D**		500 U	500 U	
Heavy Oil-Range Organics	500														
NWTPH-Dx (µg/L)															
Diesel-Range Organics (DRO)	500											100 U	100 U		
Diesel (Fuel Oil)	500									**50** J	50 UJ				
Mineral Oil	500									**50** J	50 UJ				
Heavy Oil	500									**1390** J	**1100** J	200 U	200 U		
DISSOLVED METALS (µg/L)															
Method EPA 200.8/SW7470A															
Antimony	640		0.2 U	0.20 U		0.2 U	**0.295**		0.2 U	0.20 U	0.20 U		0.2 U	0.20 U	
Arsenic	5		**1.8**	**1.64**		**0.4**	**0.679**		**0.4**	**1.97** J	**2.98** J		**1.9**	**1.32**	
Cadmium	8.8		0.1 U	0.20 U		0.1 U	0.20 U		0.1 U	0.20 U	0.20 U		0.1 U	**0.20**	
Chromium	240,000		0.5 U	**23.4**		**1.0**	**31.1**		0.5 U	**10.2** J	**14.3** J		0.5 U	**24.2**	
Copper	3.1		**2.9**	0.50 U		0.5 U	0.50 U		**0.6**	**2.68** J	0.50 UJ		**0.8**	0.50 U	
Lead	8.1		0.1 U	**0.946** J		0.1 U	**0.886** J		0.1 U	1.0 U	**1.01**		**0.3**	1.0 U	
Mercury	0.1	0.02 U	0.02 U	**0.480**	0.02 U	0.02 U	**0.133**	0.02 U	0.02 U	**0.337** J	**0.141** J	0.02 U	0.02 U	**0.125** J	0.02 U
Zinc	81		**6**	**2.93**		**7**	**1.29**		**7**	**3.22** J	1.5 UJ		**9**	1.5 U	
TURBIDITY (NTU) (EPA 180.1)															
SEMIVOLATILES (µg/L)															
Method SW8270/SW8270D															
Acenaphthene	640		1.0 U	0.5 U		1.0 U	0.5 U		1.0 U	0.5 U			1.0 U	**6.44** J	
Diethylphthalate	28000		1.0 U	1.0 U		1.0 U	1.0 U		1.0 U	1.0 U			1.0 U	1.0 U	
Fluorene	3,500		1.0 U	0.5 U		1.0 U	0.5 U		1.0 U	0.5 U			1.0 U	**0.384** J	
Phenanthrene			1.0 U	0.5 U		1.0 U	0.5 U		1.0 U	0.5 U			1.0 U	0.5 U	
Di-n-Butylphthalate	2900		1.0 U	0.520 UJ		1.0 U	1.12 U		1.0 U	0.480 UJ			1.0 U	0.400 UJ	
bis(2-Ethylhexyl)phthalate	2.2	1.0 U	1.0 U	0.5 UJ		1.0 U	0.5 UJ	**6.8**	**3.1**	0.5 UJ			**1.0**	0.5 UJ	1.0 U
1-Methylnaphthalene	1.5		1.0 U	0.5 U		1.0 U	0.5 U		1.0 U	0.5 U			1.0 U	**0.620** J	
cPAHs (µg/L)															
Method SW8270D-SIM															
Chrysene	30		0.10 U	0.10 U		0.10 U	0.10 U		0.10 U	0.10 U			0.10 U	0.10 U	
cPAH TEQ	0.1		ND	ND		ND	ND		ND	ND			ND	ND	
VOLATILES (µg/L)															
Method SW8260B/C															
Carbon Disulfide			0.2 U	NA		0.2 U	NA		0.2 U	NA	NA		**0.4**	NA	
1,1-Dichloroethene	3.2		0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
1,1-Dichloroethane			0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
cis-1,2-Dichloroethene	16		0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
Toluene	15,000		0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
Ethylbenzene	2,100		0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
n-Butylbenzene			0.2 U	1.0 U		0.2 U	1.0 U		0.2 U	1.0 U	1.0 U		0.2 U	1.0 U	
Naphthalene	4,900		0.5 U	4.0 U		0.5 U	4.0 U		0.5 U	4.0 U	4.0 U		0.5 U	4.0 U	
Total Xylenes	1,600		NA	1.0 U		NA	1.0 U		NA	1.0 U	1.0 U		NA	1.0 U	

TABLE 13
GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS FOR DETECTED COMPOUNDS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Preliminary	RI-MW-5	RI-MW-5-Dup	RI-MW-6	RI-MW-7	SEE-EC-3	SEE-EC-3	SEE-EC-3	SEE-EC-3	SUMP	SUMP
										CHM101220-07	
	Screening	TR28G/TR93G	TR28H/TR93H	TR28I	TR28J	CHM101216-1	CHM110215-3	SK37A	TR28K/TR93I	CHM110104-5	TT03ATT04A
	Level	10/11/2011	10/11/2011	10/11/2011	10/11/2011	12/15/2010	12/15/2010	02/22/2011	10/11/2011	12/20/2010	10/19/2011
NWTPH-HCID (µg/L)											
Diesel-Range Organics (DRO)	500	500 U	500 U								
Heavy Oil	500	500 U	500 U							**D** J	
Heavy Oil-Range Organics	500										
NWTPH-Dx (µg/L)											
Diesel-Range Organics (DRO)	500			100 U							100 U
Diesel (Fuel Oil)	500									50 UJ	
Mineral Oil	500									50 UJ	
Heavy Oil	500			200 U						**268** J	210 U
DISSOLVED METALS (µg/L)											
Method EPA 200.8/SW7470A											
Antimony	640	0.2 U	0.2 U			**0.617**			0.2 U	0.20 U	0.2 U
Arsenic	5	**0.5**	**0.5**	**9.4**	**2.4**	**256**	**218**	**35.6**	**34.6**	1.0 U	**0.4**
Cadmium	8.8	0.1 U	0.1 U			0.20 U			0.1 U	**0.167**	0.1 U
Chromium	240,000	0.5 U	0.5 U			**46.1**			**1.6**	**14.0**	**1.2**
Copper	3.1	0.5 U	0.5 U	**1.0**	**1.4**	0.50 U			**0.7**	0.50 U	0.5 U
Lead	8.1	0.1 U	0.1 U	**0.2**		**0.940** J			0.1 U	1.0 U	0.1 U
Mercury	0.1	0.02 U	0.02 U			0.10 U			0.02 U	0.10 U	0.02 U
Zinc	81	**5**	4 U			**4.86**			**8**	**16.1**	**6**
TURBIDITY (NTU) (EPA 180.1)							**0.377** J				
SEMIVOLATILES (µg/L)											
Method SW8270/SW8270D											
Acenaphthene	640	**2.8**	**3.0**							**3.88** J	**1.9**
Diethylphthalate	28000	1.0 U	1.0 U							1.0 UJ	1.0 U
Fluorene	3,500	1.0 U	1.0 U							0.5 UJ	1.0 U
Phenanthrene		1.0 U	1.0 U							0.5 UJ	**1.3**
Di-n-Butylphthalate	2900	1.0 U	1.0 U							**1.60** J	1.0 U
bis(2-Ethylhexyl)phthalate	2.2	1.0 U	1.0 U							0.5 UJ	1.0 U
1-Methylnaphthalene	1.5	1.0 U	1.0 U							0.5 UJ	1.0 U
cPAHs (µg/L)											
Method SW8270D-SIM											
Chrysene	30	0.10 U	0.10 U							0.10 UJ	0.10 U
cPAH TEQ	0.1	ND	ND							ND	ND
VOLATILES (µg/L)											
Method SW8260B/C											
Carbon Disulfide		0.2 U	0.2 U			NA			**0.2**	NA	0.2 U
1,1-Dichloroethene	3.2	0.2 U	0.2 U			1.0 U			0.2 U	1.0 U	0.2 U
1,1-Dichloroethane		0.2 U	0.2 U			1.0 U			0.2 U	1.0 U	0.2 U
cis-1,2-Dichloroethene	16	0.2 U	0.2 U			1.0 U			0.2 U	1.0 U	0.2 U
Toluene	15,000	0.2 U	0.2 U			1.0 U			0.2 U	1.0 U	0.2 U
Ethylbenzene	2,100	0.2 U	0.2 U			1.0 U			0.2 U	1.0 U	0.2 U
n-Butylbenzene		0.2 U	**0.4**			1.0 U			0.2 U	1.0 U	0.2 U
Naphthalene	4,900	0.5 U	0.5 U			4.0 U			0.5 U	4.0 U	**0.8**
Total Xylenes	1,600	NA	NA			1.0 U			NA	1.0 U	NA

D = Indicates detection at or above the listed reporting limit
NA = Not analyzed
ND = Not Detected
EPA = U.S. Environmental Protection Agency
SIM = Selected Ion Monitoring
NTU = Nephelometric Turbidity Unit
µg/L = micrograms per liter

* = indicates surface water sample
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected in the sample; the reported sample detection limit is an estimate.
Bold = Detected compound.
Boxed value indicates exceedance of preliminary screening level.

TABLE 14
GROUNDWATER MONITORING FIELD PARAMETERS FOR 2010-2011
NORTH MARINA AMERON-HULBERT SITE RI/FS

Sample Location	Date Sampled	pH	Conductivity (µS/cm)	Turbidity (NTU)	Request for Centrifuge on COC?	Dissolved Oxygen (mg/L)	Temperature (degrees C)	Oxygen Reduction Potential (mv)
MONITORING WELLS:								
ECI-MW-3	12/15/2010	6.44	474	8.46	No	0.8	11.35	-98.0
	2/22/2011	5.93	317	45.5	Yes	2.01	9.29	33.8
	10/11/2011	6.66	1706	3.0	No	0.42	16.42	-85.0
P10 (G-2)	12/15/2010	6.67	555	12.7	Yes	1.60	11.06	-160
	10/11/2011	6.47	1243	7.2	No	0.62	18.62	-80.3
SEE-EC-3	12/15/2010	6.37	474	10.0	No	1.11	12.72	-140
	2/22/2011	6.22	1914	5.17	Analyzed for Dissolved Arsenic Only	1.66	10.58	-17.3
	10/11/2011	6.6	4222	4.66	No	0.52	15.62	-66.3
RI-MW-1	12/15/2010	6.65	1975	49.1	Yes	1.96	12.80	-68.9
	2/22/2011	6.14	1442	178	Yes	3.74	10.05	92.6
	10/11/2011	6.67	7160	6.81	No	0.5	16.00	8.22
RI-MW-2	12/15/2010	7.31	1037	61.8	Yes	0.62	14.18	-107
	2/22/2011	6.67	665	9.70	Analyzed for Dissolved Mercury Only	2.18	12.01	-23.0
	10/11/2011	7.70	1891	7.35	No	0.42	16.35	-52.8
RI-MW-3	12/15/2010	6.88	1109	36.7	Yes	3.02	12.63	-55.9
	2/22/2011	6.24	551	12.5	Yes	5.22	9.69	98.9
	10/11/2011	7.15	1008	5.6	No	4.59	16.68	-7.0
RI-MW-4	12/15/2010	7.53	428	29.5	Yes	0.81	11.70	-137
	2/22/2011	7.01	1388	1.3	Yes (TPH-Dx)	5.61	9.93	80.1
	10/11/2011	7.22	1400	0.7	No	0.31	16.68	-147.7
RI-MW-5	12/15/2010	6.82	394	175	Yes	1.62	11.02	-108
	2/22/2011	6.32	351	3.01	Yes (BEHP)	1.76	9.03	-17.5
	10/11/2011	7.03	1,129	31.70	Yes	1.21	15.22	-61.5
RI-MW-6	10/11/2011	7.83	6,102	12.37	Yes	0.22	16.48	-88.1
RI-MW-7	10/11/2011	7.26	8,503	4.14	Analyzed for Dissolved Arsenic and Copper Only	0.46	14.72	-63.6

TABLE 14
GROUNDWATER MONITORING FIELD PARAMETERS FOR 2010-2011
NORTH MARINA AMERON-HULBERT SITE RI/FS

Sample Location	Date Sampled	pH	Conductivity (µS/cm)	Turbidity (NTU)	Request for Centrifuge on COC?	Dissolved Oxygen (mg/L)	Temperature (degrees C)	Oxygen Reduction Potential (mv)
GROUNDWATER BORINGS:								
G-FA-113	11/22/2011	6.92	367	NM	Yes	2.36	9.38	-113.50
G-GC-100	12/20/2010	6.58	1770	551	No	2.57	12.50	-96.6
I-FA-100	12/17/2010	6.53	1570	385	No	5.14	14.55	-126
I-FA-101	12/17/2010	6.42	2142	38.2	No	7.55	8.58	-116
J-FA-100	11/29/2010	7.01	1580	>1000	No	NM	6.95	-191
J-FA-102	11/29/2010	8.76	1636	>1000	No	4.00	11.77	-219
J-GC-100	11/29/2010	6.86	530	91.3	No	4.25	11.97	-126
M-FA-100	11/22/2010	6.75	1199	NM	Yes	4.22	9.62	-134.0
M-FA-102	12/1/2010	6.50	1090	362	No	2.34	14.22	119
M-FA-103	12/2/2010	6.93	362	31.8	No	5.83	10.43	-42.2
M-FA-104	11/22/2010	7.02	731	NM	Yes	3.62	12.61	-138.6
M-FA-107	1/28/2011	7.23	1170	NM	No	1.00	8.87	NM
M-FA-108	1/28/2011	7.49	829	NM	No	1.15	9.03	NM
M-GC-100	11/30/2010	6.82	554	28.2	No	3.42	10.33	-110
M-GC-103	12/17/2010	7.12	603	389	No	2.27	12.70	-145
M-GC-105	1/28/2011	6.93	1800	NM	No	1.24	9.67	NM
N-FA-100	12/1/2010	6.56	2367	80.7	No	3.50	10.07	-98.3
N-FA-102	12/1/2010	7.79	2472	45.2	No	4.11	13.44	-134

NM = Not measured
degrees C = degrees Celsius
µS/cm = micro siemens/centimeter
NTU = nephelometric turbidity unit
mg/L = milligrams per liter
mv = millivolt
▨ Water Sample Centrifuged but NTU<10

BEHP = Bis(2-ethylhexyl) phthalate
TPH-Dx = total petroleum hydrocarbons-diesel
COC - chain-of-custody

Notes:
Values may be rounded
Dissolved oxygen,temperature, pH, conductivity, total dissolved solids, and turbidity values are the average of four replicates for samples collected from monitoring wells and the final measurement for samples collected from direct push borings.

TABLE 15
STORMWATER SYSTEM SOLIDS ANALYTICAL RESULTS - DRY WEIGHT
NORTH MARINA AMERON/HULBERT SITE RI/FS

	CB101 CHM101124-5 CHM101202-4 11/24/2010	CB111 CHM101124-5 11/24/2010	Dup of CB111 CB011 CHM101124-5 11/24/2010	SD-3 CHM101124-5 11/24/2010	SD-4 CHM101124-5 11/24/2010	SD-7 CHM101124-5 11/24/2010	SD-567- COMPOSITE UC42E/UE04A/WG38752 12/22/2011
NWTPH-DX (mg/kg)							
Diesel-Range Organics		20 U	20 U	**226**	**136**	20 U	**1100**
Diesel (Fuel Oil)	20 U	20 U	20 U	20 U	20 U	**723**	
Mineral Oil	40 U	40 U	40 U	40 U	40 U	40 U	
Heavy Oil	50 U	50 U	50 U	**951**	**521**	50 U	**1600**
NWTPH-HCID (mg/kg)							
Gasoline							26 U
Diesel							**>65**
Oil							**>130**
TOTAL METALS (mg/kg)							
Method SW6020/ SW6020/SW7471A							
Antimony	**0.776**	**70.4**	**64.6**	**2.67**	**3.51**	**5.46**	30 UJ
Arsenic	**8.37**	**568**	**550**	**19.2**	**28.1**	**25.2**	**40**
Barium							**405**
Cadmium	**0.638**	**3.00**	**3.20**	**2.74**	**3.35**	**1.53**	**3**
Chromium	**31.9**	**193**	**227**	**113**	**215**	**96.9**	**106**
Copper	**65.3**	**734** J	**477** J	**147**	**161**	**85.5**	**176**
Lead	**7.93**	**321**	**308**	**264**	**239**	**42.7**	**90**
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.11**
Selenium							30 U
Zinc	**5210**	**3180**	**2960**	**1760**	**1960**	**869**	2 U
Chromium, Hexavalent (mg/kg)							
Method SW7196		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
TCLP METALS (mg/L)							
Method TCLP-SW6020/TCLP-SW7470A							
Antimony							0.5 U
Arsenic							0.5 U
Barium							**1.00**
Cadmium							0.02 U
Chromium							0.05 U
Copper							0.02 U
Lead							0.2 U
Mercury							0.0001 U
Selenium							0.5 U
Zinc							0.03 U
PCBs (mg/kg)							
Method SW8082							
Aroclor 1016	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.032 U
Aroclor 1221	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.032 U
Aroclor 1232	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.041 U
Aroclor 1242	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.032 U
Aroclor 1248	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.032 U
Aroclor 1254	0.1 U	0.1 U	0.1 U	**1.67**	0.1 U	0.1 U	**0.055**
Aroclor 1260	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	**0.046**
Total PCBs	0.1 U	0.1 U	0.1 U	**1.67**	0.1 U	0.1 U	**0.101**
SEMIVOLATILES (mg/kg)							
Method SW8270C							
Phenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	**0.18** J
Bis-(2-Chloroethyl) Ether	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U
2-Chlorophenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
1,3-Dichlorobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
1,4-Dichlorobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Benzyl Alcohol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.96 U
1,2-Dichlorobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
2-Methylphenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
2,2'-Oxybis(1-Chloropropane)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
4-Methylphenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
N-Nitroso-di-n-propylamine	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Hexachloroethane	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Nitrobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U
Isophorone	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
2-Nitrophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U
2,4-Dimethylphenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Benzoic Acid	0.2 U	0.2 U	0.2 U	0.2 U	0.2 **	0.2 U	1.9 U
bis(2-Chloroethoxy) Methane	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
2,4-Dichlorophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.96 U
1,2,4-Trichlorobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Naphthalene	0.1 U	0.1 U	0.1 U	**2.76**	0.1 U	0.1 U	**0.23**
4-Chloroaniline	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.96 U
Hexachlorobutadiene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
4-Chloro-3-methylphenol	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.96 U
2-Methylnaphthalene	0.1 U	0.1 U	0.1 U	**0.832**	0.1 U	0.1 U	**0.18** J
Hexachlorocyclopentadiene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.96 UJ
2,4,6-Trichlorophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.96 U
2,4,5-Trichlorophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.96 U
2-Chloronaphthalene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
2-Nitroaniline	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.96 U
Dimethylphthalate	0.1 U	0.1 U	0.1 U	**0.919**	0.1 U	0.1 U	**0.46**
Acenaphthylene	0.1 U	0.1 U	0.1 U	**0.399**	**0.189**	0.1 U	0.19 U
3-Nitroaniline	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.96 U
Acenaphthene	0.1 U	0.1 U	0.1 U	**0.641**	0.1 U	0.1 U	0.88
2,4-Dinitrophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1.9 UJ
4-Nitrophenol	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.96 U
Dibenzofuran	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	**0.45**
2,6-Dinitrotoluene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.96 U
2,4-Dinitrotoluene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.96 U
Diethylphthalate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U

TABLE 15
STORMWATER SYSTEM SOLIDS ANALYTICAL RESULTS - DRY WEIGHT
NORTH MARINA AMERON/HULBERT SITE RI/FS

	CB101 CHM101124-5 CHM101202-4 11/24/2010	CB111 CHM101124-5 11/24/2010	Dup of CB111 CB011 CHM101124-5 11/24/2010	SD-3 CHM101124-5 11/24/2010	SD-4 CHM101124-5 11/24/2010	SD-7 CHM101124-5 11/24/2010	SD-567- COMPOSITE UC42E/UE04A/WG38752 12/22/2011
4-Chlorophenyl-phenylether	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Fluorene	0.1 U	0.1 U	0.1 U	**5.39**	0.1 U	0.1 U	**0.85**
4-Nitroaniline							0.96 U
4,6-Dinitro-2-methylphenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1.9 U
N-Nitrosodiphenylamine							0.19 U
4-Bromophenyl-phenylether	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Hexachlorobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.19 U
Pentachlorophenol	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.96 U
Phenanthrene	0.1 U	0.1 U	0.1 U	**27.3**	**0.390**	**0.231**	**4.5**
Carbazole	0.5 U	0.5 U	0.5 U	**2.05**	0.5 U	0.5 U	**0.40**
Anthracene	0.1 U	0.1 U	0.1 U	**1.87**	**0.126**	0.1 U	**1.4**
Di-n-butylphthalate	3.31 U	2.18 U	1.72 U	**8.03**	2.42 U	0.1 U	**0.23**
Fluoranthene	0.1 U	0.1 U	0.1 U	**27.4**	**0.567**	**0.255**	**5.2**
Pyrene	0.1 U	0.1 U	0.1 U	**16.5**	**0.541**	**0.278**	**3.4**
Butylbenzylphthalate	0.1 U	0.1 U	0.1 U	**4.75**	0.1 U	**0.255**	**2.8**
3,3'-Dichlorobenzidine							0.96 U
Benzo(a)anthracene	0.08 U	0.08 U	0.08 U	**1.54**	**0.264**	0.08 U	**1.9**
bis(2-Ethylhexyl)phthalate	**6.57**	**0.230**	**0.240**	**46.7**	**4.43**	**2.31**	**6.5**
Chrysene	0.08 U	0.08 U	0.08 U	**7.02**	**0.277**	0.08 U	**2.1**
Di-n-octyl phthalate	**6.96**	0.1 U	0.1 U	**5.32**	**0.290**	0.1 U	**0.34**
Benzo(a)pyrene	0.08 U	0.08 U	0.08 U	**1.54**	**0.239**	0.08 U	**1.7**
Indeno(1,2,3-cd)pyrene	0.08 U	0.08 U	0.08 U	**1.56**	0.08 U	0.08 U	**0.91**
Dibenz(a,h)anthracene	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	**0.52**
Benzo(g,h,i)perylene	0.08 U	0.08 U	0.08 U	**1.20**	0.08 U	0.08 U	**1.0**
1-Methylnaphthalene	0.1 U	0.1 U	0.1 U	**0.503**	0.1 U	0.1 U	**0.19** J
Total Benzofluoranthenes							**2.9**
1,2-Dinitrobenzene	0.1 U	0.1 U	0.1 U	**1.47**	0.1 U	0.1 U	
1,3-Dinitrobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	
1,4-Dinitrobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	
2,3,4,6-Tetrachlorophenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	
2,3,5,6-Tetrachlorophenol	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	
3-Methylphenol (m-cresol)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	
Aniline	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	
Azobenzene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	
Benzo(b)fluoranthene	0.08 U	0.08 U	0.08 U	**4.80**	**0.315**	0.08 U	
Benzo(k)fluoranthene	0.08 U	0.08 U	0.08 U	**1.99**	0.08 U	0.08 U	
bis (2-Ethylhexyl) adipate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	
Diphenylamine	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	
cPAH TEQ	0.08 U	0.08 U	0.08 U	**2.60**	**0.30**	0.08 U	**2.34**
CONVENTIONALS (%)							
Total Solids (EPA160.3)	**64.63**	**79.03**	**79.34**	**40.86**	**60.72**	**33.55**	**38.60**
Total Organic Carbon (SW9060A; Plumb 1981)	**4.19**	**0.469**	**0.457**	**13.2**	**3.00**	**6.39**	**4.57**
pH							**7.01**
DIOXIN/FURANS (pg/g)							
Method 1613							
2,3,7,8-TCDD							**0.510** J
1,2,3,7,8-PECDD							**3.77** J
1,2,3,4,7,8-HXCDD							**8.62**
1,2,3,6,7,8-HXCDD							**24.8**
1,2,3,7,8,9-HXCDD							**18.1**
1,2,3,4,6,7,8-HPCDD							**385**
OCDD							**2810**
2,3,7,8-TCDF							**1.92**
1,2,3,7,8-PECDF							**1.37** UJ
2,3,4,7,8-PECDF							**1.84** UJ
1,2,3,4,7,8-HXCDF							**4.92** J
1,2,3,6,7,8-HXCDF							**4.10** UJ
1,2,3,7,8,9-HXCDF							**0.305** UJ
2,3,4,6,7,8-HXCDF							**3.68** J
1,2,3,4,6,7,8-HPCDF							**62.1**
1,2,3,4,7,8,9-HPCDF							**3.43** J
OCDF							**137**
TOTAL TETRA-DIOXINS							**17.9**
TOTAL PENTA-DIOXINS							**31.8**
TOTAL HEXA-DIOXINS							**197**
TOTAL HEPTA-DIOXINS							**1020**
TOTAL TETRA-FURANS							**46.9**
TOTAL PENTA-FURANS							**51.1**
TOTAL HEXA-FURANS							**113**
TOTAL HEPTA-FURANS							**165**
TOTAL (TEQ ND=0)							**15.9**
TOTAL (TEQ ND=1/2 DL)							**16.0**

mg/kg = milligrams per kilogram
mg/L - milligrams per liter
cPAH = carcinogenic polycyclic aromatic hydrocarbon
TEQ = Toxic Equivalency Quotient
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
EPA = U.S. Environmental Protection Agency
Bold = Detected compound.

TABLE 16
INDICATOR HAZARDOUS SUBSTANCE EVALUATION FOR CHEMICALS DETECTED IN SOIL
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Number of Samples	Number of Detects	Frequency of Detection	Number of Detects Exceeding Cleanup Levels	Cleanup Level	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	Chemical Selected as an IHS?	Rational Inclusion or Exclusion as IHS
SVOCs/VOCs/cPAHs mg/kg)											
1,1-Dichloroethane	4	1	25%	0	16,000	0.0012	0.02	0.0346	0.0346	No	Analyte did not exceed the cleanup level.
1,2,4-Trimethylbenzene	6	3	50%	0	62	0.0012	0.02	0.0456	0.359	No	Analyte did not exceed the cleanup level.
1,3,5-Trimethylbenzene	6	2	33%	0	800	0.0012	0.02	0.053	0.0836	No	Analyte did not exceed the cleanup level.
2-Methylnaphthalene	10	1	10%	0	320	0.05	0.1	0.246	0.246	No	Analyte did not exceed the cleanup level.
Benzo(a)anthracene	48	12	25%	---	TEQ	0.0047	0.08	0.017	0.492	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
Benzo(a)pyrene	48	13	27%	1	0.14	0.0047	0.08	0.012	0.492	Yes	Analyte exceeded the cleanup level.
Benzo(b)fluoranthene	38	5	13%	---	TEQ	0.05	0.08	0.047	0.983	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
Benzo(g,h,i)perylene	10	2	20%	---	---	0.05	0.08	0.14	0.399	No	Analyte did not exceed the cleanup level.
Benzo(k)fluoranthene	38	2	5%	---	TEQ	0.05	0.08	0.28	1.01	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
Benzofluoranthenes	10	9	90%	---	TEQ	0.0049	0.0049	0.0083	0.19	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
bis(2-Ethylhexyl)phthalate	7	3	43%	0	4.9	0.1	0.1	0.33	0.461	No	Analyte did not exceed the cleanup level.
Butylbenzylphthalate	7	1	14%	1	2.3	0.1	0.1	14.1	14.1	No	Analyte did not exceed the cleanup level.
Chrysene	48	13	27%	---	TEQ	0.0049	0.08	0.0063	0.83	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
cPAH TEQ	57	25	44%	5	0.14	---	---	0.00146	4.217	Yes	Analyte exceeded the cleanup level.
Dibenz(a,h)anthracene	10	3	30%	---	TEQ	0.0047	0.077	0.0049	0.026	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
Di-n-butylphthalate	7	2	29%	0	100	0.501	1.5	1.22	9.89	No	Analyte did not exceed the cleanup level.
Fluoranthene	10	2	20%	0	89	0.05	0.1	0.501	1.29	No	Analyte did not exceed the cleanup level.
Fluorene	10	1	10%	0	553	0.05	0.1	0.246	0.246	No	Analyte did not exceed the cleanup level.
Indeno(1,2,3-cd)pyrene	48	11	23%	---	TEQ	0.0047	0.08	0.015	0.492	Yes	Analyte is used in the cPAH TEQ, which exceeds the cleanup level.
Methylene Chloride	4	1	25%	0	2.6	0.03	0.03	0.016	0.016	No	Analyte did not exceed the cleanup level.
Naphthalene	16	4	25%	0	140	0.0062	0.1	0.0634	0.52	No	Analyte did not exceed the cleanup level.
n-Butylbenzene	6	2	33%	0	3,900	0.0012	0.02	0.034	0.0969	No	Analyte did not exceed the cleanup level.
Phenanthrene	10	2	20%	0	12,000	0.05	0.1	0.26	1.26	No	Analyte did not exceed the cleanup level.
Pyrene	10	2	20%	0	2,400	0.05	0.1	0.42	1.32	No	Analyte did not exceed the cleanup level.
Sec-Butylbenzene	6	2	33%	---	---	0.0012	0.02	0.0323	0.0323	No	Analyte did not exceed the cleanup level.
Toluene	6	2	33%	0	110	0.02	0.02	0.0019	0.0065	No	Analyte did not exceed the cleanup level.
Trichloroethene	4	1	25%	0	0.20	0.0012	0.03	0.0408	0.0408	No	Analyte did not exceed the cleanup level.

TABLE 16
INDICATOR HAZARDOUS SUBSTANCE EVALUATION FOR CHEMICALS DETECTED IN SOIL
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Number of Samples	Number of Detects	Frequency of Detection	Number of Detects Exceeding Cleanup Levels	Cleanup Level	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	Chemical Selected as an IHS?	Rational Inclusion or Exclusion as IHS
TOTAL METALS (mg/kg)											
Antimony	69	39	57%	8	32	0.2	0.3	0.262	303	Yes	Analyte exceeded the cleanup level.
Arsenic	128	123	96%	37	20	5.0	7.0	1.77	3270	Yes	Analyte exceeded the cleanup level.
Cadmium	56	25	45%	0	80	0.1	0.2	0.2	4.5	No	Analyte did not exceed the cleanup level.
Chromium	56	56	100%	0	120,000	All Detects	All Detects	12.4	463	No	Analyte did not exceed the cleanup level.
Copper	101	101	100%	0	3,000	All Detects	All Detects	9.26	1420	No	Analyte did not exceed the cleanup level.
Lead	83	80	96%	12	250	2.0	3.0	2.09	1820	Yes	Analyte exceeded the cleanup level.
Mercury	56	4	7%	0	24	0.02	0.2	0.05	0.228	No	Analyte did not exceed the cleanup level.
Zinc	56	56	100%	0	24,000	All Detects	All Detects	21.3	5750	No	Analyte did not exceed the cleanup level.
TOTAL PETROLEUM HYDROCARBONS (mg/kg)											
Diesel-Range Organics	23	10	43%	1	2,000	5.4	25	22	2800	Yes	Analyte exceeded the cleanup level.
Lube Oil	27	8	30%	0	2,000	11	50	30	1900	No	Analyte did not exceed the cleanup level.
Gasoline-Range Organics	8	4	50%	3/2	30/100	5	5	10.1	680	Yes	Analyte exceeded the cleanup level
PCBS (mg/kg)											
Aroclor 1248	13	1	8%	---	Total PCBs	0.031	0.1	0.054	0.054	No	Location of exceedance is off-property and not related to Site.
Aroclor 1254	13	3	23%	---	Total PCBs	0.031	0.1	0.052	3.85	No	Location of exceedance is off-property and not related to Site.
Total PCBs	10	2	20%	1	1.0	0.031	0.1	0.106	3.85	No	Location of exceedance is off-property and not related to Site.
DIOXINS (pg/g)											
OCDD	1	1	100%	---	TEQ	All Detects	All Detects	8.07	8.07	No	Analyte did not exceed the cleanup level based on TEQ.
TOTAL HEPTA-DIOXINS	1	1	100%	---	TEQ	All Detects	All Detects	1.23	1.23	No	Analyte did not exceed the cleanup level based on TEQ.
TOTAL (TEQ ND=0)	1	1	100%	0	5.2	---	---	---	---	No	Analyte did not exceed the cleanup level.
TOTAL (TEQ ND=1/2 DL)	1	1	100%	0	5.2	---	---	---	---	No	Analyte did not exceed the cleanup level.

--- = No screening level available.
cPAH = carcinogenic polycyclic aromatic hydrocarbon
TEQ = Toxic Equivalency Quotient

PCBs = Polychlorinated biphenyls
IHS = Indicator Hazardous Substances
ND = Not Detected

DL = Dilution
pg/g = picogram to gram
mg/kg = milligrams per kilogram

Note: Only detected chemicals are presented in this table.

TABLE 17
INDICATOR HAZARDOUS SUBSTANCE EVALUATION FOR CHEMICALS DETECTED IN GROUNDWATER
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Number of Samples	Number of Detects	Frequency of Detection	Number of Detects Exceeding Cleanup Levels	Cleanup Level	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	Chemical Selected as an IHS?	Rational Inclusion or Exclusion as IHS
SEMIVOLATILES (µg/L)											
1-Methylnaphthalene	18	1	6%	0	1.5	0.5	1	0.62	0.62	No	Analyte did not exceed the cleanup level.
Acenaphthene	18	4	22%	0	640	0.5	1	1.9	6.44	No	Analyte did not exceed the cleanup level.
bis(2-Ethylhexyl)phthalate	22	4	18%	2	2.2	0.5	1	1	6.8	Yes	Analyte exceeded screening level.
Diethylphthalate	18	1	6%	0	28,000	1	2	5.52	5.52	No	Analyte did not exceed the cleanup level.
Di-n-butylphthalate	18	3	17%	0	2,900	0.36	2	1.6	3.92	No	Analyte did not exceed the cleanup level.
Fluorene	18	1	6%	0	3,500	0.5	1	0.384	0.384	No	Analyte did not exceed the cleanup level.
Phenanthrene	18	1	6%	---	---	0.5	1	1.3	1.3	No	No cleanup level available.
cPAHs (µg/L)											
Chrysene	18	1	6%	0	30	0.1	0.1	0.16	0.16	No	Analyte did not exceed the cleanup level.
cPAH TEQ	22	1	5%	0	0.1	---	---	---	---	No	Analyte did not exceed the cleanup level.
VOLATILES (µg/L)											
1,1-Dichloroethane	36	1	3%	---	---	0.2	1	1	1	No	Analyte detected in less than 5% of samples analyzed.
1,1-Dichloroethene	36	1	3%	1	3.2	0.2	1	12.3	12.3	Yes	Analyte detected in less than 5% of samples analyzed, but exceedance is greater than two times the cleanup level.
Carbon Disulfide	9	2	22%	---	---	0.2	0.2	0.2	0.4	No	No cleanup level available.
cis-1,2-Dichloroethene	36	1	3%	0	16	0.2	1	1.03	1.03	No	Analyte did not exceed the cleanup level.
Ethylbenzene	36	1	3%	0	2,100	0.2	1	6.22	6.22	No	Analyte did not exceed the cleanup level.
Naphthalene	36	2	6%	0	4,900	0.5	4	0.8	1.52	No	Analyte did not exceed the cleanup level.
Toluene	36	1	3%	0	15,000	0.2	1	1.65	1.65	No	Analyte did not exceed the cleanup level.
Xylenes, Total	27	3	11%	0	1,600	1	1	1.35	17.7	No	Analyte did not exceed the cleanup level.
DISSOLVED METALS (µg/L) - ALL SAMPLES											
Antimony	35	12	34%	0	640	0.2	0.2	0.176	13.5	No	Analyte did not exceed the cleanup level.
Arsenic	38	28	74%	11	5	1	1	0.4	256	Yes	Analyte exceeded the cleanup level.
Cadmium	35	3	9%	0	8.8	0.1	0.2	0.27	0.27	No	Analyte did not exceed the cleanup level.
Chromium	35	30	86%	0	240,000	0.5	1	0.424	100	No	Analyte did not exceed the cleanup level.
Copper	37	23	62%	11	3.1	0.5	0.5	0.6	127	Yes	Analyte exceeded the cleanup level.
Lead	36	8	22%	1	8.1	0.1	1	0.3	143	No	Analyte exceeded cleanup level in sample from one direct push boring, but not in sample collected from well installed immediately downgradient.
Mercury	40	8	20%	8	0.1	0.02	0.1	0.125	1.09	No	Analyte exceeded cleanup level in one of three sampling events. Exceedance not verified.
Zinc	35	23	66%	0	81	1.5	4	1.29	24	No	Analyte did not exceed the cleanup level.

TABLE 17
INDICATOR HAZARDOUS SUBSTANCE EVALUATION FOR CHEMICALS DETECTED IN GROUNDWATER
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Number of Samples	Number of Detects	Frequency of Detection	Number of Detects Exceeding Cleanup Levels	Cleanup Level	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	Chemical Selected as an IHS?	Rational Inclusion or Exclusion as IHS
DISSOLVED METALS (µg/L) - MONITORING WELLS ONLY											
Antimony	16	3	19%	0	640	0.2	0.2	0.2	0.617	No	Analyte did not exceed the cleanup level.
Arsenic	19	18	95%	7	5	1	1	0.4	256	Yes	Analyte exceeded the cleanup level.
Cadmium	16	1	6%	0	8.8	0.1	0.2	0.2	0.2	No	Analyte did not exceed the cleanup level.
Chromium	16	11	69%	0	240,000	0.5	1	1	46.1	No	Analyte did not exceed the cleanup level.
Copper	18	11	61%	2	3.1	0.5	0.5	0.6	5.23	Yes	Analyte exceeded the cleanup level.
Lead	17	7	41%	0	8.1	0.1	1	0.2	1.19	No	Analyte did not exceed the cleanup level.
Mercury	21	5	24%	5	0.1	0.02	0.1	0.125	0.48	No	Analyte exceeded cleanup level in one of three sampling events. Exceedance not verified.
Zinc	16	12	75%	0	81	1.5	4	1.29	9	No	Analyte did not exceed the cleanup level.
TOTAL PETROLEUM HYDROCARBONS (µg/L)											
Diesel Fuel	5	1	20%	0	500	50	50	50	50	No	Analyte did not exceed the cleanup level.
Diesel-Range Organics	5	1	20%	1	500	100	100	881	881	Yes	Analyte exceeded cleanup level in one of three sampling events. Exceedance not verified.
Lube Oil	9	4	44%	2	500	100	210	150	2240	Yes	Analyte exceeded cleanup level in one of three sampling events. Exceedance not verified.
Mineral Oil	5	1	20%	0	500	50	50	50	50	No	Analyte did not exceed the cleanup level.

--- = No screening level available.
IHS = Indicator Hazardous Substances
µg/L = micrograms per liter
cPAH = carcinogenic polycyclic aromatic hydrocarbon
TEQ = Toxic Equivalency Quotient

Note: Only detected chemicals are presented in this table.

TABLE 18
PROPOSED CLEANUP LEVELS
NORTH MARINA AMERON/HULBERT SITE RI/FS

	Proposed Soil Cleanup Level (mg/kg)	Proposed Groundwater Cleanup Level (µg/L)
Antimony	32	--
Arsenic	20	5
Copper	--	3.1
Lead	250	--
cPAH TEQ	0.14	--
bis(2-Ethylhexyl)phthalate	--	2.2
1,1-dichloroethylene	--	3.2
diesel-range petroleum hydrocarbons	2,000	500
oil-range petroleum hydrocarbons	--	500
gasoline-range petroleum hydrocarbons	100	--

-- Constituent is not an indicator hazardous substance for this media.

TABLE 19
SUMMARY OF MTCA OVERALL BENEFIT RANKINGS AND DISPROPOTIONATE COST ANALYSIS
NORTH MARINA AMERON/HULBERT SITE RI/FS

Alternative Number:	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alternative Name:	**Site Wide Excavation**	**Excavation in Future Redevelopment Areas and Containment**	**Containment with Focused Remedial Excavation**	**Site Wide Capping and Containment**
Alternative Description:	Excavation of contaminated soils site-wide except beneath existing buildings and critical infrastructure	Excavation of contaminated soils only in those areas scheduled for future redevelopment. Capping and containment with institutional controls of all other areas that have previously been redeveloped.	Capping and containment with institutional controls of all contaminated areas except for soil in areas subject to future redevelopment and that pose a significant threat of discharge to marine surface water and sediment.	Capping and containment with institutional controls of site-wide contamination.

Relative Benefits Ranking for DCA
[WAC 173-340-360(2)(b)(i) and WAC 173-340-360(3)(f)]

	Alternative 1 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Alternative 2 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Alternative 3 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Alternative 4 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score
-Overall Protectiveness	High	10	0.3	3	Medium High	8	0.3	2.4	Medium High	8	0.3	2.4	Medium	5	0.3	1.5
-Permanence	High	9	0.2	1.8	Medium High	7	0.2	1.4	Medium	6	0.2	1.2	Medium Low	4	0.2	0.8
-Long Term Effectiveness	Medium High	8	0.2	1.6	Medium High	7	0.2	1.4	Medium	6	0.2	1.2	Medium	5	0.2	1
-Manageability of Short Term Risk	Medium	5	0.1	0.5	Medium High	8	0.1	0.8	Medium High	8	0.1	0.8	High	10	0.1	1
-Implementability	Medium	6	0.1	0.6	Medium High	8	0.1	0.8	High	9	0.1	0.9	High	9	0.1	0.9
-Consideration of Public Concerns	High	10	0.1	1	High	10	0.1	1	High	10	0.1	1	High	10	0.1	1
Comparitive Overall Benefit				**8.5**				**7.8**				**7.5**				**6.2**

Disproportionate Cost Analysis	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Overall Weighted Benefit Score	8.5	7.8	7.5	6.2
Estimated Remedy Cost (including interim action)	$7,500,000	$4,260,000	$3,900,000	$2,380,000
Most practicable permanent solution	**Yes**	No	No	No
Lowest Cost Alternative	No	No	No	**Yes**
Relative Cost/Benefit Ratio (divided by 10,000)	8.8	5.5	5.2	3.8
Incrimental Increase/Decrease in Relative Benefit to Most Permanent Alternative	N/A	-8%	-12%	-27%
Incrimental Increase/Decrease in Relative Benefit to Next Most Permanent Alternative	N/A	-8%	-4%	-17%
Incremental Increase/Decrease in Cost Compared to Most Permanent Alternative	N/A	-43%	-48%	-68%
Incremental Increase/Decrease in Cost Compared to Next Most Permanent Alternative	N/A	-43%	-8%	-39%
Costs Disproportionate to Incremental Benefits	Yes	Yes	**No**	**No**
Remedy Permanent to the Maximum Extent Practicable?	No	No	**Yes**	No
Preferred Alternative	**No**	**No**	**Yes**	**No**

TABLE 20
SUMMARY OF MTCA ALTERNATIVES EVALUATION
NORTH MARINA AMERON/HULBERT SITE RI/FS

Alternative Number:	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Alternative Name:	**Site Wide Excavation**	**Excavation in Future Redevelopment Areas and Containment**	**Containment with Focused Remedial Excavation**	**Site Wide Capping and Containment**
Alternative Description:	Excavation of contaminated soil site-wide except beneath existing buildings and critical infrastructure.	Excavation of contaminated soil only in those areas scheduled for future redevelopment. Capping and containment of all other areas that have previously been redeveloped.	Capping and containment with institutional controls of all contaminated areas except for soil in areas subject to future redevelopment and that pose a significant threat of discharge to marine surface water and sediment.	Capping and containment of site-wide contamination.
Individual Ranking Criteria				
1 Meets Remedial Action Objectives	Yes	Yes	Yes	Yes
2 Compliance With MTCA Threshold Criteria				
[WAC 173-340-360(2)(a)]				
- Protect human health and the environment	Yes	Yes	Yes	Yes
- Comply with cleanup standards	Yes	Yes	Yes	Yes
- Comply with applicable state/federal laws	Yes	Yes	Yes	Yes
- Provide for compliance monitoring	Yes	Yes	Yes	Yes
3 Restoration Time Frame	Up to 1.5 years	Up to 1.5 years	Up to 1.5 years	Up to 6 months
[WAC 173-340-360(2)(b)(ii) and WAC 173-340-360(4)]				
- Potential risk to human health and environment	Low	Low	Low	Low
- Practicability of achieving shorter restoration time	See DCA in Table 6-2	See DCA in Table 6-2	See DCA in Table 6-2	See DCA in Table 6-2
- Current use of site, surrounding area, and resources	Current commercial/industrial with surrounding commercial and industrial	Current commercial/industrial with surrounding commercial and industrial	Current commercial/industrial with surrounding commercial and industrial	Current commercial/industrial with surrounding commercial and industrial
- Future use of site, surrounding area, and resources	Commercial and industrial	Commercial and industrial	Commercial and industrial	Commercial and industrial
- Availability of alternative water supplies	Yes	Yes	Yes	Yes
- Likely effectiveness/reliability of institutional controls	Not Applicable	Not Applicable	Not Applicable	Not Applicable
- Ability to monitor/control migration of hazardous substances	High	High	High	High
- Toxicity of hazardous substances at the site	Moderate	Moderate	Moderate	Moderate
- Natural processes that reduce concentrations	No	No	No	No
Overall Reasonable Restoration Timeframe	Yes	Yes	Yes	Yes