

TECHNICAL MEMORANDUM

TO: Andrew Kallus, Environmental Specialist, Washington State Department of Ecology

FROM: Larry Beard, P.E., and Stacy Lane, L.G. *LB* *SL*

DATE: March 8, 2010

RE: **RI/FS WORK PLAN WEST END SITE ADDENDUM NO. 1**
GROUNDWATER QUALITY MONITORING AT CONDITIONAL POINT OF COMPLIANCE
PORT OF EVERETT, WASHINGTON

This document is an addendum to the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan; Landau Associates 2009) for the Port of Everett (Port) North Marina West End Site (Site) located in Everett, Washington (Figure 1). The objective of this supplemental investigation is two fold: 1) evaluate groundwater quality closer to the groundwater/surface water interface by using angled drilling techniques, and 2) evaluate groundwater quality at selected Site monitoring wells for constituents that exceeded preliminary cleanup levels during previous rounds of monitoring. The technical approach and associated scope of work presented in this document was discussed with the Washington State Department of Ecology (Ecology) representatives during a conference call on January 27, 2010. As discussed during the conference call, the Port is presenting this work plan to Ecology for review and comment prior to its implementation. Further, this document presents supporting regulatory information for utilizing angled drilling techniques.

As shown on Figures 1 and 2, the Site abuts the Snohomish River/Port Gardner Bay to the west, which is an inlet of Possession Sound. The Site is bounded by the 12th Street Yacht Basin on the north and the North Marina on the south, which both connect to the Snohomish River. Currently, nine monitoring wells are located along the western and northern shoreline of the property, as shown on Figure 2, and concentrations of dissolved arsenic above the preliminary cleanup level of 5.0 µg/L have been detected at five of these wells. Dissolved copper has also been detected at two of the western shoreline wells at concentrations above the copper preliminary cleanup level (3.1 µg/L) and vinyl chloride has been detected at one northern shoreline well above the vinyl chloride preliminary cleanup level (2.4 µg/L). Dissolved arsenic and copper concentrations and vinyl chloride concentrations for groundwater samples collected at each well in 2009 are shown on Figures 3 and 4, respectively. Although a map view shows these wells located at the shoreline, the groundwater at these locations is a significant distance from the actual point of discharge to surface water during periods (low tides) when groundwater discharge to surface water is greatest. As a result, the groundwater quality at the existing shoreline wells is likely not representative of the groundwater quality discharging to surface water.

This addendum presents the planned scope of work for further evaluation of groundwater quality at the point of discharge to Port Gardner and the 12th Street Yacht Basin. Field investigation procedures for well installation and groundwater monitoring will be the same as presented in the Work Plan, except as described below.

SCOPE OF WORK

The scope of work in this document includes the point of compliance evaluation and supplemental groundwater sampling as presented in the following subsections.

Point of Compliance Evaluation

To evaluate groundwater quality at a location closer to the point of groundwater discharge to surface water than previously achieved by monitoring groundwater at the existing shoreline wells, an angled well will be installed at the Site and constructed so that the well screen is placed approximately four ft inland from the point of groundwater discharge to surface water. The proposed location of the new well is along the northern shoreline of the Site near monitoring well RI-MW-11, which is the shoreline well location where the highest concentrations of arsenic (61.8 µg/L and 51.2 µg/L) were previously detected in groundwater. Because the shoreline in this area is sloped, the borehole for the new monitoring well will be drilled at an angle parallel to the slope of the shoreline. The borehole will begin at the top of the shoreline and extend northward toward the 12th Street Yacht Basin. A cross-section showing a conceptual drawing of the proposed monitoring well is presented on Figure 5.

Utilizing the proposed angled groundwater monitoring for evaluating groundwater compliance at the Site is consistent with Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). In accordance with WAC 173-340-720(8)(d)(i), a property abutting surface water may have a conditional point of compliance that is located within the surface water as close as technically possible to the point where groundwater flows into the surface water. The well will be placed within the soil column, or stratum, and samples will be collected during an outgoing tide. As a result, groundwater will be collected from the well in accordance with WAC 173-340-200, which defines groundwater as “water in a saturated zone or stratum beneath the surface of land...”

The dissolved arsenic and vinyl chloride results for the groundwater sample collected at the angled well will be used to evaluate compliance with cleanup standards at that location. The dissolved arsenic concentration in the angled well will also be compared to the arsenic concentration measured at RI-MW-11 to determine the percent reduction in concentration achieved by monitoring groundwater closer to the surface water interface. This percent reduction in concentration will be applied to groundwater data for existing vertical shoreline wells to calculate the concentration of relevant

constituents at the point of groundwater discharge to surface water and determine compliance with cleanup standards.

In addition to collecting the above groundwater samples, a surface water sample will be collected from the 12th Street Yacht Basin just offshore of RI-MW-11. The sample will be analyzed for dissolved arsenic to provide supplemental information for evaluating surface water quality in the vicinity of the elevated groundwater conditions observed in RI-MW-11.

New Well Installation and Construction

A 4-inch diameter borehole will be drilled using a mud rotary drilling method for installation of the new groundwater monitoring well. Water or a bentonite slurry will be pumped into the hole during advancement of the drill rods to remove soil cuttings and stabilize the borehole wall. The borehole will be drilled at an angle (approximately 65 degrees from vertical) so that the boring parallels the upper slope of the shoreline, as shown on Figure 5. The shoreline is armored with a 3-ft thick layer of riprap and a 1-ft thick layer of crushed rock bedding material that is separated from the underlying soil by a geotextile fabric layer. The boring will be drilled at a depth that is approximately 1 ft below the geotextile fabric. The boring is expected to be about 50 ft long, beginning at the top of the shoreline (elevation 16 ft MLLW) and extending to an elevation of approximately -4 ft mean lower low water (MLLW). A conceptual drawing of the well installation is provided on Figure 5.

A prefabricated 2-inch diameter well will be installed in the borehole. The well will be constructed of PVC casing and a 25-ft well screen so that the well is screened from approximately elevation -2 ft MLLW to approximately 12 ft MLLW. The well screen will consist of a machine-slotted screen (0.010-inch) and a non-woven geotextile fabric and a PVC geogrid mesh bonded to the inside of the screen. A filter pack cannot be installed around the well screen due to the flat slope of the installation, so native material will be allowed to cave around the well screen and about the first 5 linear feet of well casing. The remaining well casing will be grouted to within 2 ft of the ground surface with bentonite grout and the well will be completed with an aboveground monument protective cover. The monument will be placed in concrete to a depth of 2 ft BGS.

The monitoring well will be constructed by a licensed drilling contractor in the state of Washington. In accordance with the *Minimum Standards for Construction and Maintenance of Wells* (WAC 173-160; Ecology 2006), a variance will be obtained from Ecology for installation of an angled well with less than a 2-inch annular seal. Oversight of drilling and well installation activities will be performed by an environmental professional familiar with environmental sampling and construction of resource protection wells. The well name and the identification number assigned by Ecology will be

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

Surface Water Quality Sampling

One surface water quality sample will be collected from the 12th Street Yacht Basin at the shoreline from RI-MW-11 and the angled well. The sample will be analyzed for dissolved arsenic and the result will be used to provide supplemental information for evaluating surface water quality in the vicinity of the elevated groundwater conditions observed in RI-MW-11. The sample will be analyzed using EPA Method 6020; however, extra volume will be collected for analysis by EPA Method 1640. The sample will be analyzed by EPA Method 1640 if the results for the initial sample indicate potential interferences. The surface water sample will be collected by lowering a capped, unpreserved, laboratory-supplied sample bottle beneath the water surface to avoid entraining any surface debris in the sample. The bottle will then be slowly uncapped and allowed to fill, and will be recapped prior to removal from the water. The surface water collected in the bottle will be field-filtered and transferred to a preserved laboratory-supplied sample bottle. Field parameters measured for each groundwater sample will also be measured for the groundwater surface sample.

Monitoring Well Sampling

Groundwater samples will be collected from shoreline wells RI-MW-1, -3, -4, -11, -12, and -13 (Figure 2) and the angled monitoring well. The groundwater samples will be collected within 1 hour before and 1 hour after a low tide (elevation 0 ft MLLW, or lower). To avoid sampling within the saltwater wedge (see Figure 5), samples will be collected from the upper 2 ft of the water column at the time of sampling. At the angled well, a sample will also be collected at mid-tide near mean sea level (approximate elevation 6 ft MLLW). This groundwater sample will be collected from the portion of the water column above elevation 6 ft MLLW. Each groundwater sample will be analyzed for those constituents previously detected at concentrations exceeding the preliminary cleanup level as follows:

- Well RI-MW-1: Dissolved arsenic and copper
- Well RI-MW-3: Dissolved copper
- Wells RI-MW-4, -12, and -13: Dissolved arsenic
- Well RI-MW-11 and the angled well (RI-MW-11A): Vinyl chloride and dissolved arsenic.

A groundwater sample will also be collected at well RI-MW-7 and analyzed for diesel- and motor oil-range petroleum hydrocarbons. Lube oil was detected in groundwater at this well in June 2009 at a

concentration above the preliminary cleanup level, but was not detected in groundwater at this well in September 2009.

At Ecology's request, a groundwater sample will also be collected from wells RI-MW-7, RI-MW-11, and RI-MW-11A in the spring of 2010 (around the first week of May 2010) and analyzed for the analytical parameters described above. However, the need for a second round of sampling from RI-MW-11 and RI-MW-11A will be evaluated in consultation with Ecology if the first round of sampling does not show a significant decrease in concentration from MW-11 to MW-11A.

Analytical methods and target reporting limits for the sample analyses will be the same as those specified in the RI/FS work plan. Field parameters pH, temperature, conductivity, dissolved oxygen, turbidity, and oxidation reduction potential (Redox) will be measured at each sampling location. At the angled well (RI-MW-11A), field parameters will be measured at multiple depths (approximately every 5 feet) prior to purging to confirm the depth of the freshwater and saltwater interface.

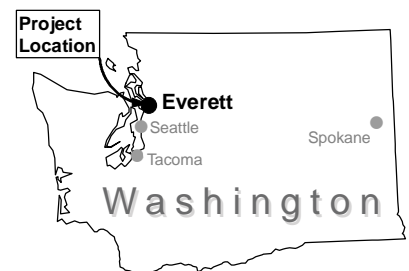
DATA EVALUATION AND REPORTING

Upon receipt of the analytical data, the data will be validated using the procedures described in the RI/FS work plan and evaluated with respect to compliance with cleanup standards. A report will be prepared and submitted to Ecology and will include tabulated summaries of the data, the results of the evaluation, and documentation of the final well construction.

REFERENCES

Landau Associates. 2009. *Final RI/FS Work Plan, West End Site, Everett, Washington*. Prepared for Port of Everett. March 20.

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Data Source: ESRI 2008

North Marina West End Site
RI/FS Work Plan
Everett, Washington










Vicinity Map

Figure
1



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Legend

- | | | |
|---|--|--|
|  2009 Direct - Push Groundwater Grab Sample Location |  Post Dredge Minor Contour (2' Interval, MLLW) |  Bathymetry (MLLW) Based on Data Collected in 2003 & 2004 |
|  2009 Groundwater Monitoring Well Location |  Post Dredge Major Contour (10' Interval, MLLW) |  Harbor Line and River Center Line |
| |  West End Site Boundary |  Interim Action Area |
| |  Approximate Boundary of Leasehold | |

Notes:

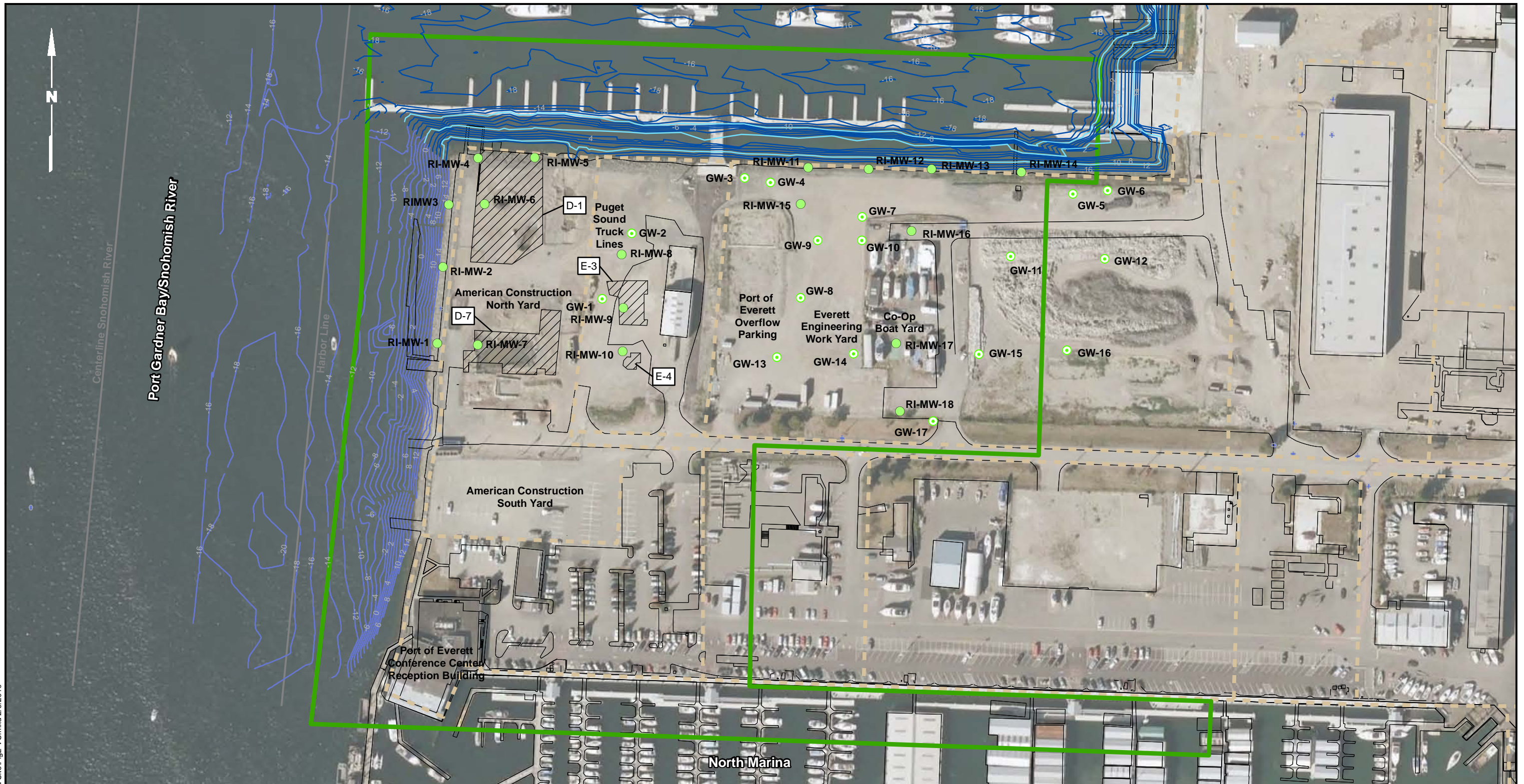
1. At locations where lube oil was analyzed, diesel and gasoline range petroleum hydrocarbons were also analyzed but were not detected.

Data Source: Google Earth (2008 Image); Elevation Contours, Harbor Line, and Centerline of Snohomish River: Port of Everett Hydrographic Survey of Tall Ship Moorage; Post Dredge Elevation Contours (2005, PND Engineers)

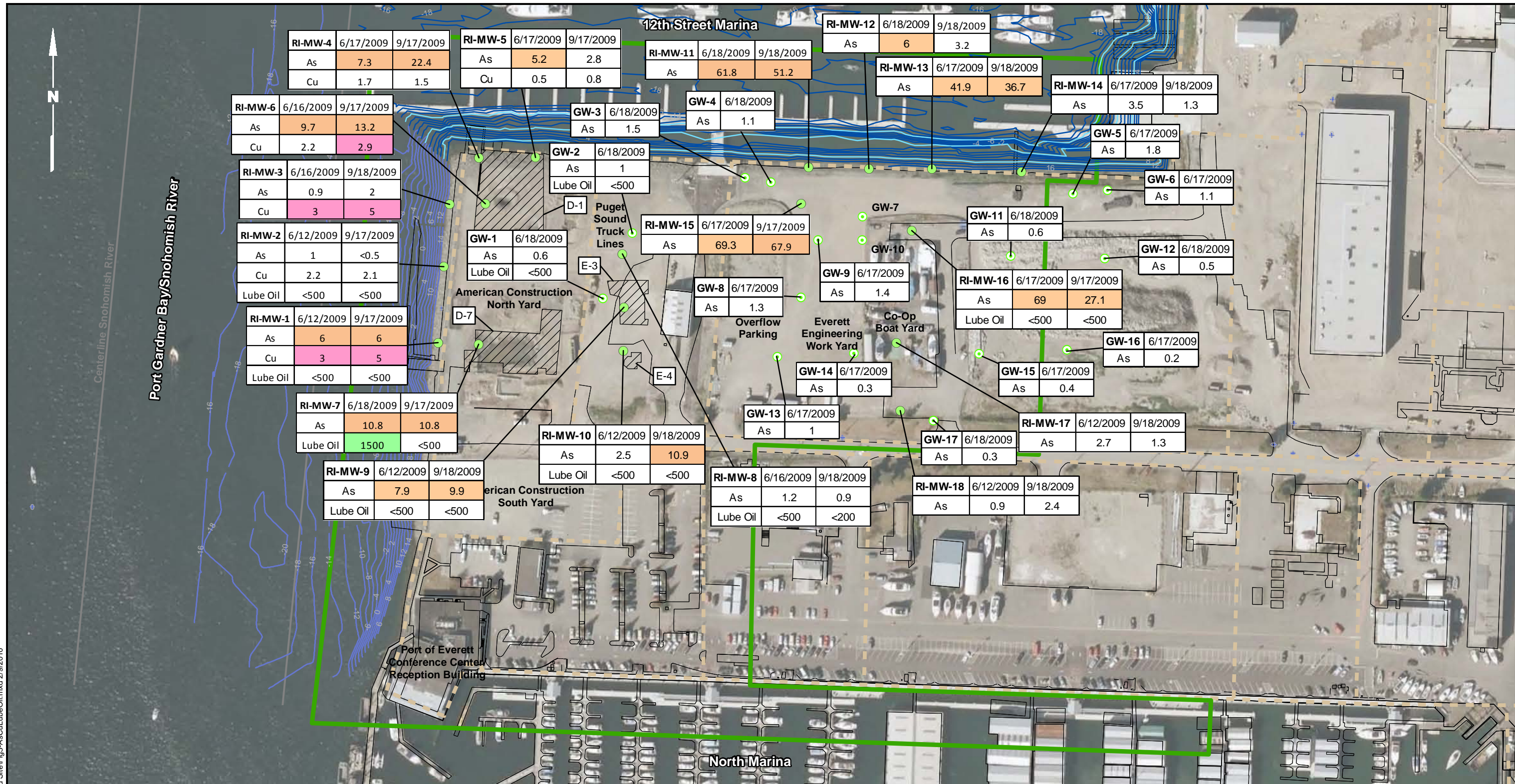
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**2009 Groundwater
Monitoring Locations**

Figure
2



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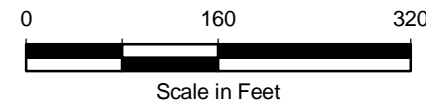


Legend

- 2009 Direct - Push Groundwater Grab Sample Location
- 2009 Groundwater Monitoring Well Location
- Post Dredge Minor Contour (2' Interval, MLLW)
- Post Dredge Major Contour (10' Interval, MLLW)
- West End Site Boundary
- Approximate Boundary of Leasehold
- Bathymetry (MLLW) Based on Data Collected in 2003 & 2004
- Harbor Line and River Center Line
- Interim Action Area

Preliminary Cleanup Levels µg/L	
As	5
Cu	2.4
Lube Oil	500

Notes:
1. Shaded box indicates preliminary cleanup level exceedance.
2. At locations where lube oil was analyzed, diesel and gasoline range petroleum hydrocarbons were also analyzed but were not detected.



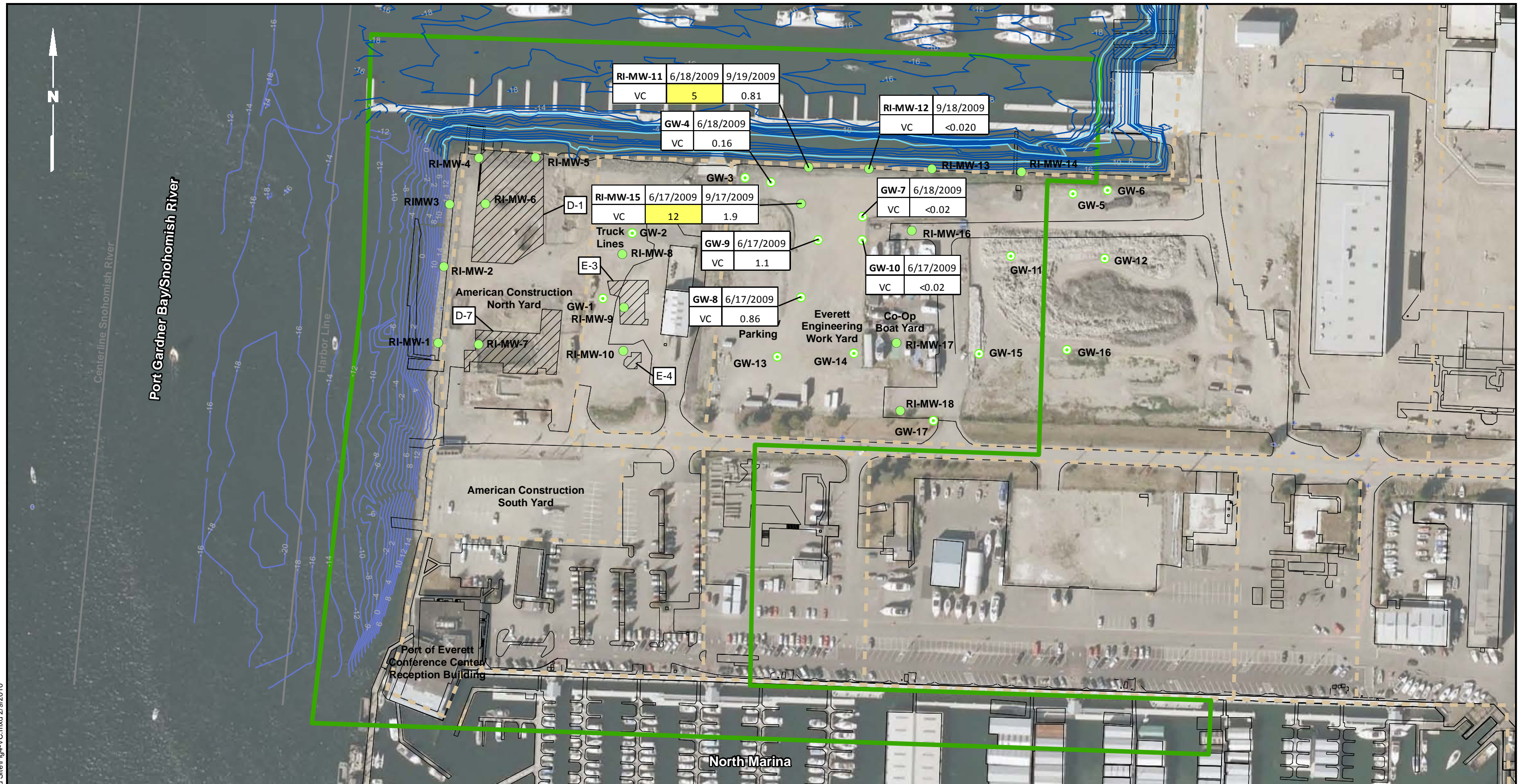
Data Source: Google Earth (2008 Image); Elevation Contours, Harbor Line, and Centerline of Snohomish River: Port of Everett Hydrographic Survey of Tall Ship Moorage; Post Dredge Elevation Contours (2005, PND Engineers)

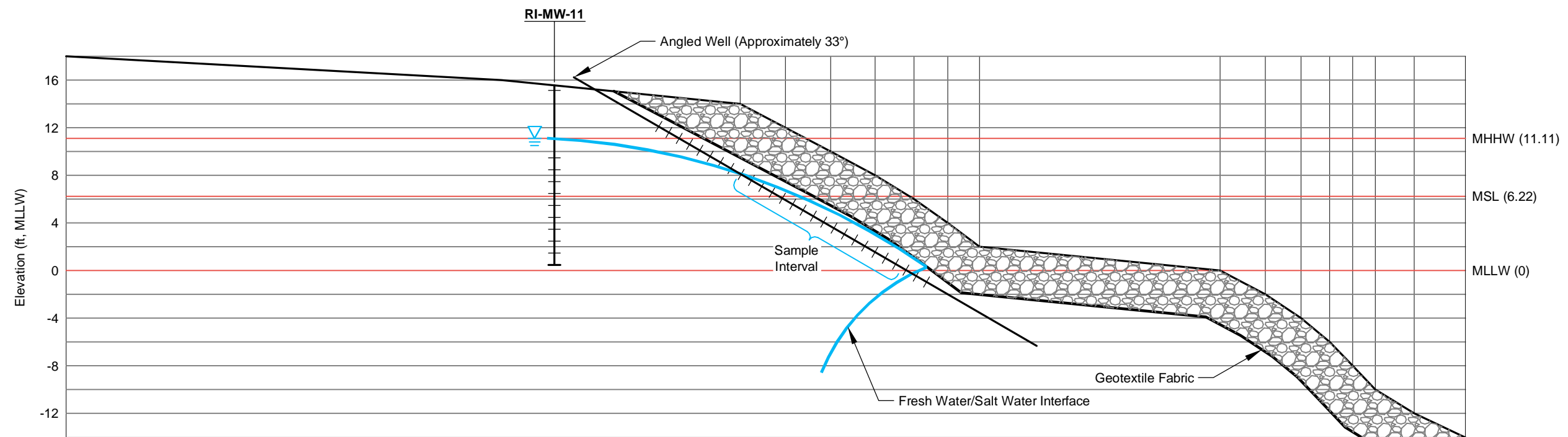
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**2009 Groundwater Arsenic,
Copper, and Lube Oil Results**

Figure
3

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Legend

- RI-MW-11** — Boring Number
- Groundwater Table Elevation
- Well Screen
- Bottom of Exploration
- Rip Rap



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**Angled Well
Draft Conceptual Drawing**

Figure
5