

**Report
4Q12 Compliance Monitoring
North Marina West End Site
Everett, Washington**

December 6, 2013

Prepared for

**Port of Everett
Everett, Washington**



**LANDAU
ASSOCIATES**

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LIST OF ABBREVIATIONS AND ACRONYMS

CAP	Cleanup Action Plan
COC	Contaminant of Concern
BGS	Below Ground Surface
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
OC	Organic Carbon
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This report summarizes the results for the compliance monitoring conducted at the North Marina West End site (Site) in Everett, Washington (Figure 1). The compliance monitoring is part of a Site cleanup action being conducted under a Consent Decree (No. 11-2-10367-4) between the Port of Everett (Port) and the Washington State Department of Ecology (Ecology). The cleanup action, as described in the Cleanup Action Plan (CAP; Ecology 2011), consists of long-term groundwater and sediment compliance monitoring and placement of institutional controls to restrict the uses of Site groundwater. This monitoring report includes recommendations for continued long-term groundwater monitoring.

2.0 LONG-TERM GROUNDWATER COMPLIANCE MONITORING

In accordance with the CAP, the long-term compliance groundwater monitoring consists of monitoring groundwater quality from eight existing monitoring wells along the shoreline on a quarterly basis for one year to demonstrate compliance with cleanup standards. The CAP specifies that if cleanup standards are not met during the initial year of groundwater compliance monitoring, additional groundwater and/or surface water quality monitoring may be required. In accordance with the CAP, the cleanup standards for groundwater include cleanup levels summarized in Table 1 and a conditional point of compliance for Site groundwater, which is the groundwater/surface water interface at the shoreline.

The eight monitoring wells identified for groundwater monitoring consist of vertical wells RI-MW-1, RI-MW-3, RI-MW-4, RI-MW-5, RI-MW-11, RI-MW-12, and RI-MW-13, and angled well RI-MW-11A. The well locations are shown on Figure 2.

2.1 SAMPLE COLLECTION AND ANALYSIS

The groundwater samples were collected on a quarterly basis using the procedures established in Appendix G of the *Remedial Investigation/Feasibility Study (RI/FS) West End Site Work Plan* (Work Plan; Landau Associates 2009) and Addendum No. 1 to the Work Plan (Landau Associates 2010). These procedures included collecting the groundwater samples within 1 hour before and 1 hour after a low tide [elevation 0 ft mean lower low water (MLLW), or lower] and collecting the samples from the upper 2 ft of the water column to avoid sampling within the saltwater wedge. At the angled well (RI-MW-11A), field parameters were measured at multiple depths prior to purging to confirm the depth of the freshwater and saltwater interface.

In accordance with the CAP, each of the groundwater samples was analyzed for dissolved arsenic. Groundwater samples collected at monitoring wells RI-MW-1 and RI-MW-3 were also analyzed for dissolved copper, and groundwater samples collected at monitoring wells RI-MW-11 and RI-MW-11A were also analyzed for vinyl chloride. A summary of the analyses for groundwater samples collected at each well for all four quarters and the analytical methods is provided in Table 2.

2.2 QUALITY ASSURANCE

Procedures for quality assurance established in Appendix G of the RI/FS Work Plan were used during the long-term groundwater compliance monitoring. Quality assurance procedures included collection of quality control samples and validation of the analytical data to determine the results were acceptable and met the quality objectives described in the RI/FS Work Plan. The quality control samples included collection of at least one blind field duplicate for each analysis performed, field trip blanks,

matrix spike and matrix spike duplicate samples, and a laboratory duplicate. A summary of the blind field duplicate samples collected and the analyses performed is provided in Table 3.

The field trip blank was analyzed for vinyl chloride. The laboratory matrix spike sample was analyzed for dissolved arsenic, dissolved copper, and vinyl chloride, and the laboratory matrix spike duplicate was analyzed for vinyl chloride. A laboratory duplicate was analyzed for dissolved arsenic and dissolved copper.

Validation of the analytical data was performed by Landau Associates following the guidelines in the appropriate sections of the U.S. Environmental Protection Agency (EPA) *Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA 1999, 2004) and included evaluation of the following:

- Chain-of-Custody records
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank results
- Blank spikes/laboratory control samples
- Blind field duplicate results
- Laboratory duplicates
- Corrective action records
- Completeness
- Overall assessment of data quality.

Based on the validation, all of the data were determined to be acceptable for use and meet the quality objectives describes in the RI/FS Work Plan; therefore, no qualification of the data was necessary.

2.3 RESULTS

During the RI/FS it was determined that groundwater contaminant concentrations decrease significantly between vertical wells constructed at the Site and the point of compliance (the groundwater/surface water interface). To evaluate the groundwater quality at the point of discharge to marine surface water, the dissolved arsenic and vinyl chloride concentrations in angled well RI-MW-11A were compared to the concentrations measured at vertical well RI-MW-11 to determine the reduction in concentration achieved by monitoring groundwater closer to the groundwater/surface water interface. The Port developed this approach to evaluate compliance with PCLs in cooperation with Ecology.

Ecology and the Port agreed that the use of an angled well for this evaluation would provide more representative groundwater data in order to make compliance determinations for the groundwater to surface water pathway (Kallus 2010).

RI analytical results indicated that dissolved arsenic and vinyl chloride concentrations decreased by about a factor of 5 between vertical well RI-MW-11 and angled well RI-MW-11A [(concentration at RI-MW-11)/(concentration at RI-MW-11A)]. The point of discharge for groundwater to marine surface water is about an additional 12 ft north of angled well RI-MW-11A. To account for the total distance between a vertical well and the discharge of groundwater to marine surface water (about twice the distance from RI-MW-11 and RI-MW-11A), the initial reduction factor was squared. As a result, a total concentration reduction factor of 25 (between the vertical shoreline wells and the groundwater/surface water interface) was estimated for the Site based on the RI data.

The concentration reduction factor was recalculated quarterly (using the method above) during long term compliance monitoring using the quarterly analytical results for vertical well RI-MW-11 and angled well RI-MW-11A. When a duplicate sample was analyzed at RI-MW-11, the lower reported value was used as the numerator to calculate the initial concentration reduction factor. When a duplicate sample was analyzed at RI-MW-11A, the higher reported value was used as the denominator to calculate the concentration reduction factor between the two wells. This approach provides the most conservative concentration factor for each case. As before, the initial reduction factor [(concentration at RI-MW-11)/(concentration at RI-MW-11A)] was then squared to calculate a total concentration reduction factor between vertical wells and the groundwater/surface water interface for each quarter. This total concentration reduction factor was used at all wells, with the exception of angled well RI-MW-11A. Since the location of angled well RI-MW-11A is already half the distance to the shoreline, the initial concentration factor [(concentration at RI-MW-11)/(concentration at RI-MW-11A)] was used to calculate adjusted concentrations at well RI-MW-11A. Groundwater analytical results are summarized in Table 4.

2.3.1 VINYL CHLORIDE

Groundwater was analyzed for vinyl chloride in compliance monitoring samples collected from RI-MW-11 and RI-MW-11A. Vinyl chloride was detected in the groundwater at both locations during all four quarters, but at concentrations below the cleanup level of 2.4 micrograms per liter (µg/L). Cleanup levels were achieved at all wells.

2.3.2 ARSENIC

Groundwater was analyzed for dissolved arsenic at eight locations: RI-MW-1, RI-MW-3, RI-MW-4, RI-MW-5, RI-MW-11, RI-MW-11A, RI-MW-12, and RI-MW-13. Arsenic was detected at

concentrations above the cleanup level (5 µg/L) at seven of these locations (RI-MW-1, RI-MW-3, RI-MW-4, RI-MW-11, RI-MW-11A, RI-MW-12, and RI-MW-13) during the compliance monitoring. However, in accordance with the CAP, a quarterly comparison of the dissolved arsenic concentration in samples collected from the angled well (MW-11A) to the concentration measured in the adjacent vertical well (MW-11) was utilized to develop a concentration reduction factor. The dimensionless concentration reduction factor for dissolved arsenic between the two wells ranged between 1.6 and 2.0 during compliance monitoring. Applying the same concentration reduction factor for the distance between MW-11A and the point of compliance produced a total arsenic concentration reduction factor ranging between 2.6 and 4.4 during the compliance monitoring.

Application of the reduction factor to the detected concentrations of dissolved arsenic at wells RI-MW-1, RI-MW-3, RI-MW-5, and RI-MW-12 resulted in concentrations of dissolved arsenic at or below the cleanup level (5 µg/L) at the point of compliance in the vicinity of these wells during each quarterly monitoring event. At wells RI-MW-4 and RI-MW-11, the calculated dissolved arsenic concentrations at the point of compliance were reduced to 14.8 µg/L (ranged from 9.3 to 14.8 µg/L) and 14.3 µg/L (ranged from 11.2 to 14.3 µg/L), respectively, during the fourth quarter. At well RI-MW-13, calculated dissolved arsenic concentration at the point of compliance was reduced to 6.6 µg/L during the fourth quarter.

2.3.3 COPPER

Groundwater was analyzed for dissolved copper at two locations, RI-MW-1 and RI-MW-3, during each of the quarterly sampling events. Dissolved copper was not detected at RI-MW-3 during any of the monitoring events. The detected concentrations of copper at RI-MW-1 were below the cleanup level of 3.1 µg/L for each monitoring event.

3.0 LONG-TERM SEDIMENT COMPLIANCE MONITORING

In accordance with the CAP, the long-term sediment compliance monitoring consisted of collecting a surficial sediment grab sample from one location. The sample was collected in general accordance with applicable state guidance and regulations, including the *Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards* (SAP Guidance; Ecology 2008) and, in accordance with the CAP, the sample was collected during the fourth quarter of the long-term compliance monitoring.

Sediment sampling and analysis was conducted to demonstrate compliance with the sediment cleanup standards identified in the CAP, which include both cleanup levels and a point of compliance. In accordance with the CAP, the point of compliance for Site sediment is throughout the predominantly biologically active zone (upper 10 centimeters of sediment). The sediment cleanup level for the only Site constituent of concern, fluoranthene, is presented in Table 1.

3.1 SAMPLE COLLECTION AND ANALYSIS

One surface sediment sample (LTCM-18) and the blind field duplicate (LTCM-20) were collected by Landau Associates personnel from a stationary marina dock, utilizing an Ekman grab sampler on November 6, 2012. The sample location was chosen to demonstrate compliance where results from the RI indicated concentrations of fluoranthene above its sediment cleanup level. The sample location is shown on Figure 2.

The sample was collected from a subsample of the Ekman grab sampler contents and homogenized in a stainless steel bowl with a stainless steel spoon in accordance with the SAP Guidance. Sample sediment included only sediment from the top 10 centimeters (considered the predominantly biologically active zone), and did not utilize sediment that was in contact with the sides of the Ekman grab sampler. In accordance with the CAP, the sediment sample was analyzed for fluoranthene using EPA method 8270D.

3.2 QUALITY ASSURANCE

Procedures for quality assurance established in the SAP Guidance were used for the sediment compliance monitoring. These included the collection of a quality control sample and validation of the analytical data to determine the results are acceptable and meet the quality objectives. The quality control samples consisted of the collection of one blind field duplicate, identified as LTCM-SED-20, and matrix spike and matrix spike duplicate samples.

As described in Section 2.2 for groundwater, validation of the sediment analytical data was performed by Landau Associates following the guidelines in the appropriate sections of the U.S. Environmental Protection Agency (EPA) *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999). Based on the validation, all of the data were determined to be acceptable for use and meet the quality objectives; therefore, no qualification of the data was necessary.

3.3 RESULTS

Fluoranthene concentrations are reported as normalized to the organic carbon (OC) concentration in the sediment. Fluoranthene concentrations in long term compliance monitoring sample LTCM-SED-18 and the blind field duplicate sample, LTCM-SED-20 were 8.0 mg/kg OC and 9.1 mg/kg OC, respectively, which are significantly below the sediment cleanup level of 160 mg/kg OC. Sediment analytical results are summarized in Table 5.

4.0 CONCLUSIONS

The results of the groundwater long-term compliance monitoring indicate that vinyl chloride and dissolved copper concentrations in groundwater were below the cleanup levels at the groundwater conditional point of compliance during all groundwater compliance monitoring events. As a result, vinyl chloride and dissolved copper do not require further compliance monitoring. Fluoranthene was detected in sediment at concentrations well below the cleanup level at the sediment point of compliance and, as a result, compliance with the Site sediment cleanup levels have been achieved and further sediment compliance monitoring is not required.

Concentrations of dissolved arsenic in monitoring wells RI-MW-1, RI-MW-3, RI-MW-5, and RI-MW-12 met the groundwater cleanup standards during each of the four quarterly monitoring events. Concentrations of dissolved arsenic were estimated to exceed the cleanup levels at the conditional point of compliance in the vicinity of monitoring wells RI-MW-4, RI-MW-11, and RI-MW-11A during all four quarterly monitoring events based on the concentration reduction factor being applied to measured groundwater concentrations at the Site. Concentrations of dissolved arsenic were estimated to exceed the cleanup levels at the conditional point of compliance in the vicinity of monitoring well RI-MW13 in the 4th quarter monitoring event. However, the concentration reduction factor is a conservative estimate of the groundwater concentration at the point of discharge to surface water, and previous surface water quality monitoring has documented that surface water concentrations of arsenic at the point of groundwater discharge to surface water are well below the Site groundwater cleanup level. Other considerations that support the conclusion that the dissolved arsenic groundwater cleanup level is being achieved at the point of compliance include:

- Dissolved arsenic concentrations in groundwater are not impacting sediment near the Site. Arsenic results for the 2009 marine sediment sampling event ranged from 6 to 30 mg/kg, which are significantly below the SMS SQS (57 mg/kg) and CSL of (93 mg/kg) for arsenic.
- Fish tissue testing conducted by SAIC for Ecology in Port Gardner Bay indicates that concentrations of arsenic in Site groundwater are not impacting fish and shellfish in the Site vicinity. Arsenic concentrations in English sole tissue samples (whole body), Dungeness crab hepatopancreas samples, and Dungeness crab meat samples collected in areas along the western shore of the Site were lower than, or similar to, the concentrations for samples collected at locations more than 1.5 miles west and south of the Site (SAIC 2009). The arsenic tissue concentration for English sole was lower in the sample collected near the Site than in the other two samples collected in Port Gardner Bay.

Based on these considerations, we recommend that long-term compliance monitoring conducted under the CAP be discontinued, and that future monitoring be conducted per the periodic review of the final cleanup action conducted by Ecology (periodic review is conducted at least every 5 years) as outlined in the consent decree.

5.0 USE OF THIS REPORT

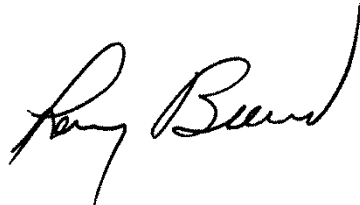
This long-term compliance monitoring report has been prepared for the exclusive use of the Port of Everett and the Washington State Department of Ecology for specific application to the North Marina West End site in Everett, Washington. The use of this report by others or for another project is at the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

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

LANDAU ASSOCIATES, INC.



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Associate Geologist

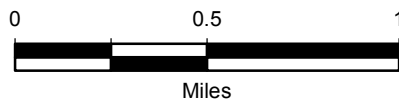


Lawrence D. Beard, P.E., L.G.
Principal

6.0 REFERENCES

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- SAIC. 2009. *Sediment Characterization Study in Port Gardner and Lower Snohomish Estuary, Port Gardner, Washington. Final Data Report*. Prepared for the Washington State Department of Ecology. Science Applications International Corp. April 21.

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Data Source: ESRI 2008

North Marina West End Site
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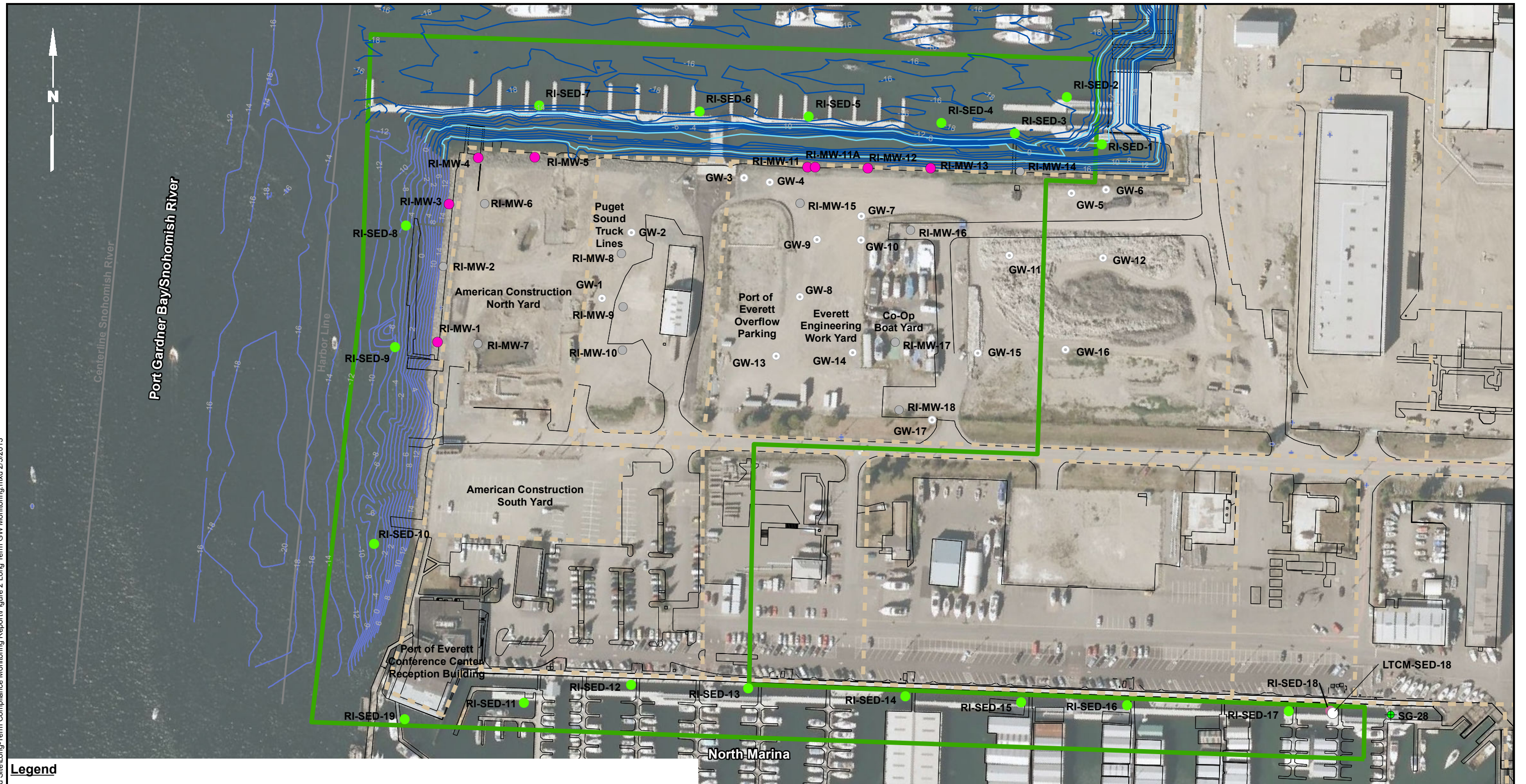
Vicinity Map

Figure
1



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Legend

- | | | |
|---|---|--|
| ○ 2012 Sediment Compliance Monitoring Sample Location | ● Everett Shipyard RI Sediment Location | — Post Dredge Minor Contour (2' Interval, MLLW) |
| ● 2009 Sediment Sampling Locations - Concentrations Above SQS and Below CSL (Landau Associates) | ● Groundwater Compliance Monitoring Sample Location | — Post Dredge Major Contour (10' Interval, MLLW) |
| ● 2009 Sediment Sampling Location - Concentrations Below SQS (Landau Associates) | ● Previous Groundwater Compliance Monitoring Location | — West End Site Boundary |
| | ● Previous Direct - Push Groundwater Grab Sample Location | — Approximate Boundary of Leasehold |
| | | — Bathymetry (MLLW) Based on Data Collected in 2003 & 2004 |
| | | — Harbor Line and River Center Line |



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)

Notes:

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

North Marina West End Site
Long-Term Compliance
Monitoring Report
Port of Everett, Washington

**Long-Term Groundwater and
Sediment Compliance
Monitoring Locations**

Figure
2

TABLE 1
GROUNDWATER AND SEDIMENT CLEANUP LEVELS FOR CONSTITUENTS OF CONCERN
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

Constituent of Concern	Groundwater Cleanup Level (µg/L)	Sediment Cleanup Level (mg/kg-OC)
Vinyl Chloride	2.4	NA
Arsenic	5	NA
Copper	3.1	NA
Fluoranthene	NA	160

NA = Not Applicable; analyte is not a constituent of concern for that medium (groundwater or sediment).

TABLE 2
COMPLIANCE MONITORING ANALYTICAL PARAMETERS
NORTH MARINA WEST END SITE
EVERETT, WASHINGTON

Location	Analyte	Analytical Method
MW-1	Arsenic, Copper	EPA Method 6020
MW-3	Arsenic, Copper	EPA Method 6020
MW-4	Arsenic	EPA Method 6020
MW-5	Arsenic	EPA Method 6020
MW-11	Arsenic, Vinyl Chloride	EPA Method 6020/ 8270C-SIM
MW-11A	Arsenic, Vinyl Chloride	EPA Method 6020/ 8270C-SIM
MW-12	Arsenic	EPA Method 6020
MW-13	Arsenic	EPA Method 6020
LTCM-18	Fluoranthene	EPA Method 8270D

TABLE 3
BLIND FIELD DUPLICATE SAMPLE AND ANALYSIS SUMMARY
NORTH MARINA WEST END SITE
EVERETT, WASHINGTON

Location	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
MW-20/MW-1	Dissolved As, Dissolved Cu	Dissolved As, Dissolved Cu	Dissolved Cu	
MW-20/MW-3				Dissolved Cu
MW-21/MW-11A	Vinyl Chloride	Vinyl Chloride, Dissolved As	Vinyl Chloride, Dissolved As	Vinyl Chloride, Dissolved As

TABLE 4
LONG-TERM COMPLIANCE GROUNDWATER MONITORING RESULTS
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

						RI Groundwater Samples					LTCM Groundwater Samples								RI Groundwater Samples			LTCM Groundwater Samples				
						Duplicate of RI-MW-1 RI-MW-1 PC60E RI-MW-19 PC60G RI-MW-1 PP11A UR98E RI-MW-101 PP11S QR08D RI-MW-1 QR08D					1st QTR		2nd QTR		3rd QTR		4th QTR	RI-MW-3 PD51A RI-MW-3 PP11C RI-MW-3 QR08E RI-MW-3 QR08E			1st QTR	2nd QTR	3rd QTR	4th QTR		
											RI-MW-1 UD98E	MW-20 UD98K	RI-MW-1 UR56A	MW-20 UR56I	RI-MW-1 VE42A	MW-20 VE42I	RI-MW-1 VO41A				RI-MW-3 UD98F	RI-MW-3 UR56B	RI-MW-3 VE42B	Duplicate of RI-MW-3 RI-MW-3 VO41B RI-MW-20 VO41I		
Cleanup Level	1 QTR 1/9/2012	2 QTR 4/23/2012	3 QTR 7/31/2012	4 QTR 10/19/2012		6/12/2009	6/12/2009	9/17/2009	9/17/2009	4/1/2010	01/09/2012	01/09/2012	4/23/2012	4/23/2012	7/31/2012	7/31/2012	10/19/2012	6/16/2009	9/18/2009	4/1/2010	01/09/2012	4/23/2012	7/31/2012	10/19/2012	10/19/2012	
VOLATILES (µg/L) Method SW8260CSIM																										
Vinyl Chloride	2.4					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Vinyl Chloride (with reduction factor applied)	2.4	22.1	12.9	21.0	33.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
DISSOLVED METALS (µg/L) Method EPA 200.8																										
Arsenic	5					6	6	6	6	5	5.3	5.9	3.9	3.9	14	NA	13	0.9	2	NA	6		5 U	5 U	5	NA
Arsenic (with reduction factor applied)	5	3.8	3.5	4.4	2.6					0.20 (a)	1.4	1.5	1.1	1.1	3.2	NA	5.0				1.6				1.9	
Copper	3.1					3	2.6	5	5	3	1.7	1.6	2	2	2	2	1.6	3	5	2.2	5 U	2 U	5 U	5 U	5 U	
FIELD PARAMETERS																										
pH						7.14	7.14	6.64	6.64	7.37	6.81	NM	6.29	NM	6.98	6.98	6.92	9.55	7.10	8.32	7.22	6.99	6.96	6.84	NM	
Conductivity (uS/cm)						1,229	1,229	11,142	11,142	12605	5548	NM	1308	NM	4348	4348	6149	2113	-299.9	14254	14173	11386	13625	19204	NM	
Turbidity (NTU)						1.21	1.21	3.52	3.52	7.16	29.59	NM	10.3	NM	low (b)	low (b)	low (b)	5.58	4.12	NM	6.60	8.75	low (b)	low (b)	NM	
Dissolved oxygen (mg/L)						2.59	2.59	6.50	6.50	0.7	0.88	NM	0.37	NM	0.48	0.48	1.03	2.43	8.24	0.39	6.42	0.61	0.37	0.56	NM	
Temperature (°C)						13.97	13.97	16.67	16.67	9.75	8.56	NM	11.89	NM	17.3	17.3	15.7	11.48	15.45	10.27	9.74	11.60	14.4	15.2	NM	
ORP (mv)						36.9	36.9	-49.2	-49.2	-33.8	-228.8	NM	-93.9	NM	NM	NM	-134.2	-288.3	-300.2	-223.2	-208.0	-285.7	NM	-155.9	NM	
Ferrous iron (mg/L)						2.2	2.2	1.3	1.3	NM	NM	NM	NM	NM	NM	NM	NM	1.0	0.8	NM	NM	NM	NM	NM	NM	

TABLE 4
LONG-TERM COMPLIANCE GROUNDWATER MONITORING RESULTS
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

						RI Groundwater Samples			LTCM Groundwater Samples				RI Groundwater Samples		LTCM Groundwater Samples				RI Groundwater Samples							
									1st QTR	2nd QTR	3rd QTR	4th QTR			1st QTR	2nd QTR	3rd QTR	4th QTR	Duplicate of RI-MW-11		Duplicate of RI-MW-11		Duplicate of RI-MW-11		Duplicate of RI-MW-11	
						Calculated Reduction Factor ^(d)			LTCM			RI-MW-4 PD51B	RI-MW-4 PP11D	RI-MW-4 QR08F	RI-MW-4 UD98G	RI-MW-4 UR56C	RI-MW-4 VE42C	RI-MW-4 VO41C	RI-MW-5 PD51C	RI-MW-5 PP11E	RI-MW-5 UD98H	RI-MW-5 UR56D	RI-MW-5 VE42D	RI-MW-5 VO41D	RI-MW-11 PD51I	RI-MW-111 PD51J
Cleanup Level	1/9/2012	4/23/2012	7/31/2012	10/19/2012	6/17/2009	9/17/2009	4/1/2010	01/09/2012	4/23/2012	7/31/2012	10/19/2012	6/17/2009	9/17/2009	01/09/2012	4/23/2012	7/31/2012	10/19/2012	6/18/2009	6/18/2009	9/18/2009	9/18/2009	4/1/2010	4/1/2010	5/14/2010	5/14/2010	
VOLATILES (µg/L) Method SW8260CSIM																										
Vinyl Chloride	2.4					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	4.5	0.81	0.91	2.3	2.6	2.6	2.4	
Vinyl Chloride (with reduction factor applied)	2.4	22.1	12.9	21.0	33.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	0.09 (c)	0.10 (c)	0.10 (c)	0.10 (c)	
DISSOLVED METALS (µg/L) Method EPA 200.8																										
Arsenic	5					7.3	22.4	8.6	37.8	37.9	40.6	38.4	5.2	2.8	3.3	1.4	1.8	1.2	61.8	58.7	51.2	NA	50.3	49.8	48	51
Arsenic (with reduction factor applied)	5	3.8	3.5	4.4	2.6			0.34 (a)	9.9	11.0	9.3	14.8			0.87	0.41	0.41	0.46					2.0 (a)	2.0 (a)	1.9 (a)	2.0 (a)
Copper	3.1					1.7	1.5	NA	NA	NA	NA	NA	0.5	0.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
FIELD PARAMETERS																										
pH						7.80	6.30	7.80	7.36	5.99	6.89	7.03	8.13	7.60	8.79	5.74	6.84	7.03	8.19	8.19	6.68	6.68	7.5	NM	8.25	NM
Conductivity (uS/cm)						225	1082	1540	6.73	1288	795	653	142	844	553	310	944	909	346	346	1980	1980	1612	NM	3220	NM
Turbidity (NTU)						12.75	66.92	417.2	6.13	27.3	low (b)	low (b)	6.35	1.61	3.44	14.6	low (b)	low (b)	18.06	18.06	70.77	70.77	4.41	NM	NA	NM
Dissolved oxygen (mg/L)						2.82	1.31	0.32	1.56	0.44	0.11	0.64	2.26	6.44	0.59	0.76	0.12	0.54	2.95	2.95	3.55	3.55	0.33	NM	0.02	NM
Temperature (°C)						12.32	15.69	9.81	9.79	9.93	14.7	15.4	13.21	16.32	9.50	10.07	17.2	15.1	13.65	13.65	17.73	17.73	10.32	NM	12.31	NM
ORP (mv)						-45.2	-151.4	-154.8	-191.0	-181.2	NM	-110.6	-68.2	-163.1	-112.0	-91.1	NM	-121.0	-90.8	-90.8	-123.3	-123.3	-123.3	NM	-142.8	NM
Ferrous iron (mg/L)						2.0	3.0	NM	NM	NM	NM	NM	1.5	1.1	NM	NM	NM	NM	2.2	2.2	5.0	5.0	NM	NM	NM	NM

TABLE 4
LONG-TERM COMPLIANCE GROUNDWATER MONITORING RESULTS
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

						LTCM Groundwater Samples				RI Groundwater Samples			LTCM Groundwater Samples							
						1st QTR	2nd QTR	3rd QTR	4th QTR				1st QTR		2nd QTR		3rd QTR		4th QTR	
	Cleanup Level	Calculated Reduction Factor ^(d)				RI-MW-11 UD98A	RI-MW-11 UR56E	RI-MW-11 VE42E	RI-MW-11 VO41E	RI-MW-11A QR07A	RI-MW-11A QW56D	RI-MW-11A(mid) QR07B	Duplicate of RI-MW-11A		Duplicate of RI-MW-11A		Duplicate of RI-MW-11A		Duplicate of RI-MW-11A	
		LTCM											RI-MW-11A		RI-MW-11A		RI-MW-11A		RI-MW-11A	
		1 QTR 1/9/2012	2 QTR 4/23/2012	3 QTR 7/31/2012	4 QTR 10/19/2012								UD98B	MW-21 UR56C	RI-MW-11A UR56F	MW-21 UR56J	RI-MW-11A VE42F	MW-21 VE42J	RI-MW-11A VO41F	MW-21 VO41J
VOLATILES (µg/L)																				
Method SW8260CSIM																				
Vinyl Chloride						2.4				0.41	0.4	0.56	0.089 J	0.050 J	0.50	0.53	0.24	0.24	0.071	0.068
Vinyl Chloride (with reduction factor applied)						2.4	22.1	12.9	21.0	33.3	0.08 (c)	0.11 (c)	0.0189	0.0106	0.139	0.148	0.052	0.052	0.0123	0.0118
DISSOLVED METALS (µg/L)																				
Method EPA 200.8																				
Arsenic						5								NA						
Arsenic (with reduction factor applied)						5	3.8	3.5	4.4	2.6	1.2 (a)	1.1 (a)	8.7	NA	9.0	9.1	10.4	10.2	11.2	14.3
Copper						3.1								NA						
FIELD PARAMETERS																				
pH														NM						
Conductivity (uS/cm)														NM						
Turbidity (NTU)														NM						
Dissolved oxygen (mg/L)														NM						
Temperature (°C)														NM						
ORP (mv)														NM						
Ferrous iron (mg/L)														NM						

TABLE 4
LONG-TERM COMPLIANCE GROUNDWATER MONITORING RESULTS
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

	Cleanup Level	Calculated Reduction Factor ^(d)				RI Groundwater Samples			LTCM Groundwater Samples				RI Groundwater Samples			LTCM Groundwater Samples			
		LTCM				RI-MW-12 PD51K	RI-MW-12 PP11L	RI-MW-12 QR08H	1st QTR MW-12 UD98I	2nd QTR MW-12 UR56G	3rd QTR MW-12 VE42G	4th QTR MW-12 VO41G	RI-MW-13 PD51L	RI-MW-13 PP11M	RI-MW-13 QR08G	1st QTR MW-13 UD98J	2nd QTR MW-13 UR56H	3rd QTR MW-13 VE42H	4th QTR MW-13 VO41H
		1 QTR	2 QTR	3 QTR	4 QTR														
		1/9/2012	4/23/2012	7/31/2012	10/19/2012														
VOLATILES (µg/L) Method SW8260CSIM																			
Vinyl Chloride	2.4					NA	0.020 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride (with reduction factor applied)	2.4	22.1	12.9	21.0	33.3	NA	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DISSOLVED METALS (µg/L) Method EPA 200.8																			
Arsenic	5					6	3.2	9.8	6.1	8.2	7.7	2.7	41.9	36.7	23.2	17.3	12.6	17.8	17
Arsenic (with reduction factor applied)	5	3.8	3.5	4.4	2.6			0.39 (a)	1.6	2.4	1.8	1.04			0.93 (a)	4.5	3.6	4.1	6.6
Copper	3.1					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD PARAMETERS																			
pH						8.32	6.93	7.62	8.35	6.64	7.07	7.00	7.86	6.45	7.56	8.55	5.66	6.88	6.41
Conductivity (uS/cm)						258	3078	363	1316	357	559	662	331	2520	786	1217	524	705	967
Turbidity (NTU)						2.69	14.25	NM	8.89	5.51	low (b)	low (b)	4.67	16.86	NM	9.26	12.9	low (b)	low (b)
Dissolved oxygen (mg/L)						2.21	1.98	0.31	0.50	0.48	0.14	0.42	3.09	1.26	0.55	0.38	0.82	0.56	0.31
Temperature (°C)						13.01	15.72	10.12	9.95	10.94	15.1	15.0	13.40	17.69	10.3	9.91	10.67	15.0	15.6
ORP (mv)						-78.1	-113.4	-107.8	-172.8	-62.0	NM	-93.2	-99.7	-90.2	-120.2	-208.8	-7.64	NM	-107.2
Ferrous iron (mg/L)						1.8	7.0	NM	NM	NM	NM	NM	1.4	2.0	NM	NM	NM	NM	NM

RI = Remedial Investigation
LTCM = Long Term Compliance Monitoring
NA = Not Analyzed.
NM = Not Measured.
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Bold = Detected compound.
Boxed Value = Concentration exceeds screening level.
ORP = Oxidation Reduction Potential

(a) A reduction factor of 25 was applied to the arsenic concentrations for MW-1, MW-4, MW-12, and MW-13 groundwater samples collected during the RI. A reduction factor of 5 was applied to the arsenic concentration for MW-11A groundwater samples collected during the RI.
(b) Based on visual observation.
(c) A reduction factor of 25 was applied to the vinyl chloride concentration for MW-11 groundwater samples collected during the RI. A reduction factor of 5 was applied to the vinyl chloride concentration for MW-11A groundwater samples collected during the RI.
(d) The calculated reduction factor for LTCM was determined based on the methods presented in Section 2.3 of the main text. Note that for arsenic and vinyl chloride groundwater data collected in April and May 2010 as part of the RI, a reduction factor of 25 was used (see notes (a) and (c) below).

TABLE 5
LONG-TERM COMPLIANCE MONITORING SEDIMENT ANALYTICAL RESULTS
NORTH MARINA WEST END SITE
PORT OF EVERETT, WASHINGTON

	Sediment Cleanup Level	LTCM-SED-18 (0-10cm) VR45A/VZ29A 11/06/2012	LTCM-SED-20 (0-10cm) VR45B/VZ29B 11/06/2012
SVOCs (µg/kg -w)			
Method SW8270D			
Fluoranthene	--	250	250
SVOCs (mg/kg OC)			
Method SW8270D			
Fluoranthene	160	8.0	9.1
CONVENTIONALS (%)			
Total Solids	--	47.70	47.40
Total Organic Carbon	--	3.13	2.76

U = Indicates the compound was not detected at the reported concentration.

Bold = Detected compound.

DW = Dry Weight

OC = Organic carbon.