Draft
Southwest Harbor Terminal 5
Groundwater Quality Monitoring
Evaluation Report
Seattle, Washington

Prepared for
Port of Seattle

September 23, 2010
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HARTCROWSER

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CONTENTS

TABLES

CONTENTS (Continued)

Page

FIGURES

APPENDIX A
EVALUATION OF GROUNDWATER CHEMICAL CONCENTRATIONS PROTECTIVE OF SURFACE WATER

TABLES

FIGURE

CONTENTS (Continued)

Page

LIST OF ACRONYMS

BEHP	Bis(2-ethylhexyl) phthalate
bgs	below ground surface
BNSF	Burlington Northern Santa Fe Railway
CEE's	chlorinated ethanes and ethenes
DCE	dichloroethene
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
GQMER	Groundwater Quality Monitoring Evaluation Report
GWCMP	Groundwater Confirmation Monitoring Program
IDW	Investigation-derived waste
PCE	Tetrachloroethene
Port	Port of Seattle
RA	Remediation Area
SWHP	Southwest Harbor Project
SSI	Seattle Steel Incorporated
TCE	trichloroethene

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SOUTHWEST HARBOR TERMINAL 5
GROUNDWATER QUALITY MONITORING EVALUATION REPORT
SEATTLE, WASHINGTON

1.0 INTRODUCTION

This Groundwater Quality Monitoring Evaluation Report (GQMER) presents the results from four semiannual (twice yearly) groundwater monitoring events for the Phase II Southwest Harbor Project (SWHP) Groundwater Confirmation Monitoring Program (GWCMP) located at the Southwest Harbor Terminal 5 (Site) in Seattle, Washington (Figure 1). The purpose of the GWCMP is to confirm that soil remedial actions conducted under the individual SWHP Cleanup Action Plans are protective of surface water quality for the Site as a whole.

Phase I of the GWCMP focused on characterizing the post-remediation groundwater flow system at the Site in 2006. The resulting Hydrologic Characterization Report (Aspect 2007a) presented a detailed characterization of the post-remediation groundwater flow system, and concluded that Fill Aquifer flow conditions at the Site had equilibrated sufficiently to proceed with Phase II of the GWCMP.

This report summarizes the sampling activities and laboratory results for the four sampling events, completed by Aspect Consulting in October 2008, March/April 2009, and September 2009 and by Hart Crowser in June 2010. Sampling was performed in accordance with the Ecology-approved Water Quality Monitoring Plan (Aspect 2007 b).

Our work was completed in general accordance with our executed contract dated April 29, 2010, authorized by Mr. Brian Knight with the Port of Seattle.

2.0 BACKGROUND

The SWHP is located along the base of the West Seattle highlands at the confluence of the West Waterway of the Duwamish River (West Waterway) and Elliott Bay. The Site location is shown on Figure 1. The SWHP comprises approximately 185 areas of land generally bordered by Harbor Avenue and non-Port industrial and commercial properties on the west, SW Spokane Street and non-Port commercial properties on the south, Elliott Bay and Florida Street on the north, and the original Terminal 5 on the east. Most of the SWHP overlies

former tideflats that have been filled and used for various industrial purposes, including but not limited to railroad yards, wood treatment facilities, steel scrap storage, and a municipal and wood waste landfill.

The SWHP was divided into five Remediation Areas (RAs). Figure 2 shows the SWHP area and the boundaries of each RA. To facilitate Port plans for redevelopment, the individual RAs were remediated in the mid- to late-1990s. RA-1, RA-2, RA-3 and RA-5 were redeveloped under oversight by Ecology, while RA-4 was addressed under agreement with EPA. The locations and histories of the individual RAs and specific remedial actions completed at each RA are summarized below.

2.1 Remediation Area (RA) Descriptions

2.1.1 Spokane Street Properties (RA-1)

RA-1 consists of two disconnected land parcels (Figure 2). The narrow northern strip of land in RA-1 is the site of the former Buckley Yard, a rail car staging area that dates from the 1920s. The portion of RA-1 south of the former Buckley Yard is referred to as the Spokane Street Properties, which was historically occupied by an aluminum foundry, a chemical distribution warehouse, automotive repair areas, a fuel oil distribution facility and retail food stores. Soil contamination associated with the Spokane Street Properties was remediated between 1994 and 1998. Low-level soil contamination associated with the Buckley Yard was left in place. Asphalt and concrete covers were placed over the Buckley Yard, except in the northern portion of the area east of RA-3, where 24 inches of ballast cover was placed under the railroad tracks. Presently, RA-1 is occupied by Burlington Northern Santa Fe (BNSF) rail spurs, the main access road into the intermodal yard facility, and office buildings.

2.1.2 Former Salmon Bay Steel Property (RA-2)

RA-2 is the former Salmon Bay Steel property, located north of Spokane Street (Figure 2), and was used to store slag and scrap for the steel mill south of Spokane Street from the early 1900s until the 1970s. The area also included two large warehouses, a scale, and railroad spurs. Beginning in the late 1800s, the tideflats on the property were gradually filled with dredge sediment, slag, and steel mill debris. This fill material is predominantly slag, and reaches depths of 25 feet in places. Between 1996 and 1998, a cleanup measure was implemented that involved covering a quarter of the RA with a gravel ballast cap and the remainder of the RA with an impermeable asphalt pavement cap. Prior to this effort, the contaminated soil from areas where the gravel ballast cover was to be placed was moved to areas where asphalt cover would be placed.

Presently, the western portion of RA-2 is occupied by the BNSF Rail Yard, and the eastern portion is occupied by the main entrance and south end of the intermodal yard.

2.1.3 Former West Seattle Landfill and Purdy Scrap/Former Seattle Steel Inc. Property (RA-3)

RA-3 was the location of both the West Seattle Landfill and the former Seattle Steel Incorporated (SSI) property (Figure 2), a scrap metal processing company. The West Seattle Landfill occupied 30 acres (approximately three-quarters of this RA) and was in operation from 1939 to 1966. The former landfill was almost entirely covered with slag, construction debris, steel mill debris, and an un-engineered soil cover. In the spring of 1995, near-surface refuse from the eastern portion of the landfill was relocated to a consolidation landfill area on the western portion of the RA. An interim cover consisting of processed solid landfill material was placed over the property. Since this time, an engineered cover consisting of clean fill and a low-permeability geomembrane has been placed over the former landfill, and an asphalt cover has been placed over the former SSI property south of the landfill. The Port operates a landfill gas collection and treatment system in the former landfill area. Presently, the asphalt-paved area on the consolidated landfill portion of RA-3 is used for tenant-lease activities including truck and vehicle parking, container chassis storage, and temporary construction laydown and component assembly for Sound Transit's light rail project.

2.1.4 Pacific Sound Resources Superfund Site (RA-4)

RA-4, a former wood treating facility referred to as the Pacific Sound Resources Superfund site, is being addressed separately under the Superfund process by EPA (Figure 2). Monitoring of groundwater downgradient of RA-4, for the purpose of verifying RA-4 cleanup action protection, is not included in the scope of the GWCMP. However, the portion of RA-4 south of Florida Street is being considered under this GWCMP in order to evaluate groundwater flow from RA-4 into the adjacent remediation areas.

Until 1994, when remediation activity began, the north portion of RA-4 (north of the Florida Street alignment) was occupied by wood treating operations, and the south portion was the location of a kiln building, laboratory area, sawmill, office building and storage areas for treated and untreated stock (Retec 1994). Remediation involved limited removal of contaminated soils and the placement of a specially-designed, low-permeability asphalt concrete cap over the entire RA. Woodwaste from an area at the west side of the RA was recycled off site and the resulting excavation pit was backfilled with fill. A geotextile identifier

layer was installed throughout the RA between clean import fill and underlying contaminated soils. In addition, a groundwater containment slurry wall was built in the northern portion of the property to reduce tidal influence on groundwater in the RA interior and limit migration of contaminants into Puget Sound. RA-4 is presently occupied by the northern end of the Terminal 5 intermodal yard, the BNSF Storage Track Yard, and the Jack Block Public Shoreline Access and Park area.

2.1.5 Former Lockheed Shipyard 2 (RA-5)

RA-5 was originally a tideflat zone that has since been filled with dredge sediment, slag, and construction debris. The western portion of the remediation area (Figure 2), filled prior to 1936, was the site of Nettleton Lumber until the late 1960s. The eastern portion of the RA was filled in the late 1950s, becoming the location of Lockheed Shipyard 2, which operated from 1956 to 1987 as a ship maintenance and refitting yard. In 1994, the area used for shipbuilding operations underwent excavation and treatment of contaminated soils. Pursuant to this cleanup effort, the shipyard-era storm drain system was removed or abandoned, and the associated contaminated storm drain sediments were disposed of. In addition, an asphalt concrete cap was placed over the entire site and a new stormwater drainage system was installed. Presently, RA-5 is used by the intermodal yard tenant for parking and interim container storage.

2.2 Monitoring Locations

The study area addressed in the GWCMP encompasses most of the SWHP Site, including the former Buckley Yard and Spokane Street Properties (RA-1), former Salmon Bay Steel Property (RA-2), former West Seattle Landfill and SSI property (RA-3), and the former Lockheed Shipyard 2 (RA-5). Phase II of the GWCMP involves sampling of Fill and Estuarine Aquifer monitoring wells within and/or downgradient of these RAs.

Figure 2 presents the locations of 11 Fill Aquifer and 3 Estuarine Aquifer monitoring wells that are currently sampled as part of the Phase II monitoring network. These wells are used to monitor groundwater quality within and/or downgradient of the target RAs, as follows:

- Wells CMP-17 and MW-125 monitor Fill Aquifer groundwater quality downgradient of the former Spokane Street Properties (RA-1).

- Well CMP-3 monitors Fill Aquifer groundwater quality downgradient of RA-2 and the extreme southern portion of the former Buckley Yard (RA-1).

- Well CMP-4, located within the former Buckley Yard (RA-1), monitors Fill Aquifer groundwater quality within this RA, and immediately downgradient of the central portion of RA-3.

- Well MW-308N monitors Fill Aquifer groundwater quality downgradient of the northern portions of the former Buckley Yard (RA-1) and RA-3.

- Well MW-308S monitors Estuarine Aquifer groundwater quality downgradient of the northern portions of the former Buckley Yard (RA-1) and RA-3.

- Well CMP-15 monitors Fill Aquifer groundwater quality on flow paths that transect the central and/or northern portions of the former Buckley Yard (RA-1) and RA-3, the southern portion of RA-4, and the western portion of RA-5.

- Well MW-36 monitors Estuarine Aquifer groundwater quality on flow paths that transect the central and/or northern portions of the former Buckley Yard (RA-1) and RA-3, the southern portion of RA-4, and the western portion of RA-5.

- Well MW-26R monitors Fill Aquifer groundwater quality on flow paths that transect the central portions of the former Buckley Yard (RA-1) and RA-3, the southern portion of RA-4, and the eastern portion of RA-5.

- Well MW-44 monitors Estuarine Aquifer groundwater quality on flow paths that transect the central portions of the former Buckley Yard (RA-1) and RA-3, the southern portion of RA-4, and the eastern portion of RA-5.

Four Phase II GWCMP wells were sampled to monitor background water quality upgradient of the target RAs, as follows:

- Background wells FM-105 and CMP-1 are located on the southern borders of RA-1 and RA-2, respectively. These wells monitor the quality of groundwater that flows beneath the Nucor Steel facility and SW Spokane Street, and enters the SWHP from the south.

- Background well CMP-2 monitors groundwater quality entering the SWHP from commercial/industrial areas located immediately southwest of RA-2.

- Background well CMP-5, located immediately upgradient of RA-3, monitors groundwater quality along the flow path of recharge from the adjacent West Seattle highlands.

The Phase II GWCMP monitoring network comprises monitoring wells sited for the Phase I groundwater flow characterization. It is possible that one or more of the monitoring wells may not prove to be optimal for Phase II water quality monitoring. The first four rounds of groundwater monitoring during the Phase II GCWMP have been completed and are summarized within this groundwater quality monitoring evaluation report. A summary of the recommendations for the replacement or addition of wells to better meet the goals of the Phase II program are detailed in Section 6.0.

2.3 Monitoring Schedule

In accordance with the Groundwater Conceptual Letter, Phase II groundwater sampling was performed semiannually (twice yearly) (Port of Seattle 1999). Aspect Consulting completed two low-level groundwater sampling events in October 2008 and September 2009 and one high-level groundwater sampling event in March/April 2009. Hart Crowser completed the second high-level groundwater sampling event in June 2010.

Figure 2 shows the spatial distribution of monitoring wells that are currently sampled as part of the Phase II monitoring network.

3.0 SCOPE OF WORK

The purpose of the Phase II Southwest Harbor Project (SWHP) Groundwater Confirmation Monitoring Program (GWCMP) is to confirm that soil remedial actions conducted under the individual SWHP Cleanup Action Plans are protective of surface water quality for the Site as a whole.

The groundwater monitoring tasks included in Phase II are described below.

- Measure depth to water in sampled monitoring wells to determine groundwater elevation contours during the high-level groundwater sampling event (Table 1).

- Sample 14 monitoring wells in the existing monitoring well network using low-flow sampling methods.

- Monitor field parameters (dissolved oxygen, pH, temperature, specific conductivity, and turbidity) using a flow-through cell during purging and sampling.

- Collect and submit one grab groundwater sample for chemical analysis, using low-flow sampling, from each monitoring well location.

4.0 GROUNDWATER ELEVATIONS

4.1 Site Hydrogeology

The Site is underlain by two aquifers, a shallow Fill Aquifer and a deeper Estuarine Aquifer. Eleven wells are completed in the Fill Aquifer and three wells are completed in the Estuarine Aquifer. The Fill Aquifer consists of groundwater in various fill materials between 20 to 40 feet below ground surface (bgs). Sandy Silt to silty fine Sand tideflat deposits, typically 1 to 10 feet in thickness, occur between the Fill and Estuarine Aquifer zones over most of the Site with the exception of the easternmost portion near the West Waterway, and in isolated areas near the former axis of Longfellow Creek along the eastern edge of RA-3. Where present, this low-permeability unit results in locally confined conditions in the Estuarine Aquifer zone. The Estuarine Aquifer is underlain by a lower permeability unit that occurs at depths ranging from 30 to 50 feet bgs. The Fill Aquifer/Estuarine Aquifer system is bounded to the north by Elliott Bay and to the east by the West Waterway. The aquifers thin to the south and west and terminate to the west against the West Seattle bluff, encountering deposits of the low-permeability Lawton Clay unit.

4.2 Groundwater Elevations

The depth to water was measured in all the monitoring wells during the June 2 through June 4, 2010, groundwater sampling event. Monitoring well groundwater elevation data for all four groundwater sampling events (low and high levels) are summarized and presented in Table 1. Since groundwater at the Site is tidally influenced and water levels were measured over a 3-day period, meaningful groundwater contours could not be plotted. Post-redevelopment and tidally corrected groundwater elevation contours based on a 72-hour mean during dry and wet season in the Fill and Estuarine Aquifers are provided in Figures 3 through 6 (Aspect 2007a).

4.2.1 Fill Aquifer

The groundwater elevations during the June 2010 measurements for shallow monitoring wells in the Fill Aquifer ranged from 8.67 to 15.09 feet bgs. Groundwater elevations in all monitoring wells increased by 0.29 to 1.85 feet relative to the September 2009 monitoring event. Based on the Aspect Consulting Hydrologic Characterization Report (2007a), groundwater flows in

the Fill Aquifer monitoring wells were generally toward the east-northeast of the West Seattle uplands, beneath RA-3, and then diverged toward the nearest water body, West Waterway or Elliott Bay, within the main Terminal 5 area. The most recent groundwater elevation contours based on a 72-hour mean during dry and wet seasons in the Fill Aquifer are provided in Figure 3 and 4, respectively. In general, Fill Aquifer groundwater flows measured during the June 2010 sampling event showed a similar trend to what was observed during the long-term study conducted by Aspect Consulting.

4.2.2 Estuarine Aquifer

The groundwater elevations in the deep monitoring wells completed in the Estuarine Aquifer ranged from 8.29 to 9.44 feet bgs. Groundwater elevations in monitoring wells MW-308A(S) and MW-36 were 0.27 to 0.38 feet lower than nearby shallow monitoring wells screened in the Fill Aquifer, indicating that a downward gradient exists between the Fill Aquifer and the Estuarine Aquifer. A downward gradient was not observed at the shallow and deep monitoring well cluster, MW-26R and MW-44. This is likely due the absence of a low-permeability confining unit on the easternmost portion of the Site near the West Waterway. However, based on the Aspect Consulting Hydrologic Characterization Report (2007a), groundwater flows in the Estuarine Aquifer monitoring wells were generally from the southwest toward the northeast, with discharge to Elliott Bay and the West Waterway. The most recent groundwater elevation contours based on a 72-hour mean during dry and wet season in the Estuarine Aquifer are provided in Figure 5 and 6, respectively. During the June 2010 sampling event, only three deep monitoring wells (MW-308S, MW-36, and MW-44) were measured, providing inadequate data for field verification of groundwater flows observed during the long-term study conducted by Aspect Consulting.

5.0 GROUNDWATER SAMPLING AND ANALYTICAL RESULTS

5.1 Surface Water Quality Screening Criteria

As noted in the Groundwater Conceptual Letter (Port of Seattle 1999), the remediation activities completed at each of the RAs are believed to be protective of groundwater quality whose highest beneficial use is discharge to surface water. Since surface water is the assumed final receptor of groundwater, surface water quality screening criteria were included in this report for preliminary comparison purposes only.

Potential surface water quality screening criteria for each analyte are summarized in Table 2. Note that the most stringent surface water criterion for arsenic is 0.14 ug/L. However, since Ecology has established the natural background concentration of arsenic in groundwater at 5 ug/L (MTCA Method A), arsenic concentrations were screened against the established background concentration of 5 ug/L. It should also be noted that surface water quality criteria are based on dissolved metals concentrations. Since the work plan for the SWHP GWCMP specified analysis of total metals, depending upon turbidity and suspended solids concentrations, reported groundwater metal concentrations may have an artificially high bias relative to the dissolved metals criteria they are being screened against.

5.2 Groundwater Concentrations Protective of Surface Water

As part of this Groundwater Quality Monitoring Evaluation Report, a memorandum was developed to identify the appropriate groundwater chemical concentrations that are protective of surface water, against which the GWCMP data should be compared (Appendix A).

The protectiveness of current groundwater chemical concentrations was assessed by modeling natural attenuation of chemical constituents within the groundwater aquifer to determine if chemicals detected in groundwater are naturally attenuated to concentrations below surface water quality criteria prior to discharge to Puget Sound marine water.

Fate and transport modeling using BIOSCREEN was conducted to predict contaminant concentrations at the shoreline. The natural attenuation processes simulated in the modeling include dispersion and sorption. Biodegradation and tidal mixing processes were not included in the model.

The model results show that even under the conservative conditions, predicted concentrations of most constituents of potential concern (COPCs), including bis(2-ethylhexyl)phthalate, PAHs and PCBs detected in groundwater will not exceed the screening level concentrations at the shoreline within 100 years. For organic compounds, groundwater concentrations as high as the solubility limit would not result in an exceedance of surface water quality criteria at the shoreline.

Tidal dilution factors ranging from 4 to 10,000 have been reported from groundwater modeling at the Terminal 5 and adjacent sites (Aspect 2007; Retec 1998). Use of the lowest tidal dilution estimate of four would further reduce the calculated chemical concentrations at the shoreline after 100 years by an additional factor of four. Incorporation of chemical degradation rates would

result in even lower chemical concentrations at the groundwater to surface water interface.

5.3 Monitoring Well Groundwater Sampling and Analysis

Groundwater samples were collected from the 11 shallow Fill Aquifer monitoring wells (CMP-1, CMP-2, CMP-3, CMP-4, CMP-5, CMP-15, CMP-17, MW-26R, MW-125, MW-308N, and FM-105) and the deep Estuarine Aquifer monitoring wells (MW-36, MW-44, and MW-308S) to evaluate water quality in the Fill and Estuarine Aquifers.

All groundwater samples were submitted for chemical analysis of:

- cPAHs by EPA Method 8270C-SIM;
- PCBs by EPA Method 8082;
- TPH-Dx by NWTPH-Dx with silica gel cleanup; and
- Bis(2-ethylhexyl) phthalate (BEHP) by EPA Method 8270C.

Additionally, selected groundwater samples were submitted for chemical analysis of:

- VOCs, chlorinated ethanes and ethenes (CEE's) by EPA Method 8260B for monitoring wells FM-105, MW-125, and CMP-17;
- Total metals by EPA Method 6010B/6020 for antimony, arsenic, chromium, copper, lead, and nickel for monitoring wells CMP-15, MW-26R, MW-36, and MW-44; and
- Total metals by EPA Method 6010B/6020 for arsenic and lead for monitoring wells CMP-1, CMP-2, CMP-3, CMP-4, CMP-5, CMP-17, MW-125, MW-308N, MW-308S, and FM-105.

Details of the low-flow sampling procedures are presented in Appendix A. The monitoring well boring logs for the Phase II GWCMP monitoring network are presented in Appendix B. Field water quality parameters including pH, temperature, conductivity, dissolved oxygen, and turbidity were monitored during groundwater sampling of the Fill and Estuarine Aquifer monitoring wells. Field water quality monitoring results are provided on the groundwater sampling forms presented in Appendix C. The review of chemical data quality and laboratory certificates is included in Appendix D.

Tables 3 through 6 present the tabulated field monitoring and analytical results for the RA-1 and RA-3, RA-2, and RA-5, respectively, for the four groundwater monitoring events (October 2008, March/April 2009, September 2009, and

June 2010). Groundwater quality data are organized by RA, background/ confirmation monitoring location, aquifer designation, and sampling date.

5.3.1 Spokane Street Properties (RA-1)

Groundwater samples were collected from within the Fill Aquifer from one upgradient background monitoring well (FM-105) and two confirmation monitoring wells (MW-125 and CMP-17) to evaluate water quality within RA-1. Groundwater monitoring and analytical results for the Phase II GWCMP are summarized in Table 3. Additional information or clarification for selected analytes and monitoring wells is provided below.

Total arsenic was detected in all background and confirmation monitoring wells. Concentrations were comparable in the background monitoring well, FM-105, and the confirmation monitoring well, MW-125. Concentrations in confirmation monitoring well, CMP-17, were somewhat higher and may be indicative of the more reducing conditions (lower dissolved oxygen) in CMP-17.

Bis(2-ethylhexyl) phthalate (BEHP) was detected in the duplicate groundwater sample but not the primary groundwater sample collected from background monitoring well, FM-105, in March 2009. BEHP was not detected in groundwater samples from the two downgradient confirmation monitoring wells, MW-125 and CMP-17.

Tetrachloroethene (PCE) and its degradation products, trichloroethene (TCE) and dichloroethene (DCE) were detected in the upgradient background monitoring well FM-105 and confirmation monitoring wells, MW-125 and CMP-17 indicating that contamination is from an off-site source not associated with the RA-1 area. Concentrations of the more mobile degradation compounds TCE and DCE are slightly higher in downgradient confirmation monitoring well CMP-17 than in background well MW-125.

5.3.2 Former Salmon Bay Steel Property (RA-2)

Groundwater samples were collected from within the Fill Aquifer from two upgradient background monitoring wells (CMP-1 and CMP-2) and one confirmation monitoring well (CMP-3) to evaluate water quality within RA-2. Groundwater monitoring and analytical results for the Phase II GWCMP are summarized in Table 4. Additional information or clarification for selected analytes and monitoring wells is provided below.

Total arsenic concentrations ranged from 2.6 to 3.1 ug/L in background monitoring well CMP-1, from 20.8 to 23.2 ug/L in background monitoring well

CMP-2, and from 6.6 to 11.6 ug/L in confirmation monitoring well CMP-3 indicating that contamination is from an off-site source not associated with the RA-2 area.

Total lead concentrations ranged from 1 to 15 ug/L in background monitoring well CMP-2 and from non-detected to 4 ug/L in confirmation monitoring well CMP-3 indicating that contamination is from an off-site source not associated with the RA-2 area.

5.3.3 Former West Seattle Landfill and Purdy Scrap/Former Seattle Steel Inc. Property (RA-3), Former Buckley Yard (RA-1)

Groundwater samples were collected from within the Fill Aquifer from one upgradient background monitoring well (CMP-5) and two confirmation monitoring wells (CMP-4 and MW-308N) within RA-3 and RA-1, and one monitoring well (MW-308S) within the Estuarine Aquifer to evaluate water quality within RA-3 and RA-1. Groundwater monitoring and analytical results for the Phase II GWCMP are summarized in Table 5. Additional information or clarification for selected analytes and monitoring wells is provided below.

BEHP was detected in background well CMP-5 and confirmation monitoring well CMP-4. Background concentrations were higher than the confirmation well concentrations suggesting that contamination is from an off-site source.

5.3.4 Former Lockheed Shipyard 2 (RA-5)

Groundwater samples were collected from within the Fill Aquifer from one upgradient background monitoring well (CMP-5) and two confirmation monitoring wells (CMP-15 and MW-26R) and two monitoring wells (MW-36 and MW-44) within the Estuarine Aquifer to evaluate water quality within RA-5. Groundwater monitoring and analytical results for the Phase II GWCMP are summarized in Table 6. Additional information or clarification for selected analytes and monitoring wells is provided below.

Diesel- and motor oil-range petroleum hydrocarbons were not detected with the exception of Estuarine Aquifer well MW-44, which had a concentration of 530 ug/L. This single result may be questionable. Monitoring well MW-44 is located in a container storage area with heavy truck traffic and, therefore, is susceptible to small oil drips on the pavement. In addition, the flush-mount well monument was full of water, presumably runoff from the pavement, which had to be removed before the well could be sampled.

Concentrations of BEHP detected in background well CMP-5 were higher than the confirmation and Estuarine Aquifer well concentrations suggesting that contamination is from an off-site source not associated with RA-5.

6.0 FUTURE ESTUARINE WELL GROUNDWATER MONITORING PROGRAM

As noted in the Ecology-approved Water Quality Monitoring Plan (Aspect 2008), the remediation activities completed at each of the RAs are believed to be protective of groundwater quality whose highest beneficial use is discharge to surface water. As such, the Phase II GWCMP is not expected to continue indefinitely. Groundwater monitoring will continue for one additional year (one high water and one low water event) after the submittal of this Groundwater Quality Monitoring Evaluation Report. Groundwater monitoring may be continued after that time in select monitoring wells for select analytes, if Ecology and the Port are in mutual agreement that additional groundwater monitoring is warranted to meet the GWCMP program's objectives. Once the goal of demonstrating that surface water protection is met, groundwater monitoring will be discontinued.

In addition, as specified in the Ecology-approved work plan and in accordance with the Groundwater Conceptual Letter (Port of Seattle 1999):

> "Assessment of whether modifications to the monitoring network are warranted will occur on an ongoing basis as the program progresses. The Port will evaluate the initial findings after completion of the first year of groundwater monitoring, and may propose modifications to the monitoring network at that time. Water quality in the monitored Estuarine Aquifer wells will be evaluated after 1 year of monitoring. If no inorganic or organic constituents are detected in the Estuarine Aquifer wells above background levels during the first year, these wells will be dropped from the program and the assessment of the Estuarine Aquifer will be considered complete."

The Port has continued monitoring estuarine wells for an additional year beyond the time required by the work plan. The following changes to groundwater monitoring for Estuarine Aquifer wells will be implemented based on the fact that the analytes have not been detected in estuarine wells during four rounds of semiannual groundwater monitoring conducted over a 2-year period, between October 2008 and June 2010 or chemical concentrations in estuarine wells are less than background levels.

Estuarine Well MW-308S

- TPH monitoring in Estuarine Aquifer well MW-308S will be discontinued since TPH has not been detected in this monitoring well.

- Lead monitoring in Estuarine Aquifer well MW-308S will be discontinued since lead has not been detected in this monitoring well.

- cPAH monitoring in Estuarine Aquifer well MW-308S will be discontinued since cPAHs have not been detected in this monitoring well.

- PCB monitoring in Estuarine Aquifer well MW-308S will be discontinued since PCBs have not been detected in this monitoring well.

Estuarine Well MW-36

- TPH monitoring in Estuarine Aquifer well MW-36 will be discontinued since TPH has not been detected in this monitoring well.

- Antimony, chromium, copper, and lead monitoring in Estuarine Aquifer well MW-36 will be discontinued since these analytes have not been detected in this monitoring well.

- cPAH monitoring in Estuarine Aquifer well MW-36 will be discontinued since cPAHs have not been detected in this monitoring well.

- PCB monitoring in Estuarine Aquifer well MW-36 will be discontinued since PCBs have not been detected in this monitoring well.

Estuarine Well MW-44

- PCB monitoring in Estuarine Aquifer well MW-44 will be discontinued since PCBs have not been detected in this monitoring well.

- Estuarine Aquifer well, MW44, which had a questionable detection of TPH will be redeveloped prior to the next round of groundwater sampling to determine if TPH is actually present in the groundwater or if it was an artifact resulting from surface water leaking into the monitoring well casing. If TPH is not detected during the next monitoring event (October 2010), TPH monitoring will be discontinued.

7.0 CONCLUSIONS

Groundwater concentrations at Terminal 5 are protective of surface water for all chemicals included in the long-term groundwater monitoring program. For semivolatile organic compounds, natural attenuation modeling demonstrates that groundwater concentrations at the shoreline would be non-detect even after 100 years. Incorporation of chemical degradation rates and tidal mixing factors would further decrease groundwater chemical concentrations and would also result in non-detect concentrations for volatile organic compounds and metals near the shore.

In accordance with the Ecology-approved work plan and the Groundwater Conceptual Letter groundwater monitoring will be discontinued in estuarine wells for chemicals that have not been detected during the past two years.

8.0 LIMITATIONS

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Port of Seattle for specific application to the referenced property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

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Table 1 - Summary of Monitoring Well Groundwater Elevation Data

Well Name	TOC Elevation in Feet [(1)]	Date	DTW in Feet	Groundwater Elevation in Feet
Fill Aquifer				
CMP-1	22.71	10/13/2008 3/31/2009 9/4/2009 6/4/2010	12.92 12.21 13.10 11.83	9.79 10.50 9.61 10.88
CMP-2	22.67	10/13/2008 3/31/2009 9/2/2009 6/4/2010	12.92 12.92 13.60 11.75	9.75 9.75 9.07 10.92
CMP-3	17.40	10/14/2008 4/1/2009 9/3/2009 6/2/2010	8.40 7.90 8.45 7.60	9.00 9.50 8.95 9.80
CMP-4	19.92	10/14/2008 4/2/2009 9/3/2009 6/2/2010	11.04 10.34 11.01 10.17	8.88 9.58 8.91 9.75
CMP-5	23.80	10/13/2008 4/1/2009 9/2/2009 6/3/2010	10.09 8.48 10.12 8.71	13.71 15.32 13.68 15.09
CMP-15	18.42	10/14/2008 4/2/2009 9/3/2009 6/3/2010	10.38 9.91 10.14 9.75	8.04 8.51 8.28 8.67
CMP-17	18.43	10/13/2008 3/31/2009 9/2/2009 6/4/2010	9.47 9.05 9.50 8.81	8.96 9.38 8.93 9.62
MW-26R	18.27	10/14/2008 4/1/2009 9/3/2009 6/4/2010	9.91 9.66 9.69 9.40	8.36 8.61 8.58 8.87
MW-125	15.90	10/13/2008 3/31/2009 9/2/2009 6/3/2010	6.88 6.40 7.01 6.25	9.02 9.50 8.89 9.65
MW-308A(N)	14.86	10/13/2008 4/2/2009 9/4/2009 6/3/2010	6.53 5.86 6.50 5.73	8.33 9.00 8.36 9.13
FM-105	20.80	10/13/2008 3/31/2009 9/2/2009 6/3/2010	11.20 10.76 11.36 10.70	9.60 10.04 9.44 10.10

Table 1 - Summary of Monitoring Well Groundwater Elevation Data

Well Name	TOC Elevation in Feet (1)	Date	DTW in Feet	Groundwater Elevation in Feet
Estuarine Aquifer				
MW-36	17.60	10/14/2008	10.00	7.60
		4/2/2009	9.06	8.54
		9/3/2009	9.72	7.88
		6/2/2010	9.31	8.29
MW-44	18.38	10/14/2008	10.90	7.48
		4/1/2009	8.94	9.44
		9/3/2009	11.46	6.92
		6/2/2010	8.94	9.44
MW-308B(S)	14.42	10/13/2008	6.30	8.12
		4/1/2009	5.74	8.68
		9/4/2009	6.17	8.25
		6/3/2010	5.56	8.86

Notes:
TOC - Top of Casing.
DTW - Depth to Water.
Vertical datum is in Feet MLLW.
(1) Based on a professional survey completed by Aspect Consulting, LLC (December 21, 2009).

Table 2 - Surface Water Quality Screening Criteria. Screening Levels for Groundwater Based on Marine Surface Water Criteria

Port of Seattle Terminal 5 Southwest Harbor

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3] (µg/L)
Metals (4)											
Antimony	--	--	--	--	--	--	640	4300	--	1000	**640**
Arsenic, inorganic	69	69	69	36	36	36	0.14	0.14	0.098	18	**0.14 (5 - MTCA A GW)**
Chromium (VI)	1100	50	1100	50	1100	50	--	--	--	490	**50**
Copper	4.8	4.8	2.4	3.1	3.1	2.4	--	--	--	2,700	**2.4**
Lead	210	210	210	8.1	8.1	8.1	--	--	--	--	**8.1**
Nickel soluble salts	74	74	74	8.2	8.2	8.2	4,600	4,600	--	1,100	**8.2**
Polychlorinated Biphenyls (PCBs)											
Aroclor 1016	--	--	--	--	--	0.03	--	--	--	0.0058	**0.0058**
Aroclor 1221	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1232	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1242	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1248	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	--	--	--	--	--	0.03	--	--	--	0.0017	**0.0017**
Aroclor 1260	--	--	--	--	--	0.03	--	--	--	--	**0.03**
Aroclor 1262	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1268	--	--	--	--	--	--	--	--	--	--	--
Polychlorinated biphenyls	10	--	--	0.03	0.03	0.03	0.000064	0.00017	0.00011	--	**0.000064**
Total Petroleum Hydrocarbons											
TPH, diesel range	--	--	--	--	--	--	--	--	--	--	**500 [5]**
TPH, heavy oils	--	--	--	--	--	--	--	--	--	--	**500 [5]**
Chlorinated Volatile Organic Compounds (VOCs)											
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	**--**
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	930,000	**420,000**
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	4	11	6.5	--	4
1,1,2-Trichloroethane	--	--	--	--	--	--	16	42	25	2,300	16
1,1-Dichloroethane	--	--	--	--	--	--	--	--	--	--	**--**
1,1-Dichloroethene	--	--	--	--	--	--	7100	3.2	--	23,000	**3.2**
1,2-Dichloroethane	--	--	--	--	--	--	37	99	59	43,000	**37**
Chloroethane	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	--	--	--	--	--	--	--	--	--	--	**--**
Tetrachloroethene	--	--	--	--	--	--	3.3	8.9	0.39	840	**0.39**
trans-1,2-Dichloroethene	--	--	--	--	--	--	10,000	--	--	33,000	**10,000**
Trichloroetlene	--	--	--	--	--	--	30	81	6.7	71	**6.7**
Vinyl chloride	--	--	--	--	--	--	2.4	530	3.7	6,600	**2.4**
Semivolatile Organic Compounds (SVOCs)											
bis(2-Ethylhexyl) phthalate	--	--	--	--	--	--	2.2	5.9	3.6	400	**2.2**
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)											
Benzo[a]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Benzo[a]pyrene	--	--	--	--	--	--	0.018	0.031	0.03	--	**0.018**
Benzo[b]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Benzo[k]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Chrysene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Dibenzo[a,h]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**

Notes

1. -- = Not established.
2. Screening levels may be adjusted depending on lab PQLs.
3. Screening levels may be adjusted based on background data results
4. Surface water quality criteria screening levels are based on dissolved metal concentrations.
5. Screening levels based on MTCA Method A Cleanup levels for groundwater.

Abbreviations

µg/L = micrograms per liter.
ARAR = applicable or relevant and appropriate requirements
CFR = code of federal regulations
WAC = Washington Administrative Code

Table 3 - RA-1 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 1 (former Spokane Street Properties)															
	Background							Confirmation Monitoring								
	Fill Aquifer															
Sample Name	FM105-081013	FM105-081013D	FM105-090331	FM105-090331D	FM105-090902	FM105-090902D	FM105	MW125-081013	MW125-090331	MW125-090902	MW125	CMP17-081013	CMP17-090331	CMP17-090902	CMP17
Sampling Date	10/13/08	10/13/08	3/31/09	3/31/09	9/2/09	9/2/09	6/3/10	10/13/08	3/31/09	9/2/09	6/3/10	10/13/08	3/31/09	9/2/09	6/4/10
Groundwater Level Measurements															
Reference Elevation in feet MLLW	20.80		20.80		20.80		20.80	15.90	15.90	15.90	15.90	18.43	18.43	18.43	18.43
Depth To Water in feet	11.20		10.76		11.36		10.70	6.88	6.40	7.01	6.25	9.47	9.05	9.50	8.81
Water Level Elevation in feet MLLW	9.60		10.04		9.44		10.10	9.02	9.50	8.89	9.65	8.96	9.38	8.93	9.62
Water Quality Field Parameters															
Temperature in degrees Celsius	14.8		11.5		14.5		12.1	18.6	11.4	19.3	15.1	17.6	12.3	17.5	13.8
pH	7.03		6.26		5.95		6.45	6.61	6.18	5.94	6.42	6.61	6.05	5.83	6.19
Conductivity in µS/cm	440		476		518		399	412	589	475	387	569	678	597	483
Dissolved Oxygen in mg/L	0.37		0.96		0.58		0.97	0.52	1.74	0.83	2.47	0.1	0.39	0.32	0.02
Turbidity in NTUs	2.1		0.53		3.64		0	0.9	0.74	2.34	0	1.74	2	4.87	135
Total Petroleum Hydrocarbons by Method NWTPH-Dx															
Diesel Range in µg/L	250 U	250 U	250 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U
Total Metals by EPA Method 200.8															
Total arsenic, inorganic in µg/L	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	2 U	**0.4**	**0.4**	**0.6**	2 U	**2.6**	**2.6**	**2.9**	**8.1**
Total lead in µg/L	1 U	1 U	1 U	1 U	1 U	1 U	*10 U*	1 U	1 U	1 U	*10 U*	1 U	1 U	1 U	1 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM															
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.097**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.140**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.100**	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.120**	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.084**	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.028**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.051**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Semi-Volatile Organics by EPA Method 8270D															
bis(2-ethylhexyl) phthalate in µg/L	1.0 U	1.0 U	1.0 UJ	5.8 J	1.0 U	1.0 U	**1.4**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Polychlorinated Biphenyls (PCBs) by EPA Method 8082															
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*
Volatile Organic Compounds by EPA Method 8260B															
tetrachloroethane;1,1,1,2- in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
tetrachloroethane;1,1,2,2- in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
trichloroethane;1,1,1- in µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	**0.2**	0.2 U	0.2 U	**0.2**	0.2 U	0.2 U	0.2 U	0.2 U
trichloroethane;1,1,2- in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
dichloroethane;1,1- in µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	**0.4**	**0.2**	**0.3**	**0.3**	0.2 U	0.2 U	0.2 U	0.2 U
dichloroethane;1,2- in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ethyl chloride in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
tetrachloroethene in µg/L	**6.1**	**6.2**	**3.4**	**3.7**	**5.2**	**5**	**5.7**	**6.7**	**4.1**	**5.1**	**5.4**	**0.3**	**0.2**	**0.3**	0.2 U
trichloroethene in µg/L	**0.9**	**0.9**	**0.6**	**0.6**	**0.6**	**0.5**	**0.8**	**2.8**	**1.0**	**1.8**	**1.4**	0.2 U	0.2 U	0.2 U	0.2 U
dichloroethene;1,1- in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
dichloroethene;1,2-,cis in µg/L	**0.7**	**0.7**	**0.4**	**0.5**	**0.2**	**0.2**	**2.5**	**2.1**	**0.4**	**1**	**1.5**	0.2 U	0.2 U	0.2 U	0.2 U
dichloroethene;1,2-,trans in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
vinyl chloride in µg/L	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	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

U - Analyte was not detected at or above the reported result.
J - The analyte was detected above the reported quantitation limit, and the reported concentrations was an estimated value.
UJ - The analyte was analyzed for, and the associated quantitation limit was an estimated value.
Detected concentrations are bolded.

Table 4 - RA-2 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 2 (former Salmon Bay Steel Property)											
	Background								Confirmation Monitoring			
	Fill Aquifer											
Sample Name	CMP1-081013	CMP1-090331	CMP1-090904	CMP1	CMP2-081013	CMP2-090331	CMP2-090902	CMP2	CMP3-081014	CMP3-090401	CMP3-090903	CMP3
Sampling Date	10/13/08	3/31/09	9/4/09	6/4/10	10/13/08	3/31/09	9/2/09	6/4/10	10/14/08	4/1/09	9/3/09	6/2/10
Groundwater Level Measurements												
Reference Elevation in feet MLLW	22.71	22.71	22.71	22.71	22.67	22.67	22.67	22.67	17.40	17.40	17.40	17.40
Depth To Water in feet	12.92	12.21	13.10	11.83	12.92	12.92	13.60	11.75	8.40	7.90	8.45	7.60
Water Level Elevation in feet MLLW	9.79	10.50	9.61	10.88	9.75	9.75	9.07	10.92	9.00	9.50	8.95	9.80
Water Quality Field Parameters												
Temperature in degrees Celsius	14.4	12.7	13.1	13.1	16.9	14.96	16.2	14.1	19.5	12.9	19.8	15.5
pH	6.9	6.23	6.36	6.61	9.38	9.08	8.42	9.01	10.96	8.68	10.01	9.55
Conductivity in µS/cm	563	506	511	482	1272	1402	1669	920	613	726	703	403
Dissolved Oxygen in mg/L	0.3	0.19	0.55	0.2	0.09	0.26	0.24	0.12	0.19	0.26	0.4	0.08
Turbidity in NTUs	1.76	1.17	0.78	38	0.86	1.58	1.31	4	1.09	1.8	5.3	4
Total Petroleum Hydrocarbons												
Diesel Range in µg/L	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U
Total Metals by EPA Method 200.8												
Total arsenic, inorganic in µg/L	**2.8**	**2.7**	**3.1**	**2.6**	**22.7**	**23.2**	**20.8**	**23**	**11.6**	**6.6**	**8.3**	**7.4**
Total lead in µg/L	1 U	1 U	1 U	1 U	**15**	**1**	1 U	**2**	1 U	**4**	1 U	1 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM												
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.010**	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.011**	0.010 U	0.010 U
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.019**	0.010 U	0.010 U
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.011**	0.010 U	0.010 U
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.013**	**0.015**	**0.010**	0.010 U
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Semi-Volatile Organics by EPA Method 8270D												
bis(2-ethylhexyl) phthalate in µg/L	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
Polychlorinated Biphenyls (PCBs) by EPA Method 8082												
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.100 U	0.100 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.100 U	0.100 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.015 Y	0.010 U	0.010 U	0.010 U	0.010 U	0.100 U	0.100 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.012 Y	0.010 U	0.010 U	0.010 U	0.200 Y	0.400 Y	0.100 U	0.100 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.015**	**0.020**	0.010 U	0.010 U	**1.2** PJ	**2.5**
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.016**	0.010 U	0.150 Y	0.400 Y	1.000 Y	**1.5**
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.015 Y	0.010 U	0.100 U	0.100 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.012 Y*	*0.015 Y*	**0.031**	**0.02**	*0.200 Y*	*0.400 Y*	**1.2** PJ	**4**

Notes

U - Analyte was not detected at or above the reported result.

Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

P - The analyte was detected on both chromatographic columns but the quantified values differ by >=40% RPD with no obvious chromatographic interference.

J - The analyte was detected above the reported quantitation limit, and the reported concentrations was an estimated value.

Detected concentrations are bolded.

Table 5 - RA-3 and RA-1 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 3 (former West Seattle Landfill and SSI Property), Remediation Area 1 (Former Buckley Yard)															
	Background				Confirmation Monitoring											
					Fill Aquifer								Estuarine Aquifer			
Sample Name	CMP5-081013	CMP5-090401	CMP5-090902	CMP5	CMP4-081014	CMP4-090402	CMP4-090903	CMP4	MW308N-081013	MW308N-090402	MW308N-090904	MW308N	MW308S-081013	MW308S-090401	MW308S-090904	MW308S
Sampling Date	10/13/08	4/1/09	9/2/09	6/3/10	10/14/08	4/2/09	9/3/09	6/2/10	10/13/08	4/2/09	9/4/09	6/3/10	10/13/08	4/1/09	9/4/09	6/3/10
Groundwater Level Measurements																
Reference Elevation in feet MLLW	23.80	23.80	23.80	23.80	19.92	19.92	19.92	19.92	14.86	14.86	14.86	14.86	14.42	14.42	14.42	14.42
Depth To Water in feet	10.09	8.48	10.12	8.71	11.04	10.34	11.01	10.17	6.53	5.86	6.50	5.73	6.30	5.74	6.17	5.56
Water Level Elevation in feet MLLW	13.71	15.32	13.68	15.09	8.88	9.58	8.91	9.75	8.33	9.00	8.36	9.13	8.12	8.68	8.25	8.86
Water Quality Field Parameters																
Temperature in degrees Celsius	16	11.2	16.8	13.4	17.1	12.6	17	14.2	16.8	12.3	16.3	13.8	15	12.9	14.5	13.7
pH	6.73	6.05	6.05	6.4	7.7	6.14	8.13	6.47	7.59	6.45	6.55	7.08	8.11	7.13	7.08	7.79
Conductivity in µS/cm	358	480	509	228	440	619	771	472	1586	1712	2509	959	15230	1565	1541	13000
Dissolved Oxygen in mg/L	0.07	0.32	0.44	0.15	0.25	0.74	0.19	0.73	0.02	0.05	0.23	0.03	0.03	0.08	0.11	0.03
Turbidity in NTUs	0.81	4.11	6.98	0	0.98	0.83	2.75	23	12.7	8.62	11.2	0	2.13	1.1	1.51	0
Total Petroleum Hydrocarbons																
Diesel Range in µg/L	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U
Total Metals by EPA Method 200.8																
Total arsenic, inorganic in µg/L	**14.2**	**1.9**	**12.9**	**3.6**	**2.8**	**1.1**	**3.8**	**1.4**	**25.4**	**16.8**	**15.3**	**16.2**	**8**	**3**	**3**	2 U
Total lead in µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**1**	1 U	1 U	1 U	1 U	5 U	5 U	5 U	5 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM																
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Semi-Volatile Organics by EPA Method 8270D																
bis(2-ethylhexyl) phthalate in µg/L	1.0 U	**23**	1 U	1.0 U	1.0 U	1.0 U	1 U	**2.4**	1.0 U	**1.1**	1.0 U	1.0 U	**1.5**	**5**	1.0 U	1.0 U
Polychlorinated Biphenyls (PCBs) by EPA Method 8082																
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.015 Y	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	**0.013**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.010**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.017**	**0.025**	**0.014**	0.010 U	0.010 U	**0.020**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.02**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	**0.013**	*0.010 U*	**0.017**	**0.045**	**0.014**	*0.015 Y*	**0.01**	**0.02**	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*

Notes
U - Analyte was not detected at or above the reported result.
Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.
Detected concentrations are bolded.

Table 6 - RA-5 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 5 (former Lockheed Shipyard 2)															
	Background				Confirmation Monitoring											
	Fill Aquifer															
Sample Name	CMP5-081013	CMP5-090401	CMP5-090902	CMP5	CMP15-081014	CMP15-090402	CMP15-090903	CMP15	MW26R-081014	MW26R-081014D	MW26R-090401	MW26R-090401D	MW26R-090903	MW26R-090903D	MW26R	MW26RD
Sampling Date	10/13/08	4/1/09	9/2/09	6/3/10	10/14/08	4/2/09	9/3/09	6/3/10	10/14/08	10/14/08	4/1/09	4/1/09	9/3/09	9/3/09	6/4/10	6/4/10
Groundwater Level Measurements																
Reference Elevation in feet MLLW	23.80	23.80	23.80	23.80	18.42	18.42	18.42	18.42	18.27		18.27		18.27		18.27	
Depth To Water in feet	10.09	8.48	10.12	8.71	10.38	9.91	10.14	9.75	9.91		9.66		9.69		9.40	
Water Level Elevation in feet MLLW	13.71	15.32	13.68	15.09	8.04	8.51	8.28	8.67	8.36		8.61		8.58		8.87	
Water Quality Field Parameters																
Temperature in degrees Celsius	16	11.2	16.8	13.4	17.7	13.2	15.9	14.2	16.9		12.3		15.4		14.2	
pH	6.73	6.05	6.05	6.4	6.88	6.69	6.39	6.64	7.29		6.43		7.14		6.86	
Conductivity in µS/cm	358	480	509	228	2336	7059	3547	6920	10190		1198		1043		9600	
Dissolved Oxygen in mg/L	0.07	0.32	0.44	0.15	0.008	0.1	0.36	0.05	0.11		0.22		0.15		0.05	
Turbidity in NTUs	0.81	4.11	6.98	0	1.12	0.73	1.78	0	0.94		0.93		1.91		11	
Total Petroleum Hydrocarbons																
Diesel Range in µg/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	250 U	250 U	250 U	100 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	500 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	500 U	500 U	500 U	200 U	200 U
Total Metals by EPA Method 200.8																
Total antimony in µg/L	**14.2**	**1.9**	**12.9**	**3.6**	0.2 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	1 U	1 U	1 U	1 U	1 U	1 U
Total arsenic, inorganic in µg/L					**1**	**1**	**0.9**	0.5 U	2 U	**3**	2 U	2 U	2 U	2 U	2 U	2 U
Total chromium (total) in µg/L					1 U	1 U	2 U	0.5 U	2 U	**3**	**3**	**3**	**3**	**3**	**3**	**4**
Total copper in µg/L					**0.8**	1 U	0.5 U	**0.7**	2 U	2 U	2 U	2 U	**3**	**3**	2 U	**3**
Total lead in µg/L	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total nickel soluble salts in µg/L					**1**	**4**	**2**	**5.6**	**6**	**7**	**6**	**7**	**7**	**6**	**6**	**6**
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM																
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.025**	**0.024**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.018**	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.016**	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.027**	**0.026**	**0.011**	**0.022**	**0.013**	**0.013**	**0.014**	**0.014**
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Semi-Volatile Organics by EPA Method 8270D																
bis(2-ethylhexyl) phthalate in µg/L	1.0 U	**23**	1.0 U	1.0 U	1.0 U	1 U	**1.6**	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
Polychlorinated Biphenyls (PCBs) by EPA Method 8082																
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.018 Y	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*

U - Analyte was not detected at or above the reported result.

Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

NA = Not available.

Detected concentrations are bolded.

Table 6 - RA-5 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 5 (former Lockheed Shipyard 2)							
	Confirmation Monitoring							
	Estuarine Aquifer							
Sample Name	MW36-081014	MW36-090402	MW36-090903	MW36	MW44-081014	MW44-090401	MW44-090903	MW44
Sampling Date	10/14/08	4/2/09	9/3/09	6/2/10	10/14/08	4/1/09	9/3/09	6/2/10
Groundwater Level Measurements								
Reference Elevation in feet MLLW	17.60	17.60	17.60	17.60	18.38	18.38	18.38	18.38
Depth To Water in feet	10.00	9.06	9.72	9.31	10.90	8.94	11.46	8.94
Water Level Elevation in feet MLLW	7.60	8.54	7.88	8.29	7.48	9.44	6.92	9.44
Water Quality Field Parameters								
Temperature in degrees Celsius	14.6	12.4	13.9	14.7	15.3	11.5	14	14.9
pH	7.47	6.48	8.78	7.43	7.23	6.42	5.84	5.94
Conductivity in µS/cm	36200	3734	3812	40000	41	46	37	11
Dissolved Oxygen in mg/L	0.06	0.11	0.13	0.08	1.59	7.25	3.84	6.88
Turbidity in NTUs	1.02	0.84	1.83	5	3.21	7.33	3.26	NA
Total Petroleum Hydrocarbons								
Diesel Range in µg/L	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	200 U	500 U	500 U	500 U	**530**
Total Metals by EPA Method 200.8								
Total antimony in µg/L	5 U	2 U	2 U	2 U	0.2 U	**0.6**	**0.3**	**0.4**
Total arsenic, inorganic in µg/L	**6**	**7**	**6**	5 U	**0.5**	**0.8**	**0.3**	**0.8**
Total chromium (total) in µg/L	10 U	5 U	5 U	5 U	1 U	**11**	**3.4**	**7.8**
Total copper in µg/L	*10 U*	*5 U*	*5 U*	5 U	**7**	**18**	**6.4**	**15.5**
Total lead in µg/L	*20 U*	*10 U*	*10 U*	10 U	**4**	**33**	**4**	**21**
Total nickel soluble salts in µg/L	*10 U*	**9**	**12**	**12**	**2**	**4.3**	**1.4**	**3.8**
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM								
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.059**	0.010 U	**0.033**
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.11**	0.010 U	**0.054**
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.27**	**0.010**	**0.079**
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.14**	0.010 U	**0.079**
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.19**	0.010 U	**0.13**
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.035**	0.010 U	**0.023**
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.11**	0.010 U	**0.063**
Semi-Volatile Organics by EPA Method 8270D								
bis(2-ethylhexyl) phthalate in µg/L	1.0 U	1.0 U	1.0 U	**1.5**	**1.0**	**2.2**	1.0 U	**2.4**
Polychlorinated Biphenyls (PCBs) by EPA Method 8082								
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.015 Y	0.010 U	0.010 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*

U - Analyte was not detected at or above the reported result.

Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

NA = Not available.

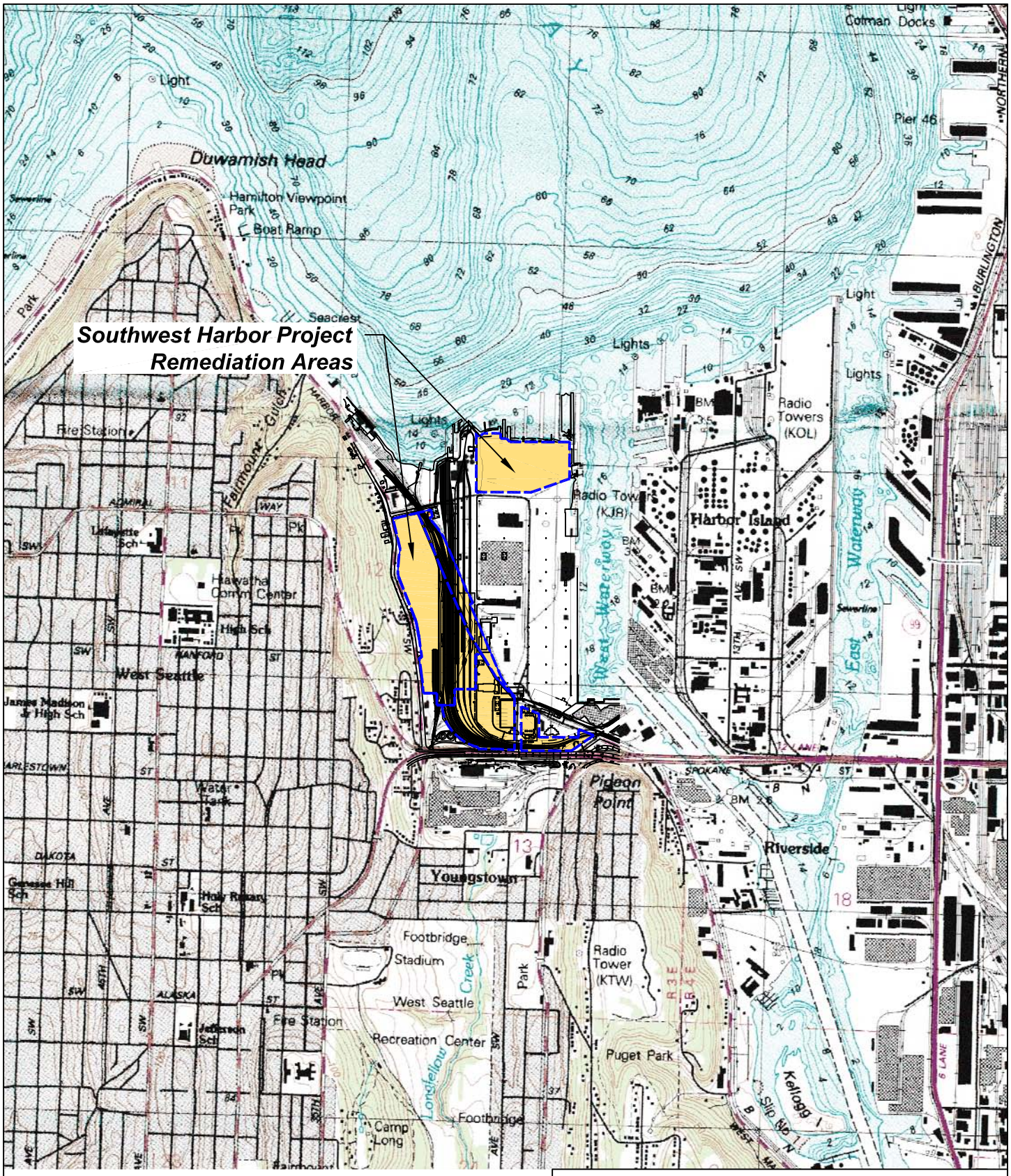
Detected concentrations are bolded.

Table 5 - RA-3 and RA-1 Groundwater Monitoring and Analytical Results

POS Terminal 5 Southwest Harbor
Phase II GWCMP SWHP

	Remediation Area 3 (former West Seattle Landfill and SSI Property), Remediation Area 1 (Former Buckley Yard)															
	Background				Confirmation Monitoring											
					Fill Aquifer								Estuarine Aquifer			
Sample Name	CMP5-081013	CMP5-090401	CMP5-090902	CMP5	CMP4-081014	CMP4-090402	CMP4-090903	CMP4	MW308N-081013	MW308N-090402	MW308N-090904	MW308N	MW308S-081013	MW308S-090401	MW308S-090904	MW308S
Sampling Date	10/13/08	4/1/09	9/2/09	6/3/10	10/14/08	4/2/09	9/3/09	6/2/10	10/13/08	4/2/09	9/4/09	6/3/10	10/13/08	4/1/09	9/4/09	6/3/10
Groundwater Level Measurements																
Reference Elevation in feet MLLW	23.80	23.80	23.80	23.80	19.92	19.92	19.92	19.92	14.86	14.86	14.86	14.86	14.42	14.42	14.42	14.42
Depth To Water in feet	10.09	8.48	10.12	8.71	11.04	10.34	11.01	10.17	6.53	5.86	6.50	5.73	6.30	5.74	6.17	5.56
Water Level Elevation in feet MLLW	13.71	15.32	13.68	15.09	8.88	9.58	8.91	9.75	8.33	9.00	8.36	9.13	8.12	8.68	8.25	8.86
Water Quality Field Parameters																
Temperature in degrees Celsius	16	11.2	16.8	13.4	17.1	12.6	17	14.2	16.8	12.3	16.3	13.8	15	12.9	14.5	13.7
pH	6.73	6.05	6.05	6.4	7.7	6.14	8.13	6.47	7.59	6.45	6.55	7.08	8.11	7.13	7.08	7.79
Conductivity in µS/cm	358	480	509	228	440	619	771	472	1586	1712	2509	959	15230	1565	1541	13000
Dissolved Oxygen in mg/L	0.07	0.32	0.44	0.15	0.25	0.74	0.19	0.73	0.02	0.05	0.23	0.03	0.03	0.08	0.11	0.03
Turbidity in NTUs	0.81	4.11	6.98	0	0.98	0.83	2.75	23	12.7	8.62	11.2	0	2.13	1.1	1.51	0
Total Petroleum Hydrocarbons																
Diesel Range in µg/L	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U	250 U	250 U	250 U	100 U
Motor Oil Range in µg/L	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U	500 U	500 U	500 U	200 U
Total Metals by EPA Method 200.8																
Total arsenic, inorganic in µg/L	**14.2**	**1.9**	**12.9**	**3.6**	**2.8**	**1.1**	**3.8**	**1.4**	**25.4**	**16.8**	**15.3**	**16.2**	**8**	**3**	**3**	2 U
Total lead in µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**1**	1 U	1 U	1 U	1 U	5 U	5 U	5 U	5 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by Method 8270D-SIM																
Benz(a)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzo(a,h)anthracene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Semi-Volatile Organics by EPA Method 8270D																
bis(2-ethylhexyl) phthalate in µg/L	1.0 U	**23**	1 U	1.0 U	1.0 U	1.0 U	1 U	**2.4**	1.0 U	**1.1**	1.0 U	1.0 U	**1.5**	**5**	1.0 U	1.0 U
Polychlorinated Biphenyls (PCBs) by EPA Method 8082																
Aroclor 1016 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.015 Y	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	**0.013**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.010**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.017**	**0.025**	**0.014**	0.010 U	0.010 U	**0.020**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.02**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260 in µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs in µg/L	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	**0.013**	*0.010 U*	**0.017**	**0.045**	**0.014**	*0.015 Y*	**0.01**	**0.02**	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*

Notes
U - Analyte was not detected at or above the reported result.
Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.
Detected concentrations are bolded.



Source: Base map prepared from USGS Topographic 7.5-Minute Series Map, Seattle South Quadrangle. Linework from drawing "990106-01.dwg," produced by Aspect Consulting.

T5 Groundwater Monitoring Report
Seattle, Washington

Vicinity Map

17627-00 8/10

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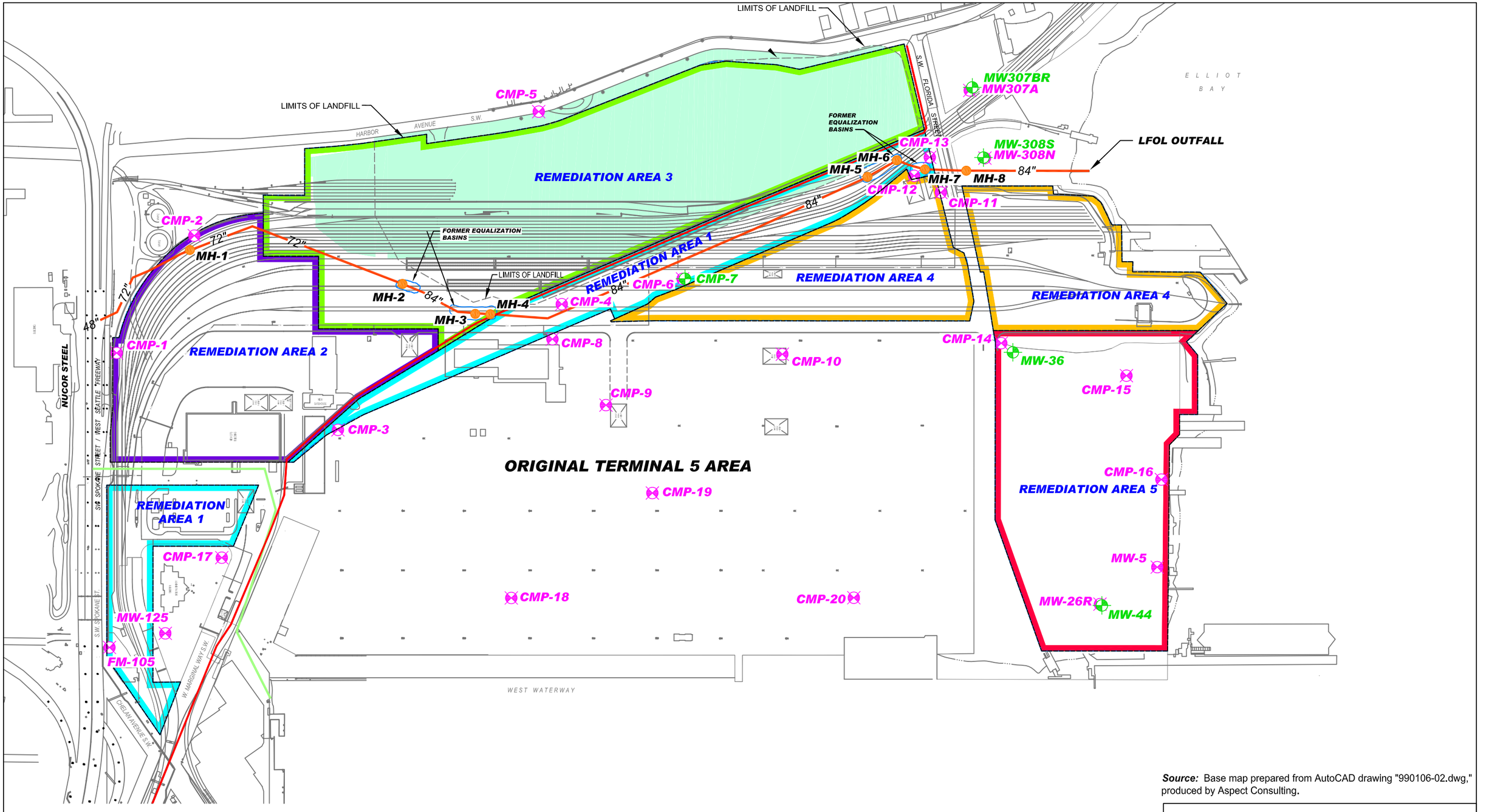
Figure
1

EAL 08/17/10 1762700-001.dwg



CMP-1 Fill Aquifer Well
MW-36 Estuarine Aquifer Well
Longfellow Creek Main Line
72" Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1 Existing LFOL Manhole

Remediation Area 1 Boundary
Remediation Area 2 Boundary
Remediation Area 3 Boundary
Remediation Area 4 Boundary
Remediation Area 5 Boundary
Landfill Cap (geomembrane)

N

0 400 800

Scale in Feet

Source: Base map prepared from AutoCAD drawing "990106-02.dwg," produced by Aspect Consulting.

T5 Groundwater Monitoring Report
Seattle, Washington

Site Plan

17627-00 8/10

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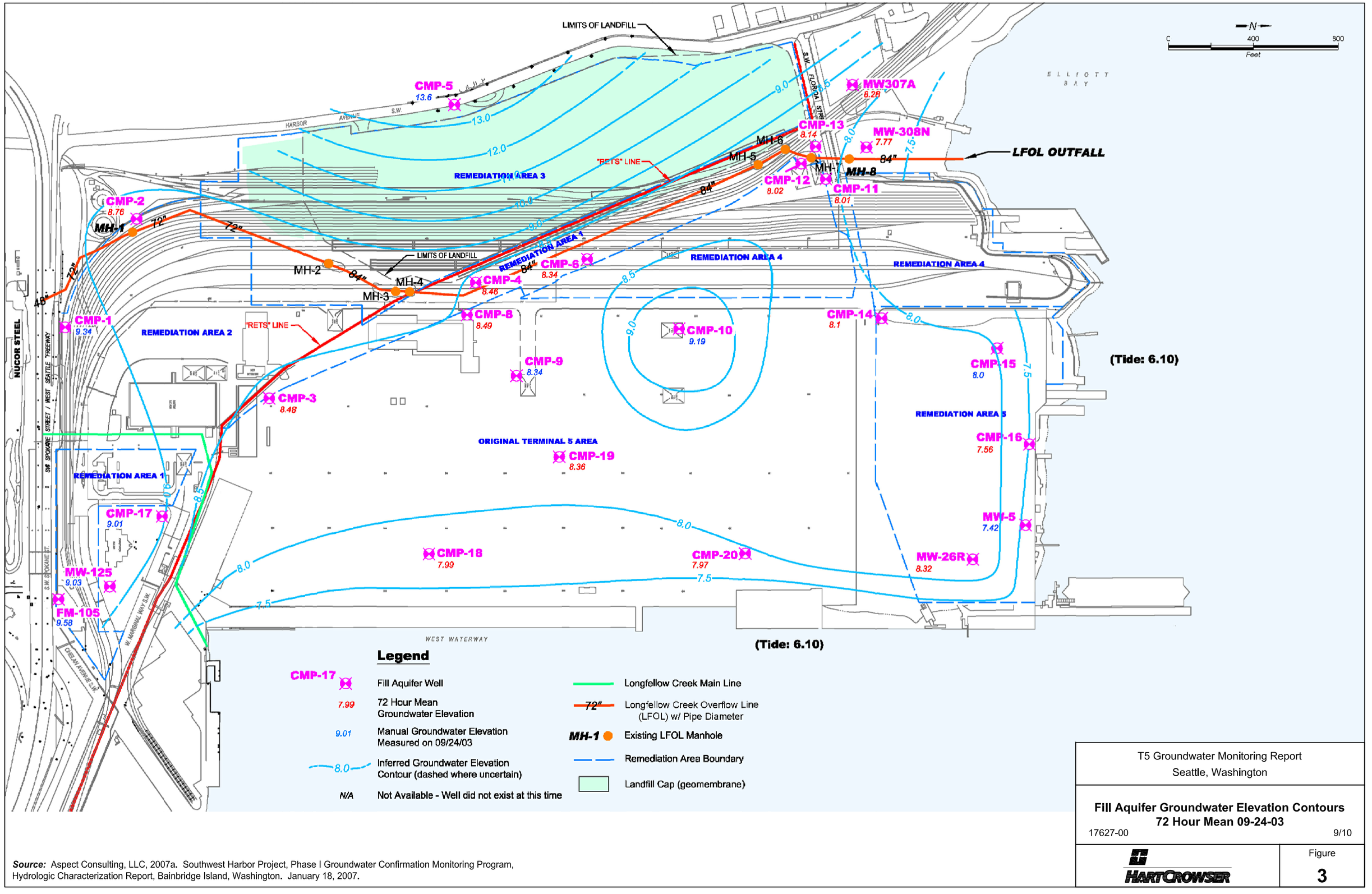
Figure
2

EAL 08/17/10 1762700-002.dwg



Source: Aspect Consulting, LLC, 2007a. Southwest Harbor Project, Phase I Groundwater Confirmation Monitoring Program, Hydrologic Characterization Report, Bainbridge Island, Washington. January 18, 2007.

T5 Groundwater Monitoring Report
Seattle, Washington

Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 09-24-03

17627-00 9/10

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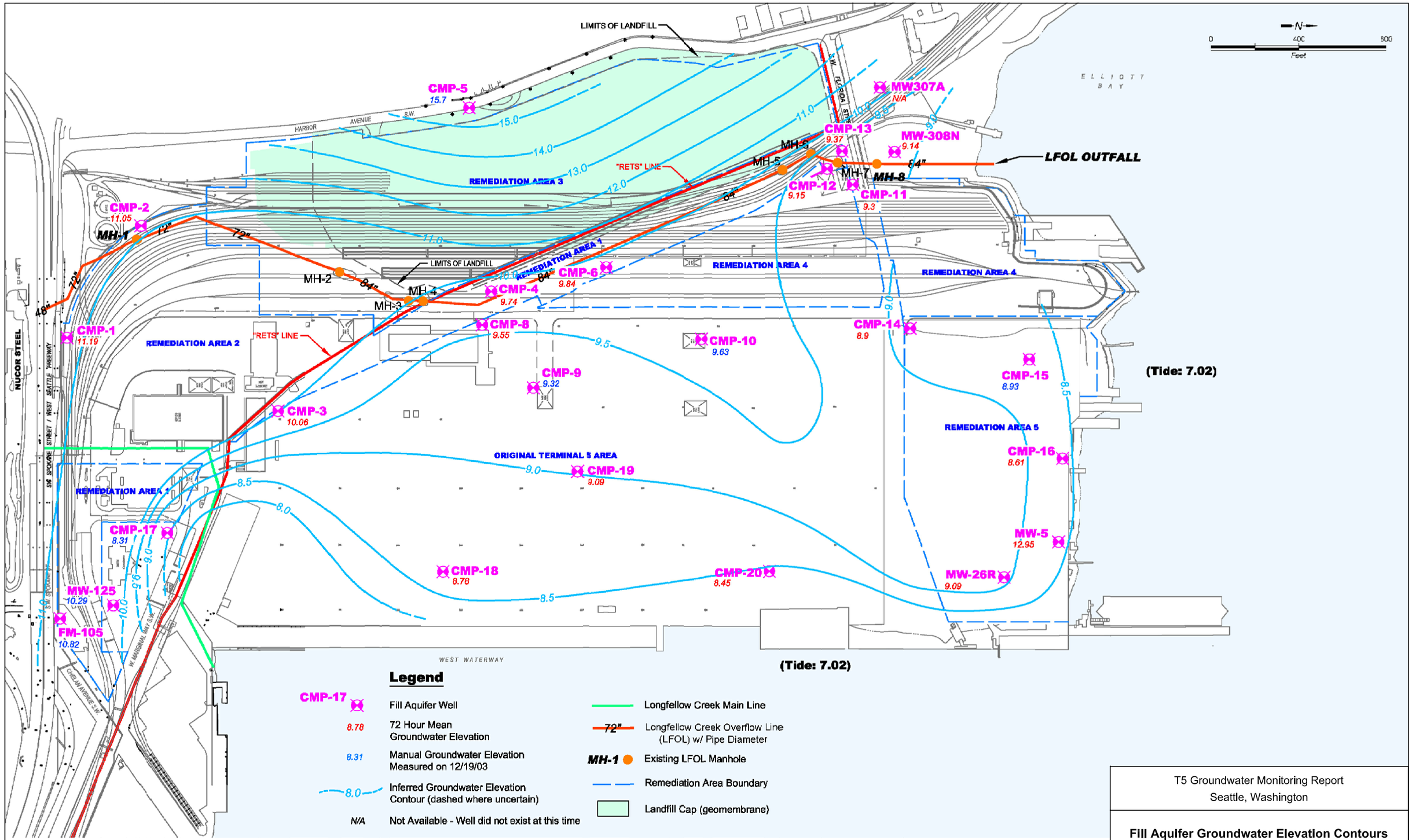
Figure
3

EAL 09/22/10 1762700-006.dwg



Legend

CMP-17	Fill Aquifer Well
8.78	72 Hour Mean Groundwater Elevation
8.31	Manual Groundwater Elevation Measured on 12/19/03
8.0	Inferred Groundwater Elevation Contour (dashed where uncertain)
N/A	Not Available - Well did not exist at this time
	Longfellow Creek Main Line
72"	Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1	Existing LFOL Manhole
	Remediation Area Boundary
	Landfill Cap (geomembrane)

Source: Aspect Consulting, LLC, 2007a. Southwest Harbor Project, Phase I Groundwater Confirmation Monitoring Program, Hydrologic Characterization Report, Bainbridge Island, Washington. January 18, 2007.

T5 Groundwater Monitoring Report
Seattle, Washington

Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 12-19-03

17627-00 9/10

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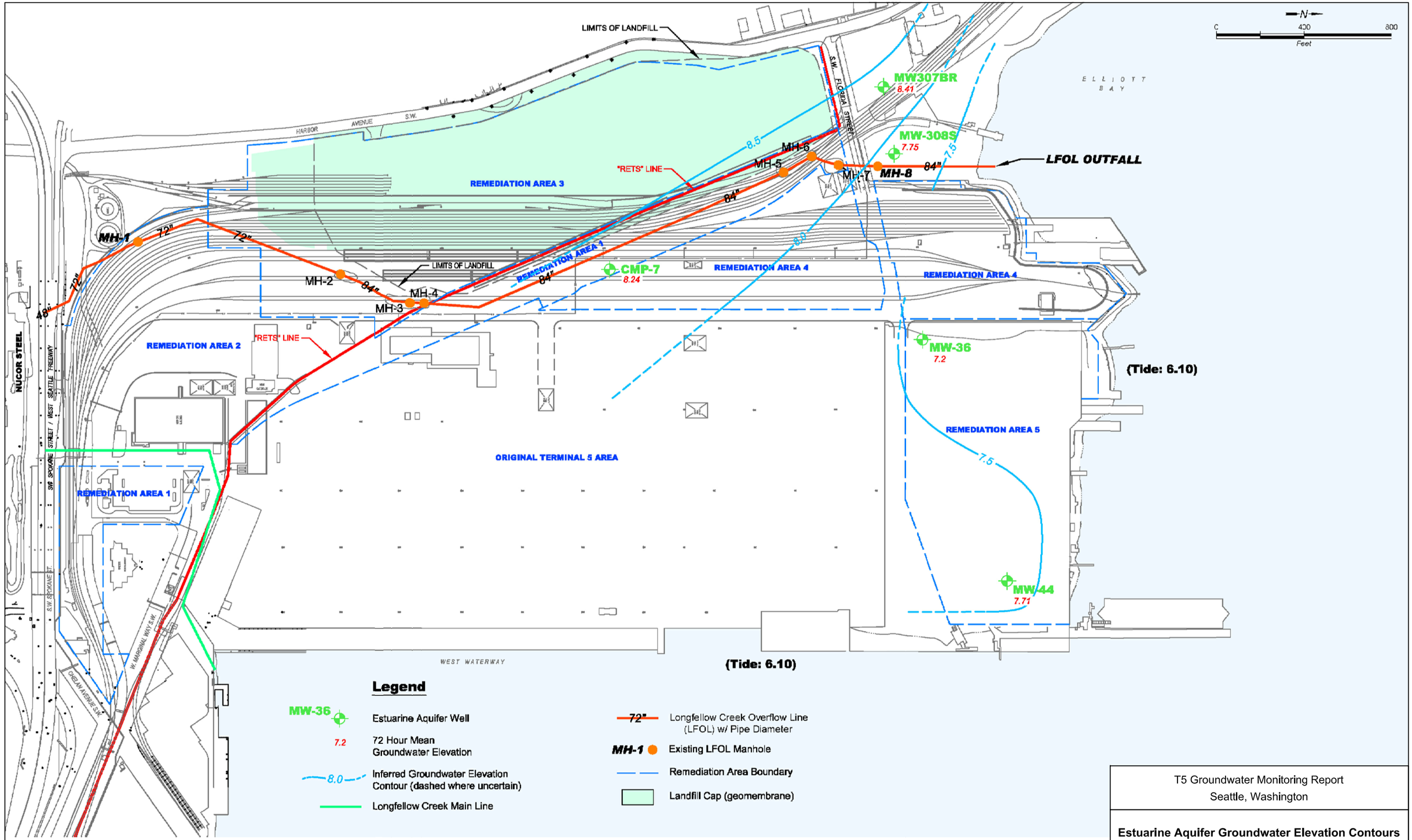
Figure **4**

EAL 09/22/10 1762700-007.dwg



Legend

- MW-36 — Estuarine Aquifer Well
- 7.2 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

Source: Aspect Consulting, LLC, 2007a. Southwest Harbor Project, Phase I Groundwater Confirmation Monitoring Program, Hydrologic Characterization Report, Bainbridge Island, Washington. January 18, 2007.

T5 Groundwater Monitoring Report
Seattle, Washington

Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 09-24-03

17627-00 9/10

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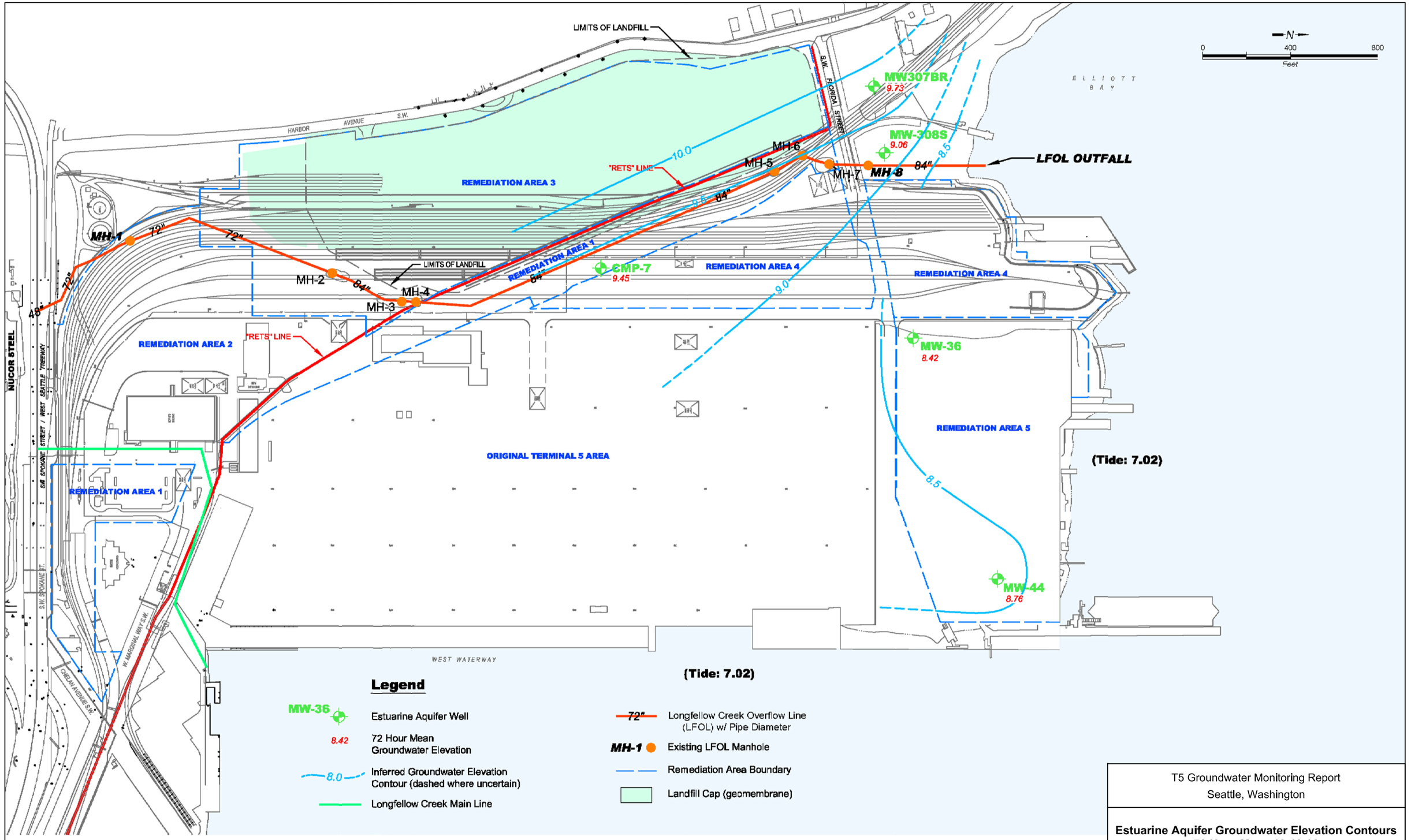
Figure **5**

EAL 09/22/10 1762700-008.dwg



Legend

- MW-36 — Estuarine Aquifer Well
- 8.42 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

Source: Aspect Consulting, LLC, 2007a. Southwest Harbor Project, Phase I Groundwater Confirmation Monitoring Program, Hydrologic Characterization Report, Bainbridge Island, Washington. January 18, 2007.

T5 Groundwater Monitoring Report
Seattle, Washington

Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 12-19-03

17627-00 9/10

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Figure 6

EAL 09/22/10 1762700-009.dwg

APPENDIX A
EVALUATION OF GROUNDWATER CHEMICAL CONCENTRATIONS PROTECTIVE OF SURFACE WATER

APPENDIX A
EVALUATION OF GROUNDWATER CHEMICAL CONCENTRATIONS PROTECTIVE OF SURFACE WATER

This Appendix presents our evaluation to determine groundwater chemical concentrations that would be protective of surface water for the Phase II Southwest Harbor Project (SWHP) located at the Southwest Harbor Terminal 5 (Terminal 5) in Seattle, Washington. The protectiveness of current groundwater chemical concentrations was assessed by modeling natural attenuation of chemical constituents. The purpose of modeling natural attenuation is to supplement the Groundwater Confirmation Monitoring Program and to determine if chemicals detected in groundwater are naturally attenuated to concentrations below surface water quality criteria prior to discharge to Puget Sound marine water.

GROUNDWATER CHEMICAL CONDITIONS

Groundwater quality data was obtained from four rounds of groundwater data collected from 14 wells between 2008 and 2010 as part of the confirmational groundwater monitoring program. Monitoring well locations for the program are presented on Figure 1 and are summarized below:

- Four background monitoring wells are screened in the Fill Aquifer (FM-105, CMP-1, CMP-2, and CMP-5);
- Seven downgradient monitoring wells are screened in the Fill Aquifer (CMP-3, CMP-4, CMP-15, CM-17, MW-26R and MW-125, and MW-308N); and
- Three downgradient monitoring wells are screened in the Estuarine Aquifer (MW-36, MW-44, and MW-308S).

Identification of Constituents of Potential Concern

A compilation of Terminal 5 groundwater quality data was reviewed to identify constituents of potential concern (COPCs). COPCs for groundwater were identified using a three-step procedure summarized below:

- Step 1 - Screening levels were developed for chemicals analyzed as part of the Terminal 5 Long-Term Monitoring Program. Screening levels for individual chemicals were defined as the most conservative of the marine surface water quality criteria taken from Washington State Department of Ecology's Cleanup Levels and Risk Calculation (CLARC) database. Groundwater quality criteria were not evaluated since the highest beneficial use for groundwater at the site is discharge to surface water. The screening levels were intended to identify COPCs and should not be considered cleanup levels or standards. The screening levels for Terminal 5 are presented in Table 1.

- Step 2 - Terminal 5 groundwater quality data collected as part of the groundwater confirmation monitoring program were reviewed to identify the chemicals detected in groundwater samples. Table 2 presents a general statistical summary of groundwater analytes and results from the Terminal 5 groundwater confirmation monitoring program compared to potentially applicable surface water quality criteria.

- Step 3 - Groundwater quality data was compared to the screening levels. A well-by-well comparison of groundwater concentrations with the screening criteria is presented in Table 3.

Groundwater Screening Process

Validated groundwater sample analytical results were compared to the most conservative surface water quality criteria to identify COPCs in groundwater at Terminal 5. Migration of upland groundwater has been identified as a potential pathway for dissolved chemicals to reach surface water. Surface water quality criteria used to screen the Terminal 5 groundwater chemical concentrations include:

- Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC);

- Clean Water Act 304 for Human Health and Chronic Aquatic Life;

- National Toxics Rule (40 CFR Part 131) for Human Health and Chronic Aquatic Life; and

- MTCA Method B carcinogen and non-carcinogen cleanup levels for surface water (WAC 173-340-730).

The published marine surface water criteria used to establish the surface water screening levels are presented in Table 1. The most conservative of these criteria for each constituent were established as the preliminary screening levels for groundwater modeling.

Groundwater Screening Results

Tables 2 and 3 present a summary of the results of groundwater comparing concentrations against the screening levels for COPCs at Terminal 5. Relatively few of the detected constituents exceed the screening levels. The analytes with one or more detections in monitoring wells, which exceed the screening levels include:

- Heavy oil-range petroleum hydrocarbons;
- Polychlorinated biphenyls (PCBs);
- Metals (arsenic, copper, lead, and nickel);
- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs);
- Bis(2-ethylhexyl) phthalate; and
- Tetrachlorethene (PCE).

Natural Attenuation of Dissolved Groundwater Chemicals

Natural attenuation refers to the reliance on natural processes to achieve site-specific cleanup goals (EPA, 1997). Natural attenuation occurs using the physical, chemical, and biological processes inherent within the aquifer that act to reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil or groundwater. These processes can include biodegradation, dispersion, dilution, sorption, transformation, stabilization, and volatilization of the unwanted contaminants.

Biodegradation is degradation of chemicals by microbes within the soil matrix. The rate of and extent of microbial degradation of chemicals are complex and regulated by the chemical properties of the contaminant, soil and groundwater chemistry, and the microbial population present. Degradation rates are typically measured in terms of half-life. The half-life is the amount of time needed for one-half of the original contaminant mass to be degraded. The half life of the COPCs are presented in Table 4.

Dispersion refers to the process whereby a plume will spread out in a longitudinal direction (along the direction of groundwater flow), transversely (perpendicular to groundwater flow), and vertically downwards due to mechanical mixing in the aquifer and chemical diffusion. Dispersion is usually estimated rather than measured, given the impracticability of measuring dispersion in the field. Dispersion is usually estimated based on the length of the plume or distance to the measurement point. Researchers indicate that dispersion values can range over two to three orders of magnitude for a given value of plume length or distance to a measurement point (Gelhar et al., 1992).

Tidal dilution is mixing of chemicals in groundwater that occurs as the result of changes in gradient during tidal changes. Groundwater will mix with tidal inflows during rising tides. The outflow during a falling tide consists of a mixture of tidal inflow and groundwater. The amount of tidal dilution is a function of the relative range in tidal stage and the aquifer properties. Tidal dilution factors ranging from 4 to 10,000 have been reported from groundwater modeling at Terminal 5 and adjacent sites (Aspect 2007; S. S. Papadopulos & Associates 1997).

Most organic chemicals are removed from solution by sorption onto soil particles. Sorption of dissolved contamination onto the aquifer matrix results in slowing or retardation of the contaminant relative to advective groundwater flow velocity and a reduction in dissolved contaminant concentrations. Sorption is generally represented in fate and transport models using a retardation factor. The retardation factor is the rate at which dissolved contaminants moving through an aquifer are reduced by sorption of contaminants to the solid aquifer matrix. The degree of retardation depends on both aquifer and constituent properties. The retardation factor is the ratio of the groundwater seepage velocity to the rate that organic chemicals migrate in the groundwater. A retardation value of two indicates that if the groundwater seepage velocity is 100 feet/year, then the organic chemicals migrate at approximately 50 feet/yr.

FATE AND TRANSPORT MODELING

A fate and transport model was implemented to evaluate the potential for existing upland groundwater to exceed the screening criteria at the point of compliance (surface water). The selected fate and transport model, BIOSCREEN (EPA 1996), is based on the Domenico analytical solution (Domenico 1987), and was used to estimate the natural attenuation of COPCs between downgradient

monitoring wells and the surface water/sediment interface. BIOSCREEN uses the following assumptions:

- Uniform and constant aquifer properties;
- One-dimensional groundwater flow;
- First-order decay, degradation, or transformation of contaminants; and
- Constant source area and concentrations.

The model predicts maximum groundwater concentrations in the centerline of the groundwater chemical plume to the receptor (Elliott Bay and Duwamish Waterway). The model was evaluated using the following conditions:

- Steady-state conditions without biodegradation;
- Assumed dispersion in the longitudinal, transverse, and vertical directions,
- Equilibrium partitioning and adsorption of COPCs to the aquifer soil matrix; and
- The minimum distance from the monitoring well to the surface water was used for the distance to the receptor.

Model Input Parameters

Model input parameters are summarized in Table 4.

Arsenic attenuation was not modeled since it is ubiquitous throughout the region. Background monitoring wells have arsenic concentrations ranging from 0.4 to 23.2 micrograms per liter (ug/L) and the downgradient wells have arsenic concentrations ranging from 0.3 to 25.4 ug/L.

The model represents the contaminant source as a vertical plane, perpendicular to groundwater flow, releasing dissolved constituents into groundwater passing through this plane. The source is assumed to have existed for a period of 100 years, with source zone concentrations set to equal measured chemical concentrations in the groundwater wells. Concentrations used for modeling were conservatively set to equal the maximum measured concentration at each well location.

The groundwater flow and velocity are defined by the hydraulic conductivity, hydraulic gradient, and porosity. Hydrogeologic and aquifer characteristics were obtained from the fate and transport analysis in the Upland Remedial Investigation and Feasibility Study report (RETEC 1997) and Marine Sediments

Remedial Investigation and Marine Sediments Feasibility Study (Weston 1998a and 1998b, respectively).

Biodegradation was not used in modeling. For references purposes, biodegradation half life values presented in Table 4 were taken from Howard, 1991.

The soil bulk density, in kg/L, of the aquifer matrix is related to porosity and pure solids density. Although this value can be measured in the lab, in most cases estimated values are used. A default value of 1.7 kg/L was used.

Fraction organic carbon (foc) is the fraction of the aquifer soil matrix comprised of natural organic carbon. More natural organic carbon typically means higher adsorption of organic constituents on the aquifer matrix. Typical values of foc are 0.002 to 0.02. A value of 0.01 was used for this study as this is a representative value for site soil based on RETEC (1997) and WESTON (1998a and 1998b). Other chemical properties (e.g., organic carbon partition coefficient) were obtained through Ecology's CLARC database.

The model was used to predict the chemical concentration at the receptor which was considered to be at the groundwater/surface water interface. The distance to the receptor was measured on the site map from the well to the closest shoreline following the groundwater flow path based on the groundwater contour maps provided in Aspect (2007). A simulation time of 100 years was considered a sufficient amount of time for the COPCs to potentially reach the surface water.

Two modeling runs were performed using: (1) a maximum concentration of the COPCs for each well from groundwater quality database (Hart Crowser 2010) as a baseline case; and (2) solubility concentrations for the COPCs for each well (solubility case). The solubility case is considered to be the worst-case scenario assuming that NAPL phase was present. There is no evidence that NAPL phase is present at Terminal 5.

Modeling Results

The model results are summarized in Table 5. The model results predict that for the baseline case using the maximum chemical concentrations detected in each well, the COPC concentrations will not reach marine surface water after 100

years except for tetrachloroethene (PCE) from MW-125 and copper from MW-26R and MW-44.

The model predicts the PCE from MW-125 will reach the shoreline at a concentration in the Fill Aquifer of 1.9 ug/L (0.0019 mg/L), which is slightly above the screening criteria of 0.39 ug/L (0.00039 mg/L). If PCE degradation is incorporated into the model, concentrations at the shoreline after 100 years would be non-detect.

The model also predicts that copper from MW-26R and MW-44 will reach the shoreline at concentrations less than 0.1 ug/L (0.0001 mg/L), which is below the screening criteria of 2.4 ug/L (0.0024 mg/L).

For organic compounds, using the solubility limit as a worst-case scenario, the model results predict the COPC concentrations will be non-detect at the surface water after 100 years, except for PCE. Given that the aqueous solubility of PCE is relatively high (200 mg/L), the predicted concentration using the solubility limit model is well above surface water criteria. This scenario assumes that PCE in the form of dense non-aqueous phase liquid (DNAPL) is present. However, the relatively low dissolved PCE concentrations observed in both upgradient and site wells do not indicate the presence of DNAPL at Terminal 5 making the solubility scenario unrealistic. If PCE degradation is incorporated into the model, concentrations at the shoreline after 100 years would be non-detect.

Solubility values for metals were not provided in the CLARC database; therefore, the metals were not modeled for the solubility case.

Tidal Mixing

Tidal mixing, while not incorporated into the model, would further reduce chemical concentrations in groundwater prior to discharge to surface water. As discussed earlier, groundwater will mix with tidal inflows during rising tides. The outflow during a falling tide consists of a mixture of tidal inflow and groundwater. The amount of tidal mixing is a function of the relative range in tidal stage and the aquifer properties. Tidal dilution factors ranging from 4 to 10,000 have been reported from groundwater modeling at the Terminal 5 and adjacent sites (Aspect 2007; S. S. Papadopulos & Associates 1997). Use of the lowest tidal dilution estimate of four would further reduce the calculated chemical concentrations at the shoreline after 100 years by an additional factor of four times less than concentrations presented in Table 5.

SUMMARY AND CONCLUSIONS

- An evaluation was completed to determine if chemicals detected in groundwater at Terminal 5 are naturally attenuated to concentrations below marine surface water quality criteria prior to discharge to Puget Sound.

- Screening criteria based on marine surface water criteria were developed to compare against the groundwater quality data collected from Terminal 5. The screening criteria are presented in Table 1. The statistical summary of groundwater quality database and a comparison with the screening criteria are presented in Tables 2 and 3.

- Fate and transport modeling using BIOSCREEN was conducted to predict contaminant concentrations at the shoreline. The natural attenuation processes simulated in the modeling include dispersion and sorption. Processes not modeled included biodegradation and tidal mixing.

- The model results show that even under conservative conditions, predicted concentrations of most COPCs, including bis(2-ethylhexyl)phthalate, PAHs and PCBs detected in groundwater will not exceed the screening level concentrations at the shoreline within 100 years. For organic compounds, concentrations as high as the solubility limit would not result in an exceedance of surface water quality criteria at the shoreline.

- The model results show that even under the conservative conditions, predicted concentrations of copper and lead detected in groundwater will not exceed the screening level concentrations at the shoreline within 100 years. If tidal mixing is incorporated into the model, copper and lead concentrations four times higher than the maximum detected concentrations will not exceed the screening level concentrations at the shoreline within 100 years.

- PCE in monitoring well MW-125 is calculated to exceed surface water quality criteria within 100 years based on retardation modeling. If degradation half-life and tidal mixing are incorporated into the model, PCE concentrations will be non-detect at the shoreline after 100 years. Furthermore, the source of PCE is from off-site of Terminal 5. PCE is present in off-site, upgradient monitoring well FM-105 at concentrations comparable to those found in MW-125.

- Although not simulated during modeling, tidal mixing and biodegradation are important natural attenuation processes that would further reduce groundwater chemical concentrations at Terminal 5.

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Table A-1 - Marine Surface Water Screening Criteria
Port of Seattle Terminal 5

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3] (µg/L)
Metals											
Antimony	--	--	--	--	--	--	640	4300	--	1,000	**640**
Arsenic, inorganic	69	69	69	36	36	36	0.14	0.14	0.098	18	**0.14 (5 - MTCA A GW)**
Chromium (VI)	1100	50	1100	50	1100	50	--	--	--	490	**50**
Copper	4.8	4.8	2.4	3.1	3.1	2.4	--	--	--	2,700	**2.4**
Lead	210	210	210	8.1	8.1	8.1	--	--	--	--	**8.1**
Nickel soluble salts	74	74	74	8.2	8.2	8.2	4,600	4,600	--	1,100	**8.2**
Polychlorinated Biphenyls (PCBs)											
Aroclor 1016	--	--	--	--	--	0.03	--	--	--	0.0058	**0.0058**
Aroclor 1221	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1232	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1242	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1248	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	--	--	--	--	--	0.03	--	--	--	0.0017	**0.0017**
Aroclor 1260	--	--	--	--	--	0.03	--	--	--	--	**0.03**
Aroclor 1262	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1268	--	--	--	--	--	--	--	--	--	--	--
Polychlorinated biphenyls	10	--	--	0.03	0.03	0.03	0.000064	0.00017	0.00011	--	**0.000064**
Total Petroleum Hydrocarbons											
TPH, diesel range organics	--	--	--	--	--	--	--	--	--	--	**500 [5]**
TPH, heavy oils	--	--	--	--	--	--	--	--	--	--	**500 [5]**
Volatile Organic Compounds (VOCs)											
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	**--**
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	930,000	**420,000**
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	4	11	6.5	--	4
1,1,2-Trichloroethane	--	--	--	--	--	--	16	42	25	2,300	16
1,1-Dichloroethane	--	--	--	--	--	--	--	--	--	--	**--**
1,1-Dichloroethene	--	--	--	--	--	--	7100	3.2	--	23,000	**3.2**
1,2-Dichloroethane	--	--	--	--	--	--	37	99	59	43,000	**37**
Chloroethane	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	--	--	--	--	--	--	--	--	--	--	**--**
Tetrachloroethene	--	--	--	--	--	--	3.3	8.9	0.39	840	**0.39**
trans-1,2-Dichloroethene	--	--	--	--	--	--	10,000	--	--	33,000	**10,000**
Trichloroetlene	--	--	--	--	--	--	30	81	6.7	71	**6.7**
Vinyl chloride	--	--	--	--	--	--	2.4	530	3.7	6,600	**2.4**

Table A-1 - Marine Surface Water Screening Criteria
Port of Seattle Terminal 5

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3] (µg/L)
Semivolatile Organic Compounds (SVOCs)											
bis(2-Ethylhexyl) phthalate	--	--	--	--	--	--	2.2	5.9	3.6	400	**2.2**
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)											
Benzo[a]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Benzo[a]pyrene	--	--	--	--	--	--	0.018	0.031	0.03	--	**0.018**
Benzo[b]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Benzo[k]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Chrysene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Dibenzo[a,h]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**

Notes
1. -- = Not established.
2. Screening levels may be adjusted depending on lab PQLs.
3. Screening levels may be adjusted based on background data results.
4. Surface water quality criteria are based on dissolved metal concentrations.

Abbreviations
µg/L = micrograms per liter.
ARAR = applicable or relevant and appropriate requirements
CFR = code of federal regulations
WAC = Washington Administrative Code

Table A-2 - Statistical Summary of Groundwater Quality Data
Port of Seattle Terminal 5

Chemical	Potential Screening Level	Number of Samples				Of the Samples Detected		
		Analyzed	Non-Detect	Detected	Exceeding Screening Levels	Minimum Concentration	Maximum Concentration	Average Concentration
TPH								
Diesel range in µg/L	500	56	56	0	0	0	0	--
Motor oil range in µg/L	500	56	55	1	1	530	530	530
Total Metals								
Total antimony in µg/L	640	16	13	3	0	0.3	0.6	0.4
Total arsenic, inorganic in µg/L	0.14/5 (1)	56	9	47	19	0.3	25.4	6.5
Total chromium in µg/L	50	16	10	6	0	3	11	5.2
Total copper in µg/L	2.4	16	9	7	5	0.7	18	7.3
Total lead in µg/L	8.1	56	47	9	3	1	33	9.4
Total nickel soluble salts in µg/L	8.2	16	1	15	3	1	12	5.5
cPAHs								
Benzo(a)anthracene in µg/L	0.018	56	51	5	4	0.01	0.097	0.045
Benzo(a)pyrene in µg/L	0.018	56	52	4	3	0.011	0.14	0.079
Benzo(b)fluoranthene in µg/L	0.018	56	50	6	4	0.01	0.27	0.082
Benzo(k)fluoranthene in µg/L	0.018	56	51	5	3	0.011	0.14	0.072
Chrysene in µg/L	0.018	56	45	11	4	0.01	0.19	0.047
Dibenzo(a,h)anthracene in µg/L	0.018	56	53	3	3	0.023	0.035	0.029
Indeno(1,2,3-cd)pyrene in µg/L	0.018	56	53	3	3	0.051	0.11	0.075
sVOCs								
bis(2-ethylhexyl) phthalate in µg/L	2.2	56	45	11	4	1	23	3.9
PCBs								
Aroclor 1016 in µg/L	0.0058	56	56	0	0	0	0	--
Aroclor 1221 in µg/L	--	56	56	0	--	0	0	--
Aroclor 1232 in µg/L	--	56	56	0	--	0	0	--
Aroclor 1242 in µg/L	--	56	54	2	--	0.01	0.013	0.012
Aroclor 1248 in µg/L	--	56	48	8	--	0.014	2.5	0.476
Aroclor 1254 in µg/L	0.0017	56	53	3	3	0.016	1.5	0.512
Aroclor 1260 in µg/L	0.03	56	56	0	0	0	0	--
Total PCBs in µg/L	0.000064	56	46	10	10	0.01	4	0.537

Table A-2 - Statistical Summary of Groundwater Quality Data
Port of Seattle Terminal 5

Chemical	Potential Screening Level	Number of Samples				Of the Samples Detected		
		Analyzed	Non-Detect	Detected	Exceeding Screening Levels	Minimum Concentration	Maximum Concentration	Average Concentration
VOCs								
Tetrachloroethane;1,1,1,2- in µg/L	--	13	13	0	--	0	0	--
Tetrachloroethane;1,1,2,2- in µg/L	4	13	13	0	0	0	0	--
Trichloroethane;1,1,1- in µg/L	420,000	13	11	2	0	0.2	0.2	0.2
Trichloroethane;1,1,2- in µg/L	16	13	13	0	0	0	0	--
Dichloroethane;1,1- in µg/L	--	13	9	4	--	0.2	0.4	0.3
Dichloroethane;1,2- in µg/L	37	13	13	0	0	0	0	--
Ethyl chloride in µg/L	--	13	13	0	--	0	0	--
Tetrachloroethene in µg/L	0.39	12	1	11	8	0.2	6.7	3.9
Trichloroethene in µg/L	6.7	12	4	8	0	0.6	2.8	1.2
Dichloroethene;1,1- in µg/L	3.2	12	12	0	0	0	0	--
Dichloroethene;1,2-,cis in µg/L	--	12	4	8	--	0.2	2.5	1.1
Dichloroethene;1,2-,trans in µg/L	10,000	12	12	0	0	0	0	--
Vinyl chloride in µg/L	2.4	12	12	0	0	0	0	--

Notes:

TPH = Total Petroleum Hydrocarbons

cPAHs = Carcinogenic Polycyclic Aromatic Hydrocarbons

sVOCs = Semivolatile Organic Compounds

PCBs = Polychlorinated Biphenyls

VOCs = Volatile Organic Compounds

(1) 0.14 is based on Surface Water screening criteria and 5 is based on MTCA Method A groundwater cleanup level.

Table A-3 - Well-by-Well Statistical Summary of Groundwater Quality Data
Port of Seattle Terminal 5

Sample Name / Sampling Date	Screen Level	CMP-15 # Samples	CMP-15 # Detects	CMP-15 # Above CUL	CMP-15 Max Concen.	MW26R # Samples	MW26R # Detects	MW26R # Above CUL	MW26R Max Concen.	MW-36 # Samples	MW-36 # Detects	MW-36 # Above CUL	MW-36 Max Concen.	MW44 # Samples	MW44 # Detects	MW44 # Above CUL	MW44 Max Concen.	CMP-5 # Samples	CMP-5 # Detects	CMP-5 # Above CUL	CMP-5 Max Concen.
Total Petroleum Hydrocarbons																					
Diesel Range in µg/L	500	4	0	0	--	4	0	0	--	4	0	0	--	4	4	0	--	0	0	0	--
Motor Oil Range in µg/L	500	4	0	0	--	4	0	0	--	4	0	0	--	4	1	1	530	0	0	0	--
Total Metals																					
Total antimony in µg/L	640	4	0	0	--	4	0	0	--	4	0	0	--	4	3	0	0.6	--	--	--	--
Total arsenic, inorganic in µg/L	0.14/5 (1)	4	3	3	**1**	4	0	0	--	4	3	3	7	4	4	0	0.8	4	4	3	14.2
Total chromium (total) in µg/L	50	4	0	0	--	4	3	0	3	4	0	0	--	4	3	0	11	--	--	--	--
Total copper in µg/L	2.4	4	3	0	0.8	4	1	1	3	4	0	0	--	4	4	4	18	--	--	--	--
Total lead in µg/L	8.1	4	0	0	--	4	0	0	--	4	0	0	--	4	4	2	33	4	0	0	--
Total nickel soluble salts in µg/L	8.2	4	4	0	5.6	4	4	0	7	4	3	3	12	4	4	0	4.3				
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																					
Benzo(a)anthracene in µg/L	0.018	4	0	0	--	4	1	1	0.025	4	0	0	--	4	2	2	0.060	4	0	0	--
Benzo(a)pyrene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	2	2	0.110	4	0	0	--
Benzo(b)fluoranthene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	3	2	0.270	4	0	0	--
Benzo(k)fluoranthene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	2	2	0.140	4	0	0	--
Chrysene in µg/L	0.018	4	0	0	--	4	4	1	0.027	4	0	0	--	4	2	2	0.190	4	0	0	--
Dibenzo(a,h)anthracene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	2	2	0.040	4	0	0	--
Indeno(1,2,3-cd)pyrene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	2	2	0.110	4	0	0	--
Semivolatile Organic																					
bis(2-ethylhexyl) phthalate in µg/L	2.2	4	1	0	1.6	4	0	0	NA	4.0	1.0	0.0	1.5	4	3	1	2.4	4	1	1	23
Polychlorinated Biphenyls (PCBs)																					
Aroclor 1016 in µg/L	0.0058	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1221 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1232 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1242 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1248 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1254 in µg/L	0.0017	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1260 in µg/L	0.03	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Total PCBs in µg/L	0.000064	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Volatile Organic Compounds																					
Tetrachloroethane;1,1,1,2- in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethane;1,1,2,2- in µg/L	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethane;1,1,1- in µg/L	420,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethane;1,1,2- in µg/L	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethane;1,1- in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethane;1,2- in µg/L	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl Chloride in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene in µg/L	0.39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene in µg/L+A22	6.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,1- in µg/L	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,2-,cis in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,2-,trans in µg/L	10,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride in µg/L	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-3 - Well-by-Well Statistical Summary of Groundwater Quality Data
Port of Seattle Terminal 5

Sample Name / Sampling Date	Screen Level	CMP-4				MW-308N				MW308S				MW308S				CMP2			
		# Samples	# Detects	# Above CUL	Max Concen.	# Samples	# Detects	# Above CUL	Max Concen.	# Samples	# Detects	# Above CUL	Max Concen.	# Samples	# Detects	# Above CUL	Max Concen.	# Samples	# Detects	# Above CUL	Max Concen.
Total Petroleum Hydrocarbons																					
Diesel Range in µg/L	500	0	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Motor Oil Range in µg/L	500	0	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Total Metals																					
Total antimony in µg/L	640																				
Total arsenic, inorganic in µg/L	0.14/5 (1)	4	4	0	3.8	4	4	4	25.4	4	3	1	8	4	4	0	3.1	4	4	4	23.2
Total chromium (total) in µg/L	50	0	--	--	--	0				0											
Total copper in µg/L	2.4	0	--	--	--	0				0											
Total lead in µg/L	8.1	4	1	0	1	4	0	0	--	4	0	0	--	4	0	0	--	4	3	1	15
Total nickel soluble salts in µg/L	8.2																				
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																					
Benzo(a)anthracene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Benzo(a)pyrene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Benzo(b)fluoranthene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Benzo(k)fluoranthene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Chrysene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Dibenzo(a,h)anthracene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Indeno(1,2,3-cd)pyrene in µg/L	0.018	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Semivolatile Organic																					
bis(2-ethylhexyl) phthalate in µg/L	2.2	4.0	1.0	1.0	2.4	4	0	0	--	4.0	2.0	1.0	5.0	4	0	0	--	4	0	0	--
Polychlorinated Biphenyls (PCBs)																					
Aroclor 1016 in µg/L	0.0058	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1221 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1232 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1242 in µg/L	--	4	1	0	0.013	4	1	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1248 in µg/L	--	4	2	0	0.025	4	2	0	--	4	0	0	--	4	0	0	--	4	2	0	0.020
Aroclor 1254 in µg/L	0.0017	4	1	1	0.020	4	0	0	--	4	0	0	--	4	0	0	--	4	1	1	0.016
Aroclor 1260 in µg/L	0.03	4	0	0	NA	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Total PCBs in µg/L	0.000064	4	3	3	0.045	4	3	3	0.020	4	0	0	--	4	0	0	--	4	2	2	0.031
Volatile Organic Compounds																					
Tetrachloroethane;1,1,1,2- in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethane;1,1,2,2- in µg/L	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethane;1,1,1- in µg/L	420,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethane;1,1,2- in µg/L	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethane;1,1- in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethane;1,2- in µg/L	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl Chloride in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene in µg/L	0.39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene in µg/L+A22	6.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,1- in µg/L	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,2-,cis in µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloroethene;1,2-,trans in µg/L	10,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride in µg/L	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-3 - Well-by-Well Statistical Summary of Groundwater Quality Data
Port of Seattle Terminal 5

Sample Name / Sampling Date	Screen Level	CMP-3 # Samples	CMP-3 # Detects	CMP-3 # Above CUL	CMP-3 Max Concen.	FM-105 # Samples	FM-105 # Detects	FM-105 # Above CUL	FM-105 Max Concen.	MW-125 # Samples	MW-125 # Detects	MW-125 # Above CUL	MW-125 Max Concen.	CMP-17 # Samples	CMP-17 # Detects	CMP-17 # Above CUL	CMP-17 Max Concen.
Total Petroleum Hydrocarbons																	
Diesel Range in µg/L	500	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Motor Oil Range in µg/L	500	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Total Metals																	
Total antimony in µg/L	640																
Total arsenic, inorganic in µg/L	0.14/5 (1)	4	4	4	11.6	4	3	0	0.5	4	3	0	0.6	4	4	0	8.1
Total chromium (total) in µg/L	50									0				0			
Total copper in µg/L	2.4									0				0			
Total lead in µg/L	8.1	4	1	0	4	4	0	0	--	4	0	0	--	4	0	0	--
Total nickel soluble salts in µg/L	8.2													0			
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																	
Benzo(a)anthracene in µg/L	0.018	4	1	0	--	4	0	0	--	4	1	1	0.097	4	0	0	--
Benzo(a)pyrene in µg/L	0.018	4	1	0	0.011	4	0	0	--	4	1	1	0.140	4	0	0	--
Benzo(b)fluoranthene in µg/L	0.018	4	1	1	0.019	4	0	0	--	4	2	1	0.100	4	0	0	--
Benzo(k)fluoranthene in µg/L	0.018	4	1	0	0.011	4	0	0	--	4	2	1	0.120	4	0	0	--
Chrysene in µg/L	0.018	4	3	0	0.015	4	0	0	--	4	2	1	0.084	4	0	0	--
Dibenzo(a,h)anthracene in µg/L	0.018	4	0	0	--	4	0	0	--	4	1	1	0.028	4	0	0	--
Indeno(1,2,3-cd)pyrene in µg/L	0.018	4	0	0	--	4	0	0	--	4	1	1	0.051	4	0	0	--
Semivolatile Organic																	
bis(2-ethylhexyl) phthalate in µg/L	2.2	4	0	0	--	4.0	1.0	0.0	1.4	4	0	0	--	4	0	0	--
Polychlorinated Biphenyls (PCBs)																	
Aroclor 1016 in µg/L	0.0058	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1221 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1232 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1242 in µg/L	--	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1248 in µg/L	--	4	2	0	2.5	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1254 in µg/L	0.0017	4	1	1	1.5	4	0	0	--	4	0	0	--	4	0	0	--
Aroclor 1260 in µg/L	0.03	4	0	0	--	4	0	0	--	4	0	0	--	4	0	0	--
Total PCBs in µg/L	0.000064	4	2	2	4.0	4	0	0	--	4	0	0	--	4	0	0	--
Volatile Organic Compounds																	
Tetrachloroethane;1,1,1,2- in µg/L	--	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Tetrachloroethane;1,1,2,2- in µg/L	4	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Trichloroethane;1,1,1- in µg/L	420,000	--	--	--	--	4	0	0	--	4	2	0	0.2	4	0	0	--
Trichloroethane;1,1,2- in µg/L	16	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Dichloroethane;1,1- in µg/L	--	--	--	--	--	4	0	0	--	4	4	0	0.4	4	0	0	--
Dichloroethane;1,2- in µg/L	37	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Ethyl Chloride in µg/L	--	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Tetrachloroethene in µg/L	0.39	--	--	--	--	4	4	4	6.1	4	4	4	6.7	4	3	0	0.3
Trichloroethene in µg/L+A22	6.7	--	--	--	--	4	4	0	0.8	4	4	0	2.8	4	0	0	--
Dichloroethene;1,1- in µg/L	3.2	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Dichloroethene;1,2-,cis in µg/L	--	--	--	--	--	**4**	**4**	**0**	**2.5**	**4**	**4**	**0**	**2.1**	4	0	0	--
Dichloroethene;1,2-,trans in µg/L	10,000	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--
Vinyl Chloride in µg/L	2.4	--	--	--	--	4	0	0	--	4	0	0	--	4	0	0	--

Table A-4 - Summary of Input Parameters Used for Groundwater Transport Model
Port of Seattle Terminal 5

Class	Chemical	Potential Screening Level in mg/L	Source Values					Hydrogeology			Dispersion			Adsorption				Bio-degradation half-life range in Years
			Well ID	Distance to Receptor in Feet	Source Concentration in mg/L	Source Width in Feet	Source Thickness in Feet	Hydraulic Conductivity in cm/sec	Hydraulic Gradient in Feet/Feet	Porosity	Longitudinal in Feet	Transverse in Feet	Vertical in Feet	Soil Bulk Density in kg/L	Koc in L/kg	Kd in L/kg	Fraction of Organic Carbon	
Background	Lead	0.0081	CMP-2	940	1.5E-02	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	--	1.00E+04	0.01	--
	Polychlorinated biphenyls	0.000000064	CMP-2	940	3.1E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.10E+05	3.10E+03	0.01	--
	Tetrachloroethene	0.00039	FM-105	355	6.2E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	2.70E+02	2.70E+00	0.01	1 - 2
	bis(2-Ethylhexyl) phthalate	0.0022	FM-105	355	5.8E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.10E+05	1.10E+03	0.01	0.027 - 1
	bis(2-Ethylhexyl) phthalate	0.0022	CMP-5	1160	2.3E-02	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.10E+05	1.10E+03	0.01	0.027 - 1
Fill Aquifer	Copper	0.0024	MW-26R	105	3.0E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	--	2.20E+01	0.01	--
	Polychlorinated biphenyls	0.000000064	CMP-3	490	1.2E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.10E+05	3.10E+03	0.01	--
	Polychlorinated biphenyls	0.000000064	CMP-4	760	1.7E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.10E+05	3.10E+03	0.01	--
	Polychlorinated biphenyls	0.000000064	MW-308N	185	1.4E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.10E+05	3.10E+03	0.01	--
	Tetrachloroethene	0.00039	MW-125	250	6.7E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	2.70E+02	2.70E+00	0.01	1 - 2
	bis(2-Ethylhexyl) phthalate	0.0022	CMP-4	760	2.4E-03	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.10E+05	1.10E+03	0.01	0.027 - 1
	Benzo[a]anthracene	0.000018	MW-125	250	9.7E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.60E+05	3.60E+03	0.01	0.56 - 2.73
	Benzo[a]anthracene	0.000018	MW-26R	105	2.5E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.60E+05	3.60E+03	0.01	0.56 - 2.73
	Benzo[a]pyrene	0.000018	MW-125	250	1.4E-04	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	9.70E+05	9.70E+03	0.01	0.31 - 2.9
	Benzo[b]fluoranthene	0.000018	MW-125	250	1.0E-04	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.20E+06	1.20E+04	0.01	1.97 - 3.34
	Benzo[b]fluoranthene	0.000018	CMP-3	490	1.9E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.20E+06	1.20E+04	0.01	1.97 - 3.34
	Benzo[k]fluoranthene	0.000018	MW-125	250	1.2E-04	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.20E+06	1.20E+04	0.01	4.99 - 11.7
	Chrysene	0.000018	MW-125	250	8.4E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	4.00E+05	4.00E+03	0.01	2.04 - 5.48
	Chrysene	0.000018	MW-26R	105	2.7E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	4.00E+05	4.00E+03	0.01	2.04 - 5.48
	Dibenzo[a,h]anthracene	0.000018	MW-125	250	2.8E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	1.80E+06	1.80E+04	0.01	1.98 - 5.15
	Indeno[1,2,3-cd]pyrene	0.000018	MW-125	250	5.1E-05	100	10	0.024	0.0007	0.45	5.5	2	1	1.7	3.50E+06	3.50E+04	0.01	3.89 - 4
Estuarine Aquifer	Copper	0.0024	MW-44	100	1.8E-02	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	--	2.20E+01	0.01	--
	Lead	0.0081	MW-44	100	3.3E-02	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	--	1.00E+04	0.01	--
	Nickel soluble salts	0.0082	MW-36	360	1.2E-02	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	--	6.50E+01	0.01	--
	TPH, heavy oils	0.5	MW-44	100	5.3E-01	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	--	--	0.01	--
	bis(2-Ethylhexyl) phthalate	0.0022	MW-308S	190	5.0E-03	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	1.10E+05	1.10E+03	0.01	0.027 - 1
	bis(2-Ethylhexyl) phthalate	0.0022	MW-44	100	2.4E-03	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	1.10E+05	1.10E+03	0.01	0.027 - 1
	Benzo[a]anthracene	0.000018	MW-44	100	5.9E-05	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	3.60E+05	3.60E+03	0.01	0.56 - 2.73
	Benzo[a]pyrene	0.000018	MW-44	100	1.1E-04	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	9.70E+05	9.70E+03	0.01	0.31 - 2.9
	Benzo[b]fluoranthene	0.000018	MW-44	100	2.7E-04	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	1.20E+06	1.20E+04	0.01	1.97 - 3.34
	Benzo[k]fluoranthene	0.000018	MW-44	100	1.4E-04	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	1.20E+06	1.20E+04	0.01	4.99 - 11.7
	Chrysene	0.000018	MW-44	100	1.9E-04	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	4.00E+05	4.00E+03	0.01	2.04 - 5.48
	Dibenzo[a,h]anthracene	0.000018	MW-44	100	3.5E-05	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	1.80E+06	1.80E+04	0.01	1.98 - 5.15
	Indeno[1,2,3-cd]pyrene	0.000018	MW-44	100	1.1E-04	100	10	0.014	0.0008	0.45	5.5	2	1	1.7	3.50E+06	3.50E+04	0.01	3.89 - 4

Notes:

Potential screening levels are obtained from GQMER (Hart Crowser 2010).

Source concentrations values are maximum concentrations for individual wells.

Source width, source thickness, hydraulic conductivity, longitudinal dispersion, transverse dispersion, vertical dispersion, and fraction of organic carbon values are referenced from the RI - PSR Marine Sediments Unit (Weston 1998b).

Hydraulic gradients are calculated from the 72-hour mean groundwater elevations provided in the Hydrologic Characterization Report (Aspect 2007).

Koc = soil adsorption coefficient.

Kd = soil distribution coefficient.

Kd = Koc x fraction of organic carbon.

-- = not applicable.

ND = not detected.

Biodegradation half-life provided for reference; not used in modeling

Table A-5 - Summary of Groundwater Transport Modeling Results
Port of Seattle Terminal 5

Class	Chemical	Well ID	Potential Screening Level in mg/L (1)	Baseline Case		Solubility Case	
				Source Concentration in mg/L (2)	Concentration After 100 Years at Receptor in mg/L	Solubility Concentration (3) in mg/L	Concentration After 100 Years at Receptor in mg/L
Background	Lead	CMP-2	8.1E-03	1.5E-02	--		--
	Polychlorinated biphenyls	CMP-2	6.4E-08	3.1E-05	--	7.0E-01	--
	Tetrachloroethene	FM-105	3.9E-04	6.2E-03	--	2.0E+02	--
	bis(2-Ethylhexyl) phthalate	FM-105	2.2E-03	5.8E-03	--	3.4E-01	--
	bis(2-Ethylhexyl) phthalate	CMP-5	2.2E-03	2.3E-02	--	3.4E-01	--
Fill Aquifer	Copper	MW-26R	2.4E-03	3.0E-03	6.5E-06		
	Polychlorinated biphenyls	CMP-3	6.4E-08	1.2E-03	ND	7.0E-01	ND
	Polychlorinated biphenyls	CMP-4	6.4E-08	1.7E-05	ND	7.0E-01	ND
	Polychlorinated biphenyls	MW-308N	6.4E-08	1.4E-05	ND	7.0E-01	ND
	Tetrachloroethene	MW-125	3.9E-04	6.7E-03	0.0019[a]	2.0E+02	57[a]
	bis(2-Ethylhexyl) phthalate	CMP-4	2.2E-03	2.4E-03	ND	3.4E-01	ND
	Benzo[a]anthracene	MW-125	1.8E-05	9.7E-05	ND	9.4E-03	ND
	Benzo[a]anthracene	MW-26R	1.8E-05	2.5E-05	ND	9.4E-03	ND
	Benzo[a]pyrene	MW-125	1.8E-05	1.4E-04	ND	1.6E-03	ND
	Benzo[b]fluoranthene	MW-125	1.8E-05	1.0E-04	ND	1.5E-03	ND
	Benzo[b]fluoranthene	CMP-3	1.8E-05	1.9E-05	ND	1.5E-03	ND
	Benzo[k]fluoranthene	MW-125	1.8E-05	1.2E-04	ND	8.0E-04	ND
	Chrysene	MW-125	1.8E-05	8.4E-05	ND	1.6E-03	ND
	Chrysene	MW-26R	1.8E-05	2.7E-05	ND	1.6E-03	ND
	Dibenzo[a,h]anthracene	MW-125	1.8E-05	2.8E-05	ND	2.5E-03	ND
	Indeno[1,2,3-cd]pyrene	MW-125	1.8E-05	5.1E-05	ND	2.2E-05	ND
Estuarine Aquifer	Copper	MW-44	2.4E-03	1.8E-02	7.2E-07	--	--
	Lead	MW-44	8.1E-03	3.3E-02	ND	--	--
	Nickel soluble salts	MW-36	8.2E-03	1.2E-02	ND	--	--
	TPH, heavy oils	MW-44	5.0E-01	5.3E-01	--	--	--
	bis(2-Ethylhexyl) phthalate	MW-308S	2.2E-03	5.0E-03	ND	3.4E-01	ND
	bis(2-Ethylhexyl) phthalate	MW-44	2.2E-03	2.4E-03	ND	3.4E-01	ND
	Benzo[a]anthracene	MW-44	1.8E-05	5.9E-05	ND	9.4E-03	ND
	Benzo[a]pyrene	MW-44	1.8E-05	1.1E-04	ND	1.6E-03	ND
	Benzo[b]fluoranthene	MW-44	1.8E-05	2.7E-04	ND	1.5E-03	ND
	Benzo[k]fluoranthene	MW-44	1.8E-05	1.4E-04	ND	8.0E-04	ND
	Chrysene	MW-44	1.8E-05	1.9E-04	ND	1.6E-03	ND
	Dibenzo[a,h]anthracene	MW-44	1.8E-05	3.5E-05	ND	2.5E-03	ND
	Indeno[1,2,3-cd]pyrene	MW-44	1.8E-05	1.1E-04	ND	2.2E-05	ND

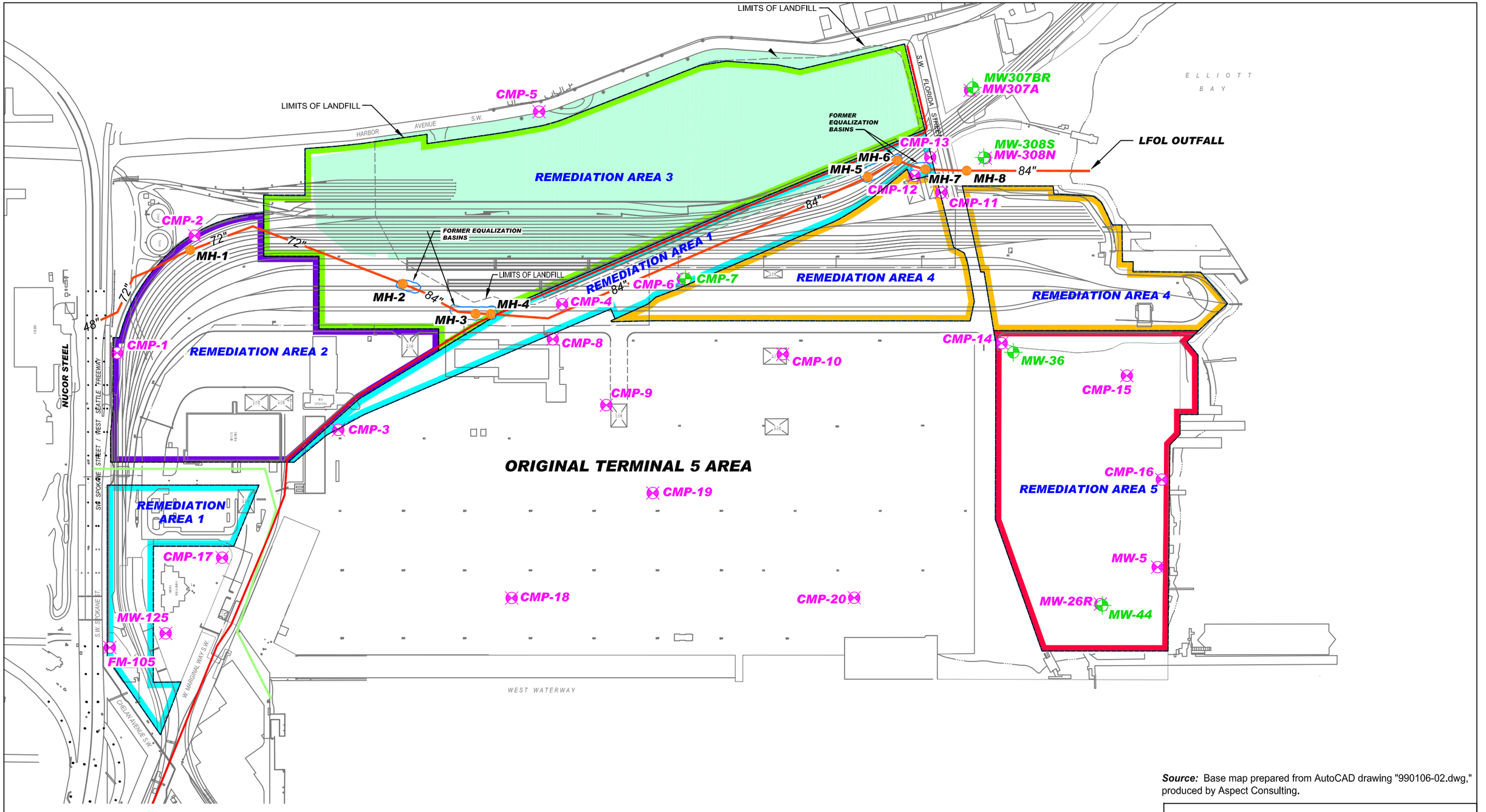
Notes:

1. Potential screening levels are obtained from GQMER (Hart Crowser 2010).
2. Source concentrations values are maximum concentrations for individual wells.
3. Solubility concentration values are obtained from CLARC database.

[a] Predicted concentrations of PCE with biodegradation (1 to 2 half life) were less than 0.0001 mg/L

Background groundwater data was not modeled.

Receptor is the surface water (Elliott Bay and/or Duwamish Waterway).



CMP-1 Fill Aquifer Well

MW-36 Estuarine Aquifer Well

Longfellow Creek Main Line

72" Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter

MH-1 Existing LFOL Manhole

Remediation Area 1 Boundary

Remediation Area 2 Boundary

Remediation Area 3 Boundary

Remediation Area 4 Boundary

Remediation Area 5 Boundary

Landfill Cap (geomembrane)

N

0 400 800

Scale in Feet

Source: Base map prepared from AutoCAD drawing "990106-02.dwg," produced by Aspect Consulting.

T5 Groundwater Monitoring Report
Seattle, Washington

Site Plan

17627-00 9/10

HARTCROWSER

Figure
A-1

EAL 09/23/10 1762700-005.dwg

APPENDIX B
GROUNDWATER SAMPLING PROCEDURES AND SAMPLE HANDLING METHODS

APPENDIX B
GROUNDWATER SAMPLING PROCEDURES AND SAMPLE HANDLING METHODS

This appendix summarizes the groundwater sampling and handling procedures used by Hart Crowser to conduct its fieldwork.

Groundwater Level Measurements

Groundwater level measurements were made during the groundwater sampling event from June 2 through June 4, 2010. Groundwater elevation data are summarized in Table 1. Depths to water measurements were made using a water level indicator. The probe was cleaned with deionized water between measurements to prevent cross-contamination of monitoring wells.

Groundwater Sampling

Groundwater samples were collected from monitoring wells CMP-1, CMP-2, CMP-3, CMP-4, CMP-5, CMP-15, CMP-17, MW-26R, MW-36, MW-44, MW-125, MW-308A(N), MW-308B(S), and FM-105 from June 2 through June 4, 2010 for chemical analysis. One duplicate sample was collected for each analyte during the sampling event. Equipment used for groundwater sample collection of groundwater samples included:

- Multiparameter water quality meter;
- Water level indicator;
- Peristaltic pump with disposable polyethylene tubing;
- Laboratory-supplied, pre-cleaned and preserved, 500 mL and 1 L HPDE and amber bottles;
- Coolers with ice; and
- Hart Crowser Sample Custody Record and Groundwater Sampling Data forms.

Upon arrival at the wellhead, field personnel recorded well conditions, depth to water, and depth to sediment in the well using a water level indicator. Purging and sampling was conducted at a depth representing the middle of the screened interval of each well. Groundwater samples were collected using low-flow sampling techniques. The wells were purged and sampled with a peristaltic pump. Clean sample tubing was used for each well and disposed of after use.

The field parameters pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxygen redox potential were measured and recorded periodically during well purging. Once the field parameters remained stable between

measurements, the groundwater sample was collected. The final stabilized readings measured just before sampling were recorded on the Groundwater Sampling Data form. Copies of the Groundwater Sampling Data forms are presented in Appendix C.

Sample Handling and Laboratory Analysis

Groundwater samples collected during the monitoring event were submitted to Analytical Resources Inc. of Tukwila, Washington. Samples were delivered by courier to the laboratory under chain of custody protocols.

One field duplicate and two trip blank samples were collected for the groundwater samples and submitted to the laboratory to assess combined field and laboratory variability. The one field duplicate sample was assigned the same exploration label with the letter "D" at the end of the number. The two trip blank samples were assigned the label "Trip Blank."

All groundwater samples were submitted for chemical analysis of cPAHs by EPA Method 8270C-SIM, PCBs by EPA Method 8082, TPH-Dx by NWTPH-Dx with silica gel cleanup, and bis(2-ethylhexyl)phthalate (BEHP) by EPA Method 8270C. Selected groundwater samples (FM-105, MW-125, and CMP-17) were submitted for chemical analysis of VOCs chlorinated ethanes and ethenes (CEEs) by EPA Method 8260B. Selected groundwater samples (CMP-15, MW-26R, MW-36, and MW-44) were submitted for chemical analysis of total metals by EPA Method 6010B/6020 for As, Pb, Sb, Cr, Cu, and Ni. Selected groundwater samples (CMP-1, CMP-2, CMP-3, CMP-4, CMP-5, CMP-17, MW-125, MW-308N, MW-308S, and FM-105) were submitted for chemical analysis of total metals by EPA Method 6010B/6020 for As and Pb.

Investigation-Derived Waste Storage and Disposal

Investigation-derived waste (IDW) generated from purging groundwater for sampling by Hart Crowser will be transported and transferred to a 1,100-gallon poly tank stored on site within a locked fence area at Pier 2-East (adjacent to SW Florida Street). Wastewater will periodically be picked up via tanker truck and transported to the Phillip Services facility in Kent, Washington for treatment. Wastewater disposal will be managed under an existing Phillip Services waste profile developed for wastewater during the Phase I Groundwater Confirmation Monitoring Program (GWCMP).

Dedicated disposable sampling equipment such as gloves, tubing, and Tyvek will be disposed of as solid waste.

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APPENDIX C
MONITORING WELL BORING LOGS

List of Well Completion Reports

CMP-1

CMP-2

CMP-3

CMP-4

CMP-5

CMP-15

CMP-17

MW-26R

MW-36

MW-44

MW-125

MW-308A(N)

MW-308B(S)

FM-105

Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines[5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥15% Fines[5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines[5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥15% Fines[5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diato-maceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT[2] blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

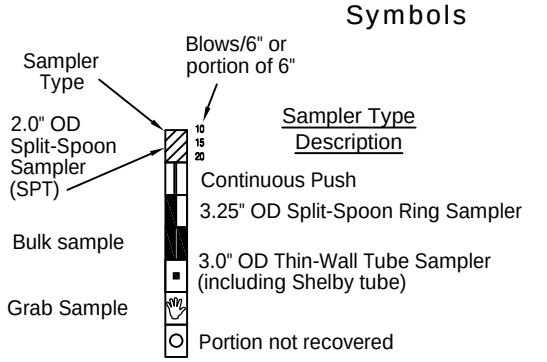
[3] Estimated Percentage

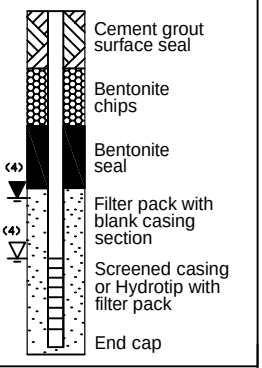
Percentage by Weight	Modifier
<5	Trace
5 to 15	Slightly (sandy, silty, clayey, gravelly)
15 to 30	Sandy, silty, clayey, gravelly)
30 to 49	Very (sandy, silty, clayey, gravelly)

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of groundwater
(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

▽ ATD = At time of drilling
▼ Static water level (date)

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Aspect consulting
earth+water
www.aspectconsulting.com
a limited liability company

Exploration Log Key

DATE:
DESIGNED BY:
DRAWN BY:
REVISED BY:

PROJECT NO.

FIGURE NO.
B-1

Q:_ACAD Standards\Standard Details\Exploration Log Key B1.dwg

Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-1	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	22.90
Location	Seattle, Washington	Water Elev. (ft mllw)	11.4
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	September 19, 2001
Sampling Method	2" Diameter, Split Spoon Sampler	Finish Date	September 19, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	S T	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type L-868 Concrete seal							**CRUSHED GRAVEL SURFACE** 1-1/4" minus crushed gravel
	Bentonite chips	0	0		12 15 17	S-1		**FILL** Dense, damp, dark brown SAND; sand fine to medium
5	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							
	Well Screen 2" ID SCH 40 PVC, 0.01" slot size	0	0		13 8 6	S-2		-grades to medium dense
10	11.5' ATD							Medium dense, wet, black SAND; sand fine to medium, trace red grains
		0	0		3 6 10	S-3		
15								Medium dense, wet, gray-brown SAND; sand fine to medium
	PVC Threaded End Cap	0	0		4 6 10	S-4		
	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							
20								Bottom of exploration boring at 19 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

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IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-2	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	23.04
Location	Seattle, Washington	Water Elev. (ft mllw)	10.5
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	September 18, 2001
Sampling Method	2" Diameter, Split Spoon Sampler	Finish Date	September 18, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type L-868 Concrete seal							**RECENT FILL** -road ballast, 1-1/4" minus gravel with sand; trace silt
	Bentonite chips	0	0		12 50/6"	S-1		**OLDER FILL** Very dense, damp to moist, brown SAND; sand fine to medium
5								Very dense, damp, brown GRAVELLY SAND with SILT
	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							Dense, damp, dark brown SANDY GRAVEL
	Well Screen 2" ID SCH 40 PVC, 0.01" slot size	0	0		18 16 12	S-2		**SLAG AND KILN BRICK** Slag and kiln brick like material at 8.5'
10								
	12.5' ATD	0	0		23 15 9	S-3		Yellow kiln brick like material in shoe at 12' -drills like gravels
15								Medium dense, wet, brown GRAVELLY SAND; some slag and kiln brick
	PVC Threaded End Cap Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand	0	0		9 16 8	S-4		
20								Bottom of exploration boring at 19 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

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IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-3	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	17.75
Location	Seattle, Washington	Water Elev. (ft mllw)	8.2
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	September 19, 2001
Sampling Method	2" Diameter, Split Spoon Sampler	Finish Date	September 19, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type L-868 Concrete seal							**ASPHALT SURFACE**
								FILL -road ballast, 1-1/4" minus crushed gravel; trace sand and silt; cobbles in cutting
	Bentonite chips	0	0		6 9 26	S-1		Dense, damp, brown GRAVELLY SAND; trace silt, sand fine to coarse
5	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							
		0	0		13 31 42	S-2		Very dense, moist, brown SANDY GRAVEL; sand fine to coarse -very gravelly to 11 feet
	9.5' ATD							
10	Well Screen 2" ID SCH 40 PVC, 0.01" slot size							Loose, wet, dark brown GRAVELLY SAND with SILT; sand fine to coarse
		0	0		3 5 3	S-3		
15								Medium dense, wet, brown SANDY GRAVEL with SILT
	PVC Threaded End Cap	0	0		4 9 11	S-4		
	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							**TIDAL MARSH DEPOSITS** Very stiff, moist, light brown SANDY SILT; sand fine
								Bottom of exploration boring at 17.5 feet.
20								

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
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IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-4	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	20.25
Location	Seattle, Washington	Water Elev. (ft mllw)	7.93
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	September 18, 2001
Sampling Method	2" Diameter, Split Spoon Sampler	Finish Date	September 18, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type L-868 Concrete seal							**ASPHALT SURFACE** **FILL** -railroad bedding, 1-1/4" crushed gravel; trace sand
		0	0		10 20 28	S-1		Dense, damp, brown SAND; sand fine to medium; no visible structure (fill)
	Bentonite chips							
5	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							
	Well Screen 2" ID SCH 40 PVC, 0.01" slot size	0	0		10 19 22	S-2		
10								
	12.32' ATD	0	0		2 3 4	S-3		-grades to loose -becomes wet
15								Loose, wet, gray SAND; few silt, trace gravels, sand fine to medium
		0	0		0 2 3	S-4		
	PVC Threaded End Cap Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							Bottom of exploration boring at 17.5 feet.
20								

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

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Geologic & Monitoring Well Construction Log

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Project Number	Well Number	Sheet
990106	CMP-5	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	24.07
Location	Seattle, Washington	Water Elev. (ft mllw)	13.1
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	October 29, 2001
Sampling Method	2" Diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	October 29, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Morris Flush Mount							**CONCRETE ROAD BED**
	Concrete seal							**FILL** Dense, damp, brown SANDY GRAVEL; trace silt, trace wood, trace glass; sand fine to medium
	Bentonite chips	0	0		16 12 15	S-1		Medium dense, damp, brown SAND; sand fine to medium
	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							
5	V-Wrap Well Screen 2" ID SCH 40 PVC, 0.01" slot size							**NATIVE DEPOSITS** Medium dense, moist, brown SAND with gray SILTY SAND interbeds to 2"
		0	0		5 6 5	S-2		
10	▼ 11.0' ATD							Loose, wet, gray SLIGHTLY SILTY to SILTY SAND; sand fine to medium
		0	0		2 3 6	S-3		
15	PVC Threaded End Cap	0	0		4 7 8	S-4		-grades to medium dense with trace gravel
		0	0		1 1 3	S-5		**LAWTON CLAY** Soft, wet, gray CLAYEY SILT
								Bottom of exploration boring at 19 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

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Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-15	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	18.74
Location	Seattle, Washington	Water Elev. (ft mllw)	6.7
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	November 5, 2001
Sampling Method	2" Diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	November 5, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type C-868							**ASPHALT**
	Concrete seal							**FILL** Very dense, damp, brown SANDY GRAVEL
	Bentonite chips	0	0		29 35 20	S-1		
5								Dense, moist, dark brown to black SANDY GRAVEL with SILT; trace wood and slag-like material
	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							Medium dense, moist, black SAND; sand fine to medium
		0	0		3 8 11	S-2		
	V-Wrap Well Screen 2" ID SCH 40 PVC, 0.01" slot size							
10								
	12.0' ATD							
		0	0		4 7 9	S-3		-wet at 12.5'
15								**TIDAL MARSH DEPOSITS**
		0	0		4 6 16	S-4		Medium dense, wet, brown SAND; trace silt, trace organics, trace shell fragments; sand fine to medium; slight creosote-like odor
	PVC Threaded End Cap							
								Bottom of exploration boring at 17.4 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

SWHARBOR SWHARBOR.GPJ February 5, 2002

Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-17	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	18.61
Location	Seattle, Washington	Water Elev. (ft mllw)	7.3
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	November 6, 2001
Sampling Method	2" Diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	November 6, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type C-868 Concrete seal Bentonite chips	0	0		15 26 28	S-1		**FILL** Very dense, moist, dark brown GRAVELLY SAND; trace silt
5	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							Dense, moist, dark brown SAND; sand fine to medium; red sand grains visible
		0	0		10 15 19	S-2		- 1" silt lense at 8.5'
10	V-Wrap Well Screen 2" ID SCH 40 PVC, 0.01" slot size							
	11.3' ATD							Medium dense, wet, dark gray SAND with silt interbeds; sand fine to medium
		0	0		5 6 8	S-3		
15		0	0		5 6 6	S-4		
	PVC Threaded End Cap							Bottom of exploration boring at 16.5 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

SWHARBOR SWHARBOR.GPJ February 5, 2002

Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	MW-26(R)	1 of 1

Project Name	Southwest Harbor Project	Monument Elev. (ft mllw)	18.59
Location	Seattle, Washington	Water Elev. (ft mllw)	7.59
Drilling Method	Hollow Stem Auger 8" OD/4" ID ; Holt Drilling	Start Date	November 6, 2001
Sampling Method	2" Diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	November 6, 2001

Depth feet	Well Construction	PID (ppm)	H2S (ppm)	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	8" Steel Monument Type C-868							**ASPHALT SURFACE**
	Concrete seal							**FILL** Medium dense, damp, brown SANDY GRAVEL; sand fine to medium, gravel medium to coarse
	Bentonite chips	0	0		5 10 6	S-1		Medium dense, damp, brown SAND; sand fine to medium
5	Filter Pack, 10 X 20 & 20 X 40 Colorado Silica Sand							-trace shell fragments in cuttings
	V-Wrap Well Screen 2" ID SCH 40 PVC, 0.01" slot size	0	0		3 6 5	S-2		-grades to wet at 9'
10	▼ 11.0' ATD							**TIDAL MARSH DEPOSITS**
		0	0		4 7 17	S-3		Medium dense, wet, dark gray to brown SILTY SAND with SILT interbeds; trace organics, trace shells
15		0	0		5 6 5	S-4		-grades to loose at 16'
	PVC Threaded End Cap							Bottom of exploration boring at 17 feet.

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- G - Grain Size
- P - Permeability
- M - Moisture Content

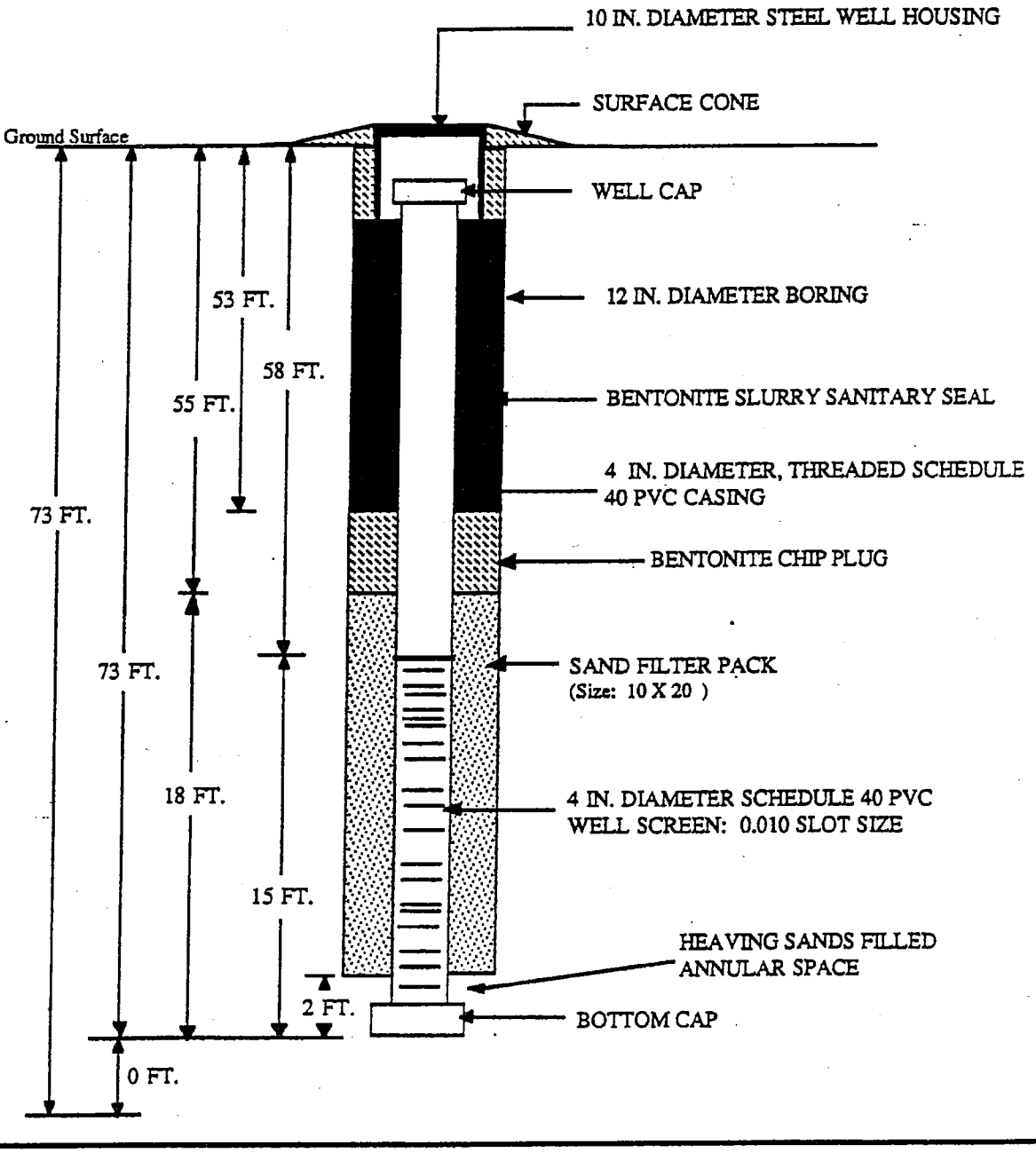
▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

SWHARBOR SWHARBOR.GPJ February 5, 2002

NOT TO SCALE

Top of Casing Elevation:



enviro	Well MW36 Completion Diagram Date Well Completed: 7/8/90 Geologist/ Engineer: M. S. SUROWIEC Job Name: POS/ Lockheed Yard 2	Figure C-39A
Job No. 900625 Appr MES Date: 1/18/90		

Log of Boring MW44

DRAFT

Analytical Results	Blow Count	Sample Recovery (%)	Depth (ft)	Soil Profile	USCS Symbol	Soil Description	PID/ Remarks
MW44-0.5 ft. WTPH-418.1	4,6, 12	90	0			ASPHALT, 6 inches.	4.2 ppm
		90			SP	Loose to medium dense, brown, fine SAND: laminated in places; trace silt; dry; no sign of contamination. (Hydraulic Fill)	no odors
	2,4,6	90	5			- occasional shell fragments and charcoal.	
MW44-5 ft. WTPH-418.1	5,6,6	90				- 2 inch bed of shell fragments and stony debris (slag?); moist.	3.4 ppm
	5,4,4	90					
	3,3,3	90				- dark gray, wet, slightly brackish odor.	slight odor
MW44-10 ft. WTPH-418.1	2,4,5	90	10		SP/ ML	Loose, dark gray, silty, fine SAND and SILT: laminated and bedded; minor shell fragments; plant fibers along laminae, 6" reedy bed at 10.5; wet. (Tidal Marsh soil)	1.8 ppm slight sulfur odor
	7,6,7	90					
	2,2,3	90					
MW44-15 ft. WTPH-418.1	1,1,1	15	15		SP	Very loose, dark gray, fine SAND. (Fluvial Deltaic soil)	no odor
	2,4,4	90			ML	Soft, dark gray SILT: laminated; occasional reeds; wet.	no odor
	2,2,2	90			CL	Soft to medium stiff, dark gray, Clayey SILT: laminated; wet; peaty debris on laminae; occasional shell fragments; sandy beds toward base.	2.7 ppm slight sulfur odor
	2,2,5	90	20				
	2,3,3	60			SP	Very loose to medium dense, dark gray, fine SAND: laminated with occasional thin clayey silt interbeds;shell fragments and/or plant debris in places. (Fluvial Deltaic soils)	
	3,4,5	90					2.4 mm Background: 0.0 ppm below 25'.
	3,5	90	25			- 4" clayey silt interbed at 24 feet.	no odor
MW44-25 ft. WTPH-418.1	4,4,4	90					0.0 ppm
	2,3,2	80				- 4" clayey silt interbed.	slight sulfur odor
	1,1,1	90					
	2,1,1	60	30				0.0 ppm
	3,6,1	90			CL	Soft, green gray, Clayey SILT: laminated, with soft sediment deformation.	slight sulfur odor
	3,8,11	90			SP	Loose to medium dense, dark gray, fine SAND: laminated; occasional silt laminae, shells, plant debris; wet; no sign of contamination. (Fluvial Deltaic beds)	
	11,17, 22	90	35			- silt laminae with soft sediment deformation.	
	13,15, 16	90					
	8,11, 14	90				- peaty layer	no odor
	8,11,9	90				- shell fragments	0.0 ppm
			40			(continues on page 2)	

enviros

Job No.900819 Task 15.3 Appr.: Date:

Date Drilled: 6-23-92
Geologist/Engineer: S.H. Evans
Equipment: 6" i.d. Hollowstem Auger
Ground Water Level When Drilling: 9.5 feet
Project Name: Southwest Harbor Project

A-

Log of Boring MW44 (cont.)

15' SCREEN 58' – 73'

DRAFT

Analytical Results	Blow Count	Sample Recovery (%)	Depth (ft)	Soil Profile	USCS Symbol	Soil Description	PID/ Remarks
			40			(continued from page 1)	
	4,4,4	90			CL	Soft, green gray to dark gray, Clayey SILT: laminated; occasional sand beds, shell fragments, soft sediment deformation; no evidence of contamination. (Fluvial Deltaic soil)	0.0 ppm no odor transitional sequence
	2,3,5	70					
	3,3,3	90					
MW44-45 ft. WTPH-418.1	2,2,2	100	45			- very dark gray bands. Interval sampled.	0.0 ppm
	1,2,3	90				- increasing sand interbeds.	
	3,2,5	90			SP/ CL	Loose and soft, interbedded, dark gray and dark green gray, fine SAND and Clayey SILT: shell fragments, peaty debris; wet; no sign of contamination. (Fluvial Deltaic soil)	slight sulfur odor
	5,6	90	50				no odor
MW44-50 ft. WTPH-418.1	3,2,5	90					0.0 ppm slight sulfur odor
	1,2,4	90					
	4,7,7	90				- clam shells and peaty laminae.	
	3,4,6	90	55				
	3,5,9	80			SP	Loose to medium dense, dark gray, fine SAND: occasional clayey silt laminae; peaty plant debris; no sign of contamination. (Fluvial Deltaic soil)	no odor
	5,9,9	90					
	3,5,5	90	60			- 2" peaty silt bed at 59.5'.	
	3,4,4	70			SM	Loose, dark gray, Silty fine SAND and SILT: wood debris at top; clayey laminae; occasional peaty material; no sign of contamination. (Fluvial Deltaic soil)	no odor slight sulfur odor
	3,4,4	90					
	3,3,3	90	65				
MW44-65 ft. Acid/Base/Nutral	4,5,8	90			SP	Medium dense to loose, dark gray, fine SAND: clean; laminated; wet; no sign of contamination. (Fluvial Deltaic beds)	no odor
	7,6,8	90				- thin silt beds.	
	3,3,3	0	70				
	1,2,3	0					
	2,2,3	5					no odor
	4,4	60	75			- occasional shell fragments	
MW44-75 ft. WTPH-418.1	3,2,4	5					
			80			Total Depth: 78.5 feet Note: sample interval at approximately 68 feet overdrilled. Sand pack on well squeezed by native soil after removal of auger, pushing sand up to 58 feet.	Background: 0.0 ppm

SCREEN 58' – 73'

enviros

Job No. 900819 Task 15.3 Appr.: Date:

Date Drilled: 6-23-92
Geologist/Engineer: S.H. Evans
Equipment: 6" i.d. Hollowstem Auger
Ground Water Level When Drilling: 9.5 feet
Project Name: Southwest Harbor Project

A-

Well Installation
(Above Grade)

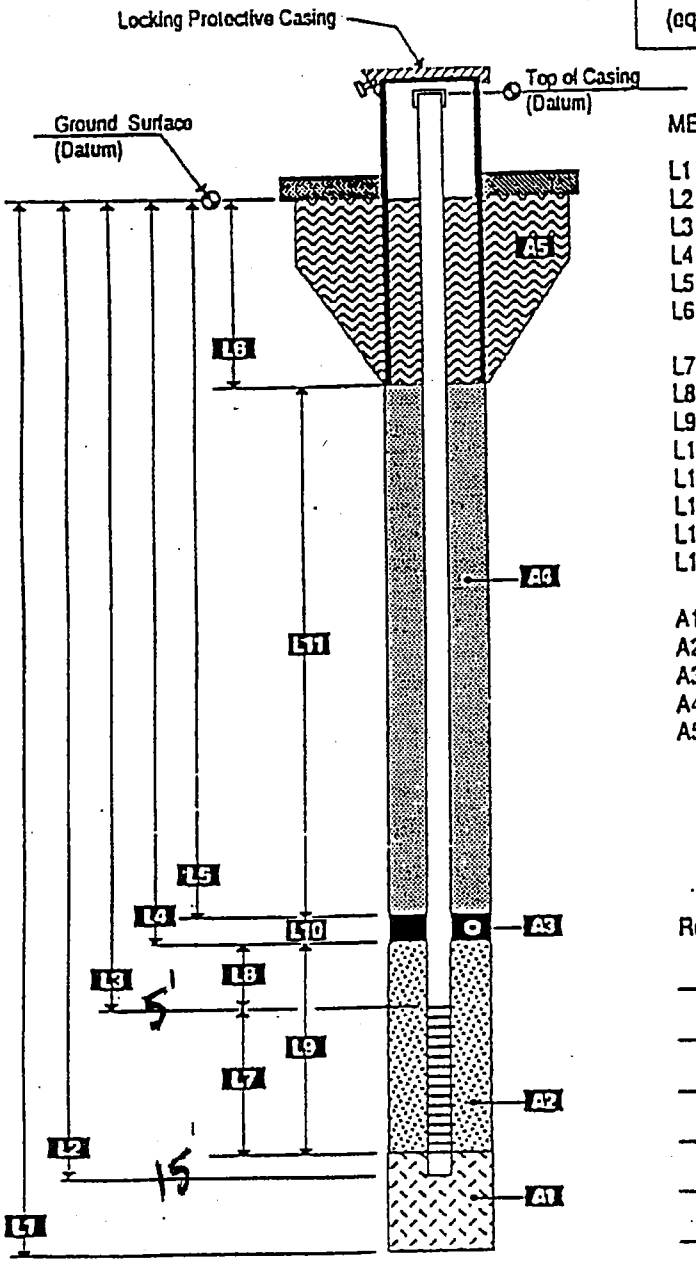
Well No. MW-125

Page 1 of 1

URS Consultants, Inc.

Client	Project SWH RA-1	Site	Zone
Location MW-125	Well Owner Port	Supervised by (company) Terra	Installed by (company) Ramlo
Date Started 5-13-94	Date Completed 5-13-94	Formation at Completion	Screen Zone

Ground Surface Elevation _____ feet MSL
(minus) Top of Casing Elevation _____ feet MSL
(equals) Well Stickup _____ feet



MEASUREMENTS IN FEET

L1	Total Borehole depth	16.5	feet (BGS)
L2	Casing depth	15	feet (BGS)
L3	Depth to top of screen	5	feet (BGS)
L4	Depth to filter material	3	feet (BGS)
L5	Depth to seal material	3	feet (BGS)
L6	Depth to backfill material	2	feet (BGS)
L7	Screen length	10	feet
L8	Height of filter above screen	2	feet
L9	Thickness of filter material	12	feet
L10	Thickness of seal material	2	feet
L11	Thickness of backfill material		feet
L12	Casing Stickup	0	feet
L13	Borehole Diameter	10	inches
L14	Casing Diameter	2	inches

A1	Backfill material	Native
A2	Filter material	10-20 Silica Sand
A3	Seal material	Bentonite Chips
A4	Annular Seal material	—
A5	Surface seal material	Concrete

Screen Slot Size 0.010
Depth to Water 7.6

Remarks
Sand - 6 bags
Bentonite - 1 bags
Concret - 2 bags

s/s centralizer on screen

Recorded By	Checked By	Date
CRL		7-10-94

10/21/93

Project: PORT OF SEATTLE Project Location: - SEATTLE, WA Project Number: 93C0423	Log of Boring MW308A(N) Sheet 1 of 1 Fill Aq.

Date(s) Drilled	4/5/94	Logged By	K. GOFFMAN	Checked By	G. DAVIS
Drilling Method	8"OD 4"ID HOLLOW STEM AUGER	Top of PVC Elevation (feet)	14.7	Total Depth Drilled (feet)	21.5
Drill Rig Type	MOBILE B-61	Drilled By	TACOMA PUMP AND DRILLING	Hammer Weight/ Drop (lbs/in.)	140#/30"
Groundwater Level (ft bgs)	8	Sampler Type	SPLIT SPOON	Approx. Surface Elevation (feet)	15.4
Diameter of Hole (inches)	8 Diameter of Well (inches) 2	Type of Well Casing	SCH 40 PVC	Screen Perforation	.02" (12.5'-17.5')
Type of Sand Pack	10/20 SILICA SAND	Type/Thickness of Seal(s)	CONCRETE / 0-2' BENTONITE / 2-10'		
Comments					

Depth, feet	Elevation, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blow Count	Graphic Log	MATERIAL DESCRIPTION	Well Completion Log	SAMPLES Recovery %	REMARKS
0	15					Asphalt			
						Loose medium to fine SAND (SP), little silt, black, damp, sand has white, red grains			
5	10	X	1	19				100	
									Initial GW contact
10	5	X	2	13		Few silt layers, little organic material, wet		90	
		X	3	50/3"				90	
15	0	X	4	47		Stiff fine sandy SILT (SM), black, wet, some organic material; thin interbeds ("2") of above sand		100	
						Loose medium to fine SAND (SP), little silt, black, wet, some organic material (wood)			
						Stiff clayey to fine sandy SILT (SM), dark grey, wet			
		X	5	14		Loose, medium to fine SAND (SP), little silt, black, wet, with some organic debris (wood)			
20	-5	X	6	51		Stiff fine sandy SILT (SM), dark gray to black, wet,			
						Loose medium to fine SAND (SP), little silt, black, wet, with some organic debris (wood)			
						Stiff fine sandy SILT (SM), dark grey to black, wet			
						Loose medium fine SAND (SP), little silt, black, wet			
25						Boring terminated at 21.5 ft bgs.			

Project: PORT OF SEATTLE
Project Location:- SEATTLE, WA
Project Number: 93C0423

Log of Boring MW308B(5)

Sheet 1 of 2 EST. AQ.

Date(s) Drilled	4/4/94	Logged By	K. GOFFMAN	Checked By	G. DAVIS
Drilling Method	8"OD 4"ID HOLLOW STEM AUGER	Top of PVC Elevation (feet)	14.5	Total Depth Drilled (feet)	40.0
Drill Rig Type	MOBILE B-61	Drilled By	TACOMA PUMP AND DRILLING	Hammer Weight/ Drop (lbs/in.)	140#/30"
Groundwater Level (ft bgs)	7.5	Sampler Type	SPLIT SPOON	Approx. Surface Elevation (feet)	15.5
Diameter of Hole (inches)	8	Diameter of Well (inches)	2	Type of Well Casing	SCH 40 PVC	Screen Perforation	.02" (35'-40')
Type of Sand Pack	10/20 SILICA SAND	Type/Thickness of Seal(s)	CONCRETE / 0-2' BENTONITE / 2-31'		
Comments					

Depth, feet	Elevation, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blow Count	Graphic Log	MATERIAL DESCRIPTION	Well Completion Log	SAMPLES Recovery %	REMARKS
0	15					Asphalt			
			1	70		Very dense, medium to fine SAND (SP), little coarse sand, some silt, black to dark gray, damp		100	Silt decreasing downward, trace at base of sampler
5	10					Silt decreasing			
			2	5		Fine to medium SAND (SP), trace silt, black, wet, some wood fragments	▽	90	Initial GW contact
10	5					Sand has white and red grains		100	
			3	28		Medium dense fine sandy SILT (SM), some shell fragments, black, wet			
15	0					Medium dense, fine to medium SAND (SP), trace silt, black, wet; sand has white and red grains		50	
			4	15		Very stiff SILT (SM), little fine sand, black, wet, with shell fragments, (interbeds of sand and silt)			
20									

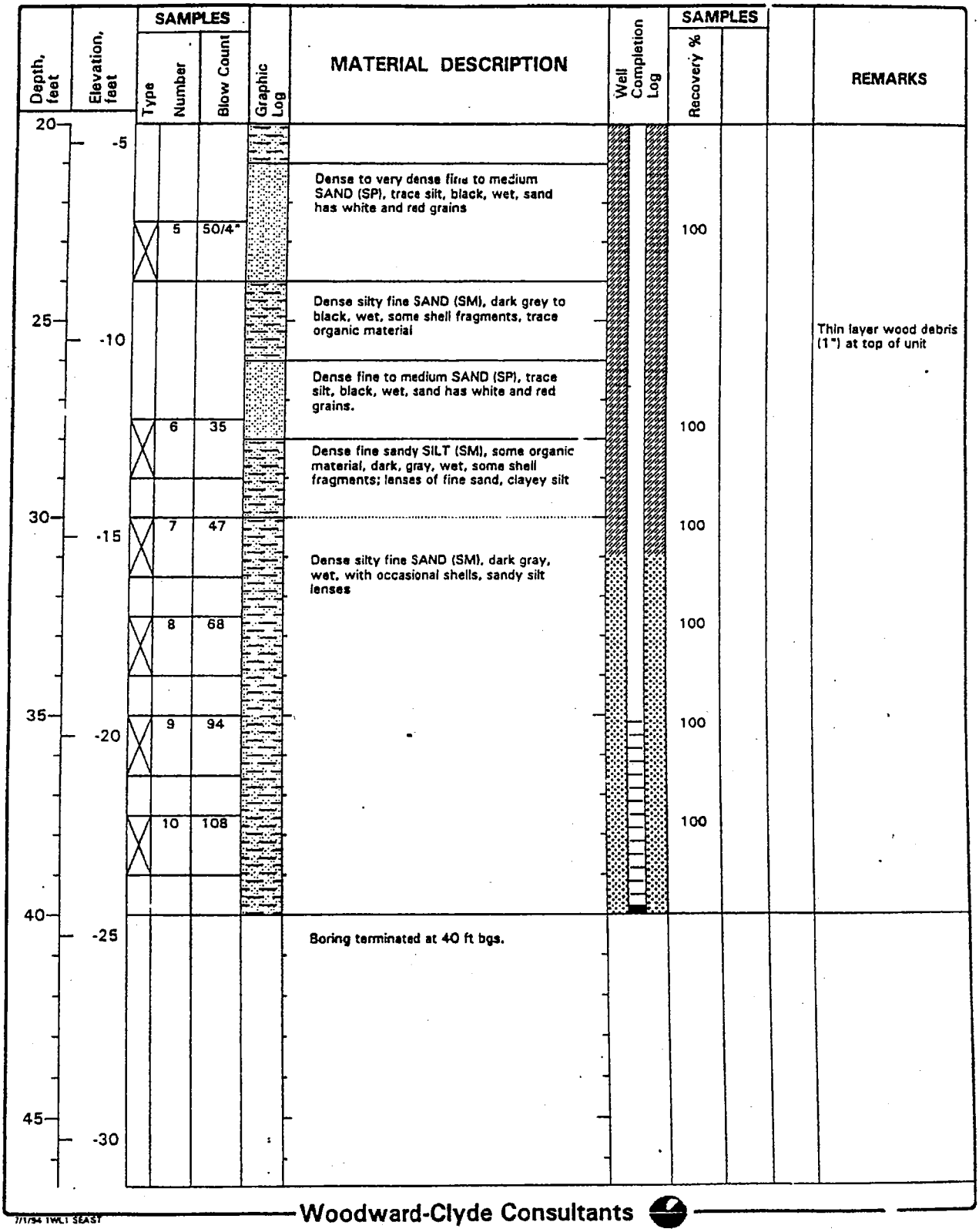
Woodward-Clyde Consultants

7/1/94 1WL1 SEA.ST

Project: PORT OF SEATTLE
Project Location: SEATTLE, WA
Project Number: 93C0423

Log of Boring MW308B(S)

Sheet 2 of 2



Woodward-Clyde Consultants

7/1/94 1WL1 SEAST

Converse NW

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
92-35175	FM-105	1 of 1

Project: ALKI CSO
Location: SW Spokane St
Elevation (Top of Well Casing):
Surface Elevation: 115
Water Level Elev.: 106
Start Date: September 28, 1992
Drilling Method: Hollow Stem Auger
Finish Date: September 29, 1992
Sampler/Driving Weight: SPT 140lb /R 300lb

Depth feet	Well Construction	Other Tests	ST	Blows/12"	Moisture/Density	Description
	flush mount steel monument					FILL
	concrete surface seal			22		SAND; mottled gray-brown, fine to medium, little gravel, clayey silt lumps with few gravel clasts; medium dense, slightly moist
	bentonite chip seal					
	2" ID schedule 40 PVC riser			9		GRAVEL; olive-brown, with fine sand matrix, scattered clay lumps; loose, slightly moist
5				9		SILT; olive-gray, few fine sand, few gravel, wood fragments; stiff, slightly moist
	10/20 silica sand					SAND; dark brown, fine to medium, few coarse; very loose, wet
	▽ 12/23/92			3		
10		G		2	21 / 95	wood fragments, gray mottled clay lumps
						gray, few fine to coarse gravel clasts
	2" ID 0.010" slot, schedule 40 PVC			2		dark gray to black, little silt, few wood fragments
15						
						SILT; dark gray to black, little fine sand, wood fragments; very loose, wet
	PVC bottom cap	FM-105-S		2		drive shoe has pitch black silt with medium strong petroleum/tar odor (0ppm) with charcoal lump
	native backfill					
20						Bottom of boring at depth 19 feet. Piezometer installed to depth 17 feet. Composite soil sample (FM-105-C) collected from 0-10 feet. Less than 1 ppm total organic vapors detected by OVM field screening of each soil sample.

ST - Sampler Type:
- 2" OD Split Spoon Sampler (SPT)
- Grab Sample

Lab Tests:
- Ch - Chemical Properties

(Sample I.D. Number)

Logged by: CJP
Approved by: VJP

APPENDIX D
GROUNDWATER SAMPLING FORMS

GROUNDWATER SAMPLING FORMS
HART CROWSER, INC.

DRAFT

Groundwater Sampling Data - Well I.D. CMP-1

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/4/10 1040
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	17
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	7-17

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	17'	Casing Volume in Gallons	0.79
Depth of Sediment (DTS) in Feet	16.71	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	11.83	Purge Volume in Gallons	—
(DTS - DTW)	4.88	Actual Purge in ~~Gallons~~ L	~5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1027	1L	6.62	13.3	0.485	83	0.26	18	Slightly Turbid, orange color, no odor/sheen
1030	2L	6.62	13.3	0.484	68	0.24	16	↓
1033	3L	6.62	13.2	0.482	71	0.19	14	yellow tint
1036	4L	6.62	13.2	0.482	75	0.20	13	↓
1039	5L	6.61	13.1	0.482	38	0.20	12	Clear
1040								

SMPL

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.34 l/min	~12
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-~~22~~ 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 4 Bolts, Removed Aspect Lock

Groundwater Sampling Data - Well I.D. CMP-2

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/14/10 0945
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	17
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	7-17

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	17'	Casing Volume in Gallons	0.81
Depth of Sediment (DTS) in Feet	16.7'	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	11.75'	Purge Volume in Gallons	—
(DTS - DTW)	4.95	Actual Purge in ~~Gallons~~ L	~5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
0932	1L	8.92	14.0	0.934	12	0.15	2	Clear, no color, no odor / sheen
0935	2L	8.94	14.0	0.930	11	0.14	-2	
0938	3L	8.97	14.0	0.928	7	0.11	-11	
0941	4L	8.99	14.0	0.928	5	0.09	-16	
0944	5L	9.01	14.1	0.928	4	0.12	-24	
SMPL 0945								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	~0.3 L/min	~12
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-22 ~~-10~~
Bailer Type	N/A	Water Level Probe	~~Waterline~~/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 4 Bolts, Removed Aspect lock

Groundwater Sampling Data - Well I.D. CMP-3

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/2/10 1305
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	16
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	6-16

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	16 ~~16~~	Casing Volume in Gallons	1.32
Depth of Sediment (DTS) in Feet	~~7.60~~ 15.71	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	7.60	Purge Volume in Gallons	—
(DTS - DTW)	8.11	Actual Purge in Gallons	~ 5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L Comments	ORP mV Quality	Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1248	1L	9.69	15.4	0.403	6	0.19	-98	Clear, no odor, no sheen, yellow tint
1252	2L	9.60	15.4	0.402	3	0.10	-107	
1256	3L	9.58	15.5	0.402	3	0.10	-105	
~~1300~~	4L	9.57	15.5	0.403	5	0.09	-108	
1304	5L	9.55	15.5	0.403	4	0.08	-103	no color
SMPL 1305								

Comments 2" inch well, (un-)locked cap

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.25 L/min	~ 14.5
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba ~~U-22~~ U-10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 3 bolts, Removed Aspect Lock

Groundwater Sampling Data - Well I.D. CMP-4

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/2/10 1510
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	17
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	7-17

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	17.0	Casing Volume in Gallons	1.68
Depth of Sediment (DTS) in Feet	16.80	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	10.17	Purge Volume in Gallons	—
(DTS - DTW)	6.63	Actual Purge in Gallons	~4L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1500	1L	6.56	14.3	0.500	136	0.50	77	Turbid, lt. brown color, no odor/sheen
1503	2L	6.49	14.3	0.479	24	0.65	70	Clear. ↓ ↓ ↓
1506	3L	6.48	14.3	0.473	22	0.70	67	↓ no color ↓ ↓
1509	4L	6.47	14.2	0.472	23	0.73	63	↓ ↓ ↓ ↓
SMPL 1510								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.3L/min	16'
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba ~~U-22~~ U-10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 3 bolts, 1 sheared off

Groundwater Sampling Data - Well I.D. CMP-5

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 1300
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	15
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	5-15

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	15'	Casing Volume in Gallons	1.01
Depth of Sediment (DTS) in Feet	14.9'	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	8.71	Purge Volume in Gallons	—
(DTS - DTW)	6.19	Actual Purge in Gallons	~5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1247	1L	6.41	13.3	0.235	10	0.46	-40	Slightly turbid on onset, red-orang. tint, no odor/sheen
1250	2L	6.42	13.3	0.233	0	0.20	-21	Clear
1253	3L	6.42	13.3	0.227	0	0.18	-7	↓
1256	4L	6.40	13.4	0.227	0	0.27	2	Clear
1259	5L	6.40	13.4	0.228	0	0.15	7	↓
SMPL 1300								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	~0.34/min	~14
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-22/10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [ ] Not OK [X] Explain Stripped bolt

Groundwater Sampling Data - Well I.D. CMP-15

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 0940
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	17
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	7-17

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	17'	Casing Volume in Gallons	1.19
Depth of Sediment (DTS) in Feet	17.10	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	9.75	Purge Volume in Gallons	—
(DTS - DTW)	7.35	Actual Purge in Gallons	~5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
0926	1L	6.64	14.2	6.93	3	0.16	-39	Clear, red-brown tint, no odor/sheen
0929	2L	6.64	14.2	6.93	0	0.14	-37	↓ ↓ ↓
0932	3L	6.64	14.2	6.93	0	0.10	-36	↓ ↓ ↓
0935	4L	6.64	14.2	6.92	0	0.07	-36	no color
0938	5L	6.64	14.2	6.92	0	0.05	-37	↓ ↓ ↓
SMPL 0940								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristalic	~0.3 L/min	~16
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite IDW
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals-As, Pb, Sb, Cr, Cu, Ni	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles ~~10~~ 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-~~22~~ 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 4 Bolts, Good condition

Groundwater Sampling Data - Well I.D. CMP-17

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/14/10 0845
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	16
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	6-16

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	16'	Casing Volume in Gallons	1.09
Depth of Sediment (DTS) in Feet	15.5'	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	8.31	Purge Volume in Gallons	—
(DTS - DTW)	6.69	Actual Purge in Gallons	~6L

	Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
	0835	1L	6.13	13.7	0.504	327	0.35	117	Turbid, orange-brown tint, no odor/sheen
	0837	2L	6.16	13.7	0.499	258	0.17	125	
	0839	3L	6.18	13.8	0.493	163	0.08	127	
	0841	4L	6.18	13.8	0.488	118	0.06	126	
SMPL	0843	5L	6.19	13.8	0.485	153	0.03	126	light yellow tint
	0845	6L	6.19	13.8	0.483	135	0.02	125	

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Dedicated QED B.P.	0.5 L/min	~14
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N
VOA Vial	3 - 40mL	Chlorinated Ethanes & Ethenes	HCL	N

Total Number of Bottles 12

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Dedicated QED Bladder Pump	Temp/pH/E.C./D.O	Horiba U-22 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 4 Bolts, Removed Aspect Lock

Groundwater Sampling Data - Well I.D. MW-26R DUP 1240

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/4/10 1210
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	16.5
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	6.5-16.5

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	16.5	Casing Volume in Gallons	1.12
Depth of Sediment (DTS) in Feet	16.25	[1" diameter = x .041 gal/ft, 2" d. = x .163 gal/ft, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	9.40	Purge Volume in Gallons	—
(DTS - DTW)	6.85	Actual Purge in Gallons	~5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1154	1L	6.89	14.4	10.6	60	0.29	13	Slightly turbid, brown tint, no odor/sheen
1157	2L	6.88	14.2	10.2	38	0.12	3	↓
1200	3L	6.88	14.2	9.6	19	0.08	-2	↓
1203	4L	6.87	14.2	9.2	15	0.07	-4	Clear
1206	5L	6.86	14.2	9.6	11	0.05	-7	↓
SMPL 1210								

Comments: Well Location: Row 601, Bay 39, Stack D

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.3 L/min	~11.5
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals-As, Pb, Sb, Cr, Cu, Ni	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N
		↳BEHP		

Total Number of Bottles 18

Duplicate Sample I.D. MW-26RD (Duplicate)

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-~~22~~ 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 4 Bolts, Removed Aspect Lock

Groundwater Sampling Data - Well I.D. MW-36

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/2/10 1621
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	73
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	58-73

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	75'? (73' per Aspect)	Casing Volume in Gallons	10.71
Depth of Sediment (DTS) in Feet	75'	[1" diameter = x .041 gal/ft, 2" d. = x .163 gal/ft, **4" d. = x .653 gal/ft**]	
Depth of Water (DTW) in Feet	9.31	Purge Volume in Gallons	—
(DTS - DTW)	65.69	Actual Purge in Gallons	~ 5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1607	1L	7.43	15.0	39.3	5	0.47	-27	Clear, yellow tint, no odor/sheen
1610	2L	7.43	14.9	39.8	5	0.25	-43	
1613	3L	7.43	14.8	39.9	5	0.19	-49	
1616	4L	7.43	14.7	40.0	6	0.10	-54	
1619	5L	7.43	14.7	40.0	5	0.08	-61	Lt. yellow tint
SMPL 1620								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.3 L/min	~ 74
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes 4.1

Purge Water Disposal Method/Volume ONSITE
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals-As, Pb, Sb, Cr, Cu, Ni	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-22 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain Replaced J-Plug

Groundwater Sampling Data - Well I.D. MW-44

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/21/10 1150
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	78.5
Field Reps.	(CFR)/KMR/(AJG)	Screened Interval in Feet	NA

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	78.5	Casing Volume in Gallons	10.77
Depth of Sediment (DTS) in Feet	75.10	[1" diameter = x .041 gal/ft, (2" d. = x .163 gal/ft) 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	8.94	Purge Volume in Gallons	—
(DTS - DTW)		Actual Purge in ~~Gallons~~ L	~9L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	ORP (MV)	DO (mg/L)	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1120	1L	5.32	15.2	—	~75	—	6.32	TURBIDE W/ VISIABLE Sediment, no odor, no sheen
1138	4L	5.87	15.2	0.012	~75	87	—	
1140	6L	5.80	14.9	0.011	~75	91	7.01	
1148	8L	5.94	14.9	0.011	~75	84	6.85	
SMPL 1150	9L	5.94	14.9	0.011	~75	84	6.88	" "

Comments: TURBIDITY IS SUSPECT FOR MW-44.
LOCATION → ROW 601, BAY 39, STACK C

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	0.5 L/min	~74
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume ONSITE IDW
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 1L	Total Metals - As, Pb	HNO3	N
HPDE	1 - 1L	Total Metals-As, Pb, Sb, Cr, Cu, Ni	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N
VOA Vial	3 - 40mL	Ethenes	HCL	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-~~22~~ 10
Bailer Type	N/A	Water Level Probe	(Waterline)/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain

Groundwater Sampling Data - Well I.D. MW-125

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 1600
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	15
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	5-15

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	15'	Casing Volume in Gallons	1.12
Depth of Sediment (DTS) in Feet	13.15'	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	6.25'	Purge Volume in Gallons	—
(DTS - DTW)	6.90	Actual Purge in Gallons	~6L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1550	1L	6.36	15.2	0.380	0	5.11	42	Clear, orange tint, no odor/sheen
1552	2L	6.35	15.2	0.381	0	5.59	47	↓
1554	3L	6.43	15.2	0.385	0	3.42	53	↓
1556	4L	6.41	15.2	0.387	0	2.79	58	↓
1558	5L	6.41	15.1	0.387	0	2.59	59	no color
1600	6L	6.42	15.1	0.387	0	2.47	59	↓

SMPL

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Dedicated QED B.P.	~0.5 L/min	~13
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N
VOA Vial	3 - 40mL	Chlorinated Ethanes & Ethenes	HCL	N

Total Number of Bottles ~~10~~ 12

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment

Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Dedicated QED Bladder Pump	Temp/pH/E.C./D.O	Horiba U-22/10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain

Groundwater Sampling Data - Well I.D. MW-308A(N)

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 1105
Job No.	17627-00	Tidally Influenced	Yes [X] No [ ]
Project Manager	Roger McGinnis	Well Depth in Feet	17.5
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	12.5-17.5

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	17.5'	Casing Volume in Gallons	1.918
Depth of Sediment (DTS) in Feet	17.5'	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	5.73'	Purge Volume in Gallons	—
(DTS - DTW)	11.77	Actual Purge in Gallons	~6 L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1051	1L	7.07	13.6	1.68	5	0.19	-24	Some sed. on onset, Clear, red tint, no odor/sheen
1054	2L	7.05	13.6	1.67	0	0.11	-35	
1057	3L	7.07	13.9	1.46	0	0.39	-51	Changed out peristaltic (low batt.)
1100	4L	7.08	13.8	0.962	0	0.10	-52	
1103	5L	7.08	13.7	0.960	0	0.04	-53	light orang tint
1106	6L	7.08	13.8	0.959	0	0.03	-54	

1105 SMPL

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	~0.34/min	~16.5
Sample	↓	↓	↓

Bails dry? Yes [ ] No [X]

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite IDW
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-22 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK [X] Not OK [ ] Explain 3 Bolts, Cut Lock, Good Condition

Groundwater Sampling Data - Well I.D. MW-308B(S)

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 1205
Job No.	17627-00	Tidally Influenced	Yes ☐ No ☐
Project Manager	Roger McGinnis	Well Depth in Feet	40
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	35-40

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet	40	Casing Volume in Gallons	5.51
Depth of Sediment (DTS) in Feet	39.35	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	5.56	Purge Volume in Gallons	—
(DTS - DTW)	33.79	Actual Purge in Gallons	~ 5L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1153	1L	7.78	13.7	12.6	0	0.29	-63	Clear, orange tint, no odor/sheen
1156	2L	7.79	13.7	12.8	0	0.11	-66	↓
1159	3L	7.79	13.7	12.8	0	0.09	-71	↓
1202	4L	7.79	13.7	13.0	0	0.04	-77	yellow tint
1205	5L	7.79	13.7	13.0	0	0.03	-80	↓
SMPL?								

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Peristaltic	~ 0.3 L/min	~ 38
Sample	↓	↓	↓

Bails dry? Yes ☐ No ☒

At no. of Casing Volumes 1

Purge Water Disposal Method/Volume Onsite IDW
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N

Total Number of Bottles 9

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment — *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type	Peristaltic Pump dedicated tubing 1/4" PE	Temp/pH/E.C./D.O	Horiba U-22 10
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK ☐ Not OK ☐ Explain 3 Stripped bolts

Groundwater Sampling Data - Well I.D. FM-105

Project	Port of Seattle - Terminal 5	Date/Time Sampled	6/3/10 1500
Job No.	17627-00	Tidally Influenced	Yes ☐ No ☐
Project Manager	Roger McGinnis	Well Depth in Feet	18
Field Reps.	CFR/KMR/AJG	Screened Interval in Feet	7-17

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth in Feet		Casing Volume in Gallons	1.15
Depth of Sediment (DTS) in Feet	17.78	[1" diameter = x .041 gal/ft, **2" d. = x .163 gal/ft**, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet	10.70	Purge Volume in Gallons	—
(DTS - DTW)	7.08	Actual Purge in Gallons	~7L

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in mS/cm	Turbidity NTU	DO mg/L	ORP	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand
1448	3L	6.54	12.3	0.397	0	1.29	40	Clear, light brown tint, no odor/sheen
1451	4L	6.51	12.2	0.397	0	1.07	46	↓
1454	5L	6.48	12.2	0.398	0	0.98	48	↓
1457	6L	6.44	12.1	0.399	0	0.96	47	no color
1500 SMPL	7L	6.45	12.1	0.399	0	0.97	46	↓

Comments

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge	Dedicated QED B.P.	~0.3 L/min	~15
Sample	↓	↓	↓

Bails dry? Yes ☐ No ☒

At no. of Casing Volumes ~1

Purge Water Disposal Method/Volume Onsite
(Stored in 1,000 gallon temporary onsite storage tank.)

2) Sampling Data

Bottle Type	No of Containers	Analyses	Perserv.	Filter
HPDE	1 - 500mL	Total Metals - As, Pb	HNO3	N
Amber	2 - 500mL	cPAHs	None	N
Amber	2 - 1L	PCBs	None	N
Amber	2 - 500mL	TPH-Dx w/ silica gel cleanup	None	N
Amber	2 - 500mL	Bis(2-ethylhexyl)phthalate	None	N
VOA Vial	3 - 40mL	Chlorinated Ethanes & Ethenes	HCL	N

Total Number of Bottles 12

Duplicate Sample I.D. —

Field Blank I.D. —

Rinseate Sample I.D. —

3) Field Equipment

Type/Brand/Serial No./Material/Units

Pump Type/Tubing Type	Dedicated QED Bladder Pump	Temp/pH/E.C./D.O	Horiba U-22 ~~10~~
Bailer Type	N/A	Water Level Probe	Waterline/Solinst/Heron
Filter Type	None	Other	ORP Pen

4) Well Conditions

OK ☒ Not OK ☐ Explain

Sample Custody Record

1 of 1

Samples Shipped to: ARI

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB 17627-00 LAB NUMBER

PROJECT NAME TERMINAL 5

HART CROWSER CONTACT C. RUST

SAMPLED BY: CFR/AJG

Q497

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	Total Metals[1]	Total Metals[2]	cPAHs (8270C SIM)	PCBs (8082)	TPH-Dx[3]	BEHP (8270C)	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	MW-44	WATER	6/2/10	1150	WATER		X	X	X	X	X	9	6-500mL, 3-1000mL
	CMP-3	↓	6/2/10	1305	WATER	X		X	X	X	X	9	↓
	CMP-4		6/2/10	1510	WATER	X		X	X	X	X	9	
	MW-36		6/2/10	1620	WATER		X	X	X	X	X	9	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	6/2/10	SIGNATURE	6/2/10
PRINT NAME Colleen Rust	TIME 1820	PRINT NAME D. Peterson	TIME 1720
COMPANY HC		COMPANY ARI	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

1) As, Pb: Total Metals 6010B/6020

2) As, Pb, Sb, Cr, Co, Ni: Total Metals 6010B/6020

3) TPH-Dx with Silica Gel Cleanup

36 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION

CUSTODY SEALS: ☐YES ☐NO ☐N/A

GOOD CONDITION ☐YES ☐NO

TEMPERATURE

SHIPMENT METHOD: ☐HAND ☐COURIER ☐OVERNIGHT

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. for Other Contract Requirements

TURNAROUND TIME:

☐ 24 HOURS ☐ 1 WEEK

☐ 48 HOURS ☒ STANDARD

☐ 72 HOURS OTHER

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

Sample Custody Record

1 of 1

Q216

Samples Shipped to: ARI

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB 17627-00 LAB NUMBER

PROJECT NAME TERMINAL 5

HART CROWSER CONTACT C. RUST

SAMPLED BY: CFR/AJG

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	Total Metals [1]	Total Metals [2]	cPAHs (8270C SIM)	PCBs (8082)	TPH-Dx [3]	BEHP (8270C)	CEE's (8260B)	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	CMP-15	WATER	6/3/10	940	WATER		X	X	X	X	X		9	Q216
	MW-302(N)	↓	↓	1105	↓	X		X	X	X	X		9	
	MW-302(S)			1205		X		X	X	X	X		9	
	CMP-5			1310		X		X	X	X	X		9	
	FM-105			1500		X		X	X	X	X	X	12	
	MW-125	↓	↓	1600	↓	X		X	X	X	X	X	12	
	TRIP BLANK	↓	↓	—	↓							X	2	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE Amy Goodwin	6/3/10	SIGNATURE Jami Peterson	6/3/10
PRINT NAME Amie Goodwin	TIME 1730	PRINT NAME J. Peterson	TIME 1730
COMPANY HC		COMPANY ARI	
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

1) 6010B/6020 for As, Pb
2) 6010B/6020 for As, Pb, Sb, Cr, Co, Ni
3) TPH-Dx WITH SILICA GEL CLEANUP

60 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☐YES ☐NO ☐N/A
GOOD CONDITION ☐YES ☐NO
TEMPERATURE
SHIPMENT METHOD: ☐HAND ☐COURIER ☐OVERNIGHT

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No.
for Other Contract Requirements

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☒ STANDARD
☐ 72 HOURS OTHER

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

QY97-00006
QY97-00007

Sample Custody Record

1 OF 1

Samples Shipped to: ARI

HART CROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB 17627-00 LAB NUMBER

PROJECT NAME TERMINAL 5

HART CROWSER CONTACT C. RUST

SAMPLED BY: CFR/AJG

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	Total Metals 1	Total Metals 2	cPAHs (8270C SIM)	PCBs (8082)	TPH-Dx 3	BEHP (8270C)	CFC's (8260B)	NO. OF CONTAINERS
	CMP-17	WATER	6/4/10	845	WATER	X		X	X	X	X	X	12
	CMP-2			945		X		X	X	X	X		9
	CMP-1			1040		X		X	X	X	X		9
	MW-26R			1210			X	X	X	X	X		9
	MW-26RD			1240			X	X	X	X	X		9
	TRIP BLANK			—								X	#2

Q241

OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	6/4/10	SIGNATURE	6/4/10
PRINT NAME Allen Rust	TIME	PRINT NAME A. Jaardsen	TIME
COMPANY HC	1550	COMPANY ARI	1550
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

1) 6010B/6020 for As Pb
2) 6010B/6020 for As, Pb, Sb, Cr, Cu, Ni
3) TPH-Dx WITH SILICA GEL CLEANUP

50 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☐YES ☐NO ☐N/A
GOOD CONDITION ☐YES ☐NO
TEMPERATURE
SHIPMENT METHOD: ☐HAND ☐COURIER ☐OVERNIGHT

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. for Other Contract Requirements

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☒ STANDARD
☐ 72 HOURS OTHER

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

GROUNDWATER SAMPLING FORMS
ASPECT CONSULTING, LLC

DRAFT

Aspect consulting
earth+water

CMP-1081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-1 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-19.0
Starting Water Level (ft TOC): 12.92
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 16.85
Casing Diameter (inches): 2

Casing Volume 3.93 (ft Water) x 0.16 (Lpfv)(gpf) = 0.63 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
830	/	0.4	/	/	/	/	/	/	/	clear discharge
835	2	↓	12.94	14.3	597	0.76	6.77	316.7	13.0	turbid after YSI
840	4	↓	12.92	14.3	576	0.50	6.85	209.3	/	↓
845	6	↓	12.93	14.4	567	0.41	6.86	188.5	/	↓
850	8	↓	12.94	14.4	564	0.36	6.87	188.3	3.56	↓
855	10	↓	12.96	14.4	565	0.31	6.88	178.6	1.78	↓
900	12	↓	12.96	14.4	563	0.30	6.90	181.7	1.76	turbid w/o YSI

Total Gallons Purged: 3.1
Total Casing Volumes Removed: 4.9

Ending Water Level (ft TOC): 12.96
Ending Total Depth (ft TOC): 16.85

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
900	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
900	500mL	Amber glass		2	none	none	↓	↓	cPAHs
900	1L	Amber glass		2	none	none	↓	↓	PCBs
900	500mL	Amber glass		2	none	none	↓	↓	TPH- DX
900	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP-2 - 081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-2 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-19.0

Starting Water Level (ft TOC): 12.92
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.3
Casing Diameter (inches): 2

Casing Volume 4.38 (ft Water) x 0.16 (Lpfv)(gpf) = 0.70 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
930	/	0.4	/	/	/	/	/	/	/	clear discharge
935	2	↓	12.94	16.7	1197	0.16	7.98	140.5	2.37	turbid after YSI
940	4	↓	12.93	16.8	1269	0.11	8.85	131.0	/	↓
945	6	↓	12.95	16.9	1276	0.11	9.18	131.8	/	↓
950	8	↓	12.95	16.9	1273	0.10	9.36	137.6	1.20	↓
955	10	↓	12.95	16.9	1273	0.09	9.36	135.3	0.92	↓
1000	12	↓	12.95	16.9	1272	0.09	9.38	134.3	0.86	turbid w/o YSI

Total Gallons Purged: 3.1
Total Casing Volumes Removed: 4.4

Ending Water Level (ft TOC): 12.95
Ending Total Depth (ft TOC): 17.3

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1000	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
1000	500mL	Amber glass		2	none	none	↓	↓	cPAHs
1000	1L	Amber glass		2	none	none	↓	↓	PCBs
1000	500mL	Amber glass		2	none	none	↓	↓	TPH- DX
1000	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP3- 081014

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-3 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 6.0-16.0
Filter Pack Interval (ft. TOC): 4.0-17.5

Starting Water Level (ft TOC): 8.40
Casing Stickup (ft): -0.37
Total Depth (ft TOC): 15.84
Casing Diameter (inches): 2

Casing Volume: 7.44 (ft Water) x 0.16 (Lpfv)(gpf) = 1.19 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~11 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
815	✓	0.4	8.40	✓	✓	✓	✓	✓	✓	clear discharge
820	2	↓	8.45	19.2	572	0.47	10.39	143.5	5.82	turbid after YSI
825	4		8.42	19.6	588	0.30	10.73	137.5	1.63	
830	6		8.42	19.7	593	0.24	10.83	133.6	1.30	
835	8		8.42	19.7	600	0.21	10.82	134.7	1.09	
840	10		8.42	19.6	608	0.19	10.98	143.8	1.08	
845	12	↓	8.42	19.5	613	0.19	10.96	142.7	1.09	turbid w/o YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 2.65

Ending Water Level (ft TOC): 8.42
Ending Total Depth (ft TOC): 15.84

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
845	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
845	500mL	Amber glass		2	none	none	↓	↓	cPAHs
845	1L	Amber glass		2	none	none			PCBs
845	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
845	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP4- 081014

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-4 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-17.5
Starting Water Level (ft TOC): 11.04
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17
Casing Diameter (inches): 2

Casing Volume 5.96 (ft Water) x 0.16 (Lpfv)(gpf) = 0.95 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
915	1	0.4	11.04	1	1	1	1	1	1	clear discharge
920	2	↓	11.08	16.8	613	0.40	9.10	272.4	4.62	turbid after YSI
925	4		11.08	16.9	497	0.33	8.77	212.0	2.79	
0930	6		11.08	16.9	449	0.26	8.32	198.3	1.76	
0935	8		11.08	17.0	439	0.23	8.02	194.3	1.67	
0940	10		11.08	17.0	438	0.24	7.81	193.3	1.55	
0945	12	↓	11.08	17.1	440	0.25	7.70	189.6	0.98	turbid before YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 3.32
Ending Water Level (ft TOC): 11.08
Ending Total Depth (ft TOC): 17.0

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
0945	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP5-080101#3

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-5 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 5.5-15.5
Filter Pack Interval (ft. TOC): 3.0-19.0
Starting Water Level (ft TOC): ~~12.92~~ 10.09
Casing Stickup (ft): -0.27
Total Depth (ft TOC): 15.1
Casing Diameter (inches): 2

Casing Volume 5.01 (ft Water) x 0.16 (Lpfv)(gpf) = 0.80 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~10.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
~~930~~	~~✓~~	~~0.4~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~clear discharge~~ DFR wrong well
1450	✓	0.4	✓	✓	✓	✓	✓	✓	✓	clear discharge
1455	2	↓	10.25	16.4	359	0.08	6.73	183.4	4.32	
1500	4	0.3	10.50	16.2	343	0.08	6.46	180.3	2.08	discharge reduced, too much DO
1505	5.5	↓	10.48	16.0	346	0.07	6.68	154.8	1.22	
1510	7.0	↓	10.46	16.0	352	0.08	6.56	137.4	1.35	
1515	8.5	↓	10.46	16.0	358	0.07	6.73	111.3	0.78	
1520	10.0	0.3	10.46	16.0	358	0.07	6.73	112.6	0.81	turbid w/o YSI

Total Gallons Purged: 2.63
Total Casing Volumes Removed: 3.28
Ending Water Level (ft TOC): 10.46
Ending Total Depth (ft TOC): 15.1

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1520	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
							↓	↓	

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP15-081014

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-15 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 4.0-17.4
Starting Water Level (ft TOC): 10.38
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.05
Casing Diameter (inches): 2

Casing Volume 6.67 (ft Water) x 0.16 (Lpfv)(gpf) = 1.06 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1155	/	0.4	10.38	/	/	/	/	/	/	clear discharge
1200	2	↓	10.50	17.7	1861	0.31	6.73	204.9	2.26	turbid after YSI
1205	4	↓	10.49	17.8	2014	0.22	6.82	188.2	1.14	
1210	6	↓	10.49	17.8	2190	0.12	6.87	92.1	1.26	
1215	8	↓	10.49	17.7	2258	0.08	6.88	48.7	1.26	
1220	10	↓	10.49	17.7	2334	0.08	6.89	44.4	1.26	
1225	12	↓	10.49	17.7	2336	0.008	6.88	48.1	1.12	turbid ~~X~~ w/o YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 2.97
Ending Water Level (ft TOC): 10.49
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1225	1L 500mL	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments: 10 total bottles

Aspect consulting
earth+water

CMP17-081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-17 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 6.0-16.0
Filter Pack Interval (ft. TOC): 4.0-16.5
Starting Water Level (ft TOC): 9.47
Casing Stickup (ft): -0.17
Total Depth (ft TOC): 16.21
Casing Diameter (inches): 2

Casing Volume 6.74 (ft Water) x 0.16 (Lpfv)(gpf) = 1.1 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 14 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1350	/	0.210	9.47	/	/	/	/	/	/	clear discharge
1355	~1	↓	9.50	17.8	459	1.86	6.63	201.8	12.5	turbid after YSI
1400	~2	↓	9.50	17.6	555	0.48	6.53	194.8	2.67	
1405	~3	↓	9.50	17.6	564	0.27	6.65	191.8	2.00	
1410	~4	↓	9.50	17.6	572	0.18	6.62	189.4	2.02	
1415	~5	↓	9.50	17.6	573	0.15	6.64	188.8	3.64	
1420	~6	↓	9.50	17.6	569	0.10	6.61	185.8	1.74	turbid w/o YSI

Total Gallons Purged: 1.57
Total Casing Volumes Removed: 1.4

Ending Water Level (ft TOC): 9.50
Ending Total Depth (ft TOC): 16.21

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1420	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
1420	500mL	Amber glass		2	none	none	↓	↓	cPAHs
1420	1L	Amber glass		2	none	none	↓	↓	PCBs
1420	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
1420	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
1420	40mL	VOA vial		3	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 147
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

FM105-081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: FM-105 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 6.0-17.5
Starting Water Level (ft TOC): 11.20
Casing Stickup (ft): -0.2
Total Depth (ft TOC): 18
Casing Diameter (inches): 2

Casing Volume: 6.8 (ft Water) x 0.16 (Lpfv)(gpf) = 1.1 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or ~~(L)~~)	Purge Rate (gpm or (Lpm))	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1045	~~0.210~~	0.210	11.20						✓	clear discharge
1050	~1	↓	11.20	14.8	715	1.31	8.65	288.2	38.5	turbid after YSI
1055	~2		11.20	14.8	600	1.17	8.35	197.3	32.4	
1100	~3		11.20	14.7	479	0.77	7.77	190.5	14.4	
1105	~4		11.20	14.7	448	0.53	7.41	187.5	6.54	
1110	5.5		11.20	14.8	442	0.44	7.21	184.3	11.8	
1115	~6.5		11.20	14.8	441	0.39	7.09	183.7	1.99	
1120	~7.5		11.20	14.8	440	0.37	7.06	181.6	1.25	
1125	8.8	↓	11.20	14.8	440	0.37	7.03	181.9	2.1	turbid w/o YSI

Total Gallons Purged: 2.2
Total Casing Volumes Removed: 2

Ending Water Level (ft TOC): 11.20
Ending Total Depth (ft TOC): 18

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1125	1L	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		4	none	none	↓	↓	cPAHs
	1L	Amber glass		4	none	none			PCBs
	500mL	Amber glass		4	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		4	none	none			Bis(2-ethyl hexyl) phthalate
↓	40mL	VOA vial		6	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 147
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments: Filled sample bottles until 1230
Second set of bottles collected for duplicate sample FM105-081013D collected @ 1130 on CoC

Aspect consulting
earth+water

MW26R-081014 / MW26R-081014D

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-26R

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 6.5-16.5
Filter Pack Interval (ft. TOC): 4.0-17.0
Starting Water Level (ft TOC): 9.91
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17.05
Casing Diameter (inches): 2

Casing Volume: 7.14 (ft Water) x 0.16 (Lpfv)(gpf) = 1.14 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 11.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1015	✓	0.4	9.91	✓	✓	✓	✓	✓	✓	clear discharge
1020	2	↓	9.91	16.2	12290	0.35	7.03	201.8	2.47	turbid after YSI
1025	4		9.93	16.5	11600	0.23	7.15	195.3	1.39	
1030	6		9.95	16.6	9,930	0.15	7.30	187.9	1.16	
1035	8		9.95	16.8	9,735	0.13	7.30	187.1	0.70	
1040	10		9.95	16.9	10,130	0.11	7.30	184.6	0.80	
1045	12	↓	9.95	16.9	10,190	0.11	7.29	184.5	0.74	turbid w/o YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 2.76
Ending Water Level (ft TOC): 9.95
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1045	1L	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		4	none	none	↓	↓	cPAHs
	1L	Amber glass		4	none	none			PCBs
	500mL	Amber glass		4	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		4	none	none			Bis(2-ethyl hexyl) phthalate
↓									

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Second set of bottles collected for duplicate sample - MW26R-081014D at 1050

Aspect consulting
earth+water

MW36-081014

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-36 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 58.0-73.0
Filter Pack Interval (ft. TOC): 55.0-71.0
Starting Water Level (ft TOC): 10.00
Casing Stickup (ft): -0.23
Total Depth (ft TOC): 73
Casing Diameter (inches): 2

Casing Volume 63 (ft Water) x 0.16 (Lpfv)(gpf) = 10.08 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 65.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1250	/	0.4	10.00	/	/	/	/	/	/	clear discharge
1255	2	↓	10.04	14.7	36,900	0.11	7.15	-30.8	1.55	turbidity after YSI
1300	4		10.04	14.6	36,760	0.07	7.27	-50.0	1.03	
1305	6		10.04	14.7	36,480	0.07	7.34	-65.7	1.40	
1310	8		10.04	14.6	36,380	0.06	7.39	-70.5	1.23	
1315	10		10.04	14.6	36,220	0.05	7.44	-78.9	1.17	
1320	12		10.04	14.6	36,190	0.05	7.46	-79.6	1.20	
1325	14	↓	10.04	14.6	36,200	0.06	7.47	-79.3	1.02	turbid w/o YSI

Total Gallons Purged: 3.68
Total Casing Volumes Removed: 0.36

Ending Water Level (ft TOC): 10.04
Ending Total Depth (ft TOC): 73

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1325	1L 500mL	HPDE		2 1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments: 10 total bottles

Aspect consulting
earth+water

MW44-081014

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-44 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/14/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): n/a
Filter Pack Interval (ft. TOC): n/a
Starting Water Level (ft TOC): 10.90
Casing Stickup (ft): -0.18
Total Depth (ft TOC): 73.9
Casing Diameter (inches): 2

Casing Volume 63 (ft Water) x ~~0.16~~ 0.08 (Lpfv)(gpf) = 10.08 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 68 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1045	✓	0.4	10.90	✓	✓	✓	✓	✓	✓	clear dish
1050	2	↓	11.00	15.8	2,020	2.31	8.01	161.2	6.35	turbid after YSI
1055	4		11.00	15.5	193	2.68	8.23	170.9	7.71	
1100	6		11.00	15.5	090	2.36	7.82	181.2	5.79	
1105	8		11.00	15.4	061	1.96	7.41	188.6	5.36	
1110	10		11.00	15.4	052	1.90	7.38	192.8	5.21	
1115	12		11.00	15.4	046	1.64	7.21	196.7	6.32	
1120	14		11.00	15.4	043	1.60	7.20	198.1	4.32	
1125	16	↓	11.00	15.3	041	1.59	7.23	199.7	3.21	turbid w/o YSI

Total Gallons Purged: 4.21
Total Casing Volumes Removed: 0.41

Ending Water Level (ft TOC): 11.00
Ending Total Depth (ft TOC): 73.9

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1125	1L 500mL	HPDE		2 1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments: 10 bottles total

Aspect consulting
earth+water

MW125-081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-125 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 5.0-15.0
Filter Pack Interval (ft. TOC): 3.0-15.0
Starting Water Level (ft TOC): 6.88
Casing Stickup (ft): -1.11
Total Depth (ft TOC): 13.35
Casing Diameter (inches): 2

Casing Volume 6.47 (ft Water) x 0.16 (Lpfv)(gpf) = 1.0 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 13 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1255	/	.210	6.88	/	/	/	/	/	/	clear discharge
1300	~1	↓	6.88	18.1	429	1.37	6.72	192.0	3.42	turbid after YSI
1305	~2	↓	6.98	18.5	428	0.90	6.66	197.7	1.25	
1310	~3	↓	6.98	18.5	423	0.73	6.63	198.5	1.23	
1315	~4	↓	7.00	18.6	420	0.66	6.62	197.9	0.97	
1320	~5	↓	7.01	18.6	415	0.56	6.62	196.4	0.60	
1325	~6	↓	7.01	18.6	412	0.52	6.61	196.0	0.90	turb. w/o YSI
[illegible]	[illegible]		[illegible]							

Total Gallons Purged: 1.65
Total Casing Volumes Removed: 1.65

Ending Water Level (ft TOC): 7.01
Ending Total Depth (ft TOC): 13.35

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1325	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
↓	40mL	VOA vial		3	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 147
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

MW308N-081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-308N Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 10/13/08
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 12.5-17.5
Filter Pack Interval (ft. TOC): 10.0-21.5
Starting Water Level (ft TOC): 6.53
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.95
Casing Diameter (inches): 2

Casing Volume: 11.02 (ft Water) x ~~0.16~~ 0.16 (Lpfv)(gpf) = 1.76 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1645	✓	0.4	6.53	✓	✓	✓	✓	✓	✓	clear discharge
1650	2	↓	6.70	16.7	1,850	0.03	8.10	-83.7	29.3	turbid after YSI
1655	4		6.71	16.7	1,595	0.02	7.82	-86.4	23.8	
1700	6		6.71	16.7	1,585	0.02	7.68	-86.5	22.2	
1705	8		6.72	16.7	1,586	0.03	7.61	-85.2	17.9	turbid w/o YSI
1710	10		6.73	16.7	1,586	0.02	7.60	-87.3	16.2	turbid w/o YSI
1715	12	↓	6.75	16.8	1,586	0.02	7.59	-88.9	12.7	turbid w/o YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: ~~3.15~~ 1.79
Ending Water Level (ft TOC): 6.75
Ending Total Depth (ft TOC): 17.95

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1715	1L	HPDE		1	none	HNO3	Slightly yellow	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

MW308S-081013

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-308S | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: _____
Developed by: DFR/AT
Measuring Point of Well: TOC
Screened Interval (ft. TOC): 35.0-40.0
Filter Pack Interval (ft. TOC): 31.0-40.0

Starting Water Level (ft TOC): 6.30
Casing Stickup (ft): -0.61
Total Depth (ft TOC): 40.5
Casing Diameter (inches): 2

Casing Volume 34.2 (ft Water) x 0.16 (Lpfv)(gpf) = 5.472 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 37.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1600	✓	0.4	6.30	✓	✓	✓	✓	✓	✓	clear discharge
1605	2	↓	7.00	14.9	15,290	0.04	7.77	3.0	3.7	turbidity taken after YSI
1610	4	0.3	6.80	14.8	15,260	0.03	7.93	-20.6	0.81	disch reduced, too much DD
1615	~~5.5~~	↓	6.97	15.0	15,250	0.03	8.01	-43.0	1.81	
1620	~~7~~	0.25	6.95	15.0	15,250	0.03	8.08	-57.9	1.79	disch reduced, too much DD
1625	8	↓	6.70	15.0	15,230	0.03	8.10	-55.9	1.46	
1630	9	↓	6.60	15.0	15,230	0.03	8.11	-56.8	2.13	turbid w/o YSI

Total Gallons Purged: 2.36
Total Casing Volumes Removed: 0.43

Ending Water Level (ft TOC): 6.60
Ending Total Depth (ft TOC): 40.5

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1630	1L	HPDE		1	none	HNO3	slightly yellow	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments: _____

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 1 of 1	
ARI Client Company: Aspect Consulting LLC	Phone: 206 780 9370	Date: 10/13/2008	Ice Present? Y
Client Contact: Chip Goodhue		No. of Coolers: 4 1/2	Cooler Temps: 15.4 – 10.2
Client Project Name: Southwest Harbor Project - Phase 2 GWCMP			
Client Project #: 080064	Samplers: DAVE RUGH / AMY TICE		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Tot Metals 6010B/6020 (As, Pb)	Tot Metals 6010B/6020 As, Pb, Sb, Cr, Cu	CEE 1s 8260B	PAHs 8270c SIM	NWTPH-Dx Diesel + Oil w/ silica cleanup	BEHP 8270C	PCBs 8082		Notes/Comments
CMP1 = CMP-1 - 081013	10/13/08	900	water	9	X			X	X	X	X		
CMP2 - 081013		1000		9	X			X	X	X	X		
FM10S - 081013		1125		12	X		X	X	X	X	X		
FM10S - 081013D		1130		12	X		X	X	X	X	X		
MW12S - 081013		1325		12	X		X	X	X	X	X		
CMP17 - 081013		1420		12	X		X	X	X	X	X		
CMP5 - 081013		1520		9	X			X	X	X	X		
MW308S - 081013		1630		9	X			X	X	X	X		
MW308N - 081013	↓	1715	↓	9	X			X	X	X	X		

Comments/Special Instructions: Supplemental Code S_LB1695	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: DAVID RUGH	Printed Name: BRIAN KLEIN	Printed Name:	Printed Name:
	Company: Aspect LLC	Company: ARI	Company:	Company:
	Date & Time: 10/13/08 1800	Date & Time: 10/13/08 1800	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD
ARI Client Company: Aspect Consulting LLC	Phone: 206-780-9370
Client Contact: Chip Goodhue	
Client Project Name: Southwest Harbor Project - Phase 2 GWCMP	
Client Project #: 080064	Samplers: DAVID RUGH / AMY TICE

Page: 1 of 1

Date: 10/14/08 Ice Present?

No. of Coolers: Cooler Temps:

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Tot Metals 6010B/6020 (As, Pb)	Tot Metals 6010B/6020 (As, Pb, Sb, Cr, Cu)	CEE's 8260B	PAHs 8270C/SIM	NWTPHD Diesel + Oil w/silica cleanup	BETIP 8270C	PCBs 8082		Notes/Comments
CMP3-081014	10/14/08	845	water	9	X			X	X	X	X		
CMP4-081014	"	945	"	9	X			X	X	X	X		
MW26R-081014	"	1045	"	9		X		X	X	X	X		
MW26R-081014D	"	1050	"	9		X		X	X	X	X		
MW44-081014	"	1125	"	10		X		X	X	X	X		
CMP15-081014	"	1225	"	10		X		X	X	X	X		
MW36-081014	↓	1325	↓	10		X		X	X	X	X		

Analysis Requested

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
Supplemental Code S_LB1695	(Signature) Dat Rgh	(Signature)	(Signature)	(Signature)
	Printed Name: DAVID RUGH	Printed Name: Amanda VAgnerson	Printed Name:	Printed Name:
	Company: Aspect LLC	Company: ARI	Company:	Company:
	Date & Time: 10/14/08 1430	Date & Time: 10/14/08 1430	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Aspect consulting
earth+water

CMP1-090331

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP# 1 | Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 3/31/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-19.0

Starting Water Level (ft TOC): 12.21
Casing Stickup (ft): -0.29
Total Depth (ft TOC): ~~16.85~~ 16.85
Casing Diameter (inche: 2

Casing Volume 5.09 (ft Water) x 0.16 (Lpfv)(gpf) = 0.81 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
915	✓	0.4	✓	✓	✓	✓	✓	✓	✓	clear discharge
920	2	↓	12.26	12.7	566	0.48	6.63	149.5	4.65	turbid after YSI
925	4		12.27→~~12.21~~	12.7	537	0.37	6.53	239.5	4.80	↓
930	6		12.27	12.7	521	0.32	6.26	278.4	1.70	
935	8		12.27	12.7	513	0.27	6.04	266.5	1.02	
940	10		12.25	12.7	511	0.22	6.20	244.6	0.81	↓
945	12	↓	12.25	12.7	506	0.19	6.23	~~238.6~~	1.17	turbid before YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 3.88
Ending Water Level (ft TOC): 12.25
Ending Total Depth (ft TOC): ~~16.85~~ 16.85

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
945	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

~~CMP2-033109~~
~~CMP-2-033109~~ CMP2-090331

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-2 **Page:** 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 3/31/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-19.0
Starting Water Level (ft TOC): 12.92
Casing Stickup (ft): -0.29
Total Depth (ft TOC): ~~18.85~~ 17.3
Casing Diameter (inche: 2

Casing Volume 4.38 (ft Water) x 0.16 (Lpfv)(gpf) = 0.70 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
815	/	0.4	/	/	/	/	/	/	/	clear discharge
820	2	↓	12.95	14.3	1650	0.52	9.20	148.5	4.09	turbid after YSI
825	4	↓	12.96	14.4	1550	0.40	9.29	132.7	1.96	↓
830	6	↓	12.96	14.5	1482	0.36	9.31	156.2	1.90	↓
835	8	↓	12.96	14.6	1447	0.32	9.26	138.7	1.82	↓
0840	10	↓	12.96	14.6	1415	0.29	9.09	134.4	1.22	↓
845	12	↓	12.96	14.6	1402	0.26	9.08	139.4	1.58	turbid before YSI

Total Gallons Purged: 3.15
Total Casing Volumes Removed: 4.5
Ending Water Level (ft TOC): 12.96
Ending Total Depth (ft TOC): ~~18.85~~ 17.3

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
845	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 147
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP3-090401

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-3 | Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/1/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 6.0-16.0
Filter Pack Interval (ft. TOC): 4.0-17.5

Starting Water Level (ft TOC): 7.90
Casing Stickup (ft): -0.37
Total Depth (ft TOC): 15.84
Casing Diameter (inche: 2

Casing Volume 7.94 (ft Water) x 0.16 (Lpfv)(gpf) = 1.27 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~11 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
840	/	0.5	/	/	/	/	/	/	/	clear discharge
845	2.5	↓	7.90	13.3	718	0.38	10.13	181.5	6.80	turbid after YSI
850	5.0	↓	7.90	13.1	715	0.32	9.75	185.8	4.79	↓
855	7.5	↓	7.90	13.1	715	0.28	9.33	201.0	3.37	↓
900	10.0	↓	7.90	13.1	719	0.25	8.91	194.7	2.1	↓
905	12.5	↓	7.90	12.9	723	0.24	8.67	211.0	1.78	↓
910	15.0	↓	7.90	12.9	726	0.26	8.68	201.3	1.80	turbid w/o YSI

Total Gallons Purged: 3.94
Total Casing Volumes Removed: 3.10

Ending Water Level (ft TOC): 12.9
Ending Total Depth (ft TOC): 15.84

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
910	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP4-090402

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-4 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 04/02/2009
Developed by: DFR/AT
Measuring Point of Wel TOC
Screened Interval (ft. TOC) 7.0-17.0
Filter Pack Interval (ft. TOC) 5.0-17.5

Starting Water Level (ft TOC): 10.34
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17
Casing Diameter (inche 2

Casing Volume 6.66 (ft Water) x 0.16 (Lpfv)(gpf) = 1.06 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
825	/	0.5	/	/	/	/	/	/	/	clear discharge
830	2.5	↓	10.41	12.6	617	0.95	6.83	117.2	1.52	turbid after YSI
835	5.0		10.42	12.7	618	0.93	6.66	151.7	1.18	↓
840	7.5		10.43	12.7	618	1.07	6.43	136.2	0.86	
845	10.0		10.43	12.6	617	0.83	6.29	151.1	0.77	
850	12.5		10.43	12.6	617	0.75	6.20	137.2	0.86	↓
855	15.0	↓	10.43	12.6	619	0.74	6.19	192.3	0.83	turbid w/o YSI

Total Gallons Purged: 3.94
Total Casing Volumes Removed: 3.71

Ending Water Level (ft TOC): 10.43
Ending Total Depth (ft TOC): 17.0

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
855	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting
earth+water

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-5 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/1/2009
Developed by: DFR/AT
Measuring Point of Wel TOC
Screened Interval (ft. TOC) 5.5-15.5
Filter Pack Interval (ft. TOC) 3.0-19.0
Starting Water Level (ft TOC): 8.48
Casing Stickup (ft): -0.27
Total Depth (ft TOC): 15.1
Casing Diameter (inche 2

Casing Volume 6.62 (ft Water) x ~~1.5~~ 0.16 (Lpfv)(gpf) = 1.05 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~10.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1245	/	0.5	8.48	/	/	/	/	/	/	clear discharge
1250	2.5	↓	8.73	11.0	467	0.41	6.22	230.1	12.3	turbid after YSI
1255	5.0	0.4	8.76	11.2	480	0.31	6.22	231.8	11.4	↓
1300	7.0	0.4	8.75	11.1	482	0.42	6.22	254.3	8.91	
1305	9.0	↓	8.75	11.2	482	0.47	5.96	272.9	8.85	
1310	11.0		8.75	11.2	480	0.33	6.12	258.3	4.77	↓
1315	13.0	↓	8.75	11.2	480	0.32	6.05	257.6	4.11	turbid w/o YSI

Total Gallons Purged: 3.42
Total Casing Volumes Removed: 3.25
Ending Water Level (ft TOC): 8.75
Ending Total Depth (ft TOC): 15.1

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1315	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP15 - 090402

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-15 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/2/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 4.0-17.4

Starting Water Level (ft TOC): 9.91
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.05
Casing Diameter (inche: 2

Casing Volume 7.14 (ft Water) x 0.16 (Lpfv)(gpf) = 1.14 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1045	✓	0.15	✓	✓	✓	✓	✓	✓	✓	clear discharge
1050	2.5	↓	10.02	13.3	7340	0.14	6.82	207.9	0.97	turbid after YSI
1055	5.0		10.03	13.5	7044	0.15	6.56	210.0	1.19	
1100	7.5		10.03	13.4	7295	0.15	6.31	206.6	0.96	↓
1105	10.0		10.04	13.4	7196	0.12	6.20	207.7	0.99	
1110	12.5		10.04	13.3	7070	0.11	6.12	203.5	1.04	↓
1115	15.0	↓	10.04	13.2	7059	0.10	6.09	198.2	0.73	turbid w/o YSI

Total Gallons Purged: 3.94
Total Casing Volumes Removed: 3.45

Ending Water Level (ft TOC): 10.04
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1115	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP17-090331

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-17 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 3/31/09
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 6.0-16.0
Filter Pack Interval (ft. TOC): 4.0-16.5

Starting Water Level (ft TOC): 9.05
Casing Stickup (ft): -0.17
Total Depth (ft TOC): 16.21
Casing Diameter (inche: 2

Casing Volume 7.16 (ft Water) x .16 (Lpfv)(gpf) = 1.14 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 14 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1415	/	0.35	/	/	/	/	/	/	/	clear discharge
1420	1.75		9.08	12.4	663	0.80	6.03	287.6	33	SI cloudy
1425	3.50		9.08	12.4	680	0.60	6.04	284.1	16	turbid after YSI
1430	5.25		9.08	12.3	679	0.47	6.03	281.6	5.46	
1435	7.00		9.08	12.3	681	0.44	6.05	280.8	3.11	
1440	8.75		9.08	12.3	678	0.39	6.04	279.5	6.08	
1445	10.5		9.08	12.3	679	0.41	6.04	279.1	6.04	
1450	12.25	✓	9.08	12.3	678	0.39	6.05	278.3	2.00	turbid w/o YSI

Total Gallons Purged: 3.22
Total Casing Volumes Removed: 2.82

Ending Water Level (ft TOC): 9.08
Ending Total Depth (ft TOC): 16.21

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1450	1L	HPDE		1	none	HNO3			Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none			cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate
✓	40mL	VOA vial		3	none	HCl			Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 #
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

FM105-090331 and FM105-090331D

GROUNDWATER SAMPLING RECORD | **WELL NUMBER: FM-105** | Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP | Project Number: 080064

Date: _____

Developed by: DFR/AT

Measuring Point of Wel: TOC

Screened Interval (ft. TOC): 7.0-17.0

Filter Pack Interval (ft. TOC): 6.0-17.5

Starting Water Level (ft TOC): 10.76

Casing Stickup (ft): -0.2

Total Depth (ft TOC): 18

Casing Diameter (inche: 2

Casing Volume 7.24 (ft Water) x 0.16 (Lpfv)(gpf) = 1.15 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1105	✓	0.35	✓	✓	✓	✓	✓	✓	✓	clear discharge
1110	1.75	↓	10.80	11.7	519	1.90	6.31	73.8	2.68	turbid after YSI
1115	3.50		10.80	11.7	513	1.34	6.32	65.0	1.37	↓
1120	5.25		10.80	11.6	501	1.20	6.30	44.1	1.02	
1125	7.00		10.80	11.6	491	1.08	6.30	31.7	0.74	
1130	8.75		10.80	11.6	486	1.03	6.26	43.2	0.68	
1135	10.5		10.81	11.5	480	0.99	6.23	75.4	0.60	↓
1140	12.25	↓	10.81	11.5	476	0.96	6.26	74.3	0.53	turbid before YSI
1										

Total Gallons Purged: 3.22

Total Casing Volumes Removed: 2.80

Ending Water Level (ft TOC): 10.81

Ending Total Depth (ft TOC): 18

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1140 for sample		FM105-	090331						
1145	1L for dup	PCBs		2	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		4	none	none	↓	↓	cPAHs
	1L	Amber glass		4	none	none			PCBs
	500mL	Amber glass		4	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		4	none	none			Bis(2-ethyl hexyl) phthalate
↓	40mL	VOA vial		6	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 #

Purging Equipment: Dedicated QED Well Wizard Bladder Pump Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments: _____

Second set of bottles collected for duplicate sample dup collected @ 1145

Aspect consulting
earth+water

MW26R-090401 and duplicate

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-26R | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/1/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 6.5-16.5
Filter Pack Interval (ft. TOC): 4.0-17.0

Starting Water Level (ft TOC): 9.66
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17.05
Casing Diameter (inche: 2

Casing Volume 7.39 (ft Water) x 0.16 (Lpfv)(gpf) = 1.18 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 11.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
950	/	0.5	/	~~12.6~~	/	/	/	/	/	clear discharge
955	2.5	↓	9.66	12.6	1556	0.42	6.59	242.3	2.70	turbid after YSI
1000	5.0	↓	9.66	12.6	1394	0.34	6.56	233.2	2.22	↓
1005	7.5	↓	9.66	12.4	1304	0.26	6.47	235.8	0.92	↓
1010	10.0	↓	9.66	12.4	1258	0.25	6.42	229.6	1.24	↓
1015	12.5	↓	9.66	12.4	1212	0.22	6.41	227.3	1.06	↓
1020	15.0	↓	9.66	12.3	1198	0.22	6.43	229.6	0.93	turbid w/o YSI

Total Gallons Purged: 3.94
Total Casing Volumes Removed: 3.34

Ending Water Level (ft TOC): 9.66
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1020	1L	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		4	none	none	↓	↓	cPAHs
	1L	Amber glass		4	none	none			PCBs
	500mL	Amber glass		4	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		4	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
1025	—	—	—	—	—	—	—	→	duplicate
									MW26R-090401D

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Second set of bottles collected for duplicate sample at 1025

Aspect consulting
earth+water

MW36-090402

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-36 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP | Project Number: 080064

Date: 4/2/2009

Developed by: DFR/AT

Measuring Point of Wel: TOC

Screened Interval (ft. TOC): 58.0-73.0

Filter Pack Interval (ft. TOC): 55.0-71.0

Starting Water Level (ft TOC): 9.06

Casing Stickup (ft): -0.23

Total Depth (ft TOC): 73

Casing Diameter (inche: 2

Casing Volume 63.94 (ft Water) x 0.15 (Lpfv)(gpf) = 10.23 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 65.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
945	~	0.15	~	~	~	~	~	~	~	clear discharge
950	7.5	↓	9.11	12.5	3657	0.24	6.47	211.6	0.98	turbid after YSI
955	5.0		9.13	12.6	3689	0.18	6.50	212.3	1.03	↓
1000	7.5		9.13	12.5	3727	0.12	6.50	220.2	0.92	
1005	10.0		9.13	12.5	3733	0.12	6.48	204.3	0.95	
1010	12.5		9.13	12.4	3737	0.12	6.48	210.3	0.97	
1015	15.0	↓	9.13	12.4	3734	0.11	6.48	219.9	0.84	turbid w/o YSI

Total Gallons Purged: 3.94

Total Casing Volumes Removed: 0.38

Ending Water Level (ft TOC): 9.13

Ending Total Depth (ft TOC): 73

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1015	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #

Purging Equipment: Peristaltic Pump w/ dedicated tubing Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting
earth+water

MW125-090331

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-125 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 3/31/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 5.0-15.0
Filter Pack Interval (ft. TOC): 3.0-15.0

Starting Water Level (ft TOC): 6.40
Casing Stickup (ft): -1.11
Total Depth (ft TOC): 13.35
Casing Diameter (inche: 2

Casing Volume 6.94 (ft Water) x 0.16 (Lpfv)(gpf) = 1.11 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 13 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1310	/	0.35	/	/	/	/	/	/	/	clear discharge
1315	1.75	↓	6.56	11.4	608	2.65	6.26	131.5	1.75	turbid after YSI
1320	3.50		6.56	11.4	609	2.44	6.30	118.4	1.27	↓
1325	5.25		6.56	11.4	604	2.27	6.30	155.8	1.02	
1330	7.00		6.56	11.4	593	2.05	6.31	169.3	1.01	
1335	8.75		6.56	11.3	586	1.84	6.25	162.9	0.68	
1340	10.5		6.58	11.4	586	1.77	6.19	224.3	0.79	↓
1345	12.25	↓	6.58	11.4	589	1.74	6.18	150.1	0.74	turbid w/o YSI

Total Gallons Purged: 3.22
Total Casing Volumes Removed: 2.90

Ending Water Level (ft TOC): 6.58
Ending Total Depth (ft TOC): 13.35

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1345	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate
↓	40mL	VOA vial		3	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 147
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

MW44 - 090401

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-44 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP | Project Number: 080064

Date: 4/01/2009

Developed by: DFR/AT

Measuring Point of Wel: TOC

Screened Interval (ft. TOC): n/a

Filter Pack Interval (ft. TOC): n/a

Starting Water Level (ft TOC): 8.94

Casing Stickup (ft): -0.18

Total Depth (ft TOC): 73.9

Casing Diameter (inche: 2

Casing Volume 64.96 (ft Water) x 0.16 (Lpfv)(gpf) = 10.39 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 68 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1030	✓	0.5	✓	✓	✓	✓	✓	✓	✓	clear discharge
1035	2.5	↓	8.45	12.1	106	7.07	7.25	138.3	10.32	turbid w/ YSI
1040	5.0		8.96	11.9	67	6.94	7.13	120.6	9.57	↓
1045	7.5		8.97	12.3	48	6.97	6.89	164.4	9.47	
1050	10.0		8.98	12.4	43	7.18	6.74	162.8	9.31	
1055	12.5		8.99	12.4	49	7.06	6.60	179.9	9.79	↓
1100	15.6	↓	9.01	11.5	46	7.25	6.42	194.8	7.33	turbid w/o YSI

Total Gallons Purged: 3.94

Total Casing Volumes Removed: 0.38

Ending Water Level (ft TOC): 9.01

Ending Total Depth (ft TOC): 73.9

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1100	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #

Purging Equipment: Peristaltic Pump w/ dedicated tubing

Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting
earth+water

MW308N - 090402

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-308N | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/2/2009
Developed by: DFR/AT
Measuring Point of Wel: TOC
Screened Interval (ft. TOC): 12.5-17.5
Filter Pack Interval (ft. TOC): 10.0-21.5
Starting Water Level (ft TOC): 5.86
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.95
Casing Diameter (inche: 2

Casing Volume 12.09 (ft Water) x 0.16 (Lpfv)(gpf) = 1.93 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1240	✓	0.5	✓	✓	✓	✓	✓	✓	✓	
1245	2.5	0.3	7.06	12.0	2400	0.35	6.74	180.1	24.0	algae particles present
1250	5.0	0.25	7.20	12.3	1801	0.07	6.60	183.7	515.6	turbid after YSI
1255	5.5	0.2	8.00	12.2	1766	0.06	6.50	181.5	14.1	
1300	7.0	↓	8.00	12.2	1748	0.06	6.45	176.2	13.5	↓
1305	8.5		8.30	12.2	1734	0.06	6.43	182.4	11.5	
1310	10.0		8.32	12.3	1714	0.06	6.43	190.9	8.92	
1315	12.5	↓	8.34	12.3	1712	0.05	6.45	188.3	8.62	turbid w/o YSI

Total Gallons Purged: 3.28
Total Casing Volumes Removed: 1.704
Ending Water Level (ft TOC): 8.34
Ending Total Depth (ft TOC): 17.95

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1315	1L	HPDE		1	none	HNO3			Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none			cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate
↓									

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

~~MW-30~~ MW308S-090401

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-308S Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 4/1/2009
Developed by: DFR/AT
Measuring Point of Wel TOC
Screened Interval (ft. TOC) 35.0-40.0
Filter Pack Interval (ft. TOC) 31.0-40.0

Starting Water Level (ft TOC): 5.74
Casing Stickup (ft): -0.61
Total Depth (ft TOC): 40.5
Casing Diameter (inche: 2

Casing Volume 34.76 (ft Water) x 0.16 (Lpfv)(gpf) = 5.56 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 37.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1400	/	0.5	5.74	/	/	/	/	/	/	clear discharge
1405	2.5	0.3	6.48	13.1	1558	0.12	7.55	238.2	1.29	turbid w/ YSI
1410	4.0	0.3	6.37	13.0	1567	0.09	7.26	239.0	1.01	
1415	5.5	0.3	6.25	12.9	1567	0.08	7.16	232.6	0.96	
1420	7.0	↓	6.25	12.9	1567	0.08	7.15	205.5	1.13	
1425	8.5		6.25	12.9	1565	0.09	7.13	212.3	1.48	↓
1430	10.0	↓	6.23	12.9	1565	0.08	7.13	208.9	1.01	turbid w/o YSI

Total Gallons Purged: 2.63
Total Casing Volumes Removed: 0.47

Ending Water Level (ft TOC): 6.23
Ending Total Depth (ft TOC): 40.5

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1430	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↑	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 1 of 1	
ARI Client Company: Aspect Consulting LLC	Phone: 206 780 9370	Date: 3/31/2009	Ice Present? Y
Client Contact: Chip Goodhue		No. of Coolers: 2 of 4	Cooler Temps: 5.4, 3.8, 7.2, 5.8
Client Project Name: Southwest Harbor Project - Phase 2 GWCMP			
Client Project #: 080064	Samplers: DAVE RUGH / AMY TICE		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Total Metals 6010B/6020 (As, Pb)	CEE's 8260B	cPAHs 8270C SIM	NWTPH-Dx Diesel + Oil w/silica cleanup	BEHP 8270C	PCBs 8082			Notes/Comments
					Analysis Requested								
CMP2-090331	3/31/09	845	W	9	X		X	X	X	X			
CMP4-090331	"	945	"	9	X		X	X	X	X			
FM105-090331	"	1140	"	12	X	X	X	X	X	X			
MW125-090331	"	1345	"	12	X	X	X	X	X	X			
CMP17-090331	↓	1450	↓	12	X	X	X	X	X	X			
FM105[redacted]-090331D	↓	1145	↓	12	X	X	X	X	X	X			

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: DAVID RUGH	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Aspect LLC	Company: ARI	Company:	Company:
	Date & Time: 3/31/09 1550	Date & Time: 3/31/09 1556	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 1 of 1	
ARI Client Company: Aspect Consulting LLC	Phone: 206 780 9370	Date: 4/1/2009	Ice Present? Y-S
Client Contact: Chip Goodhue		No. of Coolers: 3 (2)	Cooler Temps: 6.6, 5.2, 7.4
Client Project Name: Southwest Harbor Project - Phase 2 GWCMP			
Client Project #: 080064	Samplers: DAVID RUGH / AMY TICE		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Tot Metals 6010B/6020 (As, Pb)	Tot Metals 6010B/6020 (As, Pb, Sb, Cr, Cu)	CPAHs 8270C SIM	NWTPHD Diesel + Oil w/silica cleanup	BEHP 8270C	PCBs 8082			Notes/Comments
CMP3-090401	4/1/2009	910	W	9	X		X	X	X	X			
MW26R-090401		1020	W	9		X	X	X	X	X			
MW26R-090401D		1025	W	9		X	X	X	X	X			
MW44-090401		1100	W	9		X	X	X	X	X			
CMP5-090401		1315	W	9	X	DR	X	X	X	X			Tot Metals - As, Pb only
MW3085-090401		1430	W	9	X		X	X	X	X			

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: DAVID RUGH	Printed Name: Dana Hayes	Printed Name:	Printed Name:
	Company: Aspect LLC	Company: ARI	Company:	Company:
	Date & Time: 4/1/09 1540	Date & Time: 4/1/09 1540	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 1 of 1	
ARI Client Company: Aspect Consulting LLC	Phone: 206 780 9370	Date: 4/2/2009	Ice Present?
Client Contact: Chip Goodhue		No. of Coolers: 2i	Cooler Temps:
Client Project Name: Southwest Harbor Project - Phase 2 GWCMP			
Client Project #: 080064	Samplers: DAVID RUGH / AMY TICE		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Total Metals 6010B/6020 (As, Pb)	Total Metals 6010B/6020 (As, Pb, Sb, Cr, Cu)	cPAH's 8270C SIM	NwTPH-D Diesel + Oil w/silica cleanup	BEHP 8270C	PCBs 8082			Notes/Comments
					Analysis Requested								
CMP4-090402	4/2/09	855	Water	9	X		X	X	X	X			
MW36-090402	"	1015	"	9		X	X	X	X	X			
CMP15-090402	"	1115	"	9		X	X	X	X	X			
MW30RN-090402	↓	1315	↓	9	X		X	X	X	X			

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: DAVID RUGH	Printed Name: Mikki Mulumba	Printed Name:	Printed Name:
	Company: Aspect LLC	Company: ARI	Company:	Company:
	Date & Time: 4/2/2009 1400	Date & Time: 4/2/2009 1400	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Aspect consulting
earth+water

CMP1-090904

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-1 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/4/08
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) 7.0-17.0
Filter Pack Interval (ft. TOC) 5.0-19.0

Starting Water Level (ft TOC): 13.10
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 16.85
Casing Diameter (inche 2

Casing Volume 3.75 (ft Water) x 0.62 (Lpfv)(gpf) = 2.33 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0819	0	350	13.10	–	–	–	–	–	–	NTU thru YSI
0822	1050		13.11	13.01	536	1.06	6.32	37.4	16.1	except last
0825	2100		13.11	12.98	521	0.79	6.21	32.2	2.54	reading
0828	3150		13.11	13.05	513	0.62	6.35	31.6	1.42	
0831	4200		13.11	13.08	511	0.55	6.31	31.0	0.78	

Total Gallons Purged: ~4.5 Gallons
Total Casing Volumes Removed: 1.96
Ending Water Level (ft TOC): 13.11
Ending Total Depth (ft TOC): 16.85

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
0826	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
	500mL	Amber glass		2	none	none			cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP2-090902

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-2 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/2/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 5.0-19.0

Starting Water Level (ft TOC): 13.60'
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.3
Casing Diameter (inche: 2

Casing Volume 3.7 (ft Water) x 0.62 (Lpfv)(gpf) = 2.29 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0853	0	480	13.60	—	—	—	—	—	—	NTU Thru YSI
0856	1.44	480	13.59	16.28	1685	.35	8.40	190.4	0.87	except last reading
0859	2.88	480	13.62	16.23	1662	.27	8.43	159.8	0.48	J
0902	4.32	480	13.59	16.19	1669	.24	8.42	148.9	1.31	

Total Gallons Purged: ~4.5 Liters
Total Casing Volumes Removed: 1.97

Ending Water Level (ft TOC): 13.59
Ending Total Depth (ft TOC): 17.3

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
0905	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP3-090903

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-3 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP | Project Number: 080064

Date: 9/3/09

Developed by: DFR/AT

Measuring Point of We: TOC

Screened Interval (ft. TOC): 6.0-16.0

Filter Pack Interval (ft. TOC): 4.0-17.5

Starting Water Level (ft TOC): 8.45

Casing Stickup (ft): -0.37

Total Depth (ft TOC): 15.84

Casing Diameter (inche: 2

Casing Volume: 7.39 (ft Water) x 0.62 (Lpfv)(gpf) = 4.58 (L)(gal)

Casing volumes: 2" = 0.16 gpf, 4" = 0.65 gpf, 6" = 1.47 gpf; 2" = 0.62 Lpf, 4" = 2.46 Lpf, 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~11 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0815	0	400mL	8.45	—	—		—	—	—	NTU lines YSI
0818	1200	400mL	8.115	18.76	685	0.82	9.92	169	19.8	except last
0821	2400	400	8.[illegible]	19.58	693	0.63	10.03	159.9	11.0	
0824	3600	400	8.48	19.27	703	0.40	10.01	171.8	5.3	

Total Gallons Purged: 4 Liters

Total Casing Volumes Removed: 0.87

Ending Water Level (ft TOC): 8.48

Ending Total Depth (ft TOC): 15.84

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
0900	1L	HPDE		1	none	HNO3	none	none	Total Metals - As, Pb
	500mL	Amber glass		2	none	none			cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120

Purging Equipment: Peristaltic Pump w/ dedicated tubing

Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting earth+water

CMP4.090904

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-4

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Date: 9/3/09
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) 7.0-17.0
Filter Pack Interval (ft. TOC) 5.0-17.5

Project Number: 080064
Starting Water Level (ft TOC): 11.01
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17
Casing Diameter (inche 2

Casing Volume 5.99 (ft Water) x 0.62 (Lpfv)(gpf) = 3.71 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0934	0	400	11.01	—	—	—	—	—	—	NTU thru YSI
0937	1200	400	11.06	16.81	789	0.25	8.22	38.8	6.96	
0940	2400	400	11.05	16.97	775	0.21	8.20	30.2	2.63	
0943	3600	400	11.05	17.05	771	0.19	8.13	22.1	2.75	

Total Gallons Purged: ~4 Liters

Total Casing Volumes Removed: 1.08

Ending Water Level (ft TOC): 11.05

Ending Total Depth (ft TOC): 17.0

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance Color	Appearance Turbidity & Sediment	Remarks
0945	1L	HPDE		1	none	HNO3	none	clear	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120

Purging Equipment: Peristaltic Pump w/ dedicated tubing

Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting
earth+water

CMP5-090902

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-5 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/2/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 5.5-15.5
Filter Pack Interval (ft. TOC): 3.0-19.0
Starting Water Level (ft TOC): 10.12
Casing Stickup (ft): -0.27
Total Depth (ft TOC): 15.1
Casing Diameter (inche: 2

Casing Volume 4.99 (ft Water) x 0.62 (Lpfv)(gpf) = 3.09 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~10.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L) mL	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1229	0	425	10.12	--	--	--	--	--	--	NTU meter YSI
1234	1200	400	10.39	17.74	509	0.78	6.05	-65.9	20.0	
1235	2400	375	10.64	17.89	509	0.52	6.09	-82.1	5.7	
1238		375	10.70	16.84	509	0.44	6.05	-94.2	6.98	

Total Gallons Purged: ~4 Liters
Total Casing Volumes Removed: 1.29
Ending Water Level (ft TOC): 10.90
Ending Total Depth (ft TOC): 15.1

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1240	1L	HPDE		1	none	HNO3	Clear	None	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 170
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP15-090903

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-15 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/3/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 4.0-17.4
Starting Water Level (ft TOC): 10.01
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.05
Casing Diameter (inche: 2

Casing Volume 6.91 (ft Water) x 0.62 (Lpfv)(gpf) = 4.28 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~12 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1113	0	350	10.14	-	-	-	-	-	-	NTU too high!
1116	1050	350	10.22	15.95	3911	0.32	7.10	-114.7	1.92	purged 1050
1119	2100	350	10.24	15.96	3706	0.34	7.60	-114.7	1.50	reading
1122	3150	350	10.24	15.97	3543	0.36	6.??	-3.5	1.78	

Total Gallons Purged: ~4 (1105 — illegible)
Total Casing Volumes Removed: 0.93

Ending Water Level (ft TOC): 10.24
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	
1125	1L	HPDE		1	none	HNO3	clear	[illegible]	Total Metals - As, Pb, Sb, Cr, Cu, Ni
"	500mL	Amber glass		2	none	none	"	"	cPAHs
"	1L	Amber glass		2	none	none	"	"	PCBs
"	500mL	Amber glass		2	none	none	"	"	TPH- DX (w/silica gel cleanup)
"	500mL	Amber glass		2	none	none	"	"	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

CMP17-090902

GROUNDWATER SAMPLING RECORD

WELL NUMBER: CMP-17 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/2/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 6.0-16.0
Filter Pack Interval (ft. TOC): 4.0-16.5

Starting Water Level (ft TOC): 9.50'
Casing Stickup (ft): -0.17
Total Depth (ft TOC): 16.21
Casing Diameter (inche: 2

Casing Volume 6.71 (ft Water) x 0.62 (Lpfv)(gpf) = 4.16 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 14 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1025	0	500	9.50	–	–	–	–			NTU 1000 45.1
1028	1500	500	9.58	17.53	599	0.57	5.85	124.3	86.3	until last reading
1031	3000	500	9.60	17.48	598	0.25	5.83	120.1	15.2	
1034	4500	500	9.58	17.46	597	0.32	5.83	115.4	41.82	

Total Gallons Purged: 4500 mL
Total Casing Volumes Removed: 1.08

Ending Water Level (ft TOC): 9.58
Ending Total Depth (ft TOC): 16.21

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1040	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
↓	40mL	VOA vial		3	none	HCl	↓	↓	Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 12.0
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

FM105-090902 - FM105-090902-2

GROUNDWATER SAMPLING RECORD

WELL NUMBER: FM-105 Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/2/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 7.0-17.0
Filter Pack Interval (ft. TOC): 6.0-17.5
Starting Water Level (ft TOC): 11.36
Casing Stickup (ft): -0.2
Total Depth (ft TOC): 18
Casing Diameter (inche: 2

Casing Volume 6.64 (ft Water) x 0.62 (Lpfv)(gpf) = 4.12 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): 15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1107	0	500 mLpm	11.36	—	—	—	—	—	—	NTU meter YSI
1105	1500	500	11.98	14.47	520	0.81	5.96	108.3	6.89	
1108	3000	500	11.40	14.44	513	0.69	5.94	109.8	1.14	
1111	4500	500	11.39	14.44	518	0.58	5.95	110.9	3.64	

Total Gallons Purged: 25 Liters
Total Casing Volumes Removed: 1.21
Ending Water Level (ft TOC): 11.39
Ending Total Depth (ft TOC): 18

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1115	1L	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb
	500mL	Amber glass		4	none	none			cPAHs
	1L	Amber glass		4	none	none			PCBs
	500mL	Amber glass		4	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		4	none	none			Bis(2-ethyl hexyl) phthalate
	40mL	VOA vial		6	none	HCl			Chlorinated Ethanes and Ethenes (CEEs)
1120	← duplicate								

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 120
Purging Equipment: Dedicated QED Well Wizard Bladder Pump
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:
Second set of bottles collected for duplicate sample

Aspect consulting
earth+water

MW26R-090903 + MW26R-090903D

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-26R **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Date: 9/3/09
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) 6.5-16.5
Filter Pack Interval (ft. TOC) 4.0-17.0

Project Number: 080064
Starting Water Level (ft TOC): 9.69
Casing Stickup (ft): -0.32
Total Depth (ft TOC): 17.05
Casing Diameter (inche 2

Casing Volume 7.36 (ft Water) x 0.62 (Lpfv)(gpf) = 4.56 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 11.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1335	0	400	9.69	-	-	-	-	-	-	NTU thru YSI
1338	1200	400	9.78	15.14	1165	0.20	7.39	-20.8	5.47	except last
1341	2400	400	9.78	15.29	1117	0.17	7.01	-26.1	2.69	
1344	3600	400	9.78	15.43	1043	0.15	7.14	-30.5	1.91	

Total Gallons Purged: ~4 Liters
Total Casing Volumes Removed: 0.88
Ending Water Level (ft TOC): 9.78
Ending Total Depth (ft TOC): 17.05

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1350	1L	HPDE		2	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		4	none	none	↓	↓	cPAHs
↓	1L	Amber glass		4	none	none	↓	↓	PCBs
↓	500mL	Amber glass		4	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		4	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
1355	duplicate								

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:
Second set of bottles collected for duplicate sample

Aspect consulting
earth+water

mw36-090903

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-36 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Project Number: 080064
Date: 9/3/09
Developed by: DFR/AT
Measuring Point of We: TOC
Screened Interval (ft. TOC): 58.0-73.0
Filter Pack Interval (ft. TOC): 55.0-71.0

Starting Water Level (ft TOC): 9.72
Casing Stickup (ft): -0.23
Total Depth (ft TOC): 73
Casing Diameter (inche: 2

Casing Volume 63.28 (ft Water) x 0.62 (Lpfv)(gpf) = 39.23 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 65.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm) mL/pm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1035	0	350	9.72	-	-	-	-	-	-	NTU through [illegible]
1038	1050	350	9.74	14.11	3810	0.19	8.89	-93.9	1.84	[illegible]
1041	2450	350	9.72	13.96	3813	0.15	9.01	-105.3	1.43	reading
1042	3150	350	9.74	13.87	3812	0.12	8.78	-119.6	1.83	

Total Gallons Purged: ~3.5 Liters
Total Casing Volumes Removed: 0.09

Ending Water Level (ft TOC): 9.74
Ending Total Depth (ft TOC): 73

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1050	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate
↓									

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 120
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting earth+water

MW44-090903

GROUNDWATER SAMPLING RECORD	WELL NUMBER: MW-44	Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Date: 9.3.09
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) n/a
Filter Pack Interval (ft. TOC) n/a

Project Number: 080064
Starting Water Level (ft TOC): 11.46
Casing Stickup (ft): -0.18
Total Depth (ft TOC): 73.9
Casing Diameter (inche 2

Casing Volume 62.44 (ft Water) x 0.62 (Lpfv)(gpf) = 38.71 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 68 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L)	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1411	0	400	11.46	--	-	--	--	--	.	NTU thru YSI
1414	1200	400	11.51	14.40	207	4.18	6.98	[illegible]	11.3	except last
1417	2400	400	11.50	14.22	90	4.10	6.73	13.8	9.29	reading
1420	3600	400	11.50	14.12	38	3.96	6.[illegible]	[illegible]	[illegible]	
1423	4800	400	11.50	14.06	~ 36*	3.85	5.86	25.4	4.63	* sp. cond variable
1426	6000	400	11.50	14.07	37	3.84	5.84	80.1	3.26	between 55 and
										~3

Total Gallons Purged: ~ 6 Liters

Total Casing Volumes Removed: 0.15

Ending Water Level (ft TOC): 11.50

Ending Total Depth (ft TOC): 73.9

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1430	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb, Sb, Cr, Cu, Ni
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 #170

Purging Equipment: Peristaltic Pump w/ dedicated tubing

Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting
earth+water

MW125-090902

GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-125 | **Page: 1 of 1**

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP | Project Number: 080064

Date: 9/2/09

Developed by: DFR/AT

Measuring Point of We: TOC

Screened Interval (ft. TOC): 5.0-15.0

Filter Pack Interval (ft. TOC): 3.0-15.0

Starting Water Level (ft TOC): 7.01

Casing Stickup (ft): -1.11

Total Depth (ft TOC): 13.35

Casing Diameter (inche: 2

Casing Volume 6.34 (ft Water) x 0.62 ((Lpf)/(gpf)) = 3.93 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): 13 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L) mL	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0951	0	500	7.01	—	—	—	—	—	—	NW: then YSI
0954	1500	500	7.23	19.24	542	1.04	5.94	129.1	7.48	error last
0957	3000	500	7.21	19.33	496	0.94	5.94	129.4	1.55	reading
1000	4500	500	7.19	19.33	486	0.85	5.93	130.3	1.64	0
1002	6000	500	7.20	19.31	475	0.83	5.94	130.3	2.84	

Total Gallons Purged: ~6 liters

Total Casing Volumes Removed: 1.53

Ending Water Level (ft TOC): 7.20

Ending Total Depth (ft TOC): 13.35

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1005	1L	HPDE		1	none	HNO3	none	clear	Total Metals - As, Pb
	500mL	Amber glass		2	none	none			cPAHs
	1L	Amber glass		2	none	none			PCBs
	500mL	Amber glass		2	none	none			TPH- DX (w/silica gel cleanup)
	500mL	Amber glass		2	none	none			Bis(2-ethyl hexyl) phthalate
	40mL	VOA vial		3	none	HCl			Chlorinated Ethanes and Ethenes (CEEs)

METHODS

Sampling Equipment and IDs: Dedicated QED Well Wizard Bladder Pump and YSI 556 # 126

Purging Equipment: Dedicated QED Well Wizard Bladder Pump Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Aspect consulting earth+water

MW308N-090904

GROUNDWATER SAMPLING RECORD	WELL NUMBER: MW-308N	Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Date: 9/4/09
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) 12.5-17.5
Filter Pack Interval (ft. TOC) 10.0-21.5

Project Number: 080064
Starting Water Level (ft TOC): 6.50
Casing Stickup (ft): -0.29
Total Depth (ft TOC): 17.95
Casing Diameter (inche 2

Casing Volume 11.45 (ft Water) x 0.62 (Lpfv)(gpf) = 7.10 (L)(gal)
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): ~15 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L) mL	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
0909	0	400	6.50	--	←	←	←	←	--	NTU [illegible] YSI
0912	1200	150	8.00	15.49	2723	0.73	6.40	[illegible]	6.79	[illegible]
0915	surged →								→	reading
										surged and purged
0920	~2400	150	8.60	—	—	—	—	—	—	to attempt to
0923	2850	↓	8.50	16.26	3065	0.51	6.40	-124.4	15.0	clear screen
0926	3300	↓	8.62	16.31	2592	0.34	6.41	-124.2	10.7	
0929	3750	↓	8.70	16.38	2539	0.23	6.52	-127.1	9.24	bacterial growth
0932	4200	↓	8.72	16.34	2509	0.23	6.55	-121.9	11.2	inside casing

Total Gallons Purged: ~4200 mL
Total Casing Volumes Removed: 0.59
Ending Water Level (ft TOC): 8.72
Ending Total Depth (ft TOC): 17.95

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
0935	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 170
Purging Equipment: Peristaltic Pump w/ dedicated tubing
Decon Equipment: Alconox, Distilled Water
Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank
Observations/Comments:

Aspect consulting
earth+water

MW308S-090904

GROUNDWATER SAMPLING RECORD	WELL NUMBER: MW-308S	Page: 1 of 1

Project Name: SOUTHWEST HARBOR PROJECT - Phase II GCWMP
Date: 9/4/09
Developed by: DFR/AT
Measuring Point of We TOC
Screened Interval (ft. TOC) 35.0-40.0
Filter Pack Interval (ft. TOC) 31.0-40.0

Project Number: 080064
Starting Water Level (ft TOC): 6.17
Casing Stickup (ft): -0.61
Total Depth (ft TOC): 40.5
Casing Diameter (inche 2

Casing Volume 34.33 (ft Water) x 0.62 (Lpfv)(gpf) = 21.28 (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ~ 37.5 ft

PURGING MEASUREMENTS

Time	Cumul. Vol. (gal or L) mL	Purge Rate (gpm or Lpm) mLpm	Water Level (ft)	Temp. (C or F)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments
1022	0	250	6.17	-	-	-	-	-	-	[illegible]
1025	750	↓	6.[illegible]	14.91	1520	0.[illegible]	7.[illegible]	[illegible]	3.50	[illegible]
1028	1500	↓	6.67	14.69	1537	0.13	7.09	-179.2	2.19	
1031	2250	↓	6.68	14.49	1541	0.11	7.08	-175.2	1.51	

Total Gallons Purged: ~ 2.5 Liters

Total Casing Volumes Removed: 0.12

Ending Water Level (ft TOC): 6.68

Ending Total Depth (ft TOC): 40.5

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance: Color	Appearance: Turbidity & Sediment	Remarks
1035	1L	HPDE		1	none	HNO3	clear	none	Total Metals - As, Pb
↓	500mL	Amber glass		2	none	none	↓	↓	cPAHs
↓	1L	Amber glass		2	none	none	↓	↓	PCBs
↓	500mL	Amber glass		2	none	none	↓	↓	TPH- DX (w/silica gel cleanup)
↓	500mL	Amber glass		2	none	none	↓	↓	Bis(2-ethyl hexyl) phthalate

METHODS

Sampling Equipment and IDs: Peristaltic Pump and YSI 556 # 170

Purging Equipment: Peristaltic Pump w/ dedicated tubing

Decon Equipment: Alconox, Distilled Water

Disposal of Discharged Water: Stored in 1,000 gallon temporary onsite storage tank

Observations/Comments:

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: STD
ARI Client Company: Aspect Consulting LLC	Phone: 206 780 9370
Client Contact: Chip Goodhue	
Client Project Name: Southwest Harbor Project Phase 2 GW CMP	
Client Project #: 080064	Samplers: Bob Hanford, Amy Tice
Date: 9/2/09	Page: 1 of 1
No. of Coolers: 3	Cooler Temps: [illegible]

Sample ID	Date	Time	Matrix	No. Containers	Tot metals 6010B/6020 (As, Pb)	CVOCs 8260B	cPAHs 8270 SIM	NWTPH-Dx (diesel/oil w/silica clean)	BEHP 8270C	PCBs 8082			Notes/Comments
CMP2-090902	9/2/09	0905	W	9	X		X	X	X	X			
MW125-090902	↓	1005	↓	12	X	X	X	X	X	X			
CMP17-090902	↓	1040	↓	12	X	X	X	X	X	X			
FMIC5-090902	↓	1115	↓	12	X	X	X	X	X	X			
FMIC5-090902 D	↓	1120	↓	12	X	X	X	X	X	X			
CMP5-090902	↓	1240	↓	9	X		X	X	X	X			

Comments/Special Instructions

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Amy Tice	Printed Name: [illegible]	Printed Name:	Printed Name:
Company: Aspect	Company: ARI	Company:	Company:
Date & Time: 9/2/09 1345	Date & Time: 9/2/09 [illegible]	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alernate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:
Turn-around Requested: STD
ARI Client Company: Aspect Consulting
Phone:
Client Contact: Chip Goodhue
Client Project Name: Southwest Harbor Project - Phase 2 GW CMP
Client Project #: 060004
Samplers: AET PSB
Date: 9/3/09
Page: 1 of 1
No. of Coolers:
Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	total metals 6010/6020 (As, Pb)	tot metals 6010B/6020 As, Pb, Sb, Cr, Cu, Ni	cPAHs 8270 Csim	NWTPH-Dx Diesel + oil w/silica clean	BEHP 8270C	PCBs 8082			Notes/Comments
CMP3-090903	9/3/09	0900	water	9	X		X	X	X	X			
CMP4-090903	↓	0945	↓	9	X		X	X	X	X			
CMP15-090903	↓	1125	↓	9		X	X	X	X	X			
MW26R-090903	↓	1350	↓	9		X	X	X	X	X			
MW26R-090903D	↓	1355	↓	9		X	X	X	X	X			
MW41-090903	↓	1430	↓	9		X	X	X	X	X			
MW36-090903	↓	1050	↓	9		X	X	X	X	X			

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Amy Tice	Printed Name: Nikka Mulumbu	Printed Name:	Printed Name:
	Company: Aspect	Company: ARI	Company:	Company:
	Date & Time: 9/3/09 1512	Date & Time: 9/3/09 1512	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alernate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD
ARI Client Company: Aspect Consulting LLC	Phone: 206-780-9370
Client Contact: Chip Goodhue	
Client Project Name: Southwest Harbor Project Phase 2 GW CMP	
Client Project #: 080064	Samplers: AET, PSB

Date: 9/11/09

Page: 1 of 1

No. of Coolers: 1 Cooler Temps: 17.2, 19.2

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: Total Metals (As, Pb)	Analysis Requested: Total Metals (As, Pb)	Analysis Requested: cPAHs 8270c SIM	Analysis Requested: Multiple Dissolved Metals	Analysis Requested: BEHP 8270c	Analysis Requested: PCBs 8082	Analysis Requested	Analysis Requested	Notes/Comments
CMP1-090904	9/1/09	0835	water	9	X		X	X	X	X			
MW308N-090904	↓	0935	↓	9	X		X	X	X	X			
MW308S-090904	↓	1035	↓	9	X		X	X	X	X			

Comments/Special Instructions

Relinquished by: (Signature)		Received by: (Signature)	
Printed Name:	Amy Tice	Printed Name:	A. Vehanderson
Company:	Aspect	Company:	
Date & Time:	9/11/09 1135	Date & Time:	9/11/09 1135
Relinquished by: (Signature)		Received by: (Signature)	
Printed Name:		Printed Name:	
Company:		Company:	
Date & Time:		Date & Time:	

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alernate retention schedules have been established by work-order or contract.

APPENDIX E
DATA VALIDATION REPORT AND CERTIFICATES OF ANALYSIS

DATA VALIDATION REPORT
PYRON ENVIRONMENTAL, INC.
HART CROWSER, INC.

DRAFT

Data Validation Report

Port of Seattle, Southwest Harbor
Phase II Groundwater Quality Confirmation Monitoring
June 2010 Sampling

Laboratory SDG Numbers:

QY97, QZ16, & QZ41

Prepared for:

Hart Crowser, Inc.
1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212

Prepared by:

Pyron Environmental, Inc.
3530 32nd Way NW
Olympia, WA 98502

July 15, 2010

ACRONYMS

%D	percent difference
%D_f	percent drift
%R	percent recovery
%RSD	percent relative standard deviation
AMU	atomic mass unit
ARI	Analytical Resources, Inc.
BFB	Bromofluorobenzene
CCB	continuing calibration blank
CCV	continuing calibration verification
CF	calibration factor
CLP	U.S. EPA Contract Laboratory Program
COC	chain-of-custody
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
DFTPP	Decafluorotriphenylphosphine
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
GC/MS	gas chromatograph/mass spectrometer
ICAL	initial calibration
ICB	initial calibration blank
ICP/MS	inductively coupled plasma/ mass spectrometer
ICS	ICP interference check sample
ICV	initial calibration verification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
µg/L	microgram per liter
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFGs	CLP National Functional Guidelines for Data Review (EPA 1999 – Organics; EPA 2004 - Inorganics)
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls

QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
RF	response factor
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SIM	selective ion monitoring
SVOCs	semi-volatile organic compounds
TPH	total petroleum hydrocarbon
VOCs	volatile organic compounds

INTRODUCTION

This report presents and discusses findings of the data validation performed on analytical data for samples collected during June 2010 for the referenced project. The laboratory reports validated herein were submitted by Analytical Resources, Inc. (ARI), assigned sample delivery group (SDG) numbers QY97, QZ16, and QZ47.

A level III data validation was performed on the laboratory reports. The validation followed the procedures specified in USEPA CLP Functional Guidelines ([NFGs], EPA 2004 and EPA 1999) with modifications to accommodate project and analytical method requirements. The numerical quality assurance/quality control (QA/QC) criteria applied to the validation were in accordance with those specified in the quality assurance project plan ([QAPP], Aspect 2008) and the current performance-based control limits established by the laboratory (laboratory control limits). Instrument calibration, frequency of QC analyses, and analytical sequence requirements were evaluated against the respective analytical methods.

Validation findings are discussed in each section pertinent to the QC parameter for each type of analysis. Qualified data with applied data qualifiers are summarized in the **Summary** section at the end of this report. Field duplicate results and evaluation is presented in **Appendix A**.

Samples and the associated analyses validated herein are summarized as follows:

Field Sample ID	Laboratory Sample ID	Sampling Date	Sample Type	Analysis						
				VOCs	SVOCs	cPAHs	PCBs	As Pb	Metals	TPH
MW44	QY97A	06/02/10	GW		X	X	X		X	X
CMP3	QY97B	06/02/10	GW		X	X	X	X		X
CMP4	QY97C	06/02/10	GW		X	X	X	X		X
MW36	QY97D	06/02/10	GW		X	X	X		X	X
CMP15	QZ16A	06/03/10	GW		X	X	X		X	X
MW308(N)	QZ16B	06/03/10	GW		X	X	X	X		X
MW308(S)	QZ16C	06/03/10	GW		X	X	X	X		X
CMP5	QZ16D	06/03/10	GW		X	X	X	X		X
FM105	QZ16E	06/03/10	GW	X	X	X	X	X		X
MW125	QZ16F	06/03/10	GW	X	X	X	X	X		X
Trip Blank	QZ16G	06/03/10	TB	X						
CMP17	QZ47A	06/04/09	GW	X	X	X	X	X		X
CMP2	QZ47B	06/04/09	GW		X	X	X	X		X
CMP1	QZ47C	06/04/09	GW		X	X	X	X		X
MW26R	QZ47D	06/04/09	GW		X	X	X		X	X
MW26RD	QZ47E	06/04/09	FD		X	X	X		X	X
Trip Blank	QZ47F	06/04/10	TB	X						

Notes:
X - The analysis was requested and performed on the sample
VOCs – Volatile organic compounds, chlorinated ethanes and ethenes only
SVOCs – Semi-volatile organic compound, *bis(*2-ethylhexyl)phthalate only
PAHs – Polycyclic aromatic hydrocarbons, carcinogenics only
PCBs – Polychlorinated biphenyl Aroclors
As – Arsenic
Pb - Lead
Metals – Antimony, arsenic, chromium, copper, lead, and nickel
TPH – Diesel and motor oil range total petroleum hydrocarbon
GW – Groundwater sample
FD – Field duplicate
TB – Trip blank

Analytical methods in respect to analytical parameters validated herein and the laboratory performing the analyses are summarized below:

Parameter	Analytical Method	Laboratory
VOCs	SW846 Method 8260B	Analytical Resources, Inc. (ARI) Tukwila, WA
SVOCs	SW846 Method 8270D-Full Scan	
cPAHs	SW846 Method 8270D-SIM	
PCB Aroclors	SW846 Method 8082	
Metals (Sb, As, Cr, Cu, Pb, & Ni)	EPA Method 200.8	
TPH-Diesel and Motor Oil	NWTPH-Dx	

Notes:
1. SW846 Methods - *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.
2. EPA Method 200.8 - *USEPA Methods for Chemical Analysis of Water and Wastes,* EPA –600/4-79-020, March 1983 Revision.
3. NWTPH - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602, Washington State Department of Ecology, June 1997.
4. SIM – Selective ion monitoring

DATA VALIDATION FINDINGS

1. VOCs by GC/MS (EPA Method SW8260B)

1.1 Sample Management and Holding Time

Samples were received in the laboratory intact and in consistence with the accompanying chain-of-custody (COC) documentation. The temperature for coolers was outside the upper limit of 4±2°C upon the receipt at the laboratory. All samples were hand-delivered to the laboratory the same day of collection. The higher cooler temperature had no significant effects on data quality. No other anomalies were identified in relation to sample preservation, handling, and transport.

Water samples should be analyzed within 14 days of collection. All samples were analyzed within the required holding time.

1.2 GC/MS Instrument Performance Check

Bromofluorobenzene (BFB) tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

1.3 Initial Calibration

The National Functional Guidelines (NFGs) require that the percent relative standard deviation (%RSD) be <30% and the average response factor (RF) be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. Initial calibration met the criteria for all target compounds.

1.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the percent difference (%D) be within ±20%, and (3) the RF be >0.01 for poor response compounds and >0.05 for all other compounds. Calibration verification analyses met the method requirements.

1.5 Method Blank

A method blank was prepared and analyzed as required. Target compounds were not detected at or above the method detection limits (MDLs) in the method blank.

1.6 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD were prepared and analyzed as required by the method. All percent recovery (%R) and relative percent difference (RPD) values met the laboratory control criteria.

1.7 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

1.8 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

1.9 Internal Standard

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

1.10 Reporting Limits (RLs)

The sample-specific RLs met the QAPP requirements and were supported with adequate initial calibration concentrations.

1.11 Overall Assessment of VOCs Data Usability

VOCs data are of known quality and acceptable for use.

2. *bis*(2-Ethylhexyl)phthalate by GC/MS (EPA Method SW8270C)

2.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

2.2 GC/MS Instrument Performance Check

Decafluorotriphenylphosphine (DFTPP) tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

2.3 Initial Calibration

The NFGs criteria require that the percent %RSD be <30% and the average RF be >0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be <15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

2.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be >0.01 for poor response compounds and >0.05 for all other compounds. Calibration verifications met the criteria.

2.5 Method Blank

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the MDL in the method blanks.

2.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

2.7 Matrix Spike (MS) and MS Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

2.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

2.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

2.10 Field Duplicates

One pair of field duplicates (samples MW26R and MW26RD) were submitted for *bis*(2-ethylhexyl)phthalate analyses. *bis*(2-Ethylhexyl)phthalate was not detected at or above the RL in these samples. The field precision met the project criterion.

2.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

2.12 Overall Assessment of *bis*(2-Ethylhexyl)phthalate Data Usability

bis(2-Ethylhexyl)phthalate data are of known quality and acceptable for use.

3. cPAHs by GC/MS - SIM (EPA Method SW8270C)

3.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

3.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

3.3 Initial Calibration

The NFGs criteria require that the %RSD be <30% and the average RRF be >0.05 for all target compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be <15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria, except for the following:

Initial Calibration ID	Analyte	Exceedance	Affected Sample	Data Qualification
Instrument: NT11 Calibration Date: 06/12/2010	Benzo(a)pyrene	%RSD = 19.2% (>15%)	MW-44	**J**

3.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be >0.01 for poor response compounds and >0.05 for all other compounds. Calibration verification analyses met the criteria.

3.5 Method Blanks

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the MDLs in the method blanks.

3.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate %R values were within the laboratory control limits.

3.7 Matrix Spike (MS) and MS Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

3.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

3.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

3.10 Field Duplicates

One pair of field duplicates (samples MW26R and MW26RD), were submitted for cPAHs analyses. The duplicate RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

3.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

3.12 Overall Assessment of cPAHs Data Usability

cPAHs data are of known quality and acceptable for use.

4. PCB Aroclors by GC/ECD (EPA Method SW8082)

4.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

4.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using the mixture of Aroclor 1016 and 1260, (2) a single-point calibration be performed for the other five Aroclors to establish calibration factors (CFs) and for Aroclor pattern recognition, (3) at least 3 peaks (preferably 5 peaks) must be chosen for each Aroclor for characterization, (4) the relative standard deviation (%RSD) values of Aroclor 1016 and 1260 CFs must be ≤20%, and (5) if dual column analysis is chosen, both columns should meet the requirements.

The laboratory chose the internal-standard linear calibration for the Aroclor quantitation. The average RF %RSD values met the linearity criterion (20%). All RFs were >0.01, as recommended by SW846 Method 8000. The initial calibrations met the method requirements and were acceptable.

4.3 Calibration Verification

The method requires that (1) the initial calibration be verified prior to any analysis for each 12-hour analysis sequence, and (2) the percent drift ($\%D_f$) be within ±15% to demonstrate the linearity of the initial calibration. Calibration verifications were performed at the required frequency. All $\%D_f$ values either met the method criterion or at levels that had no effects on sample results (*e.g.,* biased-high $\%D_f$ values where target analytes were not detected in associated samples).

4.4 Method Blanks

Method blanks were prepared and analyzed as required. PCB Aroclors were not detected at or above the MDLs in the method blanks.

4.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

4.6 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

4.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

4.8 Internal Standards

The laboratory chose the internal-standard calibration approach for analyte quantitation. The SW-846, Method 8000 requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

4.9 Field Duplicates

One pair of field duplicates (samples MW26R and MW26RD) were submitted for PCB Aroclors analyses. PCB Aroclors were not detected at or above the RLs in these samples. The field precision met the project criterion.

4.10 Reporting Limits and Target Compound Quantitation

Sample-specific RLs met the QAPP requirements. RLs in selected samples were raised due to non-target chemical interference or response peaks that did not meet the laboratory Aroclor identification criteria (*e.g.*, peak ratios, chromatographic patterns).

The dual column RPD values were within 40% for Aroclor detections greater than the RLs.

4.11 Overall Assessment of PCB Aroclors Data Usability

PCB Aroclor data are of known quality and acceptable for use as qualified.

5. Total Metals by ICP/MS (EPA Method 200.8)

5.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be analyzed within 180 days. Samples were analyzed within the required holding time.

5.2 ICP/MS Tuning

Instrument tuning was performed at the required frequency. The stability check (%RSD <5%), mass calibration (mass difference <0.1 AMU), and resolution check (peak width <1.0 AMU at 5% peak height) met the NFG and method criteria.

5.3 Initial Calibration

The ICP methods requires that (1) a blank and one calibration standard be used in establishing the analytical curve, and (2) the average of replicate exposures be reported for all standards, QC, and sample analyses.

A check standard containing target analytes at the reporting limit levels was analyzed at the beginning of each analytical run. The results were within the NFGs criteria of 70-130%.

5.4 Calibration Verification (ICV and CCV)

Initial calibration verifications (ICVs) and continuing calibration verifications (CCVs) were analyzed at the required frequency. The %R values met the control criteria (90 – 110%).

5.5 Blanks

Calibration Blanks: Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) were analyzed at required frequency. Target analytes were not detected at or above the MDLs in ICBs/CCBs.

Method Blanks: Method blanks were prepared and analyzed as required. Target analytes were not detected at or above the MDLs in the method blanks.

5.6 ICP Interference Check Sample (ICS)

The method requires that (1) an inter-element interference check sample be analyzed at the beginning of each analytical run, and (2) the results should be within ± 20% of the true value. ICP interference check sample analyses met the requirements.

5.7 Laboratory Control Sample (LCS)

LCS analyses were performed as required by the method. All %R values met the control limits (80 – 120%).

5.8 Duplicate Sample Analysis

Duplicate sample analyses were performed on sample CMP-15. The RPD or concentration difference values met the laboratory control limits for all target analytes.

5.9 Matrix Spike (MS)

Matrix spike analyses were performed on sample CMP-15. The %R values were within the control limits for all target analytes.

5.10 Internal Standards

At least three internal standards were added to all field and QC samples for ICP/MS analyses. All percent relative intensity values were within the method criteria (30 - 120% of those for the associated calibration blank).

5.11 ICP Serial Dilution

Serial dilution analyses were performed on samples CMP-15 and MW-44. The %D values were within ±10% for anaytes with concentrations greater than 50xMDLs.

5.12 Field Duplicates

One pair of field duplicates (samples MW26R and MW26RD) were submitted for metals analyses. The duplicate RPD or concentration difference values for detected analytes and data qualification are presented in Appendix A of this report.

5.13 Analyte Quantitation and Reporting Limits

RLs for selected analytes in a number of samples were raised due to the required dilution to overcome matrix interference associated with the samples. The QAPP requirements for quantitation limits were achieved.

5.14 Overall Assessment of Metals Data Usability

Metals data are of known quality and acceptable for use.

6. TPH-Diesel & Motor Oil by GC/FID (Method NWTPH-Dx)

6.1 Holding Time

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. The extraction and analysis of samples met the requirements.

6.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using individual petroleum product reference standards to ensure the proper identification and quantitation of petroleum hydrocarbons in samples, (2) the calibration curve includes a sufficiently low standard to provide the necessary reporting limits, and (3) the linear working range of the instrument be defined.

The ICAL met the method requirements. The linearity of the ICAL curve was verified with %RSD of RFs (%RSD ≤ 20%, according to EPA SW 846 Method 8000), and was acceptable for both diesel and motor oil range total petroleum hydrocarbon (TPH).

6.3 Calibration Verification

The method requires that (1) a mid-range check standard be analyzed prior to and after each analytical batch, and (2) the percent drift value be within ±15% of the true value. The calibration verification analyses met the requirements.

6.4 Method Blanks

Method blanks were prepared and analyzed as required. TPH-Diesel and TPH-Motor Oil were not detected at or above the MDLs in the method blanks.

6.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

6.6 Duplicate Analysis

Duplicate analyses were not performed on project samples in these SDGs, and therefore were not reported. Analytical precision was evaluated based on the LCS/LCSD analyses.

6.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

6.8 Field Duplicates

One pair of field duplicates (samples MW26R and MW26RD) were submitted for TPH-Diesel & Motor Oil analyses. The target compounds were not detected at or above the RLs in these samples. The field precision met the project criterion.

6.9 Reporting Limits

The reported RLs were supported with adequate ICAL concentrations. Sample-specific RLs met the QAPP requirements.

6.10 Overall Assessment of TPH-Diesel and Motor Oil Data Usability

TPH-Diesel and Motor Oil data are of known quality and acceptable for use.

SUMMARY

I. Data qualification are summarized as follows:

Sample ID	Analyte	Data Qualifier	Reason	Report Section
MW-44	Benzo(a)pyrene	**J**	The initial calibration %RSD value exceeded 15%.	**3.2**

II. Data affected by associated blanks are qualified and results adjusted as follows:

Sample ID	Analyte	Original Result	Adjusted Result	Unit	Report Section
No data were qualified in relation to detections in blanks in these SDGs.					

III. Data Qualifiers are defined as follows:

Data Qualifier	Definition
J	The analyte was detected above the reported quantitation limit, and the reported concentration was an estimated value.
NJ	The analyte was not definitively identified and the reported concentration was an estimated value.
R	The result was rejected and could not be used.
U	The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.
UJ	The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Approved By: _____ Date: _____

Mingta Lin

REFERENCES

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Port of Seattle, Southwest Harbor Project, Phase II Groundwater Confirmation Monitoring Program, Water Quality Monitoring Plan, Aspect Consulting, Inc., October 2008.

APPENDIX A

The precision criterion (≤ 50%) was applied to evaluating the relative percent difference (RPD) values of field duplicate results greater than five times the RL (5xRL). For results less than 5xRL, an advisory criterion of 2xRL was applied to evaluating the concentration differences.

The RPD and concentration difference values for detected analytes and data qualification are presented as follows:

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		MW26R	MW26RD			
Chrysene	0.01	0.014	0.014	-	0	No action
Chromium	2	3	4	-	1	No action
Copper	2	ND	3	-	1	No action
Nickel	2	6	6	-	0	No action

Notes:
RL – Reporting limit
ND – Not detected at or above the RL
RPD – Relative percent difference
Conc. Difference – Concentration difference between the parent sample and the field duplicate sample

DATA VALIDATION REPORT
PYRON ENVIRONMENTAL, INC.
ASPECT CONSULTING, LLC

DRAFT

Data Validation Report

Port of Seattle, Southwest Harbor
Phase II Groundwater Quality Confirmation Monitoring
October 2008 Sampling

Laboratory SDG Numbers:

NU12 & NU25

Prepared for:

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December 22, 2008

ACRONYMS

%D	percent difference
%D_f	percent drift
%R	percent recovery
%RSD	percent relative standard deviation
AMU	atomic mass unit
ARI	Analytical Resources, Inc.
BFB	bromofluorobenzene
CCB	continuing calibration blank
CCV	continuing calibration verification
CF	calibration factor
CLP	U.S. EPA Contract Laboratory Program
COC	chain-of-custody
DFTPP	decafluorotriphenylphosphine
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
GC/MS	gas chromatograph/mass spectrometer
ICAL	initial calibration
ICB	initial calibration blank
ICP/MS	inductively coupled plasma/ mass spectrometer
ICS	ICP interference check sample
ICV	initial calibration verification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
µg/L	microgram per liter
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFGs	CLP National Functional Guidelines for Data Review (EPA 2008 – Organics, EPA 2004 - Inorganics)
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control

RF	response factor
RPD	relative percent difference
SDG	sample delivery group
SIM	selective ion monitoring
SVOCs	semi-volatile organic compounds
TPH	total petroleum hydrocarbon
VOCs	volatile organic compounds

INTRODUCTION

This report presents and discusses findings of the data validation performed on analytical data for samples collected during October 2008 for the referenced project. The laboratory reports validated herein were submitted by Analytical Resources, Inc. (ARI), assigned sample delivery group (SDG) numbers NU12 and NU25.

A level III data validation was performed on the laboratory reports. The validation followed the procedures specified in USEPA CLP Functional Guidelines ([NFGs], EPA 2004 and 2008) with modifications to accommodate project and analytical method requirements. The numerical quality assurance/quality control (QA/QC) criteria applied to the validation were in accordance with those specified in the quality assurance project plan ([QAPP], Aspect 2008) and the current performance-based control limits established by the laboratory (laboratory control limits). Instrument calibration, frequency of QC analyses, and analytical sequence requirements were evaluated against the respective analytical methods.

Validation findings are discussed in each section pertinent to the QC parameter for each type of analysis. Qualified data with applied data qualifiers are summarized in the **Summary** section at the end of this report. Field duplicate results and evaluation is presented in **Appendix A**.

Samples and the associated analyses validated herein are summarized as follows:

Field Sample ID	Laboratory Sample ID	Sampling Date	Sample Type	Analysis						
				VOCs	SVOCs	PAH	PCBs	As Pb	Metals	TPH
CMP1-081013	NU12A	10/13/08	GW		X	X	X	X		X
CMP2-081013	NU12B	10/13/08	GW		X	X	X	X		X
FM105-081013	NU12C	10/13/08	GW	X	X	X	X	X		X
FM105-081013D	NU12D	10/13/08	FD	X	X	X	X	X		X
MW125-081013	NU12E	10/13/08	GW	X	X	X	X	X		X
CMP17-081013	NU12F	10/13/08	GW	X	X	X	X	X		X
CMP5-081013	NU12G	10/13/08	GW		X	X	X	X		X
MW308S-081013	NU12H	10/13/08	GW		X	X	X	X		X
MW308N-081013	NU12I	10/13/08	GW		X	X	X	X		X
Trip Blank	NU12J	10/13/08	TB	X						
CMP3-081014	NU25A	10/14/08	GW		X	X	X	X		X
CMP4-081014	NU25B	10/14/08	GW		X	X	X	X		X
MW26R-081014	NU25C	10/14/08	GW		X	X	X		X	X
MW26R-081014D	NU25D	10/14/08	FD		X	X	X		X	X
MW44-081014	NU25E	10/14/08	GW		X	X	X		X	X
CMP15-081014	NU25F	10/14/08	GW		X	X	X		X	X
MW36-081014	NU25G	10/14/08	GW		X	X	X		X	X

Notes:

X - The analysis was requested and performed on the sample
VOCs – Volatile organic compounds, chlorinated ethanes and ethenes only
SVOCs – Semi-volatile organic compound, *bis(*2-ethylhexyl)phthalate only
PAHs – Polycyclic aromatic hydrocarbons, carcinogenics only
PCBs – Polychlorinated biphenyl Aroclors
As – Arsenic
Pb - Lead
Metals – Antimony, arsenic, chromium, copper, lead, and nickel
TPH – Diesel and motor oil range total petroleum hydrocarbon
GW – Groundwater sample
FD – Field duplicate
TB – Trip blank

Analytical methods in respect to analytical parameters validated herein and the laboratory performing the analyses are summarized below:

Parameter	Analytical Method	Laboratory
VOCs	SW846 Method 8260B	Analytical Resources, Inc. (ARI) Tukwila, WA
SVOCs	SW846 Method 8270C – Full Scan	
PAHs	SW846 Method 8270C-SIM	
PCB Aroclors	SW846 Method 8082	
Metals (Sb, As, Cr, Cu, Pb, & Ni)	EPA Method 200.8	
TPH-Diesel and Motor Oil	NWTPH-Dx	

Notes:

1. SW846 Methods - *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.
2. EPA Method 200.8 - *USEPA Methods for Chemical Analysis of Water and Wastes,* EPA –600/4-79-020, March 1983 Revision.
3. NWTPH - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602, Washington State Department of Ecology, June 1997
4. SIM – Selective ion monitoring

DATA VALIDATION FINDINGS

1. VOCs by GC/MS (EPA Method SW8260B)

1.1 Sample Management and Holding Time

Samples were received in the laboratory intact and in consistence with the accompanying chain-of-custody (COC) documentation. The cooler temperature was measured at 10.5℃ and 15℃ upon the receipt at the laboratory. All samples were hand-delivered to the laboratory the same of day of collection. The higher cooler temperature had no significant effects on data quality. No other anomalies were identified in relation to sample preservation, handling, and transport.

Water samples should be analyzed within 14 days of collection. All samples were analyzed within the required holding time.

1.2 GC/MS Instrument Performance Check

Bromofluorobenzene (BFB) tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

1.3 Initial Calibration

The National Functional Guidelines (NFGs) require that the percent relative standard deviation (%RSD) be <30% and the average response factor (RF) be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. Initial calibration met the criteria for all target compounds.

1.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the percent difference (%D) be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

Calibration verification analyses met the method requirements.

1.5 Blanks

Method Blank: Method blanks were prepared and analyzed as required. Target compounds were not detected at or above the method detection limits (MDLs) in method blanks.

Trip Blank: One trip blank was submitted with samples for VOCs analyses. No target compounds were detected at or above the RLs in the trip blank.

1.6 Laboratory Control Sample (LCS)

LCS and LCS duplicate (LCSD) were prepared and analyzed as required by the method. All percent recovery (%R) and relative percent difference (RPD) values met the laboratory control criteria.

1.7 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

1.8 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

1.9 Internal Standard

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

1.10 Field Duplicates

Samples FM105-081013 and FM105-081013D were field duplicates. The duplicate sample RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

1.11 Reporting Limits

The sample-specific RLs met the QAPP requirements and were supported with adequate initial calibration concentrations.

1.12 Overall Assessment of VOCs Data Usability

VOCs data are of known quality and acceptable for use.

2. *bis*(2-Ethylhexyl)phthalate by GC/MS (EPA Method SW8270C)

2.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

2.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

2.3 Initial Calibration

The NFGs criteria require that the percent %RSD be <30% and the average RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

2.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verifications met the criteria.

2.5 Method Blank

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the RLs in the method blanks.

2.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. %R values for one of the four surrogate spikes, nitrobenzene-d4, were below the lower control limits in selected samples. %R values for all other surrogates were within the laboratory control limits. No data were qualified on this basis.

2.7 Matrix Spike (MS) and MS Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

2.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

2.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

2.10 Field Duplicates

Two pairs of field duplicates - samples FM105-081013 and FM105-081013D; and samples MW26R-081014 and MW26R-081014D, were submitted for *bis*(2-ethylhexyl)phthalate analyses. *bis*(2-Ethylhexyl)phthalate was not detected at or above the RL in these samples. The field precision met the project criterion.

2.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

2.12 Overall Assessment of *bis*(2-Ethylhexyl)phthalate Data Usability

bis(2-Ethylhexyl)phthalate data are of known quality and acceptable for use.

3. PAHs by GC/MS - SIM (EPA Method SW8270C)

3.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

3.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

3.3 Initial Calibration

The NFGs criteria require that the %RSD be <30% and the average RRF be >0.05 for all target compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995,

and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

3.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verification analyses met the criteria.

3.5 Method Blanks

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the RLs in the method blanks.

3.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate %R values were within the laboratory control limits.

3.7 Matrix Spike (MS) and MS Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

3.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

3.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

3.10 Field Duplicates

Two pairs of field duplicates - samples FM105-081013 and FM105-081013D; and samples MW26R-081014 and MW26R-081014D, were submitted for PAHs analyses. The duplicate RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

3.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

3.12 Overall Assessment of PAHs Data Usability

PAHs data are of known quality and acceptable for use.

4. PCB Aroclors by GC/ECD (EPA Method SW8082)

4.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

4.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using the mixture of Aroclor 1016 and 1260, (2) a single-point calibration be performed for the other five Aroclors to establish calibration factors (CFs) and for Aroclor pattern recognition, (3) at least 3 peaks (preferably 5 peaks) must be chosen for each Aroclor for characterization, (4) the relative standard deviation (%RSD) values of Aroclor 1016 and 1260 CFs must be ≤ 20%, and (5) if dual column analysis is chosen, both columns should meet the requirements.

The laboratory chose the internal-standard linear calibration for the Aroclor quantitation. The average RF %RSD values met the linearity criterion (20%). All RFs were >0.01, as recommended by SW846 Method 8000. The initial calibrations met the method requirements and were acceptable.

4.3 Calibration Verification

The method requires that (1) the initial calibration be verified prior to any analysis for each 12-hour analysis sequence, and (2) the percent drift ($\%D_f$) be within ±15% to demonstrate the linearity of the initial calibration. Calibration verifications were performed at the required frequency. All $\%D_f$ values either met the method criterion or at levels that had no effects on sample results (*e.g.,*biased high recovery where target analytes were not detected in associated samples).

4.4 Method Blanks

Method blanks were prepared and analyzed as required. PCB Aroclors were not detected at or above the RLs in the method blanks.

4.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

4.6 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

4.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

4.8 Internal Standards

The laboratory chose the internal-standard calibration approach for analyte quantitation. The SW-846, Method 8000 requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

4.9 Field Duplicates

Two pairs of field duplicates - samples FM105-081013 and FM105-081013D; and samples MW26R-081014 and MW26R-081014D, were submitted for PCB Aroclors analyses. PCB Aroclors were not detected at or above the RL in these samples. The field precision met the project criterion.

4.10 Reporting Limits and Target Compound Quantitation

Sample-specific RLs met the QAPP requirements. RLs in selected samples were raised due to non-target chemical interference or response peaks that did not meet the Aroclor identification criteria (*e.g.*, peak ratios, chromatographic patterns).

4.11 Overall Assessment of PCB Aroclors Data Usability

PCB Aroclor data are of known quality and acceptable for use.

5. Total Metals by ICP/MS (EPA Method 200.8)

5.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be analyzed within 180 days. Samples were analyzed within the required holding time.

5.2 ICP/MS Tuning

Instrument tuning was performed at the required frequency. The stability check (%RSD <5%), mass calibration (mass difference <0.1 AMU), and resolution check (peak width <1.0 AMU at 5% peak height) met the NFG and method criteria.

5.3 Initial Calibration

The ICP methods requires that (1) a blank and one calibration standard be used in establishing the analytical curve, and (2) the average of replicate exposures be reported for all standards, QC, and sample analyses.

A check standard containing target analytes at the reporting limit levels was analyzed at the beginning of each analytical run. The results were within the NFGs criteria of 70-130%.

5.4 Calibration Verification (ICV and CCV)

Initial calibration verifications (ICVs) and continuing calibration verifications (CCVs) were analyzed at the required frequency. The %R values met the control criteria (90 – 110%).

5.5 Blanks

Calibration Blanks: Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) were analyzed at required frequency. Target analytes were not detected in ICBs/CCBs at or above the method detection limits (MDLs).

Method Blanks: Method blanks were prepared and analyzed as required. Target analytes were not detected at or above the RLs.

5.6 ICP Interference Check Sample (ICS)

The method requires that (1) an inter-element interference check sample be analyzed at the beginning of each analytical run, and (2) the results should be within ± 20% of the true value. ICP interference check sample analyses met the requirements.

5.7 Laboratory Control Sample (LCS)

LCS analyses were performed as required by the method. All %R values met the control limits (80 – 120%).

5.8 Duplicate Sample Analysis

Duplicate sample analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical precision was evaluated based on the field duplicate results.

5.9 Matrix Spike (MS)

Matrix spike analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical accuracy was evaluated based on the LCS results.

5.10 Internal Standards

At least three internal standards were added to all field and QC samples for ICP/MS analyses. All percent relative intensity values were within the method criteria (30 - 120% of those for the associated calibration blank).

5.11 ICP Serial Dilution

Serial dilution analysis were not performed on project samples in these SDGs, and therefore not reported.

5.12 Field Duplicates

Two pairs of field duplicates - samples FM105-081013 and FM105-081013D; and samples MW26R-081014 and MW26R-081014D, were submitted for metals analyses. The duplicate RPD or concentration difference values for detected analytes and data qualification are presented in Appendix A of this report.

5.13 Analyte Quantitation and Reporting Limits

RLs for selected analytes in a number of samples were raised due to the required dilution to overcome matrix interference associated with the samples. The QAPP requirements for quantitation limits were achieved.

5.14 Overall Assessment of Metals Data Usability

Metals data are of known quality and acceptable for use.

6. TPH-Diesel & Motor Oil by GC/FID (Method NWTPH-Dx)

6.1 Holding Time

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. The extraction and analysis of samples met the requirements.

6.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using individual petroleum product reference standards to ensure the proper identification and quantitation of petroleum hydrocarbons in samples, (2) the calibration curve includes a sufficiently low standard to provide the necessary reporting limits, and (3) the linear working range of the instrument be defined.

The ICAL met the method requirements. The linearity of the ICAL curve was verified with %RSD of RFs (%RSD ≤ 20%, according to EPA SW 846 Method 8000), and was acceptable for both diesel and motor oil range total petroleum hydrocarbon (TPH).

6.3 Calibration Verification

The method requires that (1) a mid-range check standard be analyzed prior to and after each analytical batch, and (2) the percent drift value be within ±15% of the true value. The calibration verification analyses met the requirements.

6.4 Method Blanks

Method blanks were prepared and analyzed as required. TPH-Diesel and TPH-Motor Oil were not detected at or above the RLs in the method blanks.

6.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

6.6 Duplicate Analysis

Duplicate analyses were not performed on project samples in these SDGs, and therefore were not reported. Analytical precision was evaluated based on the LCS/LCSD analyses.

6.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

6.8 Field Duplicates

Two pairs of field duplicates - samples FM105-081013 and FM105-081013D; and samples MW26R-081014 and MW26R-081014D, were submitted. TPH-Diesel & Motor Oil were not detected at or above the RL in these samples. The field precision met the project criterion.

6.9 Reporting Limits

The reported RLs were supported with adequate ICAL concentrations. Sample-specific RLs met the QAPP requirements.

6.10 Overall Assessment of TPH-Diesel and Motor Oil Data Usability

TPH-Diesel and Motor Oil data are of known quality and acceptable for use.

SUMMARY

I. Data qualification are summarized as follows:

Sample ID	Analyte	Data Qualifier	Reason	Report Section
No data were qualified in these SDGs.				

II. Data affected by associated blanks are qualified and results adjusted as follows:

Sample ID	Analyte	Original Result	Adjusted Result	Unit	Report Section
No data were qualified in relation to detections in blanks in these SDGs.					

III. Data Qualifiers are defined as follows:

Data Qualifier	Definition
J	The analyte was detected above the reported quantitation limit, and the reported concentration was an estimated value.
NJ	The analyte was not definitively identified and the reported concentration was an estimated value.
R	The result was rejected and could not be used.
U	The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.
UJ	The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Approved By: _____ Date: _____

Mingta Lin

REFERENCES

USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, June 2007, EPA-540-R-08-01.

USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, October 2004, EPA 540/R-04/004.

USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, December 1996.

State of Washington, Analytical Methods for Petroleum Hydrocarbons, ECY 97-602, Washington State Department of Ecology, June 1997

Port of Seattle, Southwest Harbor Project, Phase II Groundwater Confirmation Monitoring Program, Water Quality Monitoring Plan, Aspect Consulting, Inc., October 2008.

APPENDIX A

The precision criterion (≤ 50%) was applied to evaluating the relative percent difference (RPD) values of field duplicate results greater than five times the MRL (5xRL). For results less than 5xRL, an advisory criterion of 2xRL was applied to evaluating the concentration differences.

The RPD and concentration difference values for detected analytes and data qualification are presented as follows:

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		FM105-081013	FM105-081013D			
Arsenic	0.2	0.40	0.40	-	0	No action
cis-1,2-Dichloroethene	0.2	0.70	0.70	-	0	No action
Tetrachloroethene (PCE)	0.2	6.10	6.20	1.6%	-	No action
Trichloroethene (TCE)	0.2	0.90	0.90	-	0	No action

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		MW26R-081014	MW26R-081014D			
Benz(a)anthracene	0.01	0.025	0.024	-	0.001	No action
Chrysene	0.01	0.027	0.026	-	0.001	No action
Arsenic	2	ND	3	-	3	No action
Chromium III	2	ND	3	-	3	No action
Nickel	2	6	7	-	1	No action

Note:
RL – Reporting limit
ND – Not detected at or above the RL
RPD – Relative percent difference
Conc. Difference – Concentration difference between the parent sample and the field duplicate sample

Data Validation Report

Port of Seattle, Southwest Harbor
Phase II Groundwater Quality Confirmation Monitoring
April 2009 Sampling

Laboratory SDG Numbers:

OT19, OT38, & OT68

Prepared for:

Aspect Consulting, Inc.
179 Madrone Lane N
Bainbridge Island, WA 98110

Prepared by:

Pyron Environmental, Inc.
3530 32nd Way NW
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May 18, 2009

ACRONYMS

%D	percent difference
%D$_f$	percent drift
%R	percent recovery
%RSD	percent relative standard deviation
AMU	atomic mass unit
ARI	Analytical Resources, Inc.
BFB	Bromofluorobenzene
CCB	continuing calibration blank
CCV	continuing calibration verification
CF	calibration factor
CLP	U.S. EPA Contract Laboratory Program
COC	chain-of-custody
DFTPP	Decafluorotriphenylphosphine
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
GC/MS	gas chromatograph/mass spectrometer
ICAL	initial calibration
ICB	initial calibration blank
ICP/MS	inductively coupled plasma/ mass spectrometer
ICS	ICP interference check sample
ICV	initial calibration verification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
µg/L	microgram per liter
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFGs	CLP National Functional Guidelines for Data Review (EPA 2008 – Organics, EPA 2004 - Inorganics)
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan

QA/QC	quality assurance/quality control
RF	response factor
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SIM	selective ion monitoring
SVOCs	semi-volatile organic compounds
TPH	total petroleum hydrocarbon
VOCs	volatile organic compounds

INTRODUCTION

This report presents and discusses findings of the data validation performed on analytical data for samples collected during April 2009 for the referenced project. The laboratory reports validated herein were submitted by Analytical Resources, Inc. (ARI), assigned sample delivery group (SDG) numbers OT19, OT38, and OT68.

A level III data validation was performed on the laboratory reports. The validation followed the procedures specified in USEPA CLP Functional Guidelines ([NFGs], EPA 2004 and 2008) with modifications to accommodate project and analytical method requirements. The numerical quality assurance/quality control (QA/QC) criteria applied to the validation were in accordance with those specified in the quality assurance project plan ([QAPP], Aspect 2008) and the current performance-based control limits established by the laboratory (laboratory control limits). Instrument calibration, frequency of QC analyses, and analytical sequence requirements were evaluated against the respective analytical methods.

Validation findings are discussed in each section pertinent to the QC parameter for each type of analysis. Qualified data with applied data qualifiers are summarized in the **Summary** section at the end of this report. Field duplicate results and evaluation is presented in **Appendix A**.

Samples and the associated analyses validated herein are summarized as follows:

Field Sample ID	Laboratory Sample ID	Sampling Date	Sample Type	Analysis						
				VOCs	SVOCs	PAHs	PCBs	As Pb	Metals	TPH
CMP2-090331	OT19A	03/31/.09	GW		X	X	X	X		X
CMP1-090331	OT19B	03/31/.09	GW		X	X	X	X		X
FM105-090331	OT19C	03/31/.09	GW	X	X	X	X	X		X
MW125-090331	OT19D	03/31/.09	GW	X	X	X	X	X		X
CMP17-090331	OT19E	03/31/.09	GW	X	X	X	X	X		X
FM105-090331D	OT19F	03/31/.09	FD	X	X	X	X	X		X
Trip Blank	OT19F	03/31/.09	TB	X						
CMP3-090401	OT38A	04/01/09	GW		X	X	X	X		X
MW26R-090401	OT38B	04/01/09	GW		X	X	X		X	X
MW26R-090401D	OT38C	04/01/09	FD		X	X	X		X	X
MW44-090401	OT38D	04/01/09	GW		X	X	X		X	X
CMP5-090401	OT38E	04/01/09	GW		X	X	X	X		X
MW308S-090401	OT38F	04/01/09	GW		X	X	X	X		X
CMP4-090402	OT68A	04/02/09	GW		X	X	X	X		X
MW36-090402	OT68B	04/02/09	GW		X	X	X		X	X
CMP15-090402	OT68C	04/02/09	GW		X	X	X		X	X
MW308N-090402	OT68D	04/02/09	GW		X	X	X	X		X

Notes:
X - The analysis was requested and performed on the sample
VOCs – Volatile organic compounds, chlorinated ethanes and ethenes only
SVOCs – Semi-volatile organic compound, *bis(*2-ethylhexyl)phthalate only
PAHs – Polycyclic aromatic hydrocarbons, carcinogenics only
PCBs – Polychlorinated biphenyl Aroclors
As – Arsenic
Pb - Lead
Metals – Antimony, arsenic, chromium, copper, lead, and nickel
TPH – Diesel and motor oil range total petroleum hydrocarbon
GW – Groundwater sample
FD – Field duplicate
TB – Trip blank

Analytical methods in respect to analytical parameters validated herein and the laboratory performing the analyses are summarized below:

Parameter	Analytical Method	Laboratory
VOCs	SW846 Method 8260B	Analytical Resources, Inc. (ARI) Tukwila, WA
SVOCs	SW846 Method 8270C – Full Scan	
PAHs	SW846 Method 8270C-SIM	
PCB Aroclors	SW846 Method 8082	
Metals (Sb, As, Cr, Cu, Pb, & Ni)	EPA Method 200.8	
TPH-Diesel and Motor Oil	NWTPH-Dx	

Notes:
SW846 Methods - *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.
EPA Method 200.8 - *USEPA Methods for Chemical Analysis of Water and Wastes,* EPA –600/4-79-020, March 1983 Revision.
NWTPH - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602, Washington State Department of Ecology, June 1997.
SIM – Selective ion monitoring

DATA VALIDATION FINDINGS

1. VOCs by GC/MS (EPA Method SW8260B)

1.1 Sample Management and Holding Time

Samples were received in the laboratory intact and in consistence with the accompanying chain-of-custody (COC) documentation. The temperature for three of the coolers (7.2℃, 6.6℃, and 7.4℃) was outside the upper limit of 4±2℃ upon the receipt at the laboratory. All samples were hand-delivered to the laboratory the same day of collection. The higher cooler temperature had no significant effects on data quality. No other anomalies were identified in relation to sample preservation, handling, and transport.

Water samples should be analyzed within 14 days of collection. All samples were analyzed within the required holding time.

1.2 GC/MS Instrument Performance Check

Bromofluorobenzene (BFB) tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

1.3 Initial Calibration

The National Functional Guidelines (NFGs) require that the percent relative standard deviation (%RSD) be <30% and the average response factor (RF) be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. Initial calibration met the criteria for all target compounds.

1.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the percent difference (%D) be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

Calibration verification analyses met the method requirements.

1.5 Blanks

Method Blank: Method blanks were prepared and analyzed as required. Target compounds were not detected at or above the method detection limits (MDLs) in method blanks.

Trip Blank: One trip blank was submitted with samples for VOCs analyses. No target compounds were detected at or above the RLs in the trip blank.

1.6 Laboratory Control Sample (LCS)

LCS and LCS duplicate (LCSD) were prepared and analyzed as required by the method. All percent recovery (%R) and relative percent difference (RPD) values met the laboratory control criteria.

1.7 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

1.8 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

1.9 Internal Standard

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

1.10 Field Duplicates

Samples FM105-090331 and FM105-090331D were field duplicates. The duplicate sample RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

1.11 Reporting Limits

The sample-specific RLs met the QAPP requirements and were supported with adequate initial calibration concentrations.

1.12 Overall Assessment of VOCs Data Usability

VOCs data are of known quality and acceptable for use.

2. *bis*(2-Ethylhexyl)phthalate by GC/MS (EPA Method SW8270C)

2.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

2.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

2.3 Initial Calibration

The NFGs criteria require that the percent %RSD be <30% and the average RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

2.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verifications met the criteria.

2.5 Method Blank

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the RLs in the method blanks.

2.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

2.7 Matrix Spike (MS) and MS Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

2.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

2.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

2.10 Field Duplicates

Two pairs of field duplicates - samples FM105-090331 and FM105-090331D; and samples MW26R-090401 and MW26R-090401D, were submitted for *bis*(2-ethylhexyl)phthalate analyses. *bis*(2-Ethylhexyl)phthalate was not detected at or above the RL in these samples. The field precision met the project criterion.

2.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

2.12 Overall Assessment of *bis*(2-Ethylhexyl)phthalate Data Usability

bis(2-Ethylhexyl)phthalate data are of known quality and acceptable for use.

3. PAHs by GC/MS - SIM (EPA Method SW8270C)

3.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

3.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

3.3 Initial Calibration

The NFGs criteria require that the %RSD be <30% and the average RRF be >0.05 for all target compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995,

and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

3.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verification analyses met the criteria or the %D values were at levels that had no effects on sample results (*e.g.,* biased-high %D values and the target analytes were not detected in associated samples).

3.5 Method Blanks

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the RLs in the method blanks.

3.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate %R values were within the laboratory control limits.

3.7 Matrix Spike (MS) and MS Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

3.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

3.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

3.10 Field Duplicates

Two pairs of field duplicates - samples FM105-090331 and FM105-090331D; and samples MW26R-090401 and MW26R-090401D, were submitted for PAHs analyses. The duplicate RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

3.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

3.12 Overall Assessment of PAHs Data Usability

PAHs data are of known quality and acceptable for use.

4. PCB Aroclors by GC/ECD (EPA Method SW8082)

4.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

4.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using the mixture of Aroclor 1016 and 1260, (2) a single-point calibration be performed for the other five Aroclors to establish calibration factors (CFs) and for Aroclor pattern recognition, (3) at least 3 peaks (preferably 5 peaks) must be chosen for each Aroclor for characterization, (4) the relative standard deviation (%RSD) values of Aroclor 1016 and 1260 CFs must be ≤ 20%, and (5) if dual column analysis is chosen, both columns should meet the requirements.

The laboratory chose the internal-standard linear calibration for the Aroclor quantitation. The average RF %RSD values met the linearity criterion (20%). All RFs were >0.01, as recommended by SW846 Method 8000. The initial calibrations met the method requirements and were acceptable.

4.3 Calibration Verification

The method requires that (1) the initial calibration be verified prior to any analysis for each 12-hour analysis sequence, and (2) the percent drift ($\%D_f$) be within ±15% to demonstrate the linearity of the initial calibration. Calibration verifications were performed at the required frequency. All $\%D_f$ values either met the method criterion or at levels that had no effects on sample results (*e.g.,* biased-high $\%D_f$ values where target analytes were not detected in associated samples).

4.4 Method Blanks

Method blanks were prepared and analyzed as required. PCB Aroclors were not detected at or above the RLs in the method blanks.

4.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

4.6 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

4.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

4.8 Internal Standards

The laboratory chose the internal-standard calibration approach for analyte quantitation. The SW-846, Method 8000 requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

4.9 Field Duplicates

Two pairs of field duplicates - samples FM105-090331 and FM105-090331D; and samples MW26R-090401 and MW26R-090401D, were submitted for PCB Aroclors analyses. PCB Aroclors were not detected at or above the RL in these samples. The field precision met the project criterion.

4.10 Reporting Limits and Target Compound Quantitation

Sample-specific RLs met the QAPP requirements. RLs in selected samples were raised due to non-target chemical interference or response peaks that did not meet the Aroclor identification criteria (*e.g.*, peak ratios, chromatographic patterns).

4.11 Overall Assessment of PCB Aroclors Data Usability

PCB Aroclor data are of known quality and acceptable for use.

5. Total Metals by ICP/MS (EPA Method 200.8)

5.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be analyzed within 180 days. Samples were analyzed within the required holding time.

5.2 ICP/MS Tuning

Instrument tuning was performed at the required frequency. The stability check (%RSD <5%), mass calibration (mass difference <0.1 AMU), and resolution check (peak width <1.0 AMU at 5% peak height) met the NFG and method criteria.

5.3 Initial Calibration

The ICP methods requires that (1) a blank and one calibration standard be used in establishing the analytical curve, and (2) the average of replicate exposures be reported for all standards, QC, and sample analyses.

A check standard containing target analytes at the reporting limit levels was analyzed at the beginning of each analytical run. The results were within the NFGs criteria of 70-130%.

5.4 Calibration Verification (ICV and CCV)

Initial calibration verifications (ICVs) and continuing calibration verifications (CCVs) were analyzed at the required frequency. The %R values met the control criteria (90 – 110%).

5.5 Blanks

Calibration Blanks: Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) were analyzed at required frequency. Target analytes were not detected in ICBs/CCBs at or above the method detection limits (MDLs).

Method Blanks: Method blanks were prepared and analyzed as required. Target analytes were not detected at or above the RLs.

5.6 ICP Interference Check Sample (ICS)

The method requires that (1) an inter-element interference check sample be analyzed at the beginning of each analytical run, and (2) the results should be within ± 20% of the true value. ICP interference check sample analyses met the requirements.

5.7 Laboratory Control Sample (LCS)

LCS analyses were performed as required by the method. All %R values met the control limits (80 – 120%).

5.8 Duplicate Sample Analysis

Duplicate sample analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical precision was evaluated based on the field duplicate results.

5.9 Matrix Spike (MS)

Matrix spike analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical accuracy was evaluated based on the LCS results.

5.10 Internal Standards

At least three internal standards were added to all field and QC samples for ICP/MS analyses. All percent relative intensity values were within the method criteria (30 - 120% of those for the associated calibration blank).

5.11 ICP Serial Dilution

Serial dilution analysis were not performed on project samples in these SDGs, and therefore not reported.

5.12 Field Duplicates

Two pairs of field duplicates - samples FM105-090331 and FM105-090331D; and samples MW26R-090401 and MW26R-090401D, were submitted for metals analyses. The duplicate RPD or concentration difference values for detected analytes and data qualification are presented in Appendix A of this report.

5.13 Analyte Quantitation and Reporting Limits

RLs for selected analytes in a number of samples were raised due to the required dilution to overcome matrix interference associated with the samples. The QAPP requirements for quantitation limits were achieved.

5.14 Overall Assessment of Metals Data Usability

Metals data are of known quality and acceptable for use.

6. TPH-Diesel & Motor Oil by GC/FID (Method NWTPH-Dx)

6.1 Holding Time

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. The extraction and analysis of samples met the requirements.

6.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using individual petroleum product reference standards to ensure the proper identification and quantitation of petroleum hydrocarbons in samples, (2) the calibration curve includes a sufficiently low standard to provide the necessary reporting limits, and (3) the linear working range of the instrument be defined.

The ICAL met the method requirements. The linearity of the ICAL curve was verified with %RSD of RFs (%RSD ≤ 20%, according to EPA SW 846 Method 8000), and was acceptable for both diesel and motor oil range total petroleum hydrocarbon (TPH).

6.3 Calibration Verification

The method requires that (1) a mid-range check standard be analyzed prior to and after each analytical batch, and (2) the percent drift value be within ±15% of the true value. The calibration verification analyses met the requirements.

6.4 Method Blanks

Method blanks were prepared and analyzed as required. TPH-Diesel and TPH-Motor Oil were not detected at or above the RLs in the method blanks.

6.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

6.6 Duplicate Analysis

Duplicate analyses were not performed on project samples in these SDGs, and therefore were not reported. Analytical precision was evaluated based on the LCS/LCSD analyses.

6.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

6.8 Field Duplicates

Two pairs of field duplicates - samples FM105-090331 and FM105-090331D; and samples MW26R-090401 and MW26R-090401D, were submitted for TPH-Diesel & Motor Oil analyses. The target compounds were not detected at or above the RL in these samples. The field precision met the project criterion.

6.9 Reporting Limits

The reported RLs were supported with adequate ICAL concentrations. Sample-specific RLs met the QAPP requirements.

6.10 Overall Assessment of TPH-Diesel and Motor Oil Data Usability

TPH-Diesel and Motor Oil data are of known quality and acceptable for use.

SUMMARY

I. Data qualification are summarized as follows:

Sample ID	Analyte	Data Qualifier	Reason	Report Section
FM105-090331 FM105-090331D	*bis*(2-Ethylhexyl)phthalate	UJ J	The field duplicate result did not meet the project control limits.	**Appendix A**

II. Data affected by associated blanks are qualified and results adjusted as follows:

Sample ID	Analyte	Original Result	Adjusted Result	Unit	Report Section
No data were qualified in relation to detections in blanks in these SDGs.					

III. Data Qualifiers are defined as follows:

Data Qualifier	Definition
J	The analyte was detected above the reported quantitation limit, and the reported concentration was an estimated value.
NJ	The analyte was not definitively identified and the reported concentration was an estimated value.
R	The result was rejected and could not be used.
U	The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.
UJ	The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Approved By: _____ Date: _____

Mingta Lin

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State of Washington, Analytical Methods for Petroleum Hydrocarbons, ECY 97-602, Washington State Department of Ecology, June 1997

Port of Seattle, Southwest Harbor Project, Phase II Groundwater Confirmation Monitoring Program, Water Quality Monitoring Plan, Aspect Consulting, Inc., October 2008.

APPENDIX A

The precision criterion (≤ 50%) was applied to evaluating the relative percent difference (RPD) values of field duplicate results greater than five times the MRL (5xRL). For results less than 5xRL, an advisory criterion of 2xRL was applied to evaluating the concentration differences.

The RPD and concentration difference values for detected analytes and data qualification are presented as follows:

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		FM105-090331	FM105-090331D			
Arsenic	0.2	0.50	0.50	-	0	No action
cis-1,2-Dichloroethene	0.2	0.40	0.50	-	0.01	No action
Tetrachloroethene (PCE)	0.2	3.4	3.7	8.5%	-	No action
Trichloroethene (TCE)	0.2	0.60	0.60	-	0	No action
bis(2-Ethylhexyl)phthalate	1.0	ND	5.8	-	5.8	**UJ/J**

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		MW26R-090401	MW26R-090401D			
Benz(a)anthracene	0.01	ND	0.011	-	0.011	No action
Benzo(b)fluoranthene	0.01	ND	0.018	-	0.018	No action
Benzo(k)fluoranthene	0.01	ND	0.016	-	0.016	No action
Chrysene	0.01	0.011	0.022	-	0.011	No action
Chromium	2	3	3	-	0	No action
Nickel	2	6	7	-	1	No action

Notes:
RL – Reporting limit
ND – Not detected at or above the RL
RPD – Relative percent difference
Conc. Difference – Concentration difference between the parent sample and the field duplicate sample

Data Validation Report

Port of Seattle, Southwest Harbor
Phase II Groundwater Quality Confirmation Monitoring
September 2009 Sampling

Laboratory SDG Numbers:

PM70, PN04, & PN16

Prepared for:

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October 20, 2009

ACRONYMS

%D	percent difference
%D$_f$	percent drift
%R	percent recovery
%RSD	percent relative standard deviation
AMU	atomic mass unit
ARI	Analytical Resources, Inc.
BFB	Bromofluorobenzene
CCB	continuing calibration blank
CCV	continuing calibration verification
CF	calibration factor
CLP	U.S. EPA Contract Laboratory Program
COC	chain-of-custody
DFTPP	Decafluorotriphenylphosphine
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
GC/MS	gas chromatograph/mass spectrometer
ICAL	initial calibration
ICB	initial calibration blank
ICP/MS	inductively coupled plasma/ mass spectrometer
ICS	ICP interference check sample
ICV	initial calibration verification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
µg/L	microgram per liter
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFGs	CLP National Functional Guidelines for Data Review (EPA 2007 – Organics, EPA 2004 - Inorganics)
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
QAPP	quality assurance project plan

QA/QC	quality assurance/quality control
RF	response factor
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SIM	selective ion monitoring
SVOCs	semi-volatile organic compounds
TPH	total petroleum hydrocarbon
VOCs	volatile organic compounds

INTRODUCTION

This report presents and discusses findings of the data validation performed on analytical data for samples collected during September 2009 for the referenced project. The laboratory reports validated herein were submitted by Analytical Resources, Inc. (ARI), assigned sample delivery group (SDG) numbers PM70, PN04, and PN16.

A level III data validation was performed on the laboratory reports. The validation followed the procedures specified in USEPA CLP Functional Guidelines ([NFGs], EPA 2004 and 2007) with modifications to accommodate project and analytical method requirements. The numerical quality assurance/quality control (QA/QC) criteria applied to the validation were in accordance with those specified in the quality assurance project plan ([QAPP], Aspect 2008) and the current performance-based control limits established by the laboratory (laboratory control limits). Instrument calibration, frequency of QC analyses, and analytical sequence requirements were evaluated against the respective analytical methods.

Validation findings are discussed in each section pertinent to the QC parameter for each type of analysis. Qualified data with applied data qualifiers are summarized in the **Summary** section at the end of this report. Field duplicate results and evaluation is presented in **Appendix A**.

Samples and the associated analyses validated herein are summarized as follows:

Field Sample ID	Laboratory Sample ID	Sampling Date	Sample Type	Analysis						
				VOCs	SVOCs	PAHs	PCBs	As Pb	Metals	TPH
CMP2-090902	PM70A	09/02/09	GW		X	X	X	X		X
MW125-090902	PM70B	09/02/09	GW	X	X	X	X	X		X
CMP17-090902	PM70C	09/02/09	GW	X	X	X	X	X		X
FM105-090902	PM70D	09/02/09	GW	X	X	X	X	X		X
FM105-090902D	PM70E	09/02/09	FD	X	X	X	X	X		X
CMP5-090902	PM70F	09/02/09	GW		X	X	X	X		X
CMP3-090903	PN04A	09/03/09	GW		X	X	X	X		X
CMP4-090903	PN04B	09/03/09	GW		X	X	X	X		X
CMP15-090903	PN04C	09/03/09	GW		X	X	X		X	X
MW26R-090903	PN04D	09/03/09	GW		X	X	X		X	X
MW26R-090903D	PN04E	09/03/09	FD		X	X	X		X	X
MW44-090903	PN04F	09/03/09	GW		X	X	X		X	X
MW36-090903	PN04G	09/03/09	GW		X	X	X		X	X

Notes:
X - The analysis was requested and performed on the sample
VOCs – Volatile organic compounds, chlorinated ethanes and ethenes only
SVOCs – Semi-volatile organic compound, *bis(*2-ethylhexyl)phthalate only
PAHs – Polycyclic aromatic hydrocarbons, carcinogenics only
PCBs – Polychlorinated biphenyl Aroclors
As – Arsenic
Pb - Lead

Metals – Antimony, arsenic, chromium, copper, lead, and nickel
TPH – Diesel and motor oil range total petroleum hydrocarbon
GW – Groundwater sample
FD – Field duplicate

Analytical methods in respect to analytical parameters validated herein and the laboratory performing the analyses are summarized below:

Parameter	Analytical Method	Laboratory
VOCs	SW846 Method 8260B	Analytical Resources, Inc. (ARI) Tukwila, WA
SVOCs	SW846 Method 8270C–Full Scan	
PAHs	SW846 Method 8270C-SIM	
PCB Aroclors	SW846 Method 8082	
Metals (Sb, As, Cr, Cu, Pb, & Ni)	EPA Method 200.8	
TPH-Diesel and Motor Oil	NWTPH-Dx	

Notes:

1. SW846 Methods - *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.
2. EPA Method 200.8 - *USEPA Methods for Chemical Analysis of Water and Wastes,* EPA –600/4-79-020, March 1983 Revision.
3. NWTPH - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602, Washington State Department of Ecology, June 1997.
4. SIM – Selective ion monitoring

DATA VALIDATION FINDINGS

1. VOCs by GC/MS (EPA Method SW8260B)

1.1 Sample Management and Holding Time

Samples were received in the laboratory intact and in consistence with the accompanying chain-of-custody (COC) documentation. The temperature for coolers was outside the upper limit of 4±2℃ upon the receipt at the laboratory. All samples were hand-delivered to the laboratory the same day of collection. The higher cooler temperature had no significant effects on data quality. No other anomalies were identified in relation to sample preservation, handling, and transport.

Water samples should be analyzed within 14 days of collection. All samples were analyzed within the required holding time.

1.2 GC/MS Instrument Performance Check

Bromofluorobenzene (BFB) tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

1.3 Initial Calibration

The National Functional Guidelines (NFGs) require that the percent relative standard deviation (%RSD) be <30% and the average response factor (RF) be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. Initial calibration met the criteria for all target compounds.

1.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the percent difference (%D) be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

Calibration verification analyses met the method requirements.

1.5 Method Blank

A method blank was prepared and analyzed as required. Target compounds were not detected at or above the method detection limits (MDLs) in the method blank.

1.6 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD were prepared and analyzed as required by the method. All percent recovery (%R) and relative percent difference (RPD) values met the laboratory control criteria.

1.7 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

1.8 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

1.9 Internal Standard

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

1.10 Field Duplicates

Samples FM105-090902 and FM105-090902D were field duplicates. The duplicate sample RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

1.11 Reporting Limits (RLs)

The sample-specific RLs met the QAPP requirements and were supported with adequate initial calibration concentrations.

1.12 Overall Assessment of VOCs Data Usability

VOCs data are of known quality and acceptable for use.

2. *bis*(2-Ethylhexyl)phthalate by GC/MS (EPA Method SW8270C)

2.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

2.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

2.3 Initial Calibration

The NFGs criteria require that the percent %RSD be <30% and the average RF be > 0.01 for poor response compounds and >0.05 for all other compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995, and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

2.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verifications met the criteria.

2.5 Method Blank

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the MDL in the method blanks.

2.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits, except that the %R value for one of the surrogates, *p*-terphenyl-d_{14}, exceeded the upper control limit in sample CMP1-090904. *bis*(2-Ethylhexyl)phthalate was not detected at or above the RL in this samples. The higher surrogate recovery had no effect on data quality; no data were qualified on this basis.

2.7 Matrix Spike (MS) and MS Duplicate (MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

2.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

2.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

2.10 Field Duplicates

Two pairs of field duplicates - samples FM105-090902 and FM105-090902D; and samples MW26R-090903 and MW26R-090903D, were submitted for *bis*(2-ethylhexyl)phthalate analyses. *bis*(2-Ethylhexyl)phthalate was not detected at or above the RL in these samples. The field precision met the project criterion.

2.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

2.12 Overall Assessment of *bis*(2-Ethylhexyl)phthalate Data Usability

bis(2-Ethylhexyl)phthalate data are of known quality and acceptable for use.

3. PAHs by GC/MS - SIM (EPA Method SW8270C)

3.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

3.2 GC/MS Instrument Performance Check

DFTPP tuning was performed within each 12-hour interval. All required ion abundance ratios met the method requirements.

3.3 Initial Calibration

The NFGs criteria require that the %RSD be <30% and the average RRF be >0.05 for all target compounds.

The method linearity criteria require that (1) if linear average RFs is chosen as the quantitation option, the %RSD of RFs be < 15% for the analyte, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be >0.995,

and (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be >0.99. The initial calibration met the criteria.

3.4 Calibration Verification

The analytical method and NFGs criteria require that (1) continuing calibrations be analyzed at the beginning of each 12-hour analysis period prior to the analysis of method blank and samples, (2) the %D be within ±20%, and (3) the RF be > 0.01 for poor response compounds and >0.05 for all other compounds. Calibration verification analyses met the criteria or the %D values were at levels that had no effects on sample results (*e.g.,* biased-high %D values and the target analytes were not detected in associated samples).

3.5 Method Blanks

Method blanks were prepared and analyzed as required. No target compounds were detected at or above the MDLs in the method blanks.

3.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate %R values were within the laboratory control limits, except that the %R value (30.9%) for one of the surrogates, 2-methylnaphthalene-d_{10}, was less than the lower control limit in sample CMP2-090902. The sample was diluted and re-analyzed. The %R values for both surrogates were within the control limits in the re-analysis, indicating that the lower surrogate recovery in the initial analysis was a result of matrix interference rather than extraction deficiency. Data were not qualified on this basis.

3.7 Matrix Spike (MS) and MS Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

3.8 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

3.9 Internal Standards

The method requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

3.10 Field Duplicates

Two pairs of field duplicates - samples FM105-090902 and FM105-090902D; and samples MW26R-090903 and MW26R-090903D, were submitted for PAHs analyses.

The duplicate RPD or concentration difference values for detected compounds and data qualification are presented in Appendix A of this report.

3.11 Reporting Limits

The sample-specific RLs met the project requirements and were supported with adequate initial calibration concentrations.

3.12 Overall Assessment of PAHs Data Usability

PAHs data are of known quality and acceptable for use.

4. PCB Aroclors by GC/ECD (EPA Method SW8082)

4.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

4.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using the mixture of Aroclor 1016 and 1260, (2) a single-point calibration be performed for the other five Aroclors to establish calibration factors (CFs) and for Aroclor pattern recognition, (3) at least 3 peaks (preferably 5 peaks) must be chosen for each Aroclor for characterization, (4) the relative standard deviation (%RSD) values of Aroclor 1016 and 1260 CFs must be ≤ 20%, and (5) if dual column analysis is chosen, both columns should meet the requirements.

The laboratory chose the internal-standard linear calibration for the Aroclor quantitation. The average RF %RSD values met the linearity criterion (20%). All RFs were >0.01, as recommended by SW846 Method 8000. The initial calibrations met the method requirements and were acceptable.

4.3 Calibration Verification

The method requires that (1) the initial calibration be verified prior to any analysis for each 12-hour analysis sequence, and (2) the percent drift ($\%D_f$) be within ±15% to demonstrate the linearity of the initial calibration. Calibration verifications were performed at the required frequency. All $\%D_f$ values either met the method criterion or at levels that had no effects on sample results (*e.g.,* biased-high $\%D_f$ values where target analytes were not detected in associated samples).

4.4 Method Blanks

Method blanks were prepared and analyzed as required. PCB Aroclors were not detected at or above the MDLs in the method blanks.

4.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

4.6 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were not performed on project samples in these SDGs, and therefore not reported.

4.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed with each analytical batch. All %R and RPD values were within the project control limits.

4.8 Internal Standards

The laboratory chose the internal-standard calibration approach for analyte quantitation. The SW-846, Method 8000 requires that (1) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (2) the area counts of all internal standards be within –50% to +100% of the associated 12-hour calibration standard. All internal standards in the sample and associated QC analyses met the criteria.

4.9 Field Duplicates

Two pairs of field duplicates - samples FM105-090902 and FM105-090902D; and samples MW26R-090903 and MW26R-090903D, were submitted for PCB Aroclors analyses. PCB Aroclors were not detected at or above the RLs in these samples. The field precision met the project criterion.

4.10 Reporting Limits and Target Compound Quantitation

Sample-specific RLs met the QAPP requirements. RLs in selected samples were raised due to non-target chemical interference or response peaks that did not meet the Aroclor identification criteria (*e.g.*, peak ratios, chromatographic patterns).

The dual column RPD value for Aroclor 1248 in sample CMP3-090903 was greater than 40%. The Aroclor 1248 result in this sample was qualified (J) as estimated.

4.11 Overall Assessment of PCB Aroclors Data Usability

PCB Aroclor data are of known quality and acceptable for use as qualified.

5. Total Metals by ICP/MS (EPA Method 200.8)

5.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, as discussed in Section 1.1.

Water samples should be analyzed within 180 days. Samples were analyzed within the required holding time.

5.2 ICP/MS Tuning

Instrument tuning was performed at the required frequency. The stability check (%RSD <5%), mass calibration (mass difference <0.1 AMU), and resolution check (peak width <1.0 AMU at 5% peak height) met the NFG and method criteria.

5.3 Initial Calibration

The ICP methods requires that (1) a blank and one calibration standard be used in establishing the analytical curve, and (2) the average of replicate exposures be reported for all standards, QC, and sample analyses.

A check standard containing target analytes at the reporting limit levels was analyzed at the beginning of each analytical run. The results were within the NFGs criteria of 70-130%.

5.4 Calibration Verification (ICV and CCV)

Initial calibration verifications (ICVs) and continuing calibration verifications (CCVs) were analyzed at the required frequency. The %R values met the control criteria (90 – 110%).

5.5 Blanks

Calibration Blanks: Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) were analyzed at required frequency. Target analytes were not detected at or above the MDLs in ICBs/CCBs.

Method Blanks: Method blanks were prepared and analyzed as required. Target analytes were not detected at or above the MDLs in the method blanks.

5.6 ICP Interference Check Sample (ICS)

The method requires that (1) an inter-element interference check sample be analyzed at the beginning of each analytical run, and (2) the results should be within ± 20% of the true value. ICP interference check sample analyses met the requirements.

5.7 Laboratory Control Sample (LCS)

LCS analyses were performed as required by the method. All %R values met the control limits (80 – 120%).

5.8 Duplicate Sample Analysis

Duplicate sample analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical precision was evaluated based on the field duplicate results.

5.9 Matrix Spike (MS)

Matrix spike analyses were not performed on project samples in these SDGs, and therefore not reported. The analytical accuracy was evaluated based on the LCS results.

5.10 Internal Standards

At least three internal standards were added to all field and QC samples for ICP/MS analyses. All percent relative intensity values were within the method criteria (30 - 120% of those for the associated calibration blank).

5.11 ICP Serial Dilution

Serial dilution analysis were not performed on project samples in these SDGs, and therefore not reported.

5.12 Field Duplicates

Two pairs of field duplicates - samples FM105-090902 and FM105-090902D; and samples MW26R-090903 and MW26R-090903D, were submitted for metals analyses. The duplicate RPD or concentration difference values for detected analytes and data qualification are presented in Appendix A of this report.

5.13 Analyte Quantitation and Reporting Limits

RLs for selected analytes in a number of samples were raised due to the required dilution to overcome matrix interference associated with the samples. The QAPP requirements for quantitation limits were achieved.

5.14 Overall Assessment of Metals Data Usability

Metals data are of known quality and acceptable for use.

6. TPH-Diesel & Motor Oil by GC/FID (Method NWTPH-Dx)

6.1 Holding Time

Water samples should be extracted within seven days of collection. Extracts should be analyzed within 40 days of extraction. The extraction and analysis of samples met the requirements.

6.2 Initial Calibration

The method requires that (1) a minimum of 5-point calibration be performed using individual petroleum product reference standards to ensure the proper identification and quantitation of petroleum hydrocarbons in samples, (2) the calibration curve includes a sufficiently low standard to provide the necessary reporting limits, and (3) the linear working range of the instrument be defined.

The ICAL met the method requirements. The linearity of the ICAL curve was verified with %RSD of RFs (%RSD ≤ 20%, according to EPA SW 846 Method 8000), and was acceptable for both diesel and motor oil range total petroleum hydrocarbon (TPH).

6.3 Calibration Verification

The method requires that (1) a mid-range check standard be analyzed prior to and after each analytical batch, and (2) the percent drift value be within ±15% of the true value. The calibration verification analyses met the requirements.

6.4 Method Blanks

Method blanks were prepared and analyzed as required. TPH-Diesel and TPH-Motor Oil were not detected at or above the MDLs in the method blanks.

6.5 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate spike %R values were within the laboratory control limits.

6.6 Duplicate Analysis

Duplicate analyses were not performed on project samples in these SDGs, and therefore were not reported. Analytical precision was evaluated based on the LCS/LCSD analyses.

6.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method. All %R and RPD values were within the laboratory control limits.

6.8 Field Duplicates

Two pairs of field duplicates - samples FM105-090902 and FM105-090902D; and samples MW26R-090903 and MW26R-090903D, were submitted for TPH-Diesel & Motor Oil analyses. The target compounds were not detected at or above the RLs in these samples. The field precision met the project criterion.

6.9 Reporting Limits

The reported RLs were supported with adequate ICAL concentrations. Sample-specific RLs met the QAPP requirements.

6.10 Overall Assessment of TPH-Diesel and Motor Oil Data Usability

TPH-Diesel and Motor Oil data are of known quality and acceptable for use.

SUMMARY

I. Data qualification are summarized as follows:

Sample ID	Analyte	Data Qualifier	Reason	Report Section
CMP3-090903	Aroclor 1248	J	The dual column RPD value was greater than 40%.	**4.10**

II. Data affected by associated blanks are qualified and results adjusted as follows:

Sample ID	Analyte	Original Result	Adjusted Result	Unit	Report Section
No data were qualified in relation to detections in blanks in these SDGs.					

III. Data Qualifiers are defined as follows:

Data Qualifier	Definition
J	The analyte was detected above the reported quantitation limit, and the reported concentration was an estimated value.
NJ	The analyte was not definitively identified and the reported concentration was an estimated value.
R	The result was rejected and could not be used.
U	The analyte was analyzed for, but was considered not detected at the reporting limit or reported value.
UJ	The analyte was analyzed for, and the associated quantitation limit was an estimated value.

Approved By: _____ Date: _____

Mingta Lin

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Port of Seattle, Southwest Harbor Project, Phase II Groundwater Confirmation Monitoring Program, Water Quality Monitoring Plan, Aspect Consulting, Inc., October 2008.

APPENDIX A

The precision criterion (≤ 50%) was applied to evaluating the relative percent difference (RPD) values of field duplicate results greater than five times the MRL (5xRL). For results less than 5xRL, an advisory criterion of 2xRL was applied to evaluating the concentration differences.

The RPD and concentration difference values for detected analytes and data qualification are presented as follows:

Detected Target Analyte	RL (µg/L)	Sample ID & Concentration (µg/L)		RPD (%)	Conc. Difference (µg/L)	Data Qualification
		FM105-090902	FM105-090902D			
Arsenic	0.2	0.50	0.50	-	0	No action
cis-1,2-Dichloroethene	0.2	0.20	0.20	-	0	No action
Tetrachloroethene (PCE)	0.2	5.2	5.0	4%	-	No action
Trichloroethene (TCE)	0.2	0.60	0.50	-	0.10	No action
Detected Target Analyte	**RL (µg/L)**	**Sample ID & Concentration (µg/L)**		**RPD (%)**	**Conc. Difference (µg/L)**	**Data Qualification**
		MW26R-090903	**MW26R-090903D**			
Chrysene	0.01	0.013	0.013	-	0	No action
Chromium	2	3	3	-	0	No action
Copper	2	3	3	-	0	No action
Nickel	2	7	6	-	1	No action

Notes:
RL – Reporting limit
ND – Not detected at or above the RL
RPD – Relative percent difference
Conc. Difference – Concentration difference between the parent sample and the field duplicate sample

CERTIFICATES OF ANALYSIS
ANALYTICAL RESOURCES, INC.
HART CROWSER, INC.

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