Groundwater Monitoring Report

Former Cascade Timber No. 3 Log Sort Yard

Port of Tacoma
Tacoma, WA

Prepared for
Port of Tacoma

October 14, 2016
19000-11

HARTCROWSER

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Port of Tacoma
Tacoma, WA

Consent Decree No. 94-2-03590-3
Consent Decree Date: April 11, 1994
Monitoring Date: August 26, 2016

Prepared for
Port of Tacoma

October 14, 2016
19000-11

Prepared by
Hart Crowser, Inc.

Nicholas W. Galvin
Senior Staff
Environmental Scientist
Nicholas.Galvin@hartcrowser.com

Mark A. Dagel, LHG
Senior Associate
Hydrogeologist
Mark.Dagel@hartcrowser.com

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Groundwater Monitoring Report

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Port of Tacoma

Tacoma, WA

1.0 INTRODUCTION

This report summarizes field activities and presents the results of the groundwater monitoring event Hart Crowser conducted on August 26, 2016, on behalf of the Port of Tacoma (Port) for the Former Cascade Timber No. 3 Log Sort Yard (site), located on the south-southeastern side of Maxwell Way between Port of Tacoma Road and Thorne Road in Tacoma, Washington (Figure 1).

Hart Crowser monitored groundwater in accordance with the requirements in Consent Decree 94-2-03590-3, dated April 11, 1994, issued to the Port by the Washington State Department of Ecology (Ecology). Removal of zinc from the site groundwater monitoring analyte list was approved in an email from Dom Reale (Ecology) to Mark Rettmann (Port) dated June 28, 2011. A memorandum of understanding (MOU) between Ecology and the Port issued on September 12, 2011, updated the monitoring frequency from every 12 months to every 18 months beginning February 2012. A copy of the MOU is in Appendix A.

In February 2012, Ecology conducted a periodic review of post-cleanup site conditions and monitoring data to ensure that human health and the environment are being protected. The report on the review determined that the requirements of the restrictive convenient and consent decree were met. The next five-year review is expected to be in February 2017.

2.0 SITE BACKGROUND

The site, situated southwest of the Blair Waterway in the Tacoma tideflats area, is a 10.73-acre section in the southwest portion of an industrially zoned parcel of land. The property was leased to the Cascade Timber Company and operated as a log sort yard from 1978 to 1984. In 1982, approximately 500 tons of slag generated by Asarco Incorporated of Tacoma, Washington, was placed on the southwest portion of the property as ballast material. The property is currently leased by Washington United Terminals and is operated as a truck queuing area and as a storage facility for empty shipping containers and chassis.

Ecology collected stormwater runoff samples at the site between November 1983 and June 1984 (Norton 1985). Analytical results indicated that metals in excess of the US Environmental Protection Agency (EPA) quality standards were leaving the site in stormwater. On October 8, 1991, Ecology and the Port entered into an Agreed Order to complete a remedial investigation/feasibility study (RI/FS). An RI/FS report was submitted to Ecology in June 1993, and Ecology issued a consent decree to perform the remedial action. Construction of a low-permeability asphalt cap and stormwater drainage

system was completed in 1994. Monitoring wells MW-1 and MW-2 were installed to monitor the effectiveness of the remedial action.

In July 2003, it was discovered that the Port's two groundwater monitoring wells were damaged by a contractor working on site. Both wells were abandoned and replaced with new wells with the same designations (MW-1 and MW-2), in accordance with communications between Mr. Dom Reale of Ecology and the Port. The monitoring well abandonment and replacement is documented in a report by Kennedy/Jenks Consultants titled Monitoring Replacement Report, Port of Tacoma Cascade Timber #3 Log Yard, dated February 2, 2004.

3.0 GROUNDWATER MONITORING

In compliance with the requirements of the consent decree, the Port monitors the wells to evaluate water quality at the facility and the effectiveness of the remedial action.

On August 26, 2016, Hart Crowser collected groundwater samples from monitoring wells MW-1 and MW-2 (well locations are shown on Figure 2). Groundwater samples from each well were collected using fresh disposable tubing and low-flow sampling techniques. In addition to the groundwater samples, one field duplicate (sample MW-3) was collected from monitoring well MW-2. The samples were field-filtered during collection using a 0.45-micron filter. The collected groundwater samples were placed in a cooler on ice and delivered to Analytical Resources, Inc. (ARI) under chain-of-custody protocol. Samples were analyzed for dissolved arsenic, copper, and lead by EPA Method 200.8 for comparison to the groundwater cleanup levels established in Consent Decree 94-2-03590-3. The groundwater sampling field logs are in Appendix B.

Analytical results show that performance standards were met for dissolved arsenic, copper, and lead in wells MW-1 and MW-2. Dissolved arsenic was detected in MW-1 and MW-2 at 24.2 and 26.5 µg/L, respectively, which are below the cleanup level of 36 µg/L for arsenic. Dissolved copper and dissolved lead were not detected in MW-1 and MW-2. The analytical results are in Table 1, and the laboratory report is in Appendix C. Plots of arsenic, copper, lead, and zinc concentrations versus time for the two wells are in Appendix D.

The groundwater level in each well was measured prior to sampling. Groundwater level was measured to the nearest hundredth of a foot as depth relative to the top of the well casing using a Waterline water level meter. Groundwater depth and elevation data are in Table 2. Plots of groundwater elevation versus time are in Appendix E.

4.0 RECOMMENDATIONS

The dissolved arsenic, copper, and lead concentrations in groundwater will continue to be monitored. The next groundwater monitoring event should be scheduled for February 2018 to meet the 18-month frequency requirements of the MOU.

5.0 REFERENCES

Ecology 1994. Consent Decree 94-2-03590-3. Washington State Department of Ecology. April 1994.

Ecology 2011. Memorandum of Understanding, Former Log Yard Groundwater Monitoring and Cap Inspection. Washington State Department of Ecology. September 2011.

Ecology 2012. Periodic Review Report, Final, Cascade Timber 3, Facility Site ID#1206. Washington State Department of Ecology. February 2012.

Kennedy/Jenks Consultants 2004. Monitoring Replacement Report, Port of Tacoma Cascade Timber #3 Log Yard. February 2, 2004.

Norton, D., and A. Johnson, 1985. Completion Report on WQIS Project 1 for the Commencement Bay Nearshore/Tideflats Remedial Investigation: Assessment of Log Sort Yards as Metal Sources to Commencement Bay Waterways, November 1983 to June 1984. Washington State Department of Ecology Memorandum. February 27, 1985.

L:\Notebooks\1900011_Cascade Timber GW Monitoring\Deliverables\Reports\Final GW Report Aug 2016\Port of Tacoma 2016 GW Monitoring Rpt - CT.docx

Table 1 - Groundwater Analytical Data
Former Cascade Timber No. 3 Log Sort Yard

Well ID	Date	Concentration in µg/L			
		Dissolved Arsenic	Dissolved Copper	Dissolved Lead	Dissolved Zinc
Groundwater Cleanup Levels [a] :		36	2.9	8.5	86
MW-1	11/28/94	**940**	**8**	<3	<20
MW-1	12/09/94	**220**	**4**	<3	<20
MW-1	12/01/95	**132**	**4**	<1	53
MW-1	12/13/96	**93**	**6**	<1	9
MW-1	12/09/97	**60**	2.1	2.4	12
MW-1	12/07/98	9.7	**11**	3.6	**510**
MW-1	12/22/99	21.0	2.5	<1	**99**
MW-1	10/11/00	**73**	<1	<0.5	4.7
MW-1	11/03/00	14.0	--	--	--
MW-1	11/16/01	7.02	**8.73**	<0.5	<4
MW-1	11/26/02	13.4	<2.5	<0.5	<2.5
MW-1	11/14/03	18.4	<1.0	<0.5	5.2
MW-1	10/29/04	32.4	<2.5	<2.5	12.2
MW-1	10/26/05	**46**	<2.5	<2.5	<2.5
MW-1	01/29/07	**93**	<2.0	<2.0	<5.0
MW-1	02/08/08	**140**	<0.55	<0.22	5.2J
MW-1	02/27/09	**57.2**	<0.5	<1	6
MW-1	02/04/10	**50.3**	0.6	<1	<4
MW-1	02/22/11	**158**	<0.5	<0.5	0.8
MW-1	02/13/12	**53**	<0.5	<0.5	--
MW-1	08/23/13	28.6	<0.5	<0.5	--
MW-1	02/12/15	**57.7**	0.7	<0.1	--
MW-1	08/26/16	24.2	<0.5	<0.1	--
MW-2	11/28/94	10	**3**	<3	<20
MW-2	12/01/95	--	--	--	--
MW-2 (Duplicate)	12/01/95	**132**	**5**	<1	53
MW-2	12/13/96	3	**5**	<1	<83
MW-2 (Duplicate)	12/13/96	**76**	**41**	1	18
MW-2 (Duplicate)	12/09/97	**54**	**6.1**	2.4	43
MW-2	12/16/97	5	<2	<1	6
MW-2	12/07/98	2.3	1.8	5.1	**360**
MW-2 (Duplicate)	12/07/98	12	**13**	1.2	**600**
MW-2	12/22/99	4.4	<2	**23**	6.9
MW-2 (Duplicate)	12/22/99	19	**2.9**	<1	38
MW-2	10/11/00	<1	<1	<1	**99**
MW-2 (Duplicate)	10/11/00	**42**	<1	<0.5	6.5
MW-2	11/03/00	2	<1	**600**	8.3
MW-2 (Duplicate)	11/03/00	7	--	--	--

Table 1 - Groundwater Analytical Data
Former Cascade Timber No. 3 Log Sort Yard

Well ID	Date	Concentration in µg/L			
		Dissolved Arsenic	Dissolved Copper	Dissolved Lead	Dissolved Zinc
Groundwater Cleanup Levels [(a)] :		36	2.9	8.5	86
MW-2	11/13/00	--	--	**600**	--
MW-2 (Duplicate)	11/16/01	7.69	**10.2**	<0.5	<4
MW-2	11/19/01	1.19	<1	3.74	38.6
MW-2	11/26/02	<2.5	<2.5	**180**	3.36
MW-2 (Duplicate)	11/26/02	19.7	<2.5	<0.5	<2.5
MW-2	11/14/03	8.91	<1.0	<0.5	4.64
MW-2 (Duplicate)	11/14/03	18.5	<1.0	<0.5	3.97
MW-2	10/29/04	25.4	<2.5	<2.5	<5
MW-2 (Duplicate)	10/29/04	31.9	<2.5	<2.5	7.15
MW-2	10/26/05	**39**	<2.5	<2.5	<2.5
MW-2 (Duplicate)	10/26/05	32	<2.5	<2.5	<2.5
MW-2	01/29/07	34	<2.0	<2.0	<5.0
MW-2 (Duplicate)	01/29/07	35	<2.0	<2.0	<5.0
MW-2	02/08/08	24	0.78J	<0.22	5.1J
MW-2 (Duplicate)	02/08/08	**140**	<0.55	<0.22	6.0J
MW-2	02/27/09	32.6	1.6	<1	6
MW-2 (Duplicate)	02/27/09	32.9	1.5	<1	<4
MW-2	02/04/10	8.1	**4.1**	<1	<4
MW-2 (Duplicate)	02/04/10	18.2	5.4	<1	<4
MW-2	02/22/11	27.2	<0.5	<0.5	0.8
MW-2 (Duplicate)	02/22/11	26.9	0.5	<0.5	1.1
MW-2	02/13/12	16	0.5	<0.5	--
MW-2 (Duplicate)	02/13/12	16	0.6	<0.5	--
MW-2	08/23/13	4.1	<0.5	<0.5	--
MW-2 (Duplicate)	08/23/13	4.0	<0.5	<0.5	--
MW-2	02/12/15	**41.6**	2.0	0.1	--
MW-2 (Duplicate)	02/12/15	**40.7**	1.8	0.1	--
MW-2	08/26/16	23.6	<0.5	<0.1	--
MW-2 (Duplicate)	08/26/16	26.5	<0.5	<0.1	--
MW-3S	11/28/94	25	**28**	<3	<20
MW-3S	12/01/95	**54**	**3**	2	65
MW-3S	12/13/96	**190**	<2	3	9
MW-3S	12/09/97	**63**	2	4.2	**330**
MW-3S	12/07/98	**50**	**2.9**	2.2	<5
MW-3D	11/28/94	20	**7**	<3	<20
MW-3D	12/01/95	3	**4**	<1	35
MW-3D	12/13/96	4	**14**	<5	18

Table 1 - Groundwater Analytical Data
Former Cascade Timber No. 3 Log Sort Yard

Well ID	Date	Concentration in µg/L			
		Dissolved Arsenic	Dissolved Copper	Dissolved Lead	Dissolved Zinc
Groundwater Cleanup Levels [(a)] :		***36***	***2.9***	***8.5***	***86***
MW-3D	12/09/97	27	2.2	2	17
MW-3D	12/07/98	3	<2	<1	7.8

Notes

Zinc analysis was discontinued in 2011 with Ecology approval dated June 28, 2011.

Groundwater samples were analyzed for dissolved metals by EPA Method 200.8.

Value in **bold** indicates concentration greater than groundwater cleanup level.

(a) Groundwater cleanup levels are based on EPA chronic marine water quality criteria (WAC 173-201A).

-- Not analyzed

<0.5 - Laboratory analytical result does not exceed laboratory quantitation limit.

J - Concentration is estimated.

ND - Not detected. No quantitation limit indicated.

µg/L - Micrograms per liter

Table 2 - Water Level Data
Former Cascade Timber No. 3 Log Sort Yard

Well ID	Date	Top of Casing Elevation in Feet [(a)]	Depth of Water below Top of Casing in Feet	Water Level Elevation in Feet
MW-1	12/28/94	--	--	--
MW-1	12/09/94	--	--	--
MW-1	12/01/95	20.00	3.68	16.32
MW-1	12/13/96	20.00	3.98	16.02
MW-1	12/09/97	20.00	5.26	14.74
MW-1	12/07/98	20.00	4.71	15.29
MW-1	12/22/99	20.00	4.47	15.53
MW-1	10/11/00	20.00	6.58	13.42
MW-1	11/03/00	20.00	--	--
MW-1	11/16/01	20.00	4.35	15.65
MW-1	11/19/01	20.00	--	--
MW-1	11/26/02	20.00	6.58	13.42
MW-1	11/14/03	20.98	12.22	8.76
MW-1	10/29/04	20.98	12.31	8.67
MW-1	10/26/05	20.98	12.71	8.27
MW-1	01/29/07	20.98	11.83	9.15
MW-1	02/08/08	20.98	12.45	8.53
MW-1	02/27/09	20.98	12.18	8.80
MW-1	02/04/10	20.98	11.13	9.85
MW-1	02/22/11	20.98	11.54	9.44
MW-1	02/13/12	20.98	12.24	8.74
MW-1	09/23/13	20.98	12.23	8.75
MW-1	02/12/15	20.98	10.90	10.08
MW-1	08/26/16	20.98	12.35	8.63
MW-2	12/28/94	--	--	--
MW-2	12/09/94	--	--	--
MW-2	12/01/95	18.12	4.60	13.52
MW-2	12/13/96	18.12	7.35	10.77
MW-2	12/09/97	18.12	13.66	4.46
MW-2	12/07/98	18.12	5.82	12.30
MW-2	12/22/99	18.12	7.21	10.91
MW-2	10/11/00	18.12	12.60	5.52
MW-2	11/03/00	18.12	--	--
MW-2	11/16/01	18.12	13.55	4.57
MW-2	11/19/01	18.12	6.32	11.80
MW-2	11/26/02	18.12	8.91	9.21
MW-2	11/14/03	19.91	10.02	9.89

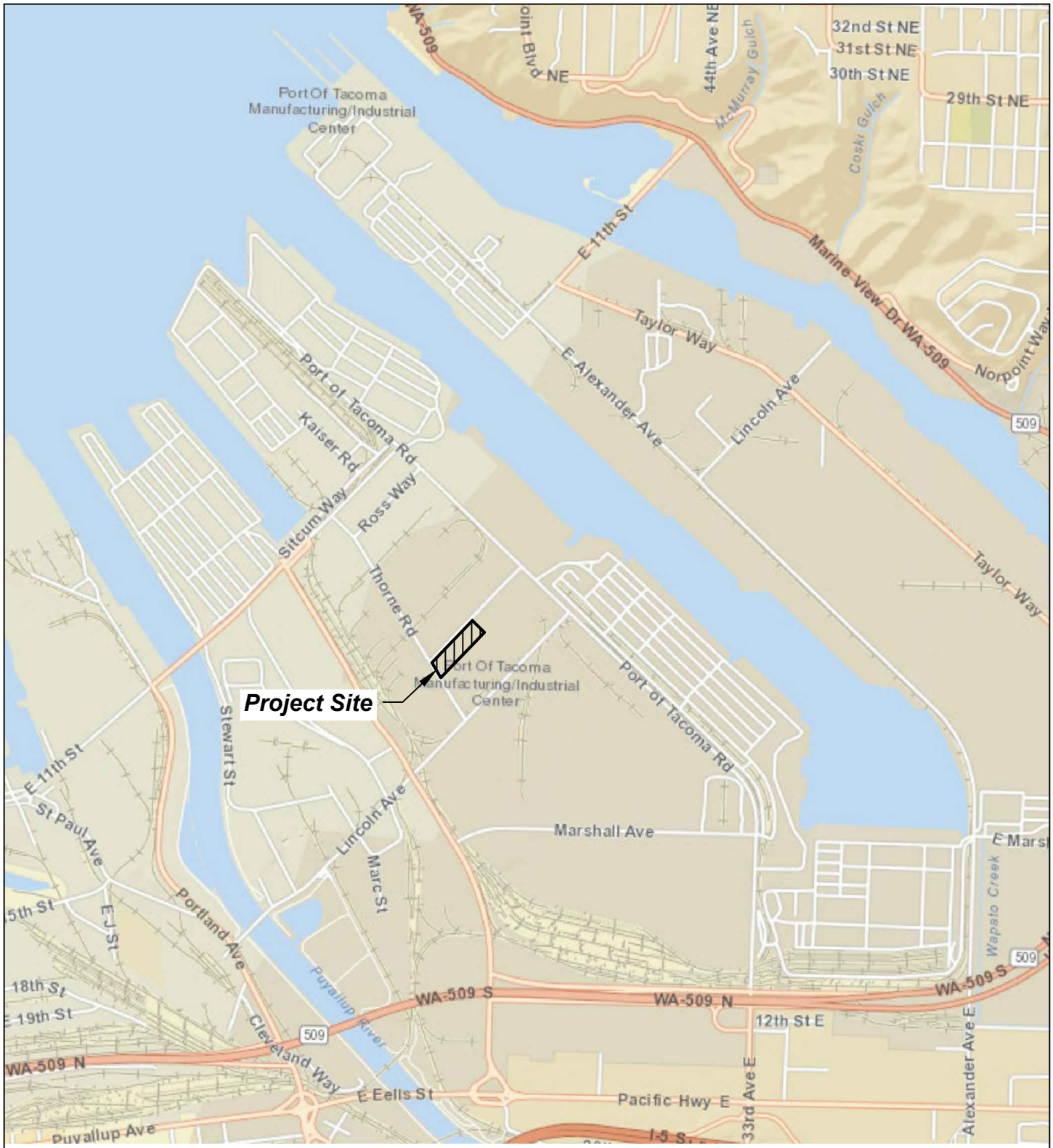
Table 2 - Water Level Data
Former Cascade Timber No. 3 Log Sort Yard

Well ID	*Date*	*Top of Casing Elevation in Feet [(a)]*	*Depth of Water below Top of Casing in Feet*	*Water Level Elevation in Feet*
MW-2	10/29/04	19.91	9.10	10.81
MW-2	10/26/05	19.91	9.74	10.17
MW-2	01/29/07	19.91	5.43	14.48
MW-2	02/08/08	19.91	10.10	9.81
MW-2	02/27/09	19.91	8.77	11.14
MW-2	02/04/10	19.91	12.19	7.72
MW-2	02/22/11	19.91	5.23	14.68
MW-2	02/13/12	19.91	6.23	13.68
MW-2	09/23/13	19.91	7.98	11.93
MW-2	02/12/15	19.91	4.76	15.15
MW-2	08/26/16	19.91	8.37	11.54

Notes

(a) Top-of-casing elevations based on information provided by the Port of Tacoma to the previous consultant.

-- Not measured



Source: Base map prepared from ArcGIS Online, 2014.

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

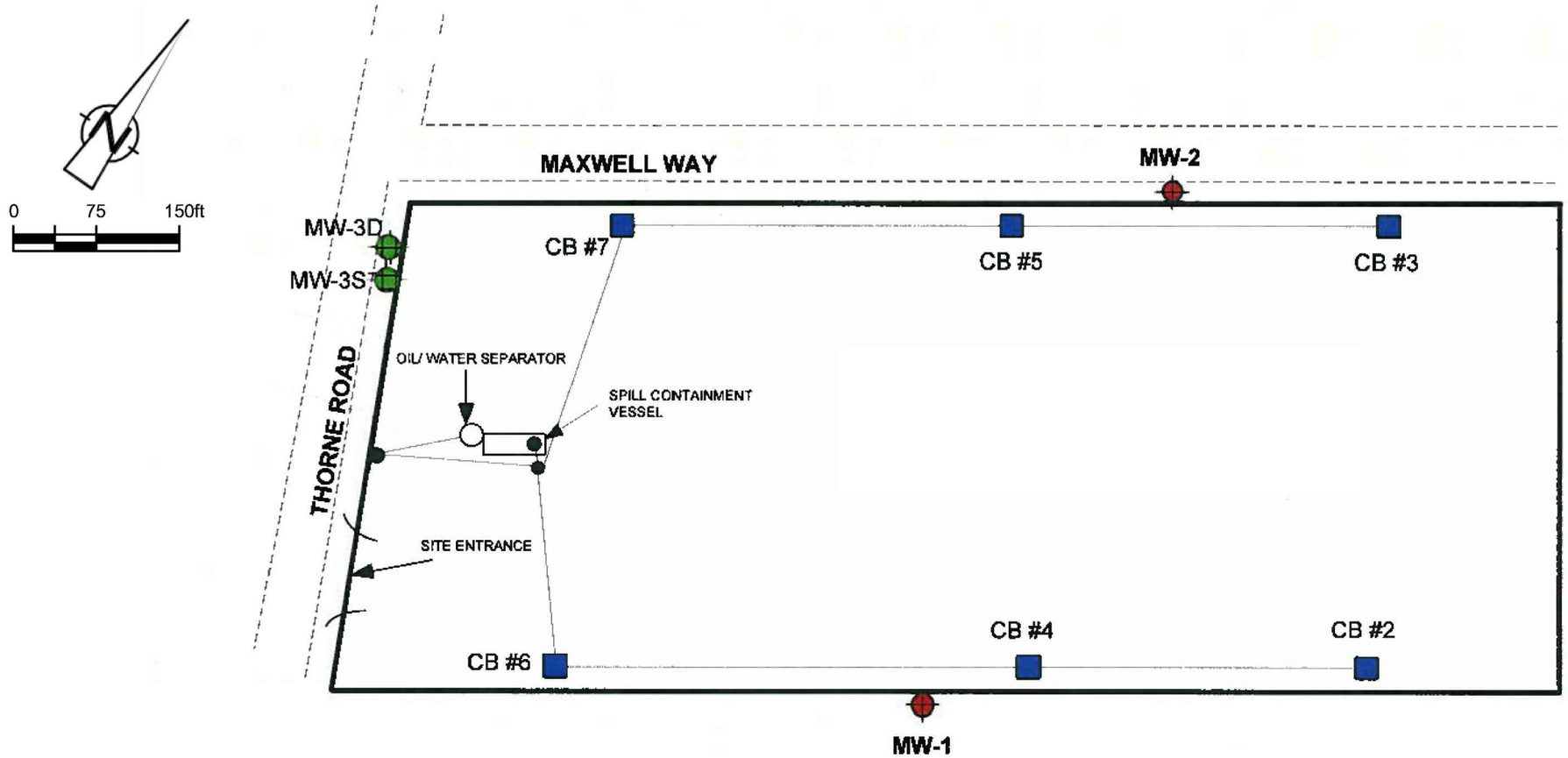
Vicinity Map

19000-11 10/16

HARTCROWSER

Figure
1

EAL 10/14/16 1900011-001.dwg



LEGEND

- GROUNDWATER MONITORING WELL (e.g. MW-1)
- CATCH BASIN (e.g. CB# 2)
- MANHOLE
- ABANDONED MONITORING WELL

Source: Kennedy/Jenks Consultants Figure 2.

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

Site Plan

19000-11 10/16

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Figure **2**

EAL 10/14/16 1900011-002.dwg

APPENDIX A
Memorandum of Understanding

6.4 Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING

Former Log Yard Groundwater Monitoring and
Cap Inspection

This Memorandum of Understanding (MOU) is entered into this 12 day of September 2011 between the Washington State Department of Ecology ("Ecology") and the Port of Tacoma ("Port") (collectively the "Parties") to memorialize the Parties' agreement to modify the requirements for future groundwater monitoring and cap inspection frequencies for five Port sites, as set forth below.

These sites affected by this agreement are Cascade Timber No. 3, Murray Pacific No. 2, Wasser Winters, Portac, and Louisiana-Pacific (aka Pony Lumber) ("Monitored Sites").

Each Monitored Site was cleaned up under an administrative agreement between Ecology and the Port, either as an original party or successor interest, as follows: Cascade Timber No. 3, Murray Pacific No. 2, and Wasser Winters were cleaned up under Consent Decrees, Louisiana-Pacific under an Enforcement Order, and Portac under a pre-Model Toxics Control Act (MTCA) Order On Consent (cumulatively referred to as: "Ecology Orders"). Portac, Inc. was also a respondent to the Portac Order on Consent along with the Port.

Each Monitored Site addressed similar contaminants of concern (COCs), which included arsenic, copper, lead, and zinc. However, each Ecology Order had site-specific requirements with respect to cleanup levels, and cap and groundwater monitoring frequencies.

In Spring 2010, the Port initiated a request to Ecology to standardize the monitoring requirements for the Monitored Sites in an effort to align the timing of the periodic monitoring/ inspections at the sites so that the Port may better align a contractor to do the work all at once, as required.

In August 2010, to supplement the information already provided to Ecology, the Port provided Ecology with a tour of the Monitored Sites. As part of the tour, Ecology inspected the type and condition of the caps; the current site uses, specifically on the capped areas, and the locations and conditions of existing monitoring wells and stormwater basins.

Ecology has reviewed the information provided by the Port, as well as observations made during the site tour, and has chosen to provide a response in the form of this MOU.

This MOU was created for the Parties to understand and agree upon the requirements associated with Ecology's response, and to memorialize the decisions made with respect to each of the Port's requests.

In preparing this MOU, Ecology took into account, for each site, the type and condition of the cap and stormwater collection system, the adequacy of the groundwater monitoring system, and the recent groundwater compliance history.

Based on the above, Ecology and the Port agree as follows:

A. CAP MONITORING FREQUENCY

1. The Port may standardize the cap monitoring (inspection and reporting) frequency for the Monitored Sites to 30 months as requested. However, the following shall also occur:

   - During the site tours, Ecology noted that some of the stormwater basins were in better condition than others. Stormwater basins at each of the Monitored Sites should be inspected quarterly and cleaned out as needed, such that they are continuously operational.

   - Any unanticipated breaches of the cap for any of the Monitored Sites shall be reported to Ecology and repaired as soon as practicable. As per the respective Ecology Orders, the Port shall provide Ecology with a plan for each of the sites that summarizes intended action and reporting by the Port for unanticipated cap breaches.

   - Advance notice shall be provided and prior approval shall be obtained from Ecology for any planned cap breaches and repairs that are not otherwise permitted under the respective Ecology Order for each Monitored Site.

   - Minor cracking and normal wear and tear shall be repaired and reported as anticipated by and according to each Monitored Site's Ecology Order.

   - The appropriate Ecology Site Manager shall be informed, in writing, of any changes in site use on capped areas.

2. The next cap monitoring for the Monitored Sites based on this new 30-month frequency shall be February 2012, which corresponds to the next 30-month groundwater monitoring event for Wasser Winters described below. Unless changed by Ecology, all future cap monitoring for the Monitored Sites shall occur every 30 months beginning February 2012 to coincide with the groundwater monitoring that is intended to target alternating wet and dry seasons.

B. GROUNDWATER MONITORING FREQUENCY

1. The Port may standardize the groundwater monitoring frequency for each of the Monitored Sites as requested, which included the following:

   - Cascade Timber No. 3 – 18 months (formerly 12 months).
   - Murray Pacific No. 2 – 18 months (formerly 6 months).
   - Wasser Winters – No change (currently 30 months).
   - Portac – No change (currently discontinued).
   - Louisiana-Pacific – 30 months (formerly 24 months wet/dry).

2. The next groundwater monitoring for the Monitored Sites shall be conducted in February 2012. Unless changed by Ecology, all future groundwater monitoring for the Monitored Sites shall occur according to the frequency identified above beginning February 2012.

C. EFFECT OF MODIFICATION

1. Except as modified herein, all provisions of the Original Ecology Orders for each Monitored Site as existing and as may have been amended, including addressing any potential data compliance issues, remain in full force and effect.

2. A copy of this MOU shall be filed with the Ecology Project Manager for each of the Monitored Sites.

John Wolfe
Chief Executive Officer
Port of Tacoma

9.1.11
Date

Rebecca S. Lawson, P.E., LHG
Section Manager, Toxics Cleanup Program
Southwest Regional Office
Washington State Department of Ecology

9/12/2011
Date

cc:
Jason Jordan – Port of Tacoma
Mark Rettmann – Port of Tacoma
William Evans – Port of Tacoma
Leslee Connor – Port of Tacoma
Scott Hooton – Port of Tacoma
Dom Reale – Ecology
Marv Coleman – Ecology
Guy Barrett – Ecology
James DeMay – Ecology
Scott Rose – Ecology
Rebecca Lawson – Ecology

APPENDIX B
Groundwater Monitoring Field Logs

8/26/16 @ 1253

HARTCROWSER Groundwater Sampling Data - Well I.D. MW-1

PROJECT: CASCADE TIMBER
JOB NO.: 19000-09
PROJECT MANAGER: M. DAGEL
FIELD REPS: N. GALWIN
DATE/TIME SAMPLED: 8/26/16
TIDALLY INFLUENCED: YES _____ NO _____ ?
WELL DEPTH IN FEET: _____
SCREENED INTERVAL IN FEET: _____

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

WELL DEPTH: _____
DEPTH TO SEDIMENT (DTS) IN FEET: 15.81
DEPTH TO WATER (DTW) IN FEET: 12.35
(DTS – DTW): 3.46
CASING VOLUME IN GALLONS: 0.56
[2" diam = x .163 gal/ft 4" diam = x .653 gal/ft]
PURGE VOLUME IN GALLONS: 1.7
ACTUAL PURGE IN GALLONS: ~

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in _____	Diss. Oxygen in _____	Turbidity	ORP in _____	Comments: quality, recovery, color, odor, sheen, accumulated silt/sand
1240	~0.5	6.99	21.23	1231	0.05	6.7	-87	CLEAR, NO/NS, BUBBLES (SMALL)
1243	~1.0	6.75	21.12	1253	0.01	6.0	-95	" " "
1246	~1.5	6.59	21.02	1266	0.0	7.0	-101	" " "
1250	~2	6.52	21.01	1278	0.0	4.6	-104	
sample: 1253								

Comments: _____

	Method	Pumping Rate in GPM	Depth of Equip. in Feet
Purge	PERISTALTIC	< 2L/MIN	~13.5
Sample			

Boils dry? Yes _____ No _____
At no. of casing volumes _____
Purge Water Disposal Method/Volume: ON SITE DRUM

(2) Sampling Data

Bottle Type	# of Containers	Analyses	Preserv.	Filter
0.5L PE	1	DISS. METALS	N/A	0.45µm

Total number of Bottles: 1
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 1/4" PE
Bailer Type: —
Filter Type: GEOTECH 0.45 µm
Temp/pH/E.C. meter: IN SITU 9500
Water Level Probe: WATERLINE
Other: _____

(4) Well Conditions

OK [X] Not OK [ ] Explain: _____

8/26/16 @ 1345

HARTCROWSER Groundwater Sampling Data - Well I.D. MW-2

PROJECT	CASCADE TIMBER	DATE/TIME SAMPLED	8/26/16
JOB NO.	9000-09	TIDALLY INFLUENCED	YES _____ NO _____ ?
PROJECT MANAGER	M. DAGEL	WELL DEPTH IN FEET	
FIELD REPS	N. GALVIN	SCREENED INTERVAL IN FEET	

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

WELL DEPTH		CASING VOLUME IN GALLONS	1.50
DEPTH TO SEDIMENT (DTS) IN FEET	17.57	[2" diam = x .163 gal/ft	4" diam = x .653 gal/ft]
DEPTH TO WATER (DTW) IN FEET	8.37	PURGE VOLUME IN GALLONS	4.50
(DTS – DTW)	9.2	ACTUAL PURGE IN GALLONS	

Time	No. of Gallons Purged	pH	Temp in °C	Conduct in _____	Diss. Oxygen in _____	Turbidity	ORP in _____	Comments: quality, recovery, color, odor, sheen, accumulated silt/sand
1328	0.5	6.52	18.71	1896	0	2.0	-141	CLEAR. NO/NS V.SL. YELLOW ORANGE TINT SM. BUBBLES
1331	1	6.52	18.55	1920	0	5.0	-149	" " "
1336	2	6.54	18.50	1928	0	8.6	-154	" " " * TURBIDITY SUSPECT
1340	3	6.58	18.70	1925	0	4.3	-157	" " "
sample: 1345	4	6.60	18.69	1919	0	6.0	-158	" " "

Comments:

	Method	Pumping Rate in GPM	Depth of Equip. in Feet
Purge	PERISTALTIC	< 2L/MIN	~ 10
Sample	"	"	"

Boils dry? Yes _____ No _____

At no. of casing volumes _____

Purge Water Disposal Method/Volume

ON SITE DRUM

(2) Sampling Data

Bottle Type	# of Containers	Analyses	Preserv.	Filter
0.5 L PE	2	DISS. METALS	N/A	0.45µm

Total number of Bottles 2

Duplicate Sample I.D. MW-3 @ 1352

Field Blank I.D. —

Rinseate Sample I.D. —

(3) Field Equipment

			Type/Brand/Serial No./Material Units
Pump Type/Tubing Type	PERISTALTIC 1/3" PE	Temp/pH/E.C. meter	IN SITU
Bailer Type	—	Water Level Probe	
Filter Type	GEOTECH 0.45µm	Other	

(4) Well Conditions

OK [X] Not OK [ ] Explain

APPENDIX C
Laboratory Report
Analytical Resources, Inc.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

14 September 2016

Mark Dagel
Hart Crowser
3131 Elliott Ave Suite 600
Seattle, WA 98121

RE: Cascade Timber

Please find enclosed sample receipt documentation and analytical results for samples from the project referenced above.

Sample analyses were performed according to ARI's Quality Assurance Plan and any provided project specific Quality Assurance Plan. Each analytical section of this report has been approved and reviewed by an analytical peer, the appropriate Laboratory Supervisor or qualified substitute, and a technical reviewer.

Should you have any questions or problems, please feel free to contact us at your convenience.

Associated Work Order(s)	Associated SDG ID(s)
16H0257	N/A

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the enclose Narrative. ARI, an accredited laboratory, certifies that the report results for which ARI is accredited meets all the reqirements of the accrediting body. A list of certified analyses, accreditations, and expiration dates is included in this report.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his/her designee, as verified by the following signature.

Analytical Resources, Inc.

Amanda Volgardsen For Kelly Bottem, Client Services Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

ACCREDITED IN ACCORDANCE WITH nelac
Cert# 100006

PJLA Testing
Accreditation # 66169

Sample Custody Record

1640257
6.1°C

Samples Shipped to: ALS

PG. 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212
Office: 206.324.9530 • Fax 206.328.5581

JOB 19000-09 LAB NUMBER

PROJECT NAME CASCADE TIMBER

HART CROWSER CONTACT N. GALVIN
M. DAGEL

SAMPLED BY: MWG

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	REQUESTED ANALYSIS: Diss As, Cu, Pb* (200.8)	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	MW-1		8/26/16	1253	H2O	X	1	
	MW-2			1345		X	1	
	MW-3			1352		X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE: Nicholas Galvin	8/26/16	SIGNATURE: Justin Meyer	8-26-16
PRINT NAME: Nicholas Galvin	TIME	PRINT NAME: Justin Meyer	TIME
COMPANY: Hart Crowser	1520	COMPANY: ARI	1520
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

DISS METALS SAMPLES ARE FIELD FILTERED

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

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Hart Crowser

Project Name: Cascade Timber

COC No(s): _____ NA

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Assigned ARI Job No: 16H0257

Tracking No: _____ NA

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler?	YES	(NO)
Were custody papers included with the cooler?	(YES)	NO
Were custody papers properly filled out (ink, signed, etc.)	(YES)	NO
Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry) 6.1		
Time: _____		

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: D0052 76

Cooler Accepted by: JM Date: 8-26-16 Time: 1520

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler?		YES	(NO)
What kind of packing material was used? ... Bubble Wrap (Wet Ice) Gel Packs Baggies Foam Block Paper Other: _____			
Was sufficient ice used (if appropriate)?	NA	(YES)	(NO)
Were all bottles sealed in individual plastic bags?		(YES)	NO
Did all bottles arrive in good condition (unbroken)?		(YES)	NO
Were all bottle labels complete and legible?		(YES)	NO
Did the number of containers listed on COC match with the number of containers received?		(YES)	NO
Did all bottle labels and tags agree with custody papers?		(YES)	NO
Were all bottles used correct for the requested analyses?		(YES)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	NA	(YES)	NO
Were all VOC vials free of air bubbles?	(NA)	YES	NO
Was sufficient amount of sample sent in each bottle?		(YES)	NO
Date VOC Trip Blank was made at ARI	(NA)		

Was Sample Split by ARI : (NO) YES Date/Time: _____ Equipment: _____ Split by: _____

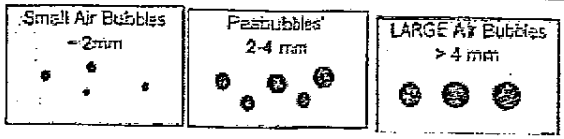
Samples Logged by: JM Date: 8-26-16 Time: 1620

*** Notify Project Manager of discrepancies or concerns ***

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: Date:



Small → "sm" (<2 mm)

Peabubbles → "pb" (2 to <4 mm)

Large → "lg" (4 to <6 mm)

Headspace → "hs" (>6 mm)

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Temperature Compliance Form

Cooler#: 1	Temperature(°C): 6.1	
Sample ID	Bottle Count	Bottle Type
All Samples over 6.1°C		

Cooler#:	Temperature(°C):	
Sample ID	Bottle Count	Bottle Type

Cooler#:	Temperature(°C):	
Sample ID	Bottle Count	Bottle Type

Cooler#:	Temperature(°C):	
Sample ID	Bottle Count	Bottle Type

Completed by: SM Date: 6-26-16 Time: 1524

WORK ORDER

16H0257

Client: Hart Crowser	**Project Manager: Kelly Bottem**
Project: Cascade Timber	**Project Number: Cascade Timber**

Preservation Confirmation

Container ID	Container Type	pH
16H0257-01 A	HDPE NM, 500 mL	>2 Fail
16H0257-02 A	HDPE NM, 500 mL	>2 Fail
16H0257-03 A	HDPE NM, 500 mL	>2 Fail

JM
Preservation Confirmed By

8-26-16
Date

JM
Reviewed By

8-26-16
Date

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-1	16H0257-01	Water	25-Aug-2016 12:53	26-Aug-2016 15:20
MW-2	16H0257-02	Water	25-Aug-2016 13:45	26-Aug-2016 15:20
MW-3	16H0257-03	Water	25-Aug-2016 13:52	26-Aug-2016 15:20

4611 S. 134th Place, Suite 100 • Tukwila, WA 98168 • Ph: (206) 695-6200 • Fax: (206) 695-6201

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

Case Narrative

Analytical Resources, Inc. (ARI) received three water samples in good condition on August 26, 2016. The samples were received with a cooler temperature of 6.1ºC. For further details regarding sample receipt, please refer to the enclosed Cooler Receipt Form and Preservation Verification sheet.

The samples were analyzed for Dissolved Metals, as requested on the COC.

Arsenic was detected in the method blank below ARI's reporting limits, it has been flagged with a "J" qualifier.

All other samples detected below ARI's reporting limits have also been flagged with a "J" qualifier.

There were no other irregularities associated with the analysis.

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

MW-1

16H0257-01 (Water)

Metals and Metallic Compounds (dissolved)

Method: EPA 200.8
Instrument: ICPMS2
Analyzed: 29-Aug-2016 19:05

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Lead, Dissolved	7439-92-1	1	0.100	ND	ug/L	U

Method: EPA 200.8 UCT-KED
Instrument: ICPMS2
Analyzed: 29-Aug-2016 19:05

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Arsenic, Dissolved	7440-38-2	1	0.200	**24.2**	ug/L	
Copper, Dissolved	7440-50-8	1	0.500	ND	ug/L	U

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Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

MW-2

16H0257-02 (Water)

Metals and Metallic Compounds (dissolved)

Method: EPA 200.8
Instrument: ICPMS2
Analyzed: 29-Aug-2016 18:35

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Lead, Dissolved	7439-92-1	1	0.100	ND	ug/L	U

Method: EPA 200.8 UCT-KED
Instrument: ICPMS2
Analyzed: 29-Aug-2016 18:35

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Arsenic, Dissolved	7440-38-2	1	0.200	**23.6**	ug/L	
Copper, Dissolved	7440-50-8	1	0.500	ND	ug/L	U

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

MW-3

16H0257-03 (Water)

Metals and Metallic Compounds (dissolved)

Method: EPA 200.8
Instrument: ICPMS2
Analyzed: 29-Aug-2016 18:40

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Lead, Dissolved	7439-92-1	1	0.100	ND	ug/L	U

Method: EPA 200.8 UCT-KED
Instrument: ICPMS2
Analyzed: 29-Aug-2016 18:40

Sample Preparation: Preparation Method: REN EPA 600/4-79-020 4.1.4 HNO3 matrix
Preparation Batch: BEH0598 Sample Size: 25 mL
Prepared: 29-Aug-2016 Final Volume: 25 mL

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Arsenic, Dissolved	7440-38-2	1	0.200	**26.5**	ug/L	
Copper, Dissolved	7440-50-8	1	0.500	ND	ug/L	U

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

Metals and Metallic Compounds (dissolved) - Quality Control

Batch BEH0598 - REN EPA 600/4-79-020 4.1.4 HNO3 matrix

Instrument: ICPMS2

QC Sample/Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Blank (BEH0598-BLK1)				Prepared: 29-Aug-2016 Analyzed: 29-Aug-2016 18:30						
Arsenic	ND	0.200	ug/L							U
Copper	ND	0.500	ug/L							U
Lead	ND	0.100	ug/L							U
LCS (BEH0598-BS1)				Prepared: 29-Aug-2016 Analyzed: 29-Aug-2016 19:15						
Arsenic	25.2	0.200	ug/L	25.0		101	80-120			
Copper	25.3	0.500	ug/L	25.0		101	80-120			
Lead	25.2	0.100	ug/L	25.0		101	80-120			
Duplicate (BEH0598-DUP1)	**Source: 16H0257-01**			Prepared: 29-Aug-2016 Analyzed: 29-Aug-2016 19:00						
Arsenic	24.4	0.200	ug/L		24.2			0.81	20	
Copper	ND	0.500	ug/L		ND				20	U
Lead	0.0700	0.100	ug/L		ND				20	U
Matrix Spike (BEH0598-MS1)	**Source: 16H0257-01**			Prepared: 29-Aug-2016 Analyzed: 29-Aug-2016 19:10						
Arsenic	47.0	0.200	ug/L	25.0	24.2	91.3	75-125			
Copper	24.1	0.500	ug/L	25.0	ND	96.4	75-125			
Lead	23.6	0.100	ug/L	25.0	ND	94.3	75-125			

Recovery limits for target analytes in MS/MSD QC samples are advisory only.

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

Certified Analyses included in this Report

Analyte	Certifications
EPA 200.8 in Water	
Lead-208	NELAP,WADOE,WA-DW,DoD-ELAP
EPA 200.8 UCT-KED in Water	
Arsenic-75a	NELAP,WADOE,WA-DW,DoD-ELAP
Arsenic-75b	NELAP,WADOE,WA-DW,DoD-ELAP
Copper-63	NELAP,WADOE,WA-DW,DoD-ELAP
Copper-65	NELAP,WADOE,WA-DW,DoD-ELAP

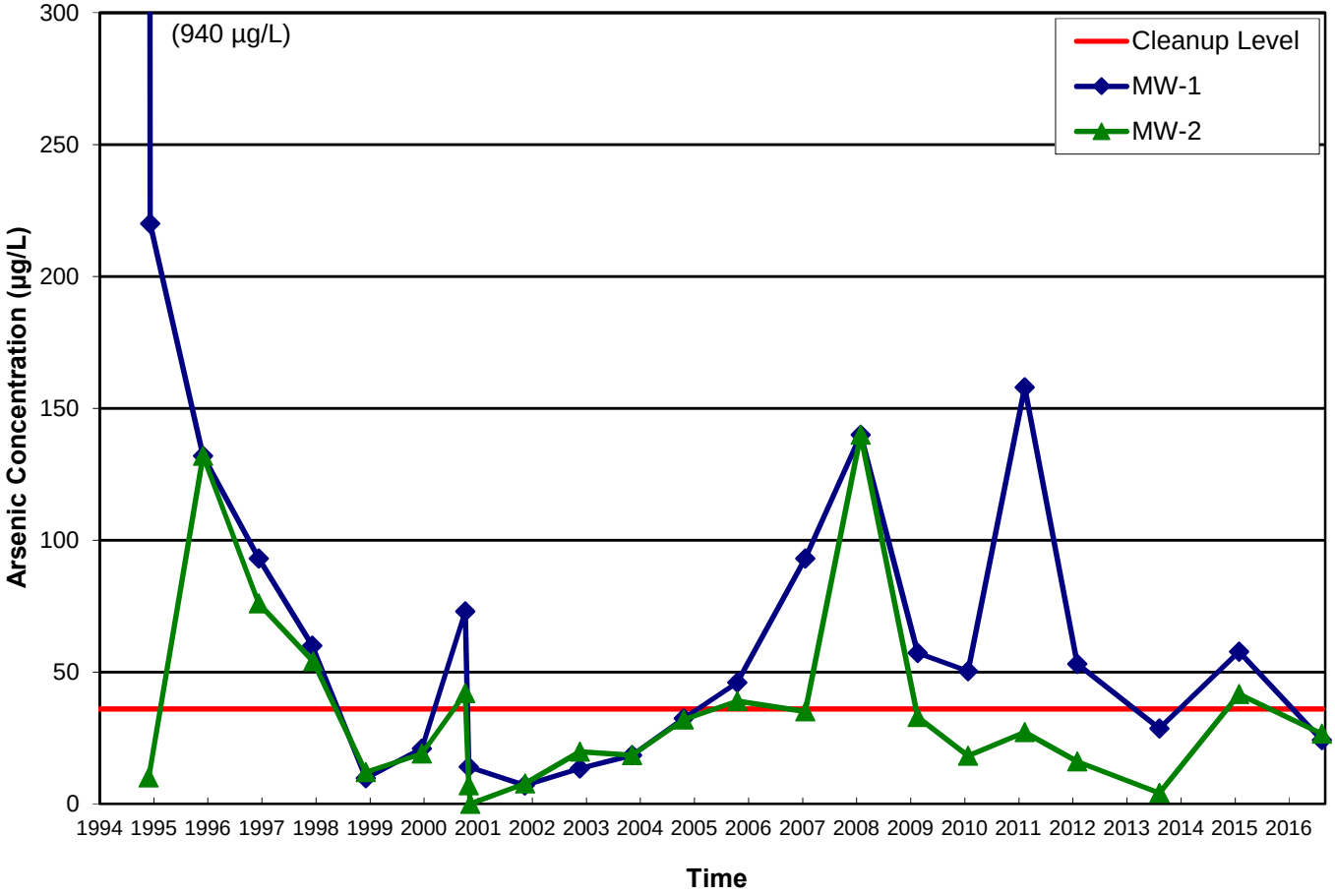
Code	Description	Number	Expires
ADEC	Alaska Dept of Environmental Conservation	UST-033	05/06/2017
CALAP	California Department of Public Health CAELAP	2748	02/28/2018
DoD-ELAP	DoD-Environmental Laboratory Accreditation Program	66169	03/30/2017
NELAP	ORELAP - Oregon Laboratory Accreditation Program	WA100006	05/11/2017
WADOE	WA Dept of Ecology	C558	06/30/2017
WA-DW	Ecology - Drinking Water	C558	06/30/2017

Hart Crowser	Project: Cascade Timber	
3131 Elliott Ave Suite 600	Project Number: Cascade Timber	**Reported:**
Seattle, WA 98121	Project Manager: Mark Dagel	14-Sep-2016 10:27

Notes and Definitions

U	This analyte is not detected above the applicable reporting or detection limit.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
[2C]	Indicates this result was quantified on the second column on a dual column analysis.

APPENDIX D
Plots of Arsenic, Copper, Lead, and Zinc Concentrations Versus Time



Note:
For sampling events that included a duplicate sample for dissolved arsenic analysis, the greater analytical result for the two samples is plotted (see Table 1).

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

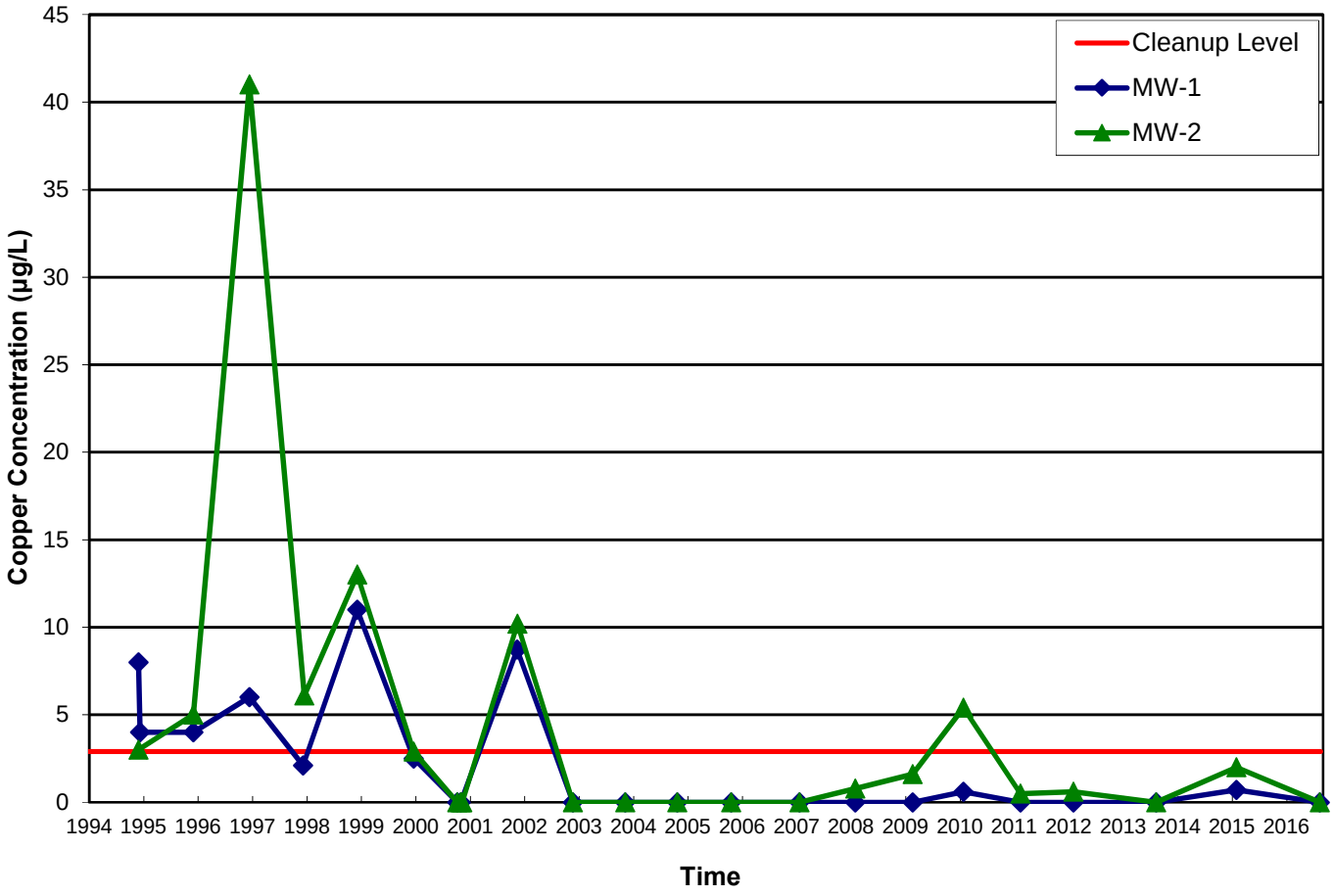
MW-1 and MW-2 Arsenic Concentration

19000-11 08/16

HARTCROWSER

Figure
D-1

NWG 09/13/2016 1900011/D1.xls



Note:
For sampling events that included a duplicate sample for dissolved copper analysis, the greater analytical result for the two samples is plotted (see Table 1).

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

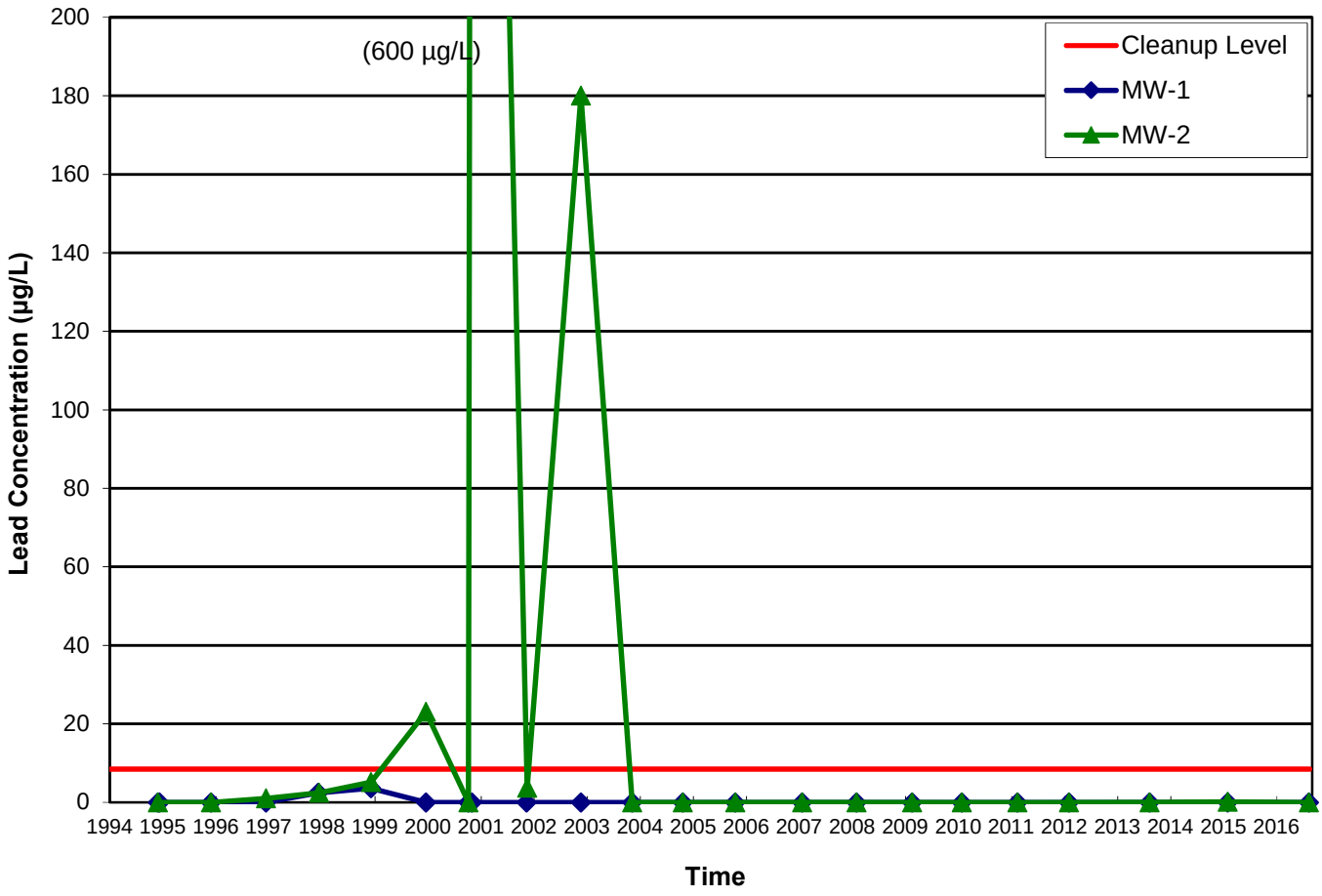
MW-1 and MW-2 Copper Concentration

19000-11 08/16

HARTCROWSER

Figure
D-2

NWG 09/13/2016 1900011/D2.xls



Note:
For sampling events that included a duplicate sample for dissolved lead analysis, the greater analytical result for the two samples is plotted (see Table 1).

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

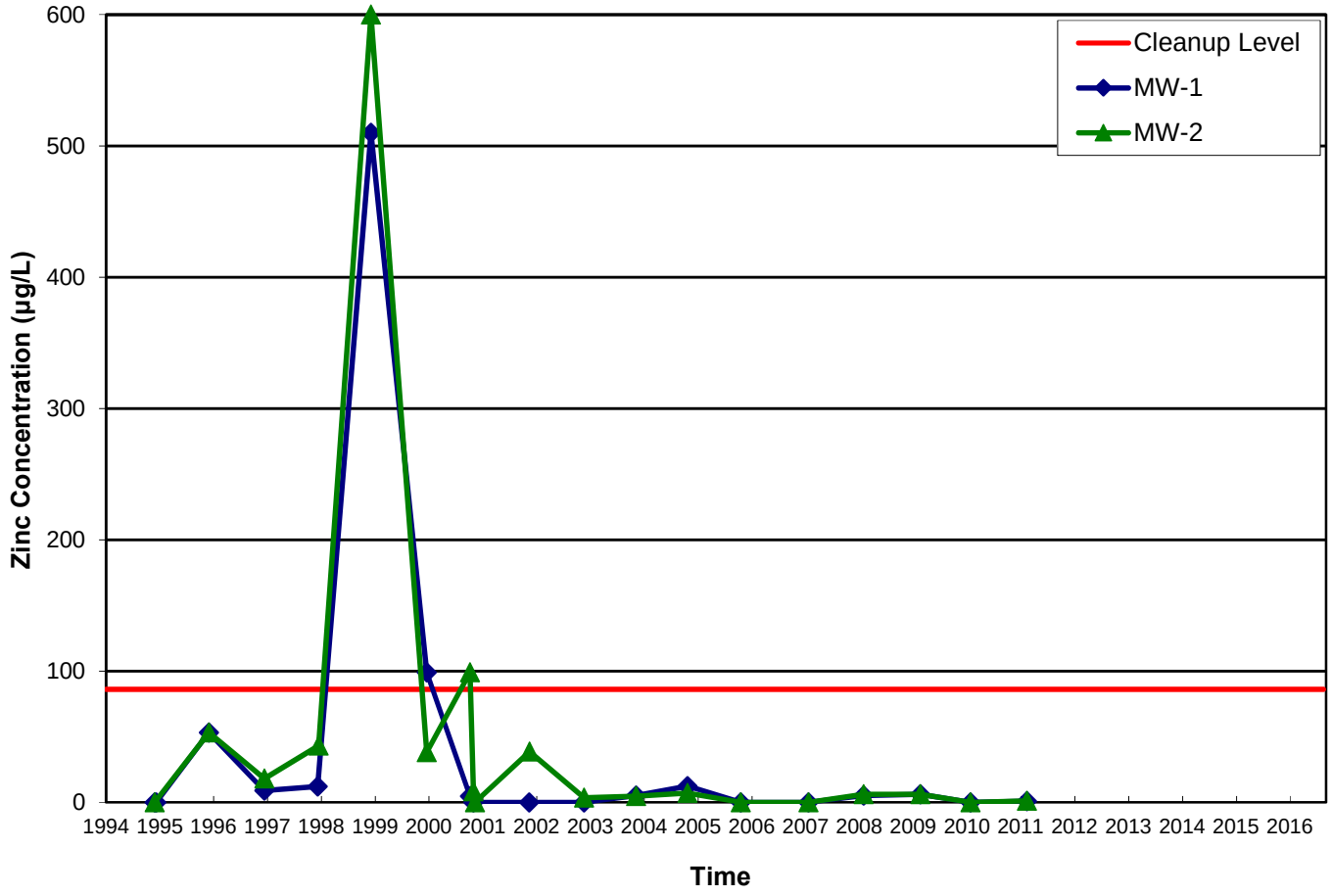
MW-1 and MW-2 Lead Concentration

19000-11 08/16

HARTCROWSER

Figure
D-3

NWG 09/13/2016 1900011/D3.xls



Note:
For sampling events that included a duplicate sample for dissolved zinc analysis, the greater analytical result for the two samples is plotted (see Table 1).

Zinc analysis was discontinued in 2011 with Ecology approval dated June 28, 2011.

Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

MW-1 and MW-2 Zinc Concentration

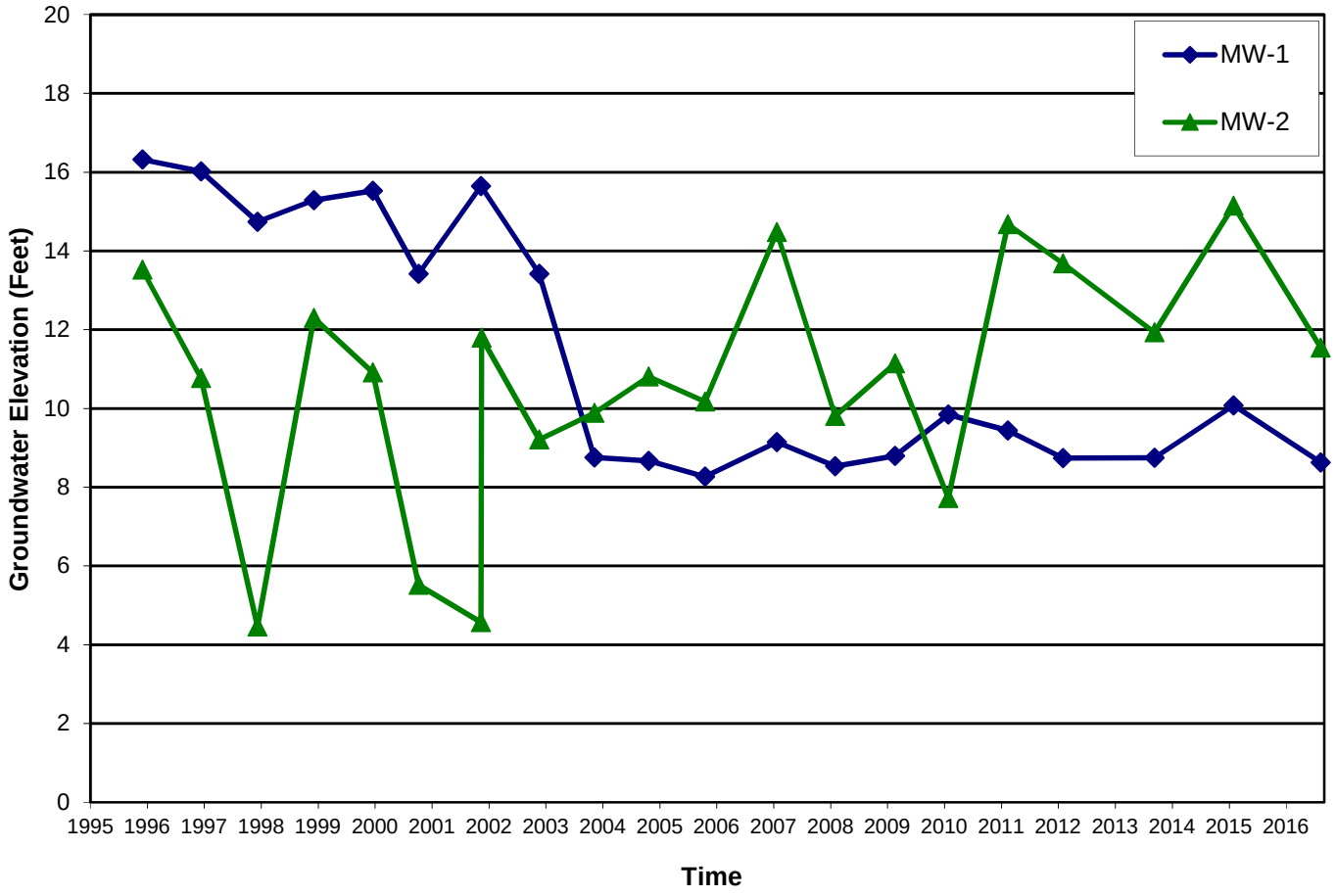
19000-11 08/16

HARTCROWSER

Figure
D-4

NWG 09/13/2016 1900011/D4.xls

APPENDIX E
Plot of Groundwater Elevations Versus Time



Former Cascade Timber No. 3 Log Sort Yard
Port of Tacoma

MW-1 and MW-2 Groundwater Elevation

19000-11 08/16

HARTCROWSER

Figure

E-1

PRS 03/06/15 1900009\E1.xls