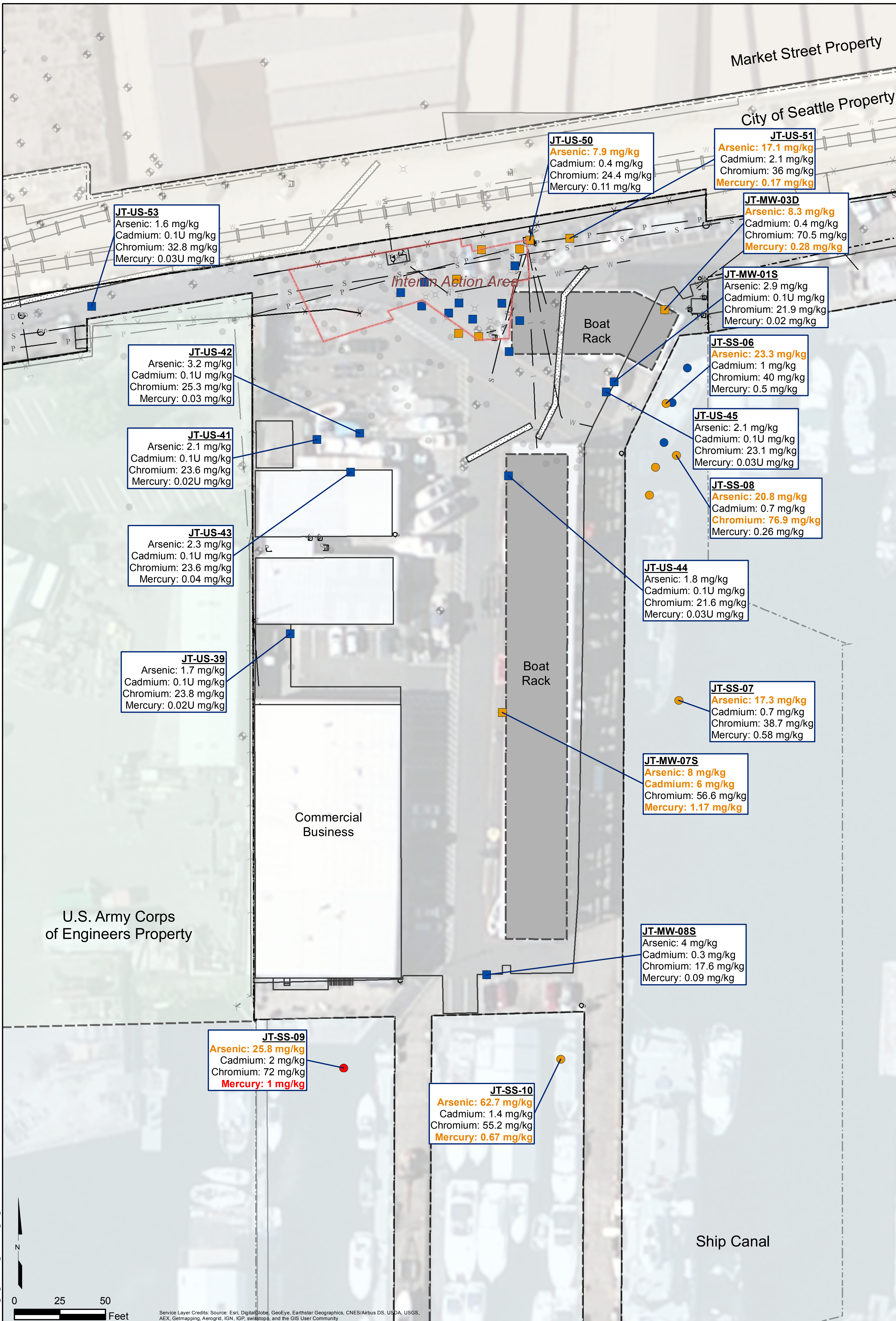


Soil Samples
- Below Screening Criteria
- Above Screening Criteria

Sediment Samples
- Below SCO Screening Level
- Above SCO Screening Level
- Above CSL Screening Level

Screening Levels

	Soil	Sediment	
		SCO	*CSL*
Arsenic	7	14	120
Cadmium	5.6	2.1	5.4
Chromium	2000	72	88
Mercury	0.146	0.66	0.8

all values mg/kg

- Fence Line
- Property Boundary
- U Utility Line
- W Water Line
- S Sanitary Sewer Line
- P Overhead Power
- Historical Soil Boring
- Historical Sediment Sample
- Injection Well
- Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.
3. Sample locations presented on figure but not identified were collected during the 2013-14 RI and are identified in the 2014 Interim Action Work Plan (IAWP).
4. Highest concentration within depth interval presented.

Jacobson Terminals
Seattle, Washington

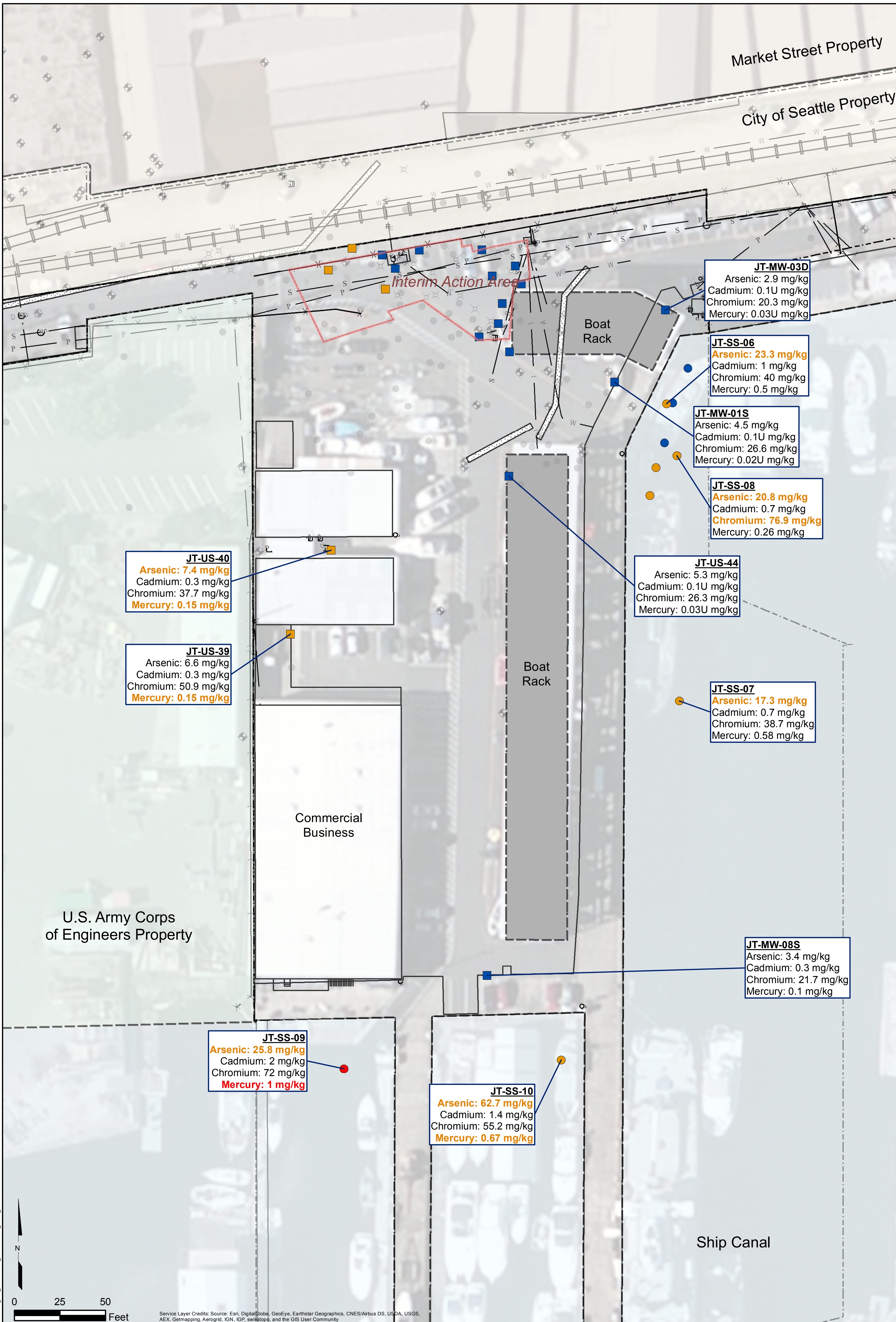
Other Metals in Soil (0 – 10 feet bgs) and Sediment

17800-56 2/16

HARTCROWSER

Figure
10a

C:\GIS_WORKING\1780056_Jacobson\GIS\Documents\Updates_020816\1780056_10a_OtherMetals_SoilSediment_0-10_P.mxd



Soil Samples
- Below Screening Criteria
- Above Screening Criteria

Sediment Samples
- Below SCO Screening Level
- Above SCO Screening Level
- Above CSL Screening Level

Screening Levels

	Soil	Sediment	
		SCO	*CSL*
Arsenic	7	14	120
Cadmium	5.6	2.1	5.4
Chromium	2000	72	88
Mercury	0.146	0.66	0.8

all values mg/kg

- Fence Line
- Property Boundary
- U Utility Line
- W Water Line
- S Sanitary Sewer Line
- P Overhead Power
- Historical Soil Boring
- Historical Sediment Sample
- Injection Well
- Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.
3. Sample locations presented on figure but not identified were collected during the 2013-14 RI and are identified in the 2014 Interim Action Work Plan (IAWP).
4. Highest concentration within depth interval presented.

Jacobson Terminals
Seattle, Washington

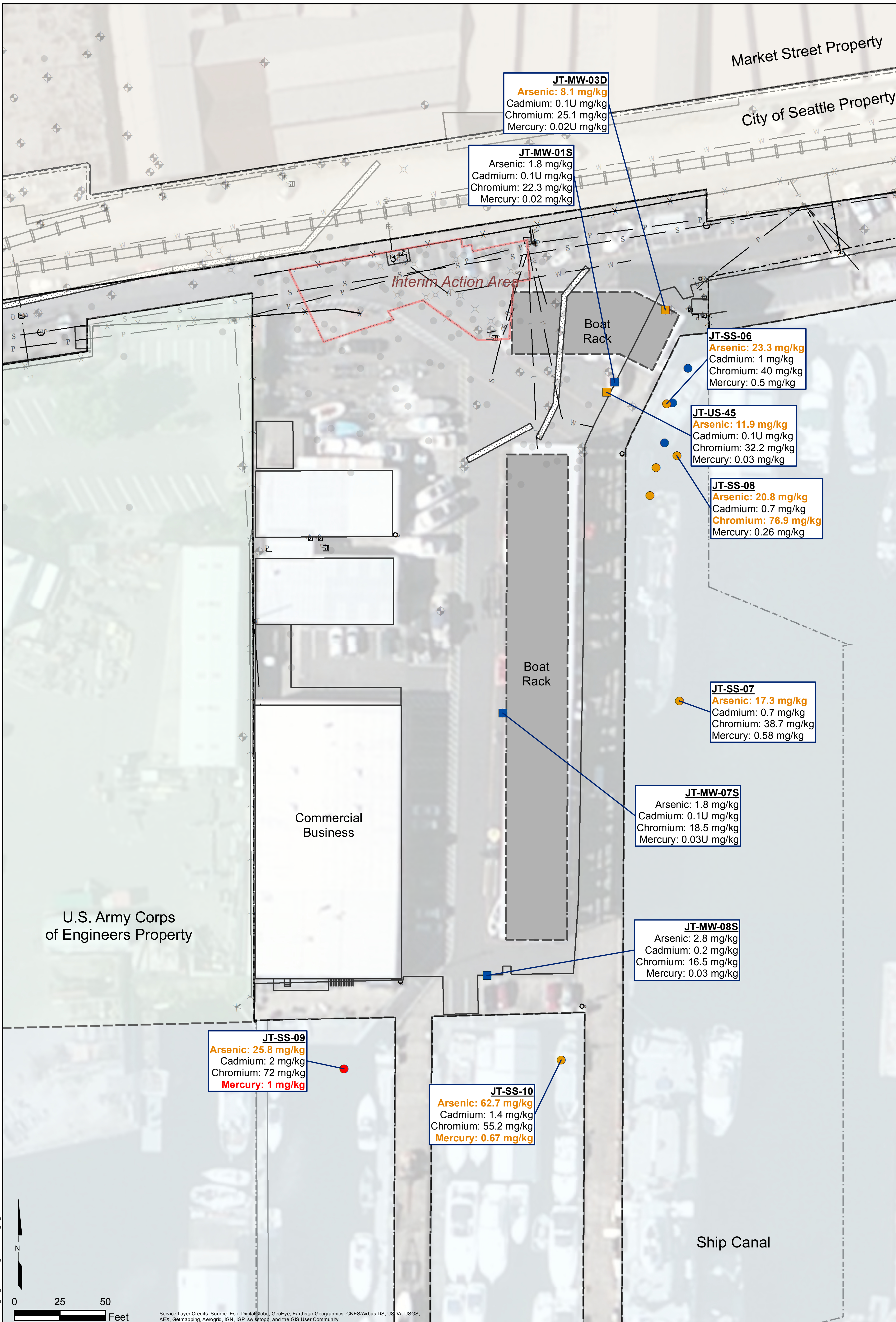
Other Metals in Soil (10 – 18 feet bgs) and Sediment

17800-56 2/16

HARTCROWSER

Figure **10b**

C:\GIS_WORKING\1780056_Jacobson\GIS\Documents\Updates_020816\1780056_10b_OtherMetals_SoilSediment_10-18_P.mxd



Soil Samples
- Below Screening Criteria
- Above Screening Criteria

Sediment Samples
- Below SCO Screening Level
- Above SCO Screening Level
- Above CSL Screening Level

Screening Levels

	Soil	Sediment	
		SCO	*CSL*
Arsenic	7	14	120
Cadmium	5.6	2.1	5.4
Chromium	2000	72	88
Mercury	0.146	0.66	0.8

all values mg/kg

- Fence Line
- Property Boundary
- U Utility Line
- W Water Line
- S Sanitary Sewer Line
- P Overhead Power
- Historical Soil Boring
- Historical Sediment Sample
- Injection Well
- Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.
3. Sample locations presented on figure but not identified were collected during the 2013-14 RI and are identified in the 2014 Interim Action Work Plan (IAWP).
4. Highest concentration within depth interval presented.

Jacobson Terminals
Seattle, Washington

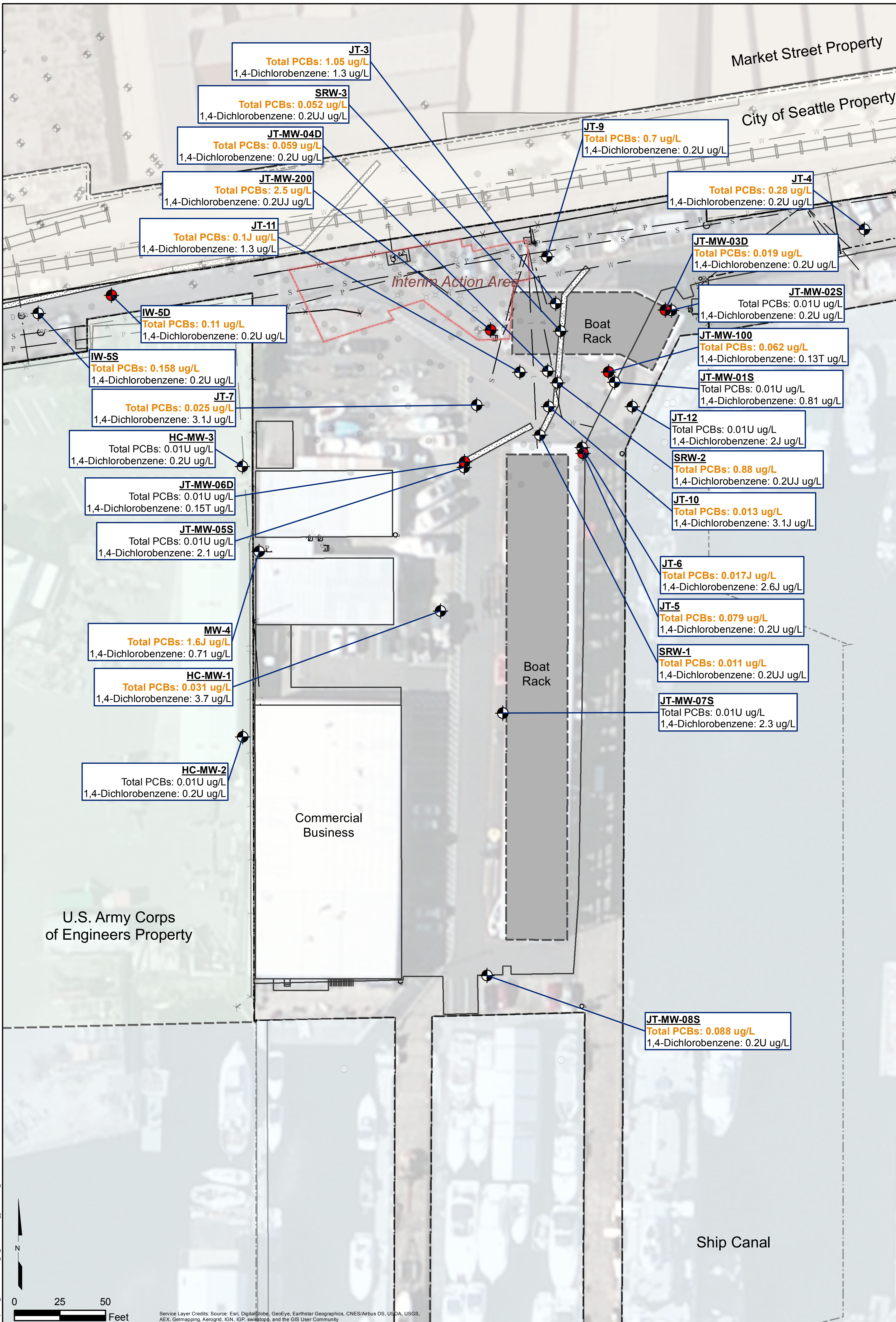
Other Metals in Soil (18+ feet bgs) and Sediment

17800-56 2/16

HARTCROWSER

Figure
10c

C:\GIS_WORKING\1780056_Jacobson\GIS\Documents\Updates_020816\1780056_10c_OtherMetals_SoilSediment_18_P.mxd



Monitoring Well

Deep Well

Location Name

Results in orange exceed screening level level for total PCBs of 0.000064 ug/L

JT-MW-08S
Total PCBs: 0.088 ug/L
1,4-Dichlorobenzene: 0.2U ug/L

Results in orange exceed cleanup level for1,4-Dichlorobenzene of 190 ug/L

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/18/13.
2. Utility locations are approximate.

- Fence Line
- Property Boundary
- U Utility Line
- W Water Line
- S Sanitary Sewer Line
- P Overhead Power
- Historical Soil Boring
- Historical Sediment Sample
- Injection Well
- Existing Monitoring Wells

Jacobson Terminals
Seattle, Washington

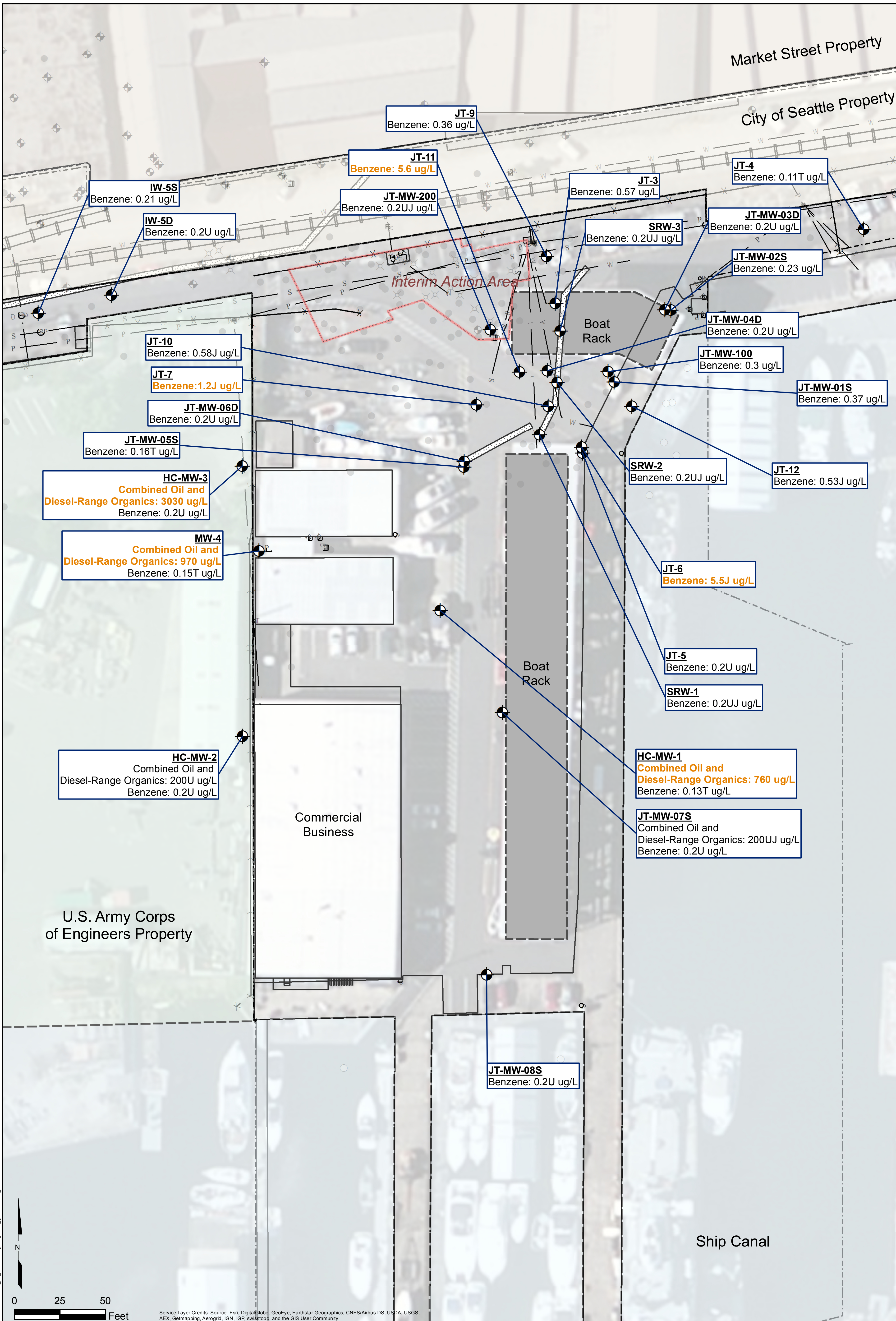
Total PCBs and 1,4-Dichlorobenzene in Groundwater

17800-56 4/15

HARTCROWSER

Figure **11**

L:\Notebooks\1780056_Jacobson Terminal Property RI-FS\GIS\Documents\Updates_032015\1780056_11_PCBs14dbzn_groundwater_P.mxd



Monitoring Well

Location Name

MW-4
Combined Oil and
Diesel-Range Organics: 970 ug/L
Benzene: 0.15T ug/L

Results in orange exceed cleanup level for Combined Oil and Diesel-Range Organics: 500 ug/L

Results in orange exceed cleanup level for Benzene: 1.2 ug/L

Fence Line
Property Boundary
Utility Line
Water Line
Sanitary Sewer Line
Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 3/15.
2. Utility locations are approximate.

Jacobson Terminals
Seattle, Washington

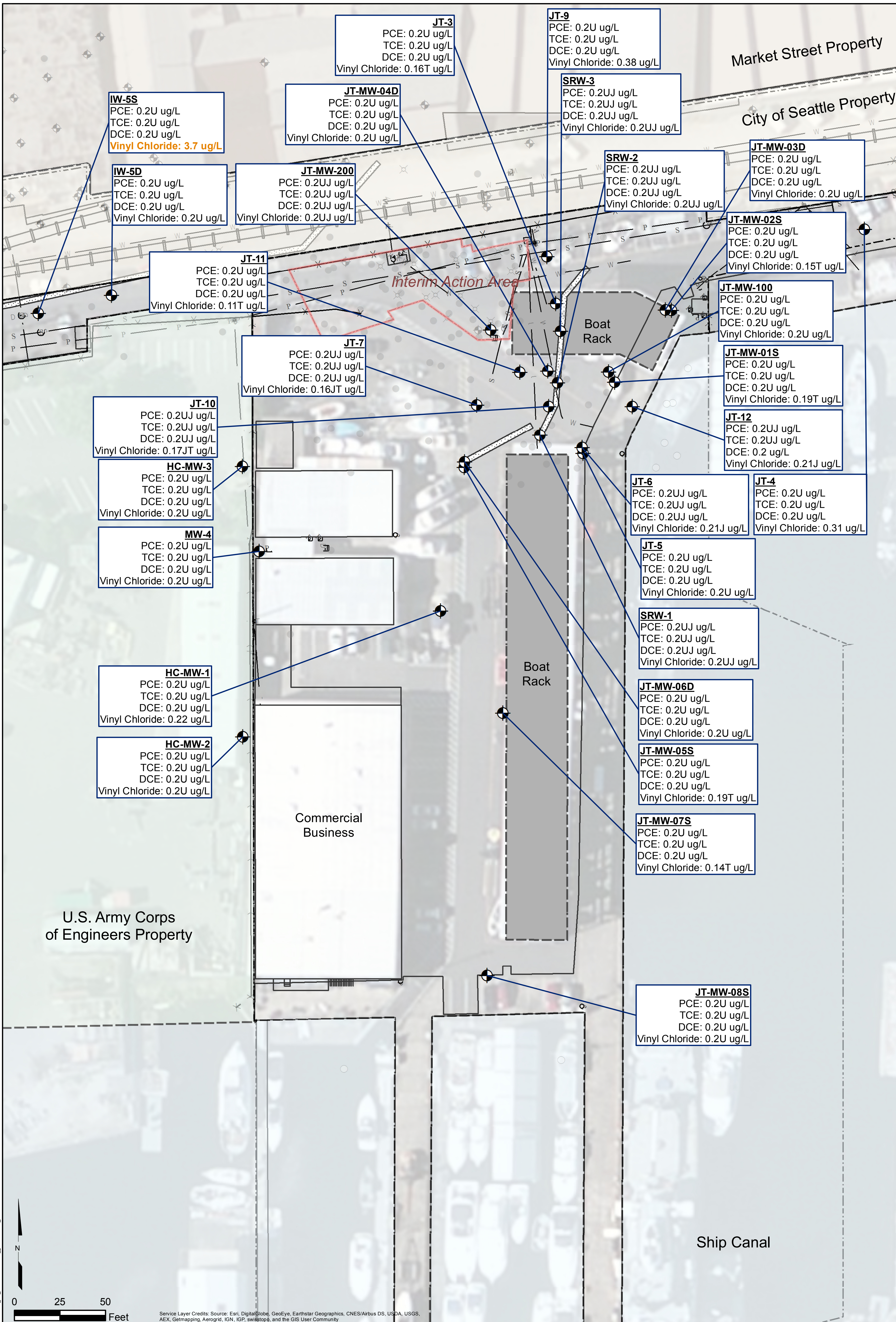
Oil and Diesel-Range Organics (Combined) and Benzene in Groundwater

17800-56 4/15

HARTCROWSER

Figure
12

C:\GIS_WORKING\archive\1780056_Jacobson\GIS\Documents\Updates_032015\1780056_12_DieselRangeOrganics_groundwater_P.mxd



Monitoring Well

Location Name

IW-5S
PCE: 0.2U ug/L
TCE: 0.2U ug/L
DCE: 0.2U ug/L
Vinyl Chloride: 3.7 ug/L

Results in orange exceed groundwater screening level.

Screening Levels
PCE = Tetrachloroethene: 29 ug/L
TCE = Trichloroethene: 7 ug/L
DCE = 1,1-Dichloroethene: 3.2 ug/L
Vinyl Chloride: 1.6 ug/L

Fence Line
Property Boundary
Utility Line
Water Line
Sanitary Sewer Line
Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

C:\GIS_WORKING\17800\56_Jacobsen\GIS\Documents\Updates_020816\1780056_13_PCETCEDCEVC_groundwater_P.mxd

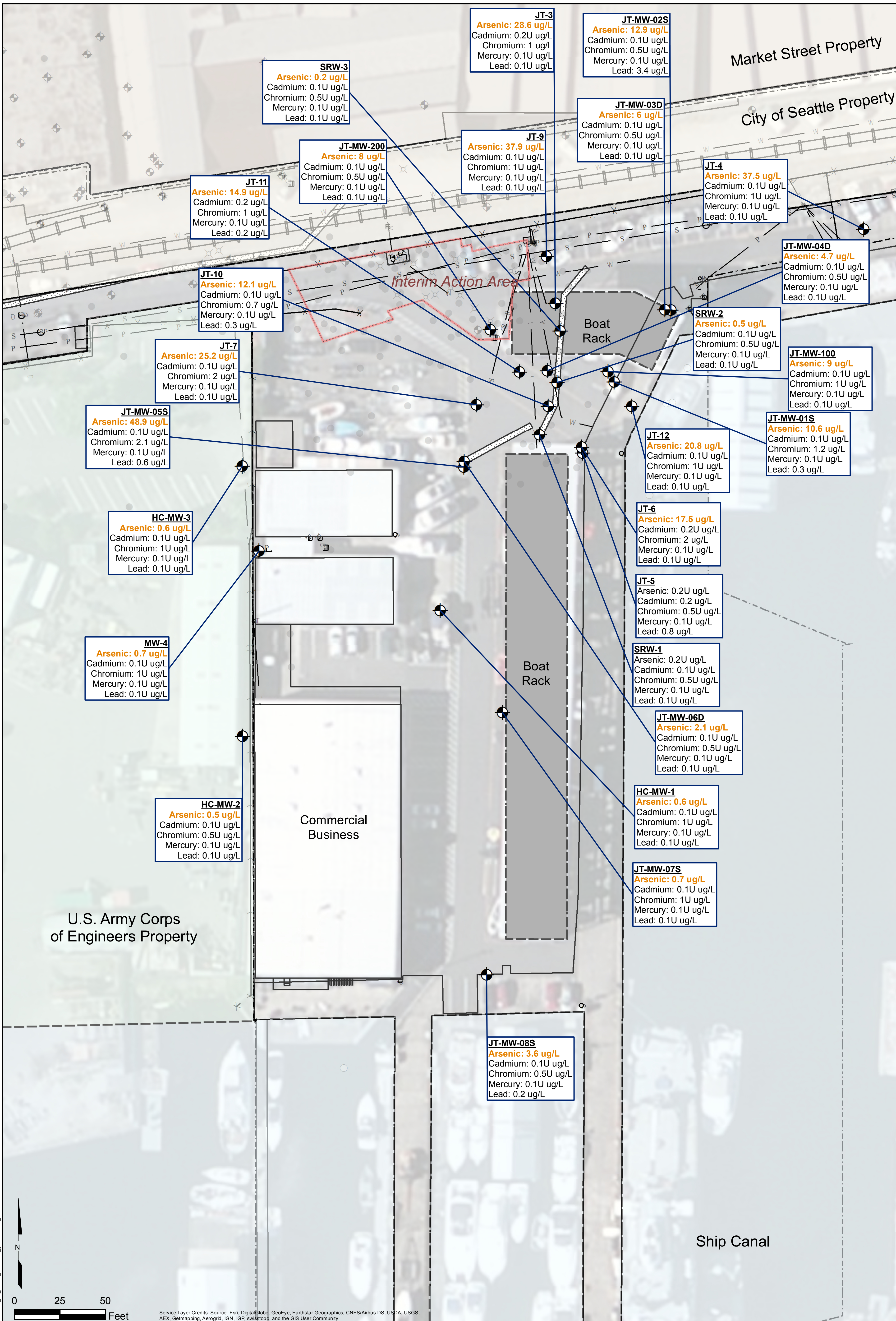
Jacobson Terminals
Seattle, Washington

PCE, TCE, DCE, and Vinyl Chloride in Groundwater

17800-56 2/16

HARTCROWSER

Figure
13



Monitoring Well

Screening Levels
Arsenic: 0.14 ug/L
Cadmium: 40.5 ug/L
Chromium: 50 ug/L
Lead: 15 ug/L
Mercury: 0.15 ug/L

Location Name — JT-MW-07S
Results in orange exceed groundwater screening level.
Arsenic: 0.7 ug/L
Cadmium: 0.1U ug/L
Chromium: 1U ug/L
Mercury: 0.1U ug/L
Lead: 0.1U ug/L

Fence Line
Property Boundary
Utility Line
Water Line
Sanitary Sewer Line
Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

Jacobson Terminals
Seattle, Washington

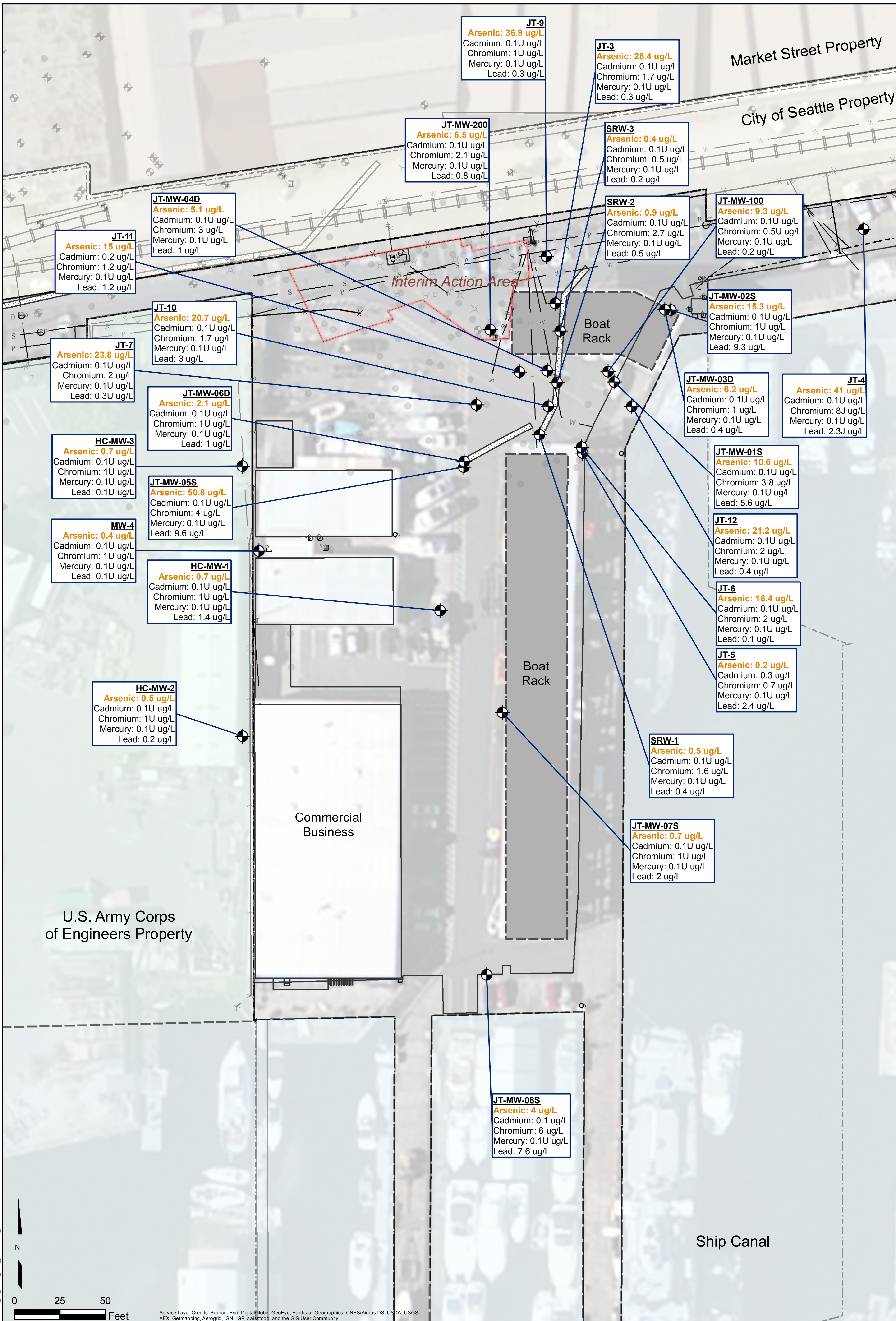
Metals (Dissolved) in Groundwater

17800-56 2/16

HARTCROWSER

Figure 14

C:\GIS_WORKING\17800\56_Jacobsen\GIS\Documents\Updates_020816\1780056_14_Metals_dissolved_groundwater_P.mxd



Monitoring Well

Screening Levels
Arsenic: ~~0.14~~ ug/L
Cadmium: ~~40.5 ug/L~~
Chromium: 50 ug/L
Lead: 15 ug/L
Mercury: 0.15 ug/L

Results in orange exceed groundwater screening level.

Location Name

JT-MW-07S
Arsenic: 0.7 ug/L
Cadmium: 0.1U ug/L
Chromium: 1U ug/L
Mercury: 0.1U ug/L
Lead: 0.1U ug/L

Fence Line
Property Boundary
Utility Line
Water Line
Sanitary Sewer Line
Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

Jacobson Terminals
Seattle, Washington

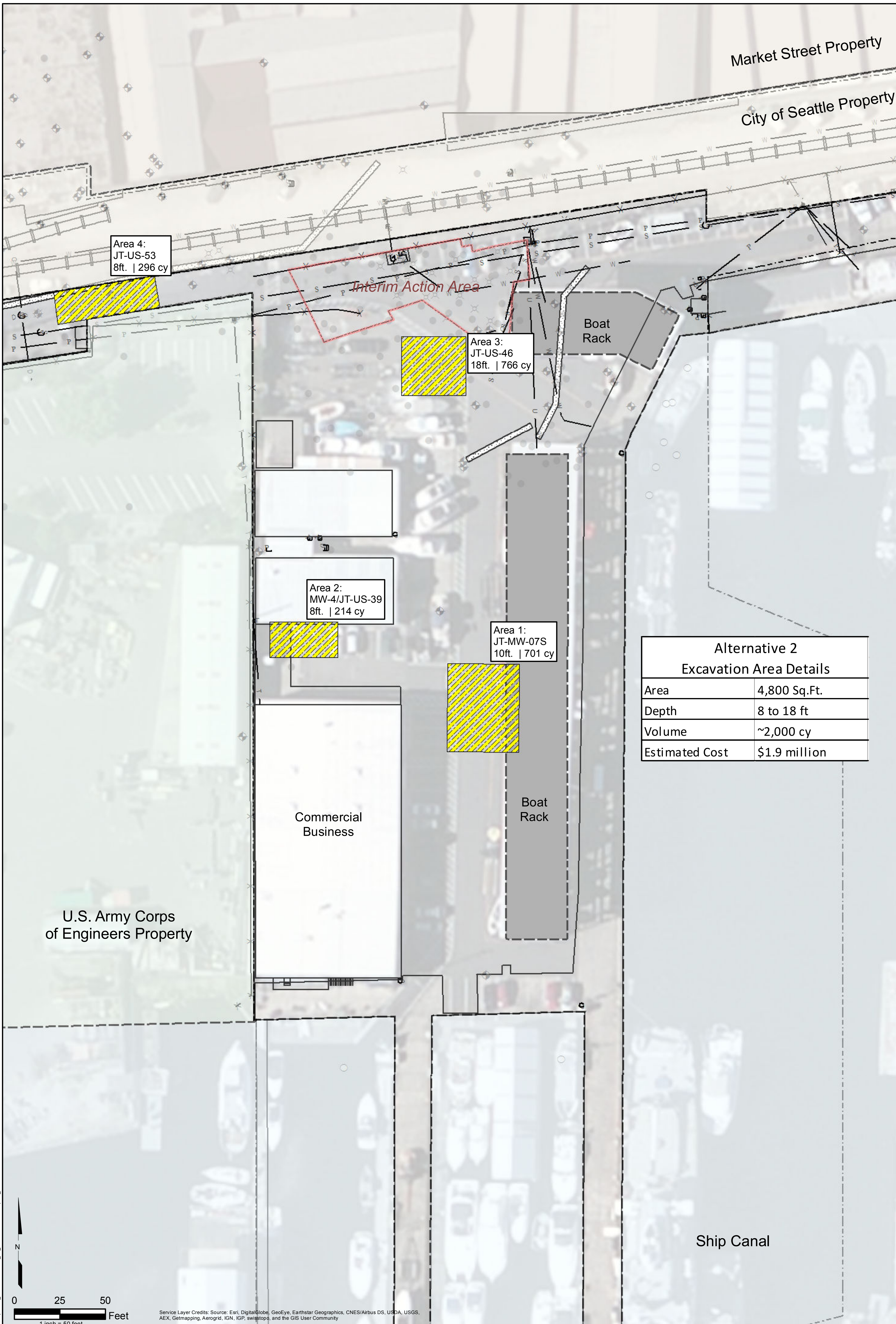
Metals (Total) in Groundwater

17800-56 2/16

HARTCROWSER

Figure
15

C:\GIS_WORKING\1780056_Jacobsen\GIS\Documents\Updates_020816\1780056_15_Metals_total_groundwater_P.mxd



Alternative 2 Excavation Area Details	
Area	4,800 Sq.Ft.
Depth	8 to 18 ft
Volume	~2,000 cy
Estimated Cost	$1.9 million

Contamination Hot Spots

Hot Spot ID — Area 4:
JT-US-53
Excavation Depth — 8ft. | 296 cy — Excavation Volume

Fence Line
Property Boundary
U Utility Line
W Water Line
S Sanitary Sewer Line
P Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

Jacobson Terminals
Seattle, Washington

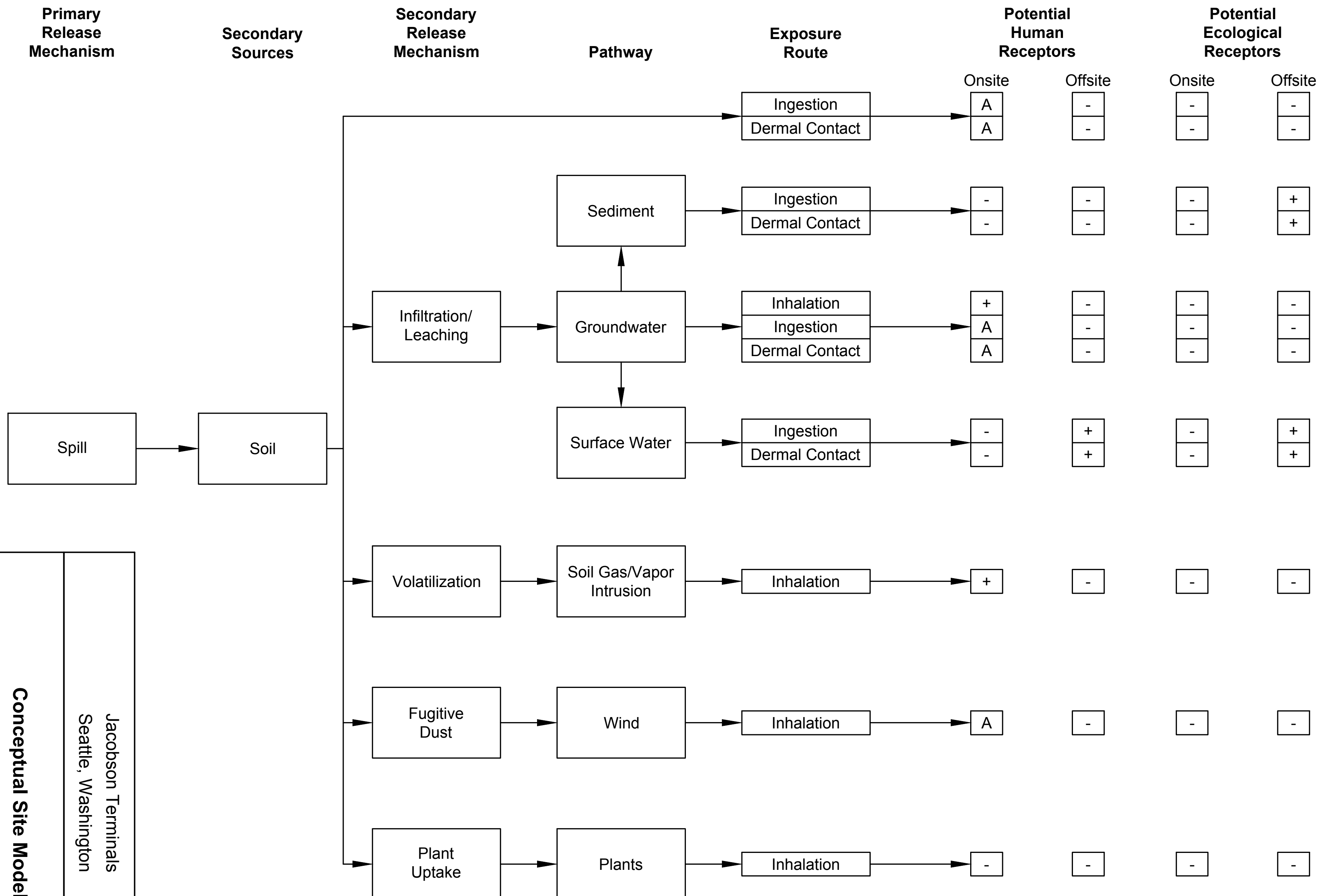
Alternative 2 – Hot Spot Excavation Areas

17800-56 4/15

HARTCROWSER

Figure **16**

L:\Notebooks\1780056_Jacobson Terminal Property RI-FS\GIS\Documents\Updates_032015\1780056_16_ContaminationHotSpots_P.mxd



Exposure Route	Human Onsite	Human Offsite	Ecological Onsite	Ecological Offsite
Soil – Ingestion	A	-	-	-
Soil – Dermal Contact	A	-	-	-
Sediment – Ingestion	-	-	-	+
Sediment – Dermal Contact	-	-	-	+
Groundwater – Inhalation	+	-	-	-
Groundwater – Ingestion	A	-	-	-
Groundwater – Dermal Contact	A	-	-	-
Surface Water – Ingestion	-	+	-	+
Surface Water – Dermal Contact	-	+	-	+
Soil Gas/Vapor Intrusion – Inhalation	+	-	-	-
Wind – Inhalation	A	-	-	-
Plants – Inhalation	-	-	-	-

+ Potentially Complete Pathway

- Incomplete Pathway

A Pathway Potentially Complete when digging in soil or groundwater

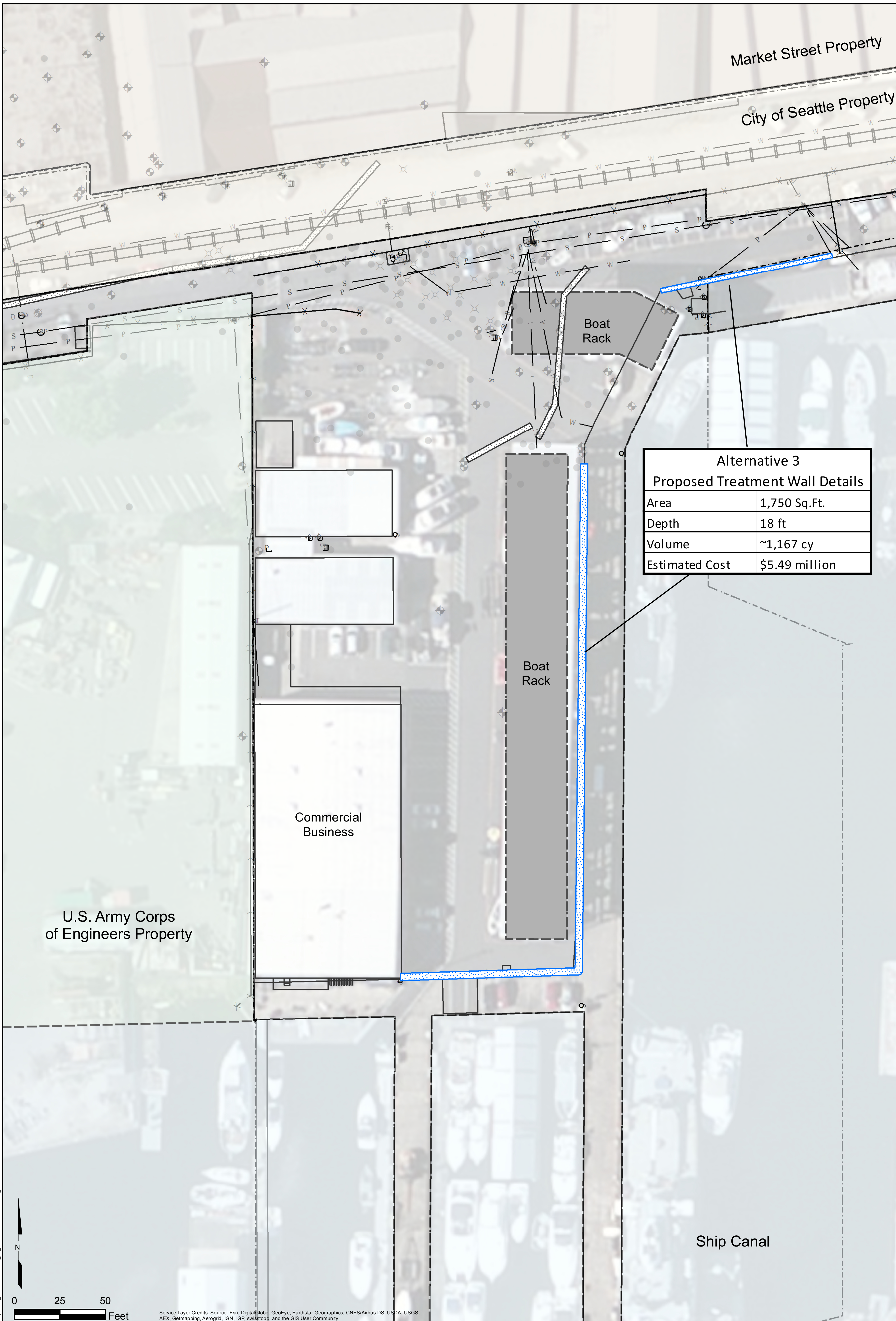
HARTCROWSER

17800-56 4/15

Conceptual Site Model

Jacobson Terminals
Seattle, Washington

Figure 17



Alternative 3 Proposed Treatment Wall Details	
Area	1,750 Sq.Ft.
Depth	18 ft
Volume	~1,167 cy
Estimated Cost	$5.49 million

Proposed Treatment Wall

Fence Line
Property Boundary
U Utility Line
W Water Line
S Sanitary Sewer Line
P Overhead Power
Historical Soil Boring
Historical Sediment Sample
Injection Well
Existing Monitoring Wells

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

Jacobson Terminals
Seattle, Washington

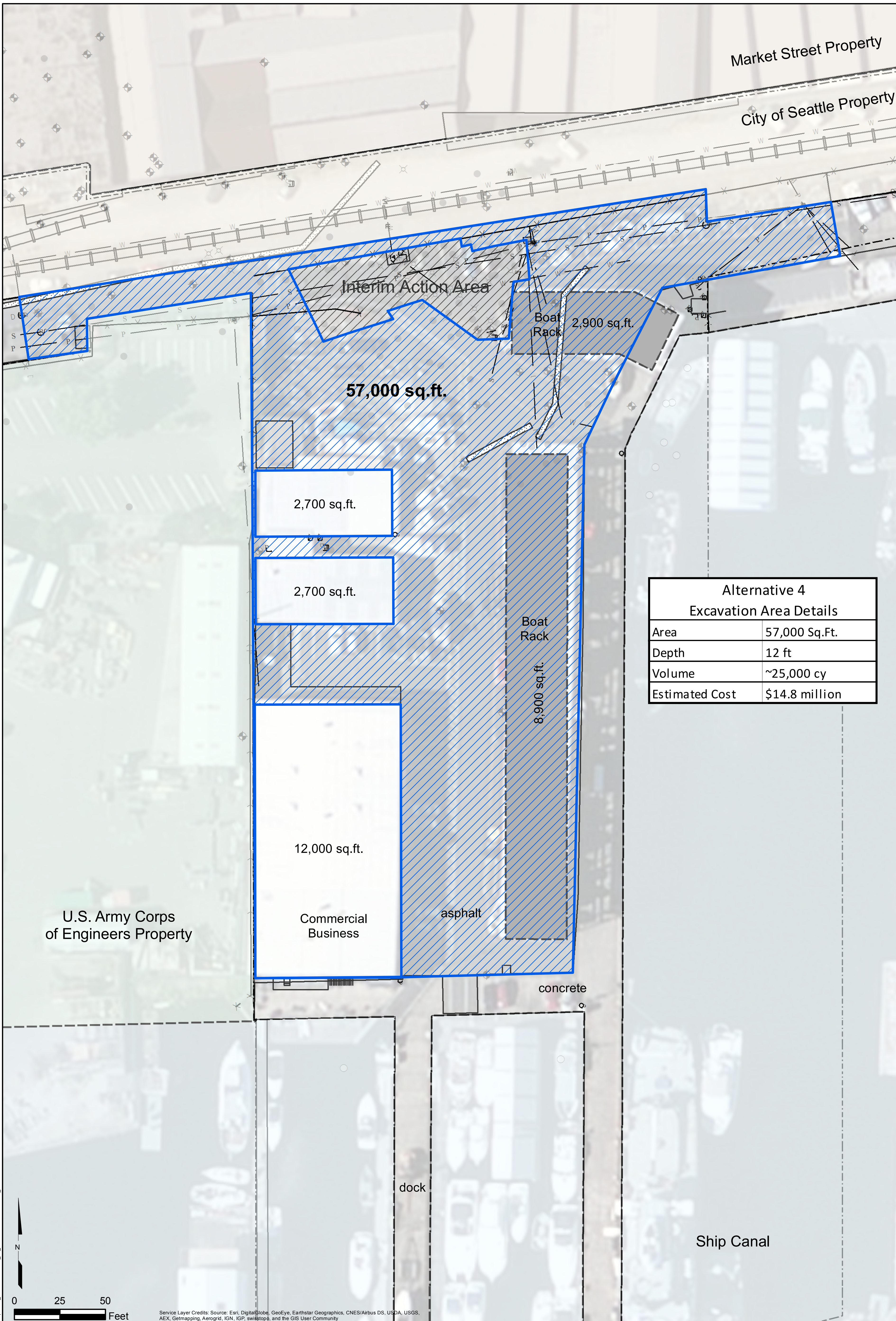
Alternative 3 – Treatment Wall Area

17800-56 4/15

HARTCROWSER

Figure
18

L:\Notebooks\1780056_Jacobson Terminal Property RI-FS\GIS\Documents\Updates_032015\1780056_18_RemediationAlternative3_P.mxd



Site-Wide Excavation (57,387 sq.ft.)

Site-wide excavation area was calculated using the total area minus the interim action area, 3 structures, and half the area of the boat storage areas.

Notes:
1. Base map prepared from AutoCAD file 020030-02.dwg by Aspect Consulting, 10/08/13.
2. Utility locations are approximate.

- Fence Line
- Property Boundary
- Utility Line
- Water Line
- Sanitary Sewer Line
- Overhead Power
- Historical Soil Boring
- Historical Sediment Sample
- Injection Well
- Existing Monitoring Wells

Jacobson Terminals
Seattle, Washington

Alternative 4 – Site-Wide Excavation Area

17800-56 4/15

HARTCROWSER

Figure **19**

L:\Notebooks\1780056_Jacobson Terminal Property RI-FS\GIS\Documents\Updates_032015\1780056_19_RemediationAlternative4_P.mxd

APPENDIX A
Field Exploration Methods and Analysis with Boring and Monitoring Well Logs

APPENDIX A
FIELD EXPLORATION METHODS AND ANALYSIS WITH BORING AND MONITORING WELL LOGS

This appendix documents the processes Hart Crowser used to determine the environmental quality of the soil, sediment, and groundwater underlying the project Site. The sections are:

- Explorations and Their Location;
- Direct Push Probes;
- Hollow-Stem Auger Borings;
- Soil Sampling Procedures;
- Soil Screening and Analysis;
- Monitoring Well Installation;
- Groundwater Sampling;
- Sediment Sampling Procedures;
- Sediment Screening and Analysis;
- Sample Handling and Laboratory Analysis; and
- Investigation-Derived Waste Storage and Disposal.

Explorations and Their Location

Subsurface explorations for this project included push-probe soil borings and hollow-stem auger borings completed as monitoring wells. Surface sediment samples were collected from the waterway adjacent to the Jacobson Terminals Site. Groundwater samples were collected from newly installed and existing monitoring wells on the Site. Exploration logs in this appendix show our interpretation of the sampling and testing data. The logs indicate the depth at which the physical characteristics of soils and sediment change; however, the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods on Figure A-1 – Key to Exploration Logs. This figure's legend explains the symbols and abbreviations used in the logs.

Figure 2 shows where the explorations were located.

Hollow-Stem Auger Borings

Hollow-stem auger borings (JT-MW-01S, JT-MW-02S, JT-MW-03D, JT-MW-04D, JT-MW-05S, JT-MW-06D, JT-MW-07S, and JT-MW-08S) were drilled between December 12 and December 16, 2014, to a depth of 20 to 31.5 feet bgs. Holt Services, Inc., of Puyallup, Washington, completed the auger explorations using a truck-mounted drill rig. A representative from Hart Crowser continuously observed the drilling and collected soil samples. Soil samples were generally collected at 5-foot intervals from a clean stainless steel split-spoon sampler. Samples were classified in general accordance with ASTM D2488 and were screened for potential soil contamination. Detailed soil logs were prepared for each boring location. The soil logs are presented on Figures A-2 and A-9 at the end of this appendix.

Direct Push Probes

Push probes JT-US-39 through JT-US-57 were advanced to depths of 9 to 20 feet bgs between December 8 and December 10, 2014. Holt Services, Inc., of Puyallup, Washington, completed the push-probe explorations using a limited-access 2-inch-diameter Geoprobe® rig. A representative from Hart Crowser continuously observed the drilling and collected soil samples. Soil samples were collected using an acetate-lined plastic sleeve sampler pushed by the drill rig. Soil samples were generally collected in continuous 5-foot depth intervals. Samples were classified in general accordance with ASTM D2488 and were screened for potential soil contamination. Detailed soil logs were prepared for each boring location. The soil logs are presented on Figures A-10 through A-28 at the end of this appendix.

Soil Sampling Procedures

Soil samples were collected for chemical analysis directly from the split-spoon sampler/push probe with a clean stainless steel spoon and/or clean disposable nitrile gloves and placed in pre-cleaned, laboratory-supplied glass sample jars and 40-milliliter (ml) volatile organics analysis (VOA) bottles. Sufficient soil was removed to overfill the glass sample jars. VOA bottles were filled with a 5-gram soil plug according to Environmental Protection Agency (EPA) Method 5035 procedures. The jars were sealed and labeled. Filled sample jars were stored in an ice-chilled cooler and submitted to the analytical laboratory under chain-of-custody protocols.

Soil Screening and Analysis

Field screening results were used as a general guideline to identify potential chemical constituents in soil samples. In addition, field screening results were used as a basis for selecting soil samples for chemical analysis.

Soil samples were continuously field screened for evidence of historical impacts using (1) field observations, (2) sheen screening, and (3) headspace vapor screening using a MultiRAE photoionization detector (PID). The effectiveness of field screening varies with temperature, moisture content, organic content, soil type, and age of the constituents. Visual examination consists of inspecting the soil for evidence of discoloration, staining, and/or abnormal components. Visual screening is generally more effective when impacts are related to heavy petroleum hydrocarbons, such as motor or hydraulic oil, or when hydrocarbon concentrations are high.

We tested water sheen by placing a small volume of soil in a pan of water and observing the water surface for signs of sheen. Sheens were classified as follows:

No sheen (NS)	No visible sheen on water surface.
Slight sheen (SS)	Light colorless film, spotty to globular; spread is irregular, not rapid; areas of no sheen remain; film dissipates rapidly.

Moderate sheen (MS)	Light to heavy film, may have some color or iridescence; globular to stringy; spread is irregular to flowing; few remaining areas of no sheen on water surface.
Heavy sheen (HS)	Heavy colorful film with iridescence; stringy; spread is rapid; sheen flows off the sample; most of the water surface may be covered with sheen.

Headspace vapor screening is intended to indicate the presence of volatile organic vapors; it involves placing a soil sample in a plastic sample bag. Air is captured in the bag and the bag is shaken to expose the soil to the air trapped in the bag. The PID probe is then inserted in the bag and the instrument measures the concentration of organic vapors in the sample headspace. The highest vapor reading for each sample is then recorded on the boring log. The PID measures concentrations in parts per million (ppm), is calibrated to isobutylene, and can typically quantify organic vapor concentrations in the range of 0 to 1,000 ppm.

All field screening observations were recorded on the boring logs, and this information was used to select which samples to submit for chemical analysis. In general, samples with the highest readings were selected for analysis.

Monitoring Well Installation

Holt Services, Inc., installed eight monitoring wells to allow for long-term groundwater level and quality monitoring. The monitoring wells were installed between December 12 and December 16, 2014, in accordance with Washington State Department of Ecology regulations.

Schedule 40 PVC riser pipe 2 inches in diameter and 0.020-inch machine-slotted screen 2 inches in diameter were used for the well casings and screens. The well screen and casing riser were lowered down through the hollow-stem auger/casing/open hole. As the auger/casing was withdrawn, No. 10/20 silica sand was placed in the annular space from the base of the boring to approximately 2 to 3 feet above the top of the well screen. Well seals were constructed by placing bentonite chips and/or grout in the annular space on the top of the sand to within 1 foot of ground surface. The remaining annular space was backfilled with concrete to complete the surface seal. The wells were completed with flush-mounted monuments, and equipped with locking well caps for security. The monitoring well construction details are illustrated on the boring logs on Figures A-2 and A-9.

Well Development

Monitoring Wells JT-MW-01S, JT-MW-02S, JT-MW-03D, JT-MW-04D, JT-MW-05S, JT-MW-06D, JT-MW-07S, and JT-MW-08S were developed on December 18, 2014. All wells were developed using a stainless steel bailer and portable pump with disposable tubing. Each well was developed until approximately 10 casing volumes were removed or the water cleared.

Groundwater Sampling

The following monitoring wells were sampled on the following dates:

- JT-5, JT-6, JT-10, JT-12, SRW-1, and SRW-2 on November 25, 2014;
- JT-4, JT-11, MW-100, and SRW-3 on December 5, 2014;
- JT-3, JT-7, JT-9, and MW-200 on November 26, 2014;
- HC-MW-1, IW-5D, JT-MW-01S, JT-MW-04D, JT-MW-05S, JT-MW-06D, JT-MW-08S, and MW-4 on December 23, 2014; and
- HC-MW-2, HC-MW-3, IW-5S, JT-MW-02S, and JT-MW-03D on December 24, 2014.

One duplicate sample was collected for analysis of each COC; a duplicate sample was not collected for conventional analysis.

Groundwater Sampling Procedures

Upon arrival at the wellhead, field personnel recorded conditions, depth to water, depth to product (if applicable), and depth to sediment in the wells using a Solinst or equivalent interface probe. If the well was pumped dry or product was present at a thickness greater than 0.05 foot, that well was not purged or sampled.

Wells were purged and sampled using a peristaltic pump and low-flow groundwater sampling techniques approximately 2 feet below the top of the water table. An In-Situ 9500 flow-through cell was used to monitor groundwater field parameters including pH, specific conductivity, oxidation-reduction potential (ORP), dissolved oxygen, turbidity, and temperature. Groundwater samples were collected once the field parameters of pH, specific conductivity, and temperature were stabilized. The water samples were collected directly from the polyethylene tubing into the pre-cleaned containers provided by the analytical laboratory. The containers were sealed, labeled, and stored in an ice-chilled cooler and submitted to the chemistry laboratory under chain-of-custody protocols.

To prevent cross-contamination of the wells, disposable polyethylene tubing was used for each groundwater sample and the interface probe was decontaminated between well locations using a non-phosphate-based cleaner and de-ionized water.

Sediment Sampling Procedures

Sediment samples were collected adjacent to the Site dock using boat-mounted pneumatic power surface grab sediment sampling equipment. Five surface sediment samples (JT-SS-06, JT-SS-07, JT-SS-08, JT-SS-09, and JT-SS-10) were collected to depths between 0 and 10 centimeters below mudline using sediment grab sampling equipment. The sediment samples were analyzed for volatiles (including dichlorobenzenes and 1,2,4-trichlorobenzene), polychlorinated biphenyls (PCBs), total metals, total organic content (TOC), ammonia by EPA Method 350.3, and total sulfides using Puget Sound Estuary Program (PSEP) protocols (PSEP 1986). Sediment was also collected at three of the locations (JT-SS-06, JT-SS-08, and JT-SS-10) for bioassay analysis.

Positioning Methods

A differential global positioning system (DGPS) was used aboard the sampling vessel for location positioning. Navigation systems were used to provide a target horizontal accuracy of 3 meters in accordance with Ecology's sediment sampling and analysis plan and PSEP protocols. The DGPS receiver was placed above the block on the sampling device deployment boom to accurately record the sampling location position. Horizontal coordinates are referenced to NAD83 State Plane North northings and eastings, and decimal minutes of latitude and longitude.

Water depths were measured directly by lead line and converted to mudline elevations.

Van Veen Sample Collection Method

A 0.1-square-meter grab sampler was used to collect large-volume surface sediment samples (approximately 1 to 2 gallons from the top 10 centimeters). During sampling, the Van Veen sampler was lowered to the sediment surface and closed using a pneumatic cylinder ram.

Sample Handling and Laboratory Analysis

At the time of collection, samples were placed in an ice-chilled cooler and submitted to the laboratory using chain-of-custody protocols. Soil, groundwater, and sediment samples were submitted to Analytical Resources, Inc., (ARI) of Tukwila, Washington, for chemical analysis. Sediment samples for bioassay analysis were sent to Northwestern Aquatic Sciences of Newport, Oregon.

Duplicate samples were collected and submitted to the laboratory to assess combined field and laboratory variability. The samples were assigned the same exploration label with two zeroes at the end of the number.

Investigation-Derived Waste Storage and Disposal

Soil cuttings and purge water generated during exploration activities and groundwater sampling were placed in separate labeled drums and left on site, pending receipt of chemical analysis results from the laboratory and determination of appropriate disposal procedures.

Table A-1 – Sediment Sample Descriptions

Location ID	Collection Method	Collection Date	Collection Depth	Depth to Sediment	Material Description
JT-SS-06	Van Veen	1/12/2015	13 cm	12 ft	(Very soft), brown, slightly sandy SILT, with wood debris, surface sheen, slight petroleum-like odor
JT-SS-07	Van Veen	1/12/2015	13 cm	18.1 ft	(Very soft), brown, organic SILT, becoming silty SAND with trash debris
JT-SS-08	Van Veen	1/12/2015	8 cm	14.7 ft	(Very soft), brown, organic SILT over slightly silty SAND with trash debris, slight sheen and petroleum-like odor
JT-SS-09	Van Veen	1/12/2015	15 cm	16.2 ft	(Very soft), brown, organic SILT with scattered debris, one mussel, and slight sheen and petroleum-like odor
JT-SS-10	Van Veen	1/12/2015	13 cm	17.5 ft	(Very soft), brown, organic SILT, becoming sandy, organic SILT with scattered debris, and slight sheen and slight petroleum-like odor

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

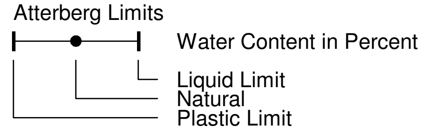
Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits



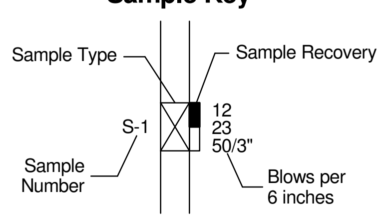
PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF
OT	Tests by Others

Groundwater Indicators

Groundwater Level on Date or (ATD) At Time of Drilling

Groundwater Seepage (Test Pits)

Sample Key



HARTCROWSER

17800-56 12/14

Figure A-1

Boring Log JT-MW-01S

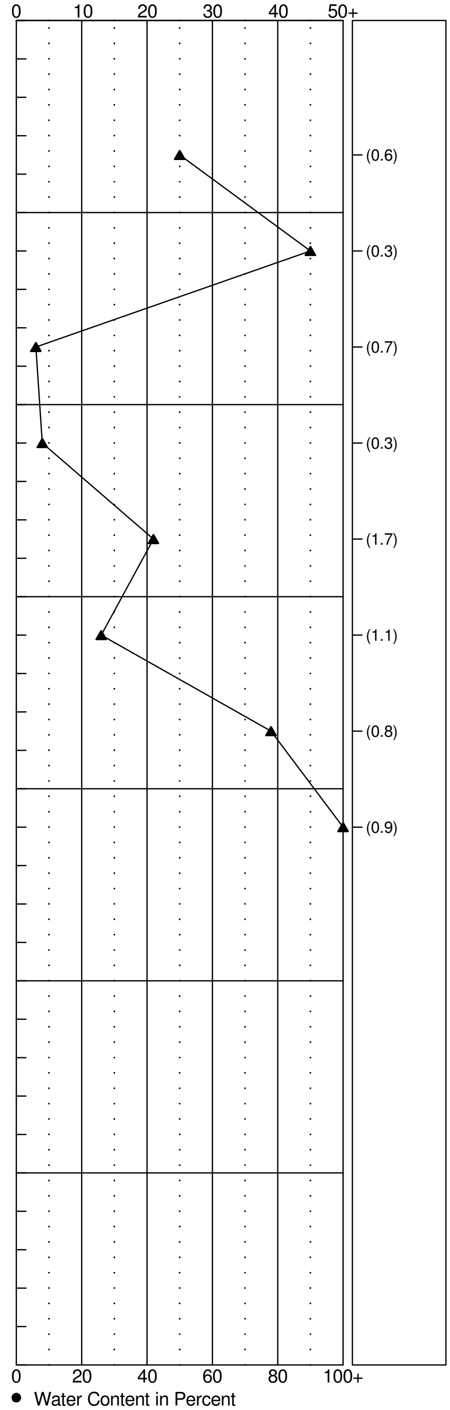
Location: Lat: 47.667503 Long: -122.393837
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet
SM	3 inches of Asphalt over damp, gray-brown, silty SAND with gravel.	0
ML	(Stiff), damp, gray, sandy SILT with gravel.	
	(Very stiff), moist, gray, slightly sandy SILT with gravel.	5
SM	(Very loose), wet, gray SILT over very silty SAND to very sandy SILT.	
ML	(Very soft), wet, brown, slightly sandy SILT.	
	(Very soft), very wet, slightly sandy SILT.	10
SP	(Loose), very wet, gray-brown SAND with gravel.	
	Wood, woody debris, fragments.	
	Becomes gray SAND.	15
	1-inch SILT pocket.	
	Becomes fine SAND.	
	(Dense), very wet, gray-brown SAND.	20
	Bottom of Boring at 21.5 Feet. Started 12/16/14. Completed 12/16/14. Ecology Well Tag #BIK-444	25

Well Construction: Flush mount monument; Concrete; Bentonite chips; 10-20 Silica sand; Screened 2" PVC

Sample	Blows	Lab Tests & (PID)
	11, 11, 14	(0.6)
S-1	18, 26, 19	(0.3)
S-2	3, 1, 2	(0.7)
	2, 2, 2	(0.3)
S-3	9, 9, 12	(1.7)
	4, 8, 5	(1.1)
S-4	11, 19, 20	(0.8)
S-5	24, 37, 30	(0.9)



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

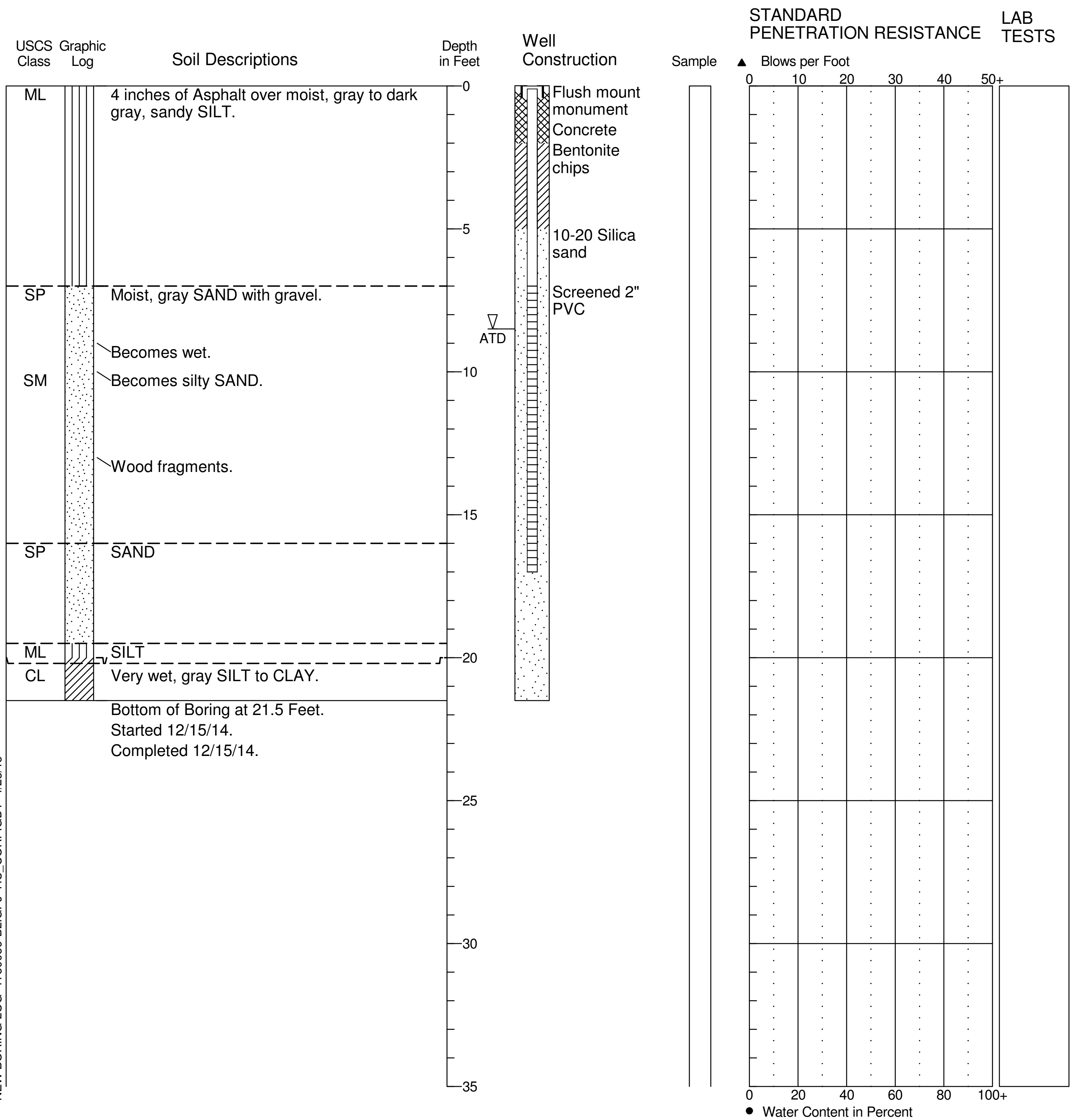
17800-56 *12/14*

Figure A-2

Boring Log JT-MW-02S

Location: Lat: 47.667633 Long: -122.393716
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin Reviewed By: M. Pagel



USCS Class	Soil Descriptions
ML	4 inches of Asphalt over moist, gray to dark gray, sandy SILT.
SP	Moist, gray SAND with gravel.
	Becomes wet.
SM	Becomes silty SAND.
	Wood fragments.
SP	SAND
ML	SILT
CL	Very wet, gray SILT to CLAY.

Bottom of Boring at 21.5 Feet.
Started 12/15/14.
Completed 12/15/14.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

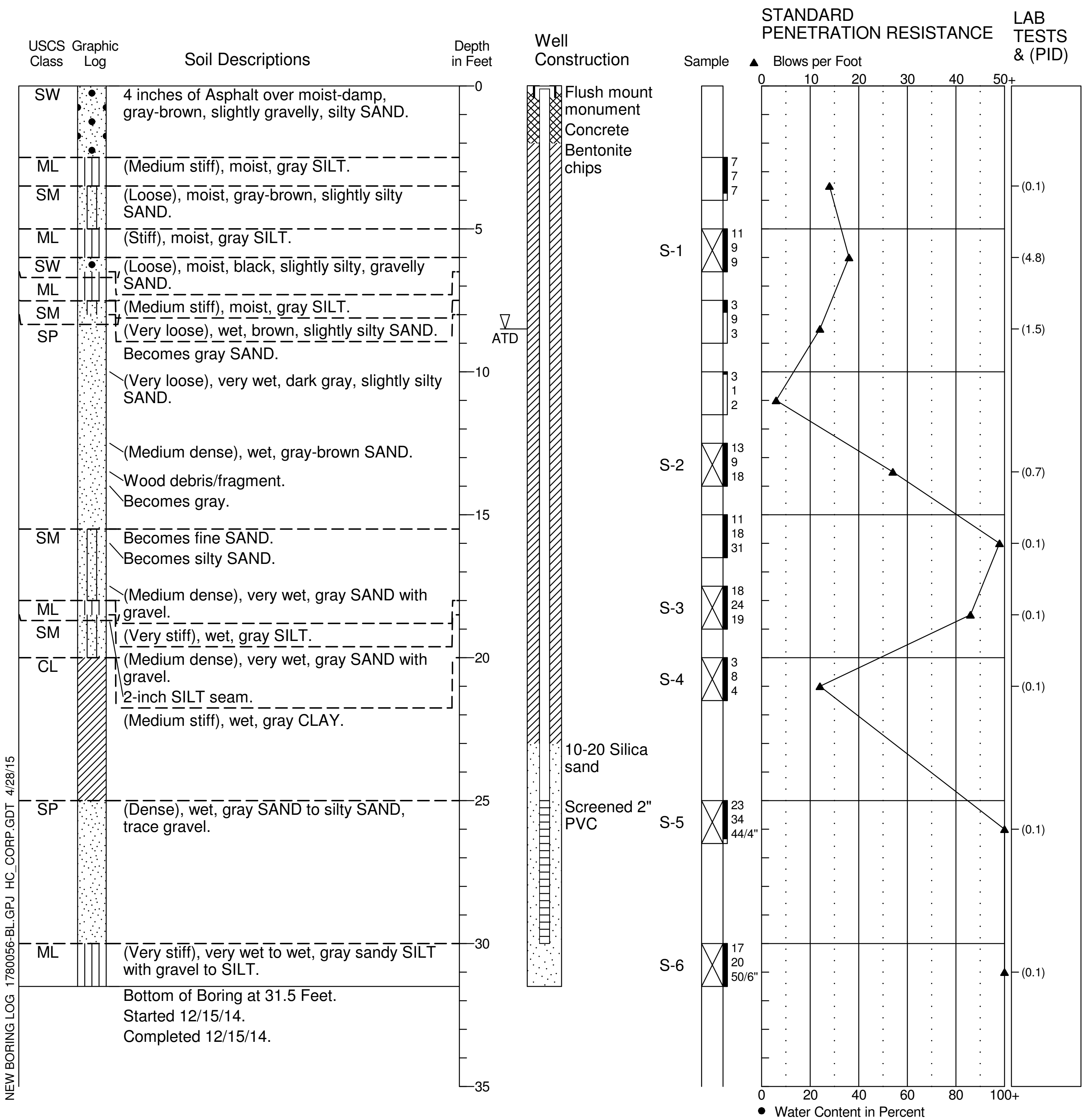
17800-56 *12/14*

Figure A-3

Boring Log JT-MW-03D

Location: Lat: 47.667608 Long: -122.393777
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin   Reviewed By: M. Pagel



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

17800-56 *12/14*

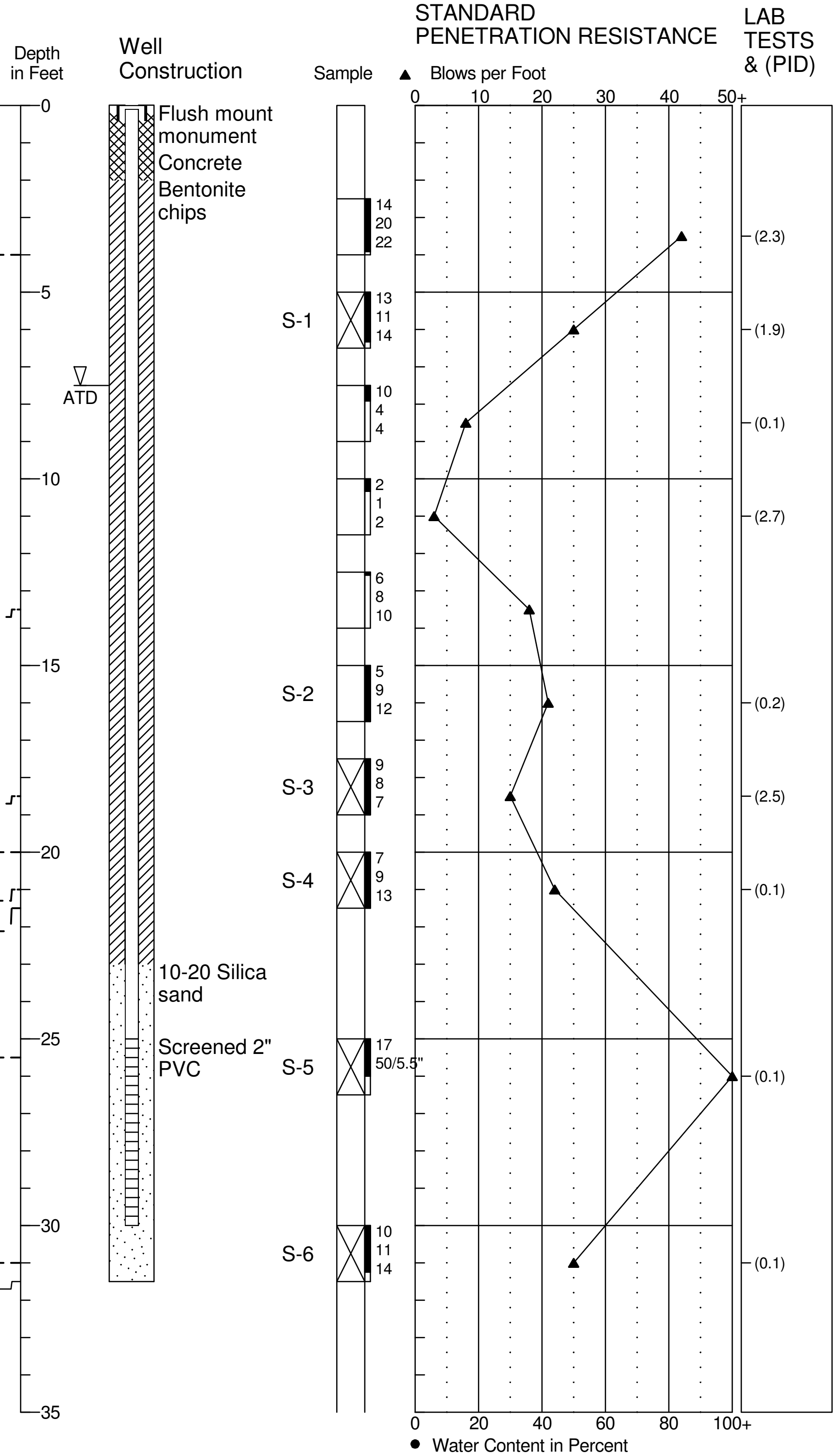
Figure A-4

Boring Log JT-MW-04D

Location: Lat: 47.667517 Long: -122.393986
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions
SM	3 inches of Asphalt over (medium dense), damp, gray-brown, slightly silty, gravelly SAND.
	Wood debris/fragments.
	Damp, gray SAND.
ML	(Stiff), damp-moist, gray SILT.
	Becomes gray-brown.
	Becomes moist to wet, sandy SILT with gravel.
	(Soft), wet, brown SAND (sluff) over wet, gray-brown SILT.
	(Soft), wet, gray-brown, sandy SILT with wood debris/fragments, pulp.
	Wood fragments, pulp.
SP	(Loose), very wet, gray-brown SAND with silt.
	(Medium dense), very wet, gray-brown SAND with 2 inches of wood debris/fragments.
	Becomes (loose), fine SAND.
ML	(Medium stiff), wet, gray SILT.
SP	(Loose), very wet, gray-brown, slightly silty SAND.
ML	(Stiff), wet, gray SILT.
SP	(Medium dense), wet, gray SAND.
SM	Becomes (medium dense), silty SAND, trace gravel.
	(Medium dense), very wet, gray, silty SAND.
ML	(Stiff), very wet, gray, slightly sandy SILT.
	Bottom of Boring at 31.5 Feet.
	Started 12/16/14.
	Completed 12/16/14.
	Ecology Well Tag #BIK-443



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

17800-56 *12/14*

Figure A-5

Boring Log JT-MW-05S

Location: Lat: 47.667370 Long: -122.394168
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet
GP	3 inches of Asphalt over damp, brown to dark brown-gray, slightly sandy, silty GRAVEL.	0
SP	Moist, gray, slightly gravelly SAND.	5
	Wood debris/fragments.	10
SM	Wet, gray, slightly silty SAND with wood debris/fragments.	
	Becomes gravelly.	20
ML	Wet, gray SILT.	
CL	Wet, gray CLAY.	
SP	Wet, gray SAND.	
	End wood debris.	
	Trace gravel.	25
	Bottom of Boring at 30.0 Feet. Started 12/15/14. Completed 12/15/14.	30

Well Construction: Flush mount monument; Concrete; Bentonite chips; 10-20 Silica sand; Screened 2" PVC; ATD

Sample

STANDARD PENETRATION RESISTANCE
▲ Blows per Foot: 0, 10, 20, 30, 40, 50+
● Water Content in Percent: 0, 20, 40, 60, 80, 100+

LAB TESTS

NEW BORING LOG 1780056-BL.GPJ HC_CORP.GDT 4/28/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

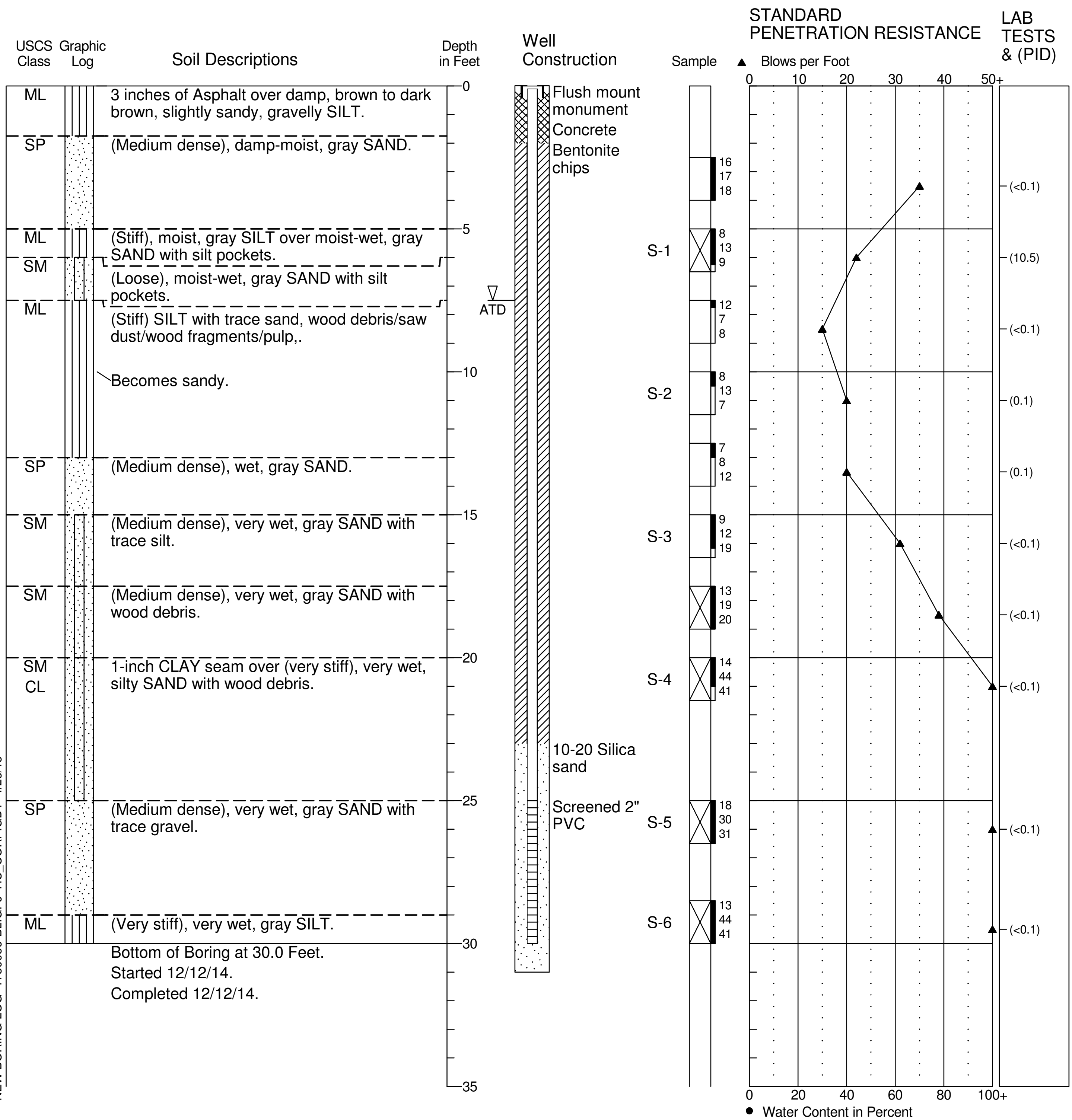
17800-56 *12/14*

Figure A-6

Boring Log JT-MW-06D

Location: Lat: 47.667378 Long: -122.394167
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin   Reviewed By: M. Pagel



NEW BORING LOG 1780056-BL.GPJ HC_CORP.GDT 4/28/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

17800-56 *12/14*

Figure A-7

Boring Log JT-MW-07S

Location: Lat: 47.667001 Long: -122.394071
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

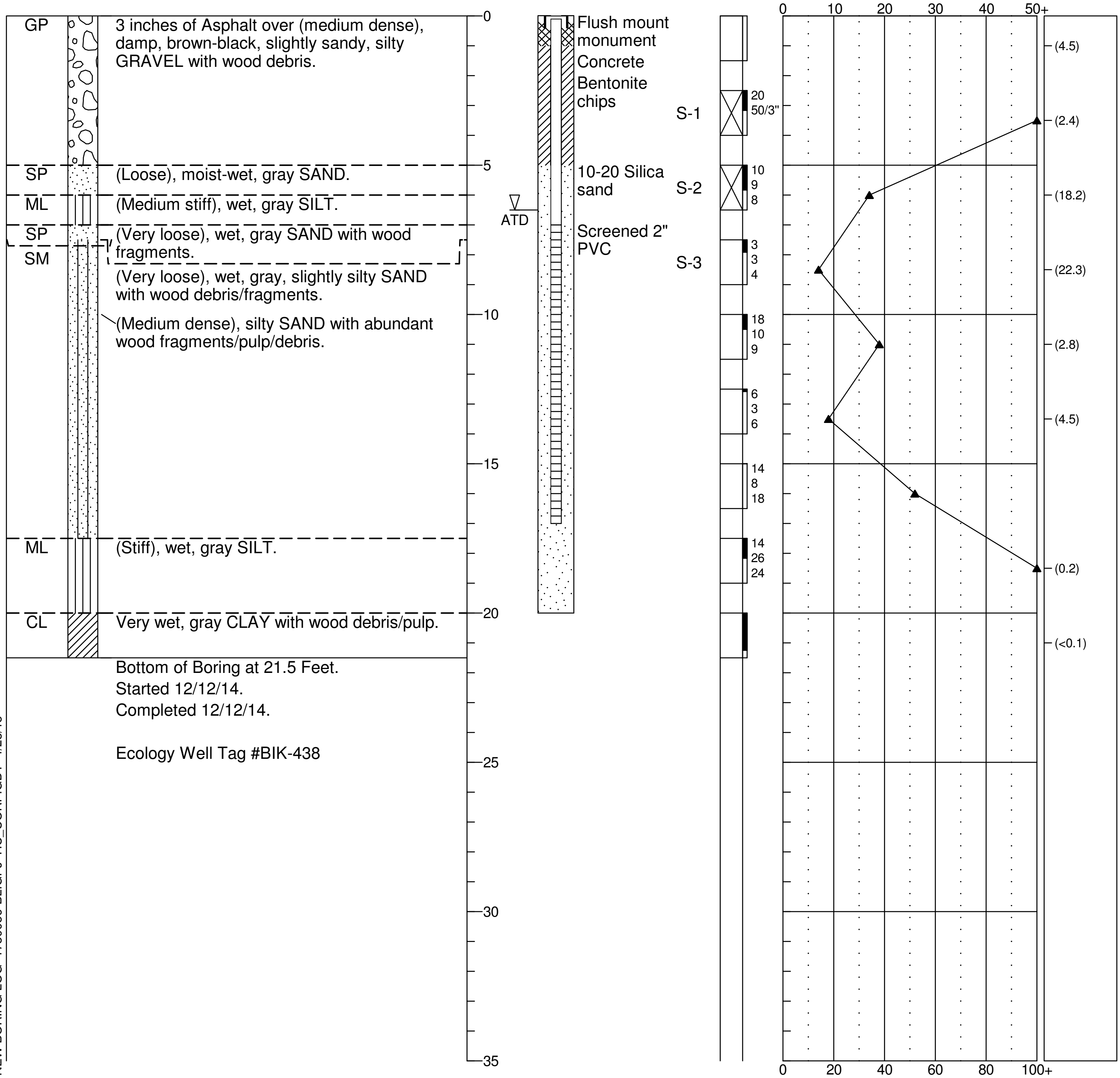
USCS Class	Soil Descriptions
GP	3 inches of Asphalt over (medium dense), damp, brown-black, slightly sandy, silty GRAVEL with wood debris.
SP	(Loose), moist-wet, gray SAND.
ML	(Medium stiff), wet, gray SILT.
SP	(Very loose), wet, gray SAND with wood fragments.
SM	(Very loose), wet, gray, slightly silty SAND with wood debris/fragments.
	(Medium dense), silty SAND with abundant wood fragments/pulp/debris.
ML	(Stiff), wet, gray SILT.
CL	Very wet, gray CLAY with wood debris/pulp.

Bottom of Boring at 21.5 Feet.
Started 12/12/14.
Completed 12/12/14.

Ecology Well Tag #BIK-438

Well Construction: Flush mount monument; Concrete; Bentonite chips; 10-20 Silica sand; Screened 2" PVC. ATD

Sample	Blows
S-1	20, 50/3"
S-2	10, 9, 8
S-3	3, 3, 4
	18, 10, 9
	6, 3, 6
	14, 8, 18
	14, 26, 24



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

17800-56   12/14

Figure A-8

Boring Log JT-MW-08S

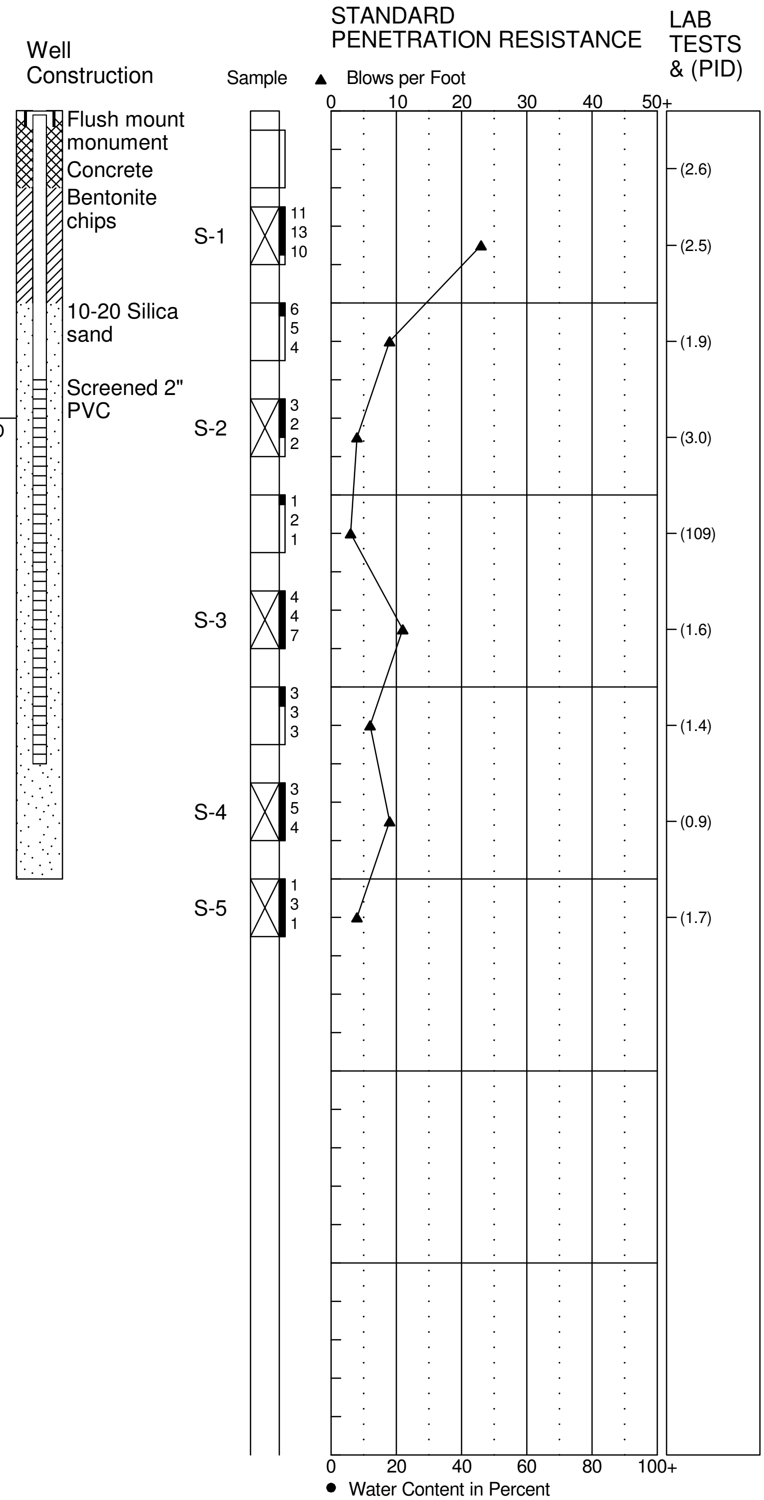
Location: Lat: 47.666606 Long: -122.394094
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: HSA (B-59)
Hammer Type: SPT
Hole Diameter: 6 inches
Logged By: M. Smith   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet
SM	6 inches of Asphalt over damp, brown-black, silty, gravelly SAND, trace wood.	0
	(Medium dense), brown-black, silty, gravelly SAND with wood fragments.	
	(Loose), black, silty SAND.	5
	(Very loose), black, silty SAND, trace gravel.	
ML	(Very soft), black, sandy SILT.	10
SM	(Loose), gray, silty SAND, trace gravel, trace wood fragments.	
	(Very loose), gray, silty SAND, trace gravel, trace wood fragments.	15
	(Loose), gray, slightly silty SAND, trace wood fragments.	
		20

Bottom of Boring at 20.0 Feet.
Started 12/16/14.
Completed 12/16/14.

Ecology Well Tag #BIK-437



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

17800-56 *12/14*

Figure A-9

Push Probe Log JT-US-39

Location: Lat: 47.667114 Long: -122.394547
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
ML	4 inches of Concrete over damp, gray-brown, sandy SILT.	0	S-1	(>300) Petroleum-like odor, MS
SM	Moist, gray, slightly silty SAND, concrete debris.	5 ∇ ATD		(20.6) Very slight odor, NS
SP	Wet, gray SAND.	10		(17.3) Very slight odor, NS
OL PT	3 inches of brown, organic PEAT/SILT with wood debris.			
ML	Wet, gray SILT with wood debris.		S-2	(4.3) No odor, NS
SP	Very wet, gray SAND. Becomes fine SAND.	15		
ML	Very wet, brown-gray, sandy SILT with wood fragments, organic material.		S-3	(3.1) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.	20		
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56   12/14

Figure A-10

Push Probe Log JT-US-40

Location: Lat: 47.667241 Long: -122.394460
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: M. Smith Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet
SM	8 inches of Concrete over damp, gray, silty SAND, trace gravel.	0
	Damp-moist, silty SAND, trace gravel.	
		5 ∇ ATD
	Abundant wood fragments.	
	Wet, gray, silty SAND, trace gravel.	
		10
	Abundant wood fragments.	
	Wet, gray to light brown, silty SAND, trace gravel, wood fragments, roots.	
		15
	Wet, gray, silty SAND.	
	Wet, brown-gray, silty SAND, trace gravel.	
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.	20
		25

Sample	LAB TESTS & (PID)
	(1.3)
S-1	
	(0.3)
S-2	(0.3)
S-3	No odor, NS
	(0.2)
	(0.3)
	(0.3)
	(0.2)
S-4	No odor, NS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-11

Push Probe Log JT-US-41

Location: Lat: 47.667406 Long: -122.394496
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
GP	2 inches of Asphalt over damp, gray-brown, slightly sandy, silty GRAVEL with wood fragments/debris.	0		(0.4) No odor, NS
	2-inch SAND seam.		S-1	
ML	Moist, gray SILT.			
SM	Moist-wet, gray, slightly gravelly, silty SAND.			(68.9) Petroleum-like odor, MS
		5 ∇ ATD		
			S-2	
	Wet, gray-black, silty, gravelly SAND with abundant wood fragments.			(2.3) Petroleum-like odor, MS
	Bottom of Probe at 9.0 Feet. Started 12/09/14. Completed 12/09/14.			
		10		
		15		
		20		
		25		

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-12

Push Probe Log JT-US-42

Location: Lat: 47.667417 Long: -122.394401
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
ML	2 inches of Asphalt over damp, gray-brown, sandy SILT.	0		
	Red staining.			(<0.1) No odor, NS
SP	Damp-moist, gray SAND		S-1	
ML	Moist, gray SILT.	5		
	Becomes wet, brown SILT.			
	Becomes gray.	∇ ATD	S-2	(0.1) No odor, NS
	1-inch SAND seam.			
SM	Brown, silty SAND with wood fragments/debris, organic material.			
ML	Very wet, gray, slightly sandy SILT with organic material, wood debris.	10		(0.2) No odor, NS
	Becomes gray-brown.			
SP	Very wet, gray SAND.		S-3	(1.0) No odor, NS
		15		
	Becomes fine SAND.			
ML	Wet to very wet, gray SILT.			
CL	1-inch CLAY seam.		S-4	(0.2) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.	20		
		25		

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

Push Probe Log JT-US-43

Location: Lat: 47.667359 Long: -122.394420
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Sample	LAB TESTS & (PID)
ML	2 inches of Asphalt over damp, brown-gray-blue, sandy SILT.		
	Becomes gray.		
	3-inch SAND seam.	S-1	(0.1) No odor, NS
	Becomes wet and gray-brown.	S-2	(0.1) No odor, NS
	Brown, organic, wood debris, sawdust.		
SP	Very wet, gray SAND.		
ML	Very wet, gray SILT.	S-3	(0.1) No odor, NS
CL	Very wet, gray CLAY.		
	Bottom of Probe at 20.0 Feet.		
	Started 12/09/14.		
	Completed 12/09/14.		

Depth in Feet: 0, 5, 10, 15, 20, 25

∇ ATD

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-14

Push Probe Log JT-US-44

Location: Lat: 47.667358 Long: -122.394068
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: M. Smith   Reviewed By: M. Pagel

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
SM		3 inches of Asphalt over damp, gray, silty SAND, trace gravel.	0
		Wood fragments.	
		Moist, wet, gray, silty, gravelly SAND, trace wood fragments.	5 ∇ ATD
		Abundant wood fragments.	
		Wet, brown-gray, silty SAND, trace gravel.	10
		Wood	
		Abundant wood fragments.	
		Wet, brown-gray, silty SAND, trace gravel.	15
		Bottom of Probe at 20.0 Feet. Started 12/08/14. Completed 12/08/14.	20
			25

Sample:
- S-1
- S-2
- S-3
- S-4

LAB TESTS & (PID):
- (48.7)
- (1.1)
- (0.8)

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-15

Push Probe Log JT-US-45

Location: Lat: 47.667487 Long: -122.393854
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: M. Smith   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
SM	3 inches of Asphalt over damp, gray, slightly gravelly, silty SAND.	0		
			S-1	(0.7)
	Moist, light brown-gray, slightly gravelly, silty SAND.	5		
	(Groundwater ATD)		S-2	(0.8)
	Wet, light brown-gray, silty SAND, trace gravel.	10		
	Wet, black, silty SAND, trace gravel, slight odor, sheen, wood fragments.		S-3	(1.7) Slight odor, MS
	Wet, gray to light brown, silty SAND, trace gravel.	15		
			S-4	(0.6)
	Bottom of Probe at 20.0 Feet. Started 12/08/14. Completed 12/08/14.	20		
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-16

Push Probe Log JT-US-46

Location: Lat: 47.667526 Long: -122.394249
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: M. Smith Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
SM	3 inches of Asphalt over damp-moist, gray, silty, gravelly SAND, trace plastic fragments.	0		
			S-1	(1.3)
		ATD (groundwater)		
	Wet, gray, silty SAND, trace gravel, trace plastic fragments.	5		
			S-2	(1.4)
	Abundant wood fragments.			
	Wet, gray to dark brown, silty, gravelly SAND, wood, plastic fragments.	10		
			S-3	(1.1)
	Wet, gray, silty SAND, trace gravel, trace plastic, wood fragments.	15		
			S-4	
	Bottom of Probe at 20.0 Feet. Started 12/08/14. Completed 12/08/14.	20		
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-17

Push Probe Log JT-US-47

Location: Lat: 47.667534 Long: -122.394359
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions
ML	3 inches of Asphalt over damp, brown, slightly sandy, slightly gravelly SILT. Wood debris.
SP	Damp, gray SAND with trace gravel, rubbish (plastic).
SM	Becomes silty SAND. WOOD (sawdust, dark brown wood debris).
ML	Wet, dark brown, sandy SILT with organic material.
SP	Very wet, gray SAND.
CL	Very wet, gray CLAY.
SP	Very wet, gray SAND.

Bottom of Probe at 20.0 Feet.
Started 12/08/14.
Completed 12/08/14.

Groundwater: ATD (between 5 and 10 feet)

Depth in Feet: 0, 5, 10, 15, 20, 25

Sample	LAB TESTS & (PID)
	(0.6) No odor, NS
S-1	
S-2	(1.3)
S-3	(0.6) No odor, NS
S-4	(0.2) No odor, NS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-18

Push Probe Log JT-US-48

Location: Lat: 47.667542 Long: -122.394445
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions
ML	3 inches of Asphalt over damp, gray-brown, slightly sandy, gravelly SILT.
	Becomes gray SILT.
SP	Moist, gray SAND.
ML	Moist, gray SILT.
SP	Becomes sandy, gravelly SAND.
	Wood debris.
ML OL	Organic material, dark brown SILT with trace sand.
GP	Very wet, sandy GRAVEL.
SM	Very wet, brown, silty SAND.
SP	Becomes gray SAND.
ML	Wet, gray SILT.
SP	Very wet, gray SAND.
ML	Very wet, gray SILT.
CL SP	3-inch CLAY seam. Very wet, gray SAND.
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.

Depth in Feet: 0, 5, 10, 15, 20, 25

Groundwater: ∇ ATD

Sample	LAB TESTS & (PID)
S-1	(1.6) No odor, NS
S-2	(1.8) No odor, NS
S-3	(2.0) No odor, NS
S-4	(7.6) No odor, NS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-19

Push Probe Log JT-US-49

Location: Lat: 47.667572 Long: -122.394544
Approximate Ground Surface Elevation: 25 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions
ML	3 inches of Asphalt over damp, brown-gray, slightly gravelly, sandy SILT. 8-inch layer of wood debris.
SP	Moist-wet, gray SAND.
ML	Wet, gray SILT.
SP	Very wet, gray SAND. Becomes gravelly.
GP	Very wet, sandy GRAVEL.
SM	Very wet, silty SAND.
ML	Wet, gray SILT.
CL	Very wet, gray CLAY.
ML	Very wet, gray SILT. Rock, ~2" diameter.
SP	Very wet, gray SAND.

Bottom of Probe at 20.0 Feet.
Started 12/09/14.
Completed 12/09/14.

Depth in Feet: 0, 5, 10, 15, 20, 25

Sample	LAB TESTS & (PID)
	(21.1) Petroleum-like odor
S-1	(1.2) No odor, NS
S-2	(2.4) No odor, SS
S-3	(1.8) No odor, NS

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

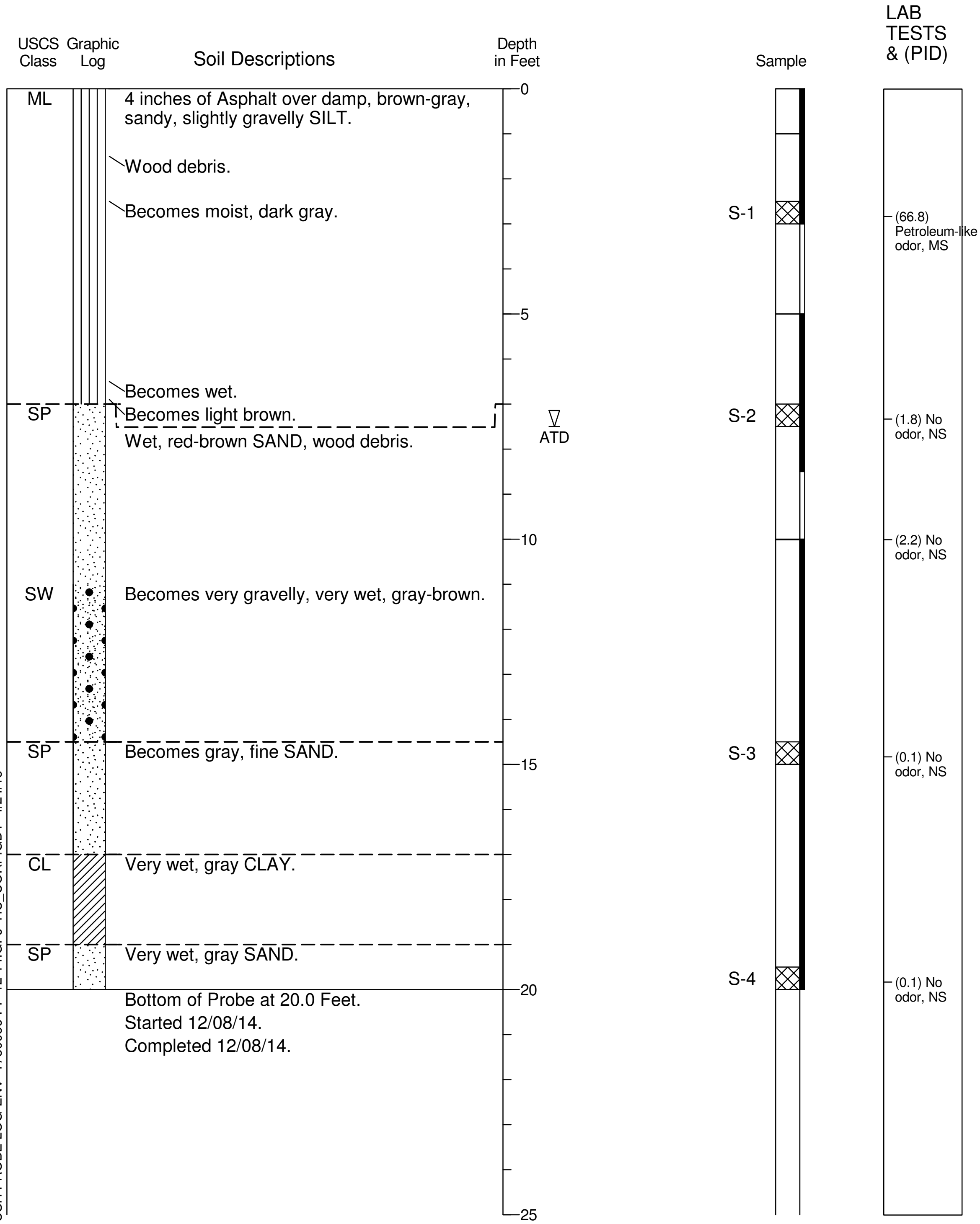
17800-56 *12/14*

Figure A-20

Push Probe Log JT-US-50

Location: Lat: 47.667713 Long: -122.394031
Approximate Ground Surface Elevation: 25 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel



PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-21

Push Probe Log JT-US-51

Location: Lat: 47.667717 Long: -122.393942
Approximate Ground Surface Elevation: 25 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
ML	3 inches of Asphalt over damp, brown, sandy, gravelly SILT.	0		
	Becomes dark gray-black.		S-1	(49.2) Solvent/petroleum-like odor, HS
ML	Moist, dark gray-black, sandy, gravelly SILT.	5		(1.0) Solvent/petroleum-like odor, HS
	Becomes gray.			
SP	Wet, light brown to red-brown SAND.	ATD	S-2	(0.9)
	Becomes silty with wood debris.			
		10		
	Becomes very wet, gray.			
SW	Trace gravel.			
			S-3	(2.3) Slight odor, NS
		15		
CL	Very wet, gray CLAY.			
ML	Very wet, gray SILT.		S-4	(0.1) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.	20		
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

Push Probe Log JT-US-52

Location: Lat: 47.667725 Long: -122.393406
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: M. Smith   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
SM	2 inches of Asphalt over damp, light brown to light gray, silty, gravelly SAND.	0		(0.2) No odor, NS
			S-1	
ML	1-inch SAND seams over damp, light brown, sandy SILT.			
SM	Moist, light gray to gray, slightly gravelly silty SAND.	5		(0.1) No odor, NS
		ATD (groundwater)		
	Moist, black, slightly gravelly, silty SAND.		S-2	
GP	Wet, gray, sandy GRAVEL, trace silt.	10		(0.3) No odor, NS
SM	Wet, light gray-brown, silty SAND, trace gravel.		S-3	
	Wet, light gray, silty SAND, trace gravel.	15		
			S-4	
	Bottom of Probe at 20.0 Feet. Started 12/08/14. Completed 12/08/14.	20		(0.1) No odor, NS
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-23

Push Probe Log JT-US-53

Location: Lat: 47.667600 Long: -122.395004
Approximate Ground Surface Elevation: 31 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
ML	3 inches of Asphalt over damp, gray-brown, sandy, gravelly SILT.	0		
SP	3-inch seam of damp, dark gray SILT. Moist, gray SAND. Charcoal fragment.		S-1	(121.5) Odor, SS
		5		(16.7) Diesel-like odor, MS
ML OL	Moist, gray to dark gray-brown SILT with organic material.			
SP	Moist, gray SAND. 2-inch black, silty SAND seam with sheen and diesel-like odor.		S-2	(>500) Solvent-like odor, NS
SM/ML	Wet, gray, very silty SAND to very sandy SILT.	▽ ATD		
SP	Very wet, gray, slightly gravelly, very silty SAND to very sandy SILT.	10		
SP	Very wet, gray SAND.		S-3	(18.7) No odor, NS
		15		
CL	Very wet, gray CLAY.		S-4	(0.9) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/08/14. Completed 12/08/14.	20		
		25		

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-24

Push Probe Log JT-US-54

Location: Lat: 47.667720 Long: -122.393868
Approximate Ground Surface Elevation: 25 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet
ML	3 inches of Asphalt over damp-moist, black-brown, sandy SILT with organic material (peat).	0
OL PT	Wood debris/fragments, organic material.	5
ML	Very wet, brown-gray, sandy SILT.	10
SP	Very wet, brown SAND.	
	3-inch gray SILT seam.	
	Very wet, brown-gray SAND.	15
CL	Very wet, gray CLAY.	
ML	(Very dense), very wet, gray SILT.	
	Bottom of Probe at 20.0 Feet. Started 12/09/14. Completed 12/09/14.	20
		25

Sample	LAB TESTS & (PID)
S-1	(0.2) No odor, NS
	(0.3) No odor, NS
S-2	(<0.1) No odor, NS
S-3	(0.1) No odor, NS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-25

Push Probe Log JT-US-55

Location: Lat: 47.667063 Long: -122.394543
Approximate Ground Surface Elevation: 24 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin   Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
GP	4 to 6 inches of Concrete over damp-moist, dark gray-brown, slightly sandy, silty GRAVEL with cobbles (2" diameter). Wood fragments.	0		(1.3) No odor, NS
PT	2 inches of black, organic PEAT.	5		
SP	Wet, gray sand.	ATD	S-1	(<0.1) No odor, NS
		10		
ML	Very wet, gray SILT. Becomes brown. Wood fragments/debris.		S-2	(<0.1) No odor, NS
SP	Very wet, gray SAND.	15		
SM	Wood debris. Becomes silty.			
ML	Wet, gray-brown SILT.		S-3	(<0.1) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/10/14. Completed 12/10/14.	20		
		25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-26

Push Probe Log JT-US-56

Location: Lat: 47.667403 Long: -122.394017
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions	Depth in Feet	Sample	LAB TESTS & (PID)
GP	3 inches of Asphalt over damp, gray-brown, sandy, silty GRAVEL.	0		
SP	Damp, gray SAND.		S-1	(0.1) No odor, NS
ML	Damp-moist, gray SILT.	5		
SP	Wet, gray SAND.			
	Rock		S-2	(0.3) No odor, NS
SM	Becomes silty.			
	Becomes very wet, gray-brown.	10		
			S-3	(0.6) No odor, SS
	Wood debris.			
SP	Becomes gray-brown SAND.	15		(0.4) No odor, NS
		20	S-4	(<0.1) No odor, NS
	Bottom of Probe at 20.0 Feet. Started 12/10/14. Completed 12/10/14.	25		

PUSH PROBE LOG-ENV 1780056-PP-12-14.GPJ HC_CORP.GDT 4/24/15

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

Push Probe Log JT-US-57

Location: Lat: 47.667374 Long: -122.393906
Approximate Ground Surface Elevation: 23 Feet
Horizontal Datum: WGS 1984
Vertical Datum: MSL

Drill Equipment: Direct Push
Sample Type: Acetate Liner
Hole Diameter: 2 inches
Logged By: N. Galvin Reviewed By: M. Pagel

USCS Class	Soil Descriptions
GP	3 inches of Asphalt over damp, gray-brown, sandy, silty GRAVEL.
SP	Damp, gray SAND.
ML	Damp, gray SILT with gravel.
SP	Wet, gray-brown SAND.
SM	6 inches of silty SAND.
SP	Becomes gray.
SM	Becomes brown, silty SAND.
ML	Very wet, brown SILT with trace sand.
SP	Very wet, gray-brown SAND.
	Becomes gray.
	1-inch SILT pocket.

Groundwater: ATD (between 5 and 6 feet)

Bottom of Probe at 20.0 Feet.
Started 12/10/14.
Completed 12/10/14.

Depth in Feet: 0, 5, 10, 15, 20, 25

Sample	LAB TESTS & (PID)
S-1	(0.7) Very slight petroleum-like odor, NS
S-2	(0.2) No odor, NS
	(<0.1) No odor, NS
S-3	(<0.1) No odor, NS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. NS = No Sheen; SS = Slight Sheen; MS = Moderate Sheen; HS = Heavy Sheen

HARTCROWSER

17800-56 *12/14*

Figure A-28

APPENDIX B
Chemical Data Quality Review
For Additional Sample Delivery Groups
ZV07, ZV45, ZW20, and ZX98

APPENDIX B
CHEMICAL DATA QUALITY REVIEW FOR ADDITIONAL SAMPLE DELIVERY GROUPS ZV07, ZV45, ZW20, AND ZX98

Between November and December 2014, 71 soil samples, 28 groundwater samples, three field duplicates, and eight trip blanks were collected. In January 2015, five sediment samples and one trip blank were collected. The samples were submitted to Analytical Resources, Inc. (ARI), of Tukwila, Washington, for analysis. The laboratory reported results as ARI Job Numbers ZM61, ZN93, ZO63, ZO64, ZO65, ZP39, ZQ10, ZQ89, and ZS52. Data validation of those samples was conducted and reported by Pyron Environmental; the data validation report is presented as an attachment to this appendix.

Additional analyses were conducted on selected soil samples and reported as ARI Job Numbers ZV07 and ZV45. Additional water samples were collected in February 2015 and reported as ARI Job Numbers ZW20 and ZX98. These additional results were validated by a Hart Crowser chemist. The results of this data validation are presented below.

Selected soil samples were analyzed for one or more of the following:

- Diesel and motor-oil-range organics by Washington State Department of Ecology (Ecology) method NWTPH-Dx; and
- Leachable lead by Toxicity Characteristic Leaching Procedure (TCLP) by EPA Method 1311/6010C.

The water samples were analyzed for one or more of the following:

- Semivolatile organic compounds (SVOCs) by EPA Method 8270D;
- Diesel- and motor-oil-range organics by Ecology method NWTPH-Dx with and without acid and silica gel cleanup; and
- Total suspended solids (TSS) by Standard Method 2540D.

The laboratory performed ongoing quality assurance/quality control (QA/QC) reviews of laboratory procedures. Hart Crowser performed the data review using laboratory QC results summary sheets to check that they met data quality objectives for the project. Our data review followed the format outlined in the National Functional Guidelines for Superfund Organic Methods Data Review (EPA 2008) and National Functional Guidelines for Inorganic Superfund Data Review (EPA 2010), modified to include specific criteria of the individual analytical methods. The following criteria were evaluated in the validation process:

- Sample preservation and holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory control sample (LCS) recoveries;

- Matrix spike (MS) recoveries;
- Internal standard (IS) recoveries;
- Calibration criteria; and
- Reporting limits (RLs).

The data were determined to be acceptable for use as qualified. Full laboratory results are at the end of this appendix. Results of the data review follow.

SAMPLE RECEIVING NOTES AND DISCREPANCIES

ZV07. The three soil samples reported under this sample delivery group (SDG) (samples JT-US-53-S2, JT-US-50-S1, and JT-US-51-S2) were originally included in SDGs ZO63 and ZO64. The soil samples were frozen to extend holding times. Sample JT-US-51-S2 was inadvertently entered into the laboratory system as JT-US-51-52. The laboratory was contacted by email on December 22, 2014, for follow-up analyses for total petroleum hydrocarbons as gasoline, diesel, and motor oil. No sample volume had been collected for gasoline analysis, and that analysis was not performed. Because of a miscommunication at the laboratory, the samples were not extracted for diesel and motor oil until after the 14-day holding time for the NWTPH-Dx method. Sample results were qualified as estimated (J) because of the holding time exceedance.

ZV45. The two soil samples reported under this SDG (samples MW-07S-S1 and JT-US-51-S1) were originally included in SDGs ZO63 and ZP39. The laboratory was contacted by email for follow-up analyses for leachable lead.

LABORATORY DETECTION LIMITS

Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. Detections that fell between the method detection limit (MDL) and the reporting limit (RL) were qualified as estimated (J) by ARI. The J qualifier was changed to T to be consistent with Washington State’s Environmental Information Management database.

SOIL SAMPLES

Diesel- and Motor-Oil-Range Hydrocarbons

Analytical Methods

The samples were prepared following EPA Method 3546. The samples were analyzed by a gas chromatograph (GC) fitted with a flame ionization detector (GC/FID) following the NWTPH-Dx method.

Sample Holding Times

The samples were extracted past the 14-day method-recommended holding time. Sample results for JT-US-53-S2, JT-US-50-S1, and JT-US-51-S2 were qualified as estimated (J) because of the holding time exceedance.

Blank Contamination

No target analytes were detected in laboratory blanks.

Surrogate Recovery

Surrogate recoveries were within laboratory control limits.

Laboratory Control Sample Recovery

The LCS recoveries were within laboratory control limits.

Calibration Criteria

The initial calibration curve (ICAL) was within acceptance criteria. The calibration check verifications (CCVs) were within laboratory control limits.

TCLP Lead

Analytical Methods

Leachable lead was prepared by EPA Method 1311 and analyzed by EPA Method 6010C.

Sample Holding Times

The samples were prepared and analyzed within holding time limits.

Blank Contamination

No target analytes were detected in laboratory blanks.

Matrix Spike Recovery

Matrix spike recoveries were within method control limits.

Laboratory Duplicate Sample Analysis

The relative percent differences (RPDs) between replicate measurements were within method control limits.

Calibration Criteria

The CCVs were within laboratory control limits.

GROUNDWATER SAMPLES

SVOCs

Analytical Methods

The sample was prepared following EPA Method 3520C. The sample was analyzed by GC fitted with a mass spectrometer (MS) following EPA Method 8270D.

Sample Holding Times

The sample was prepared and analyzed within the holding time limits.

Blank Contamination

No target analytes were detected in the method blanks.

Surrogate Recovery

Surrogate recoveries were within laboratory control limits.

Laboratory Control Sample Recovery

LCS recoveries were within laboratory control limits with the following exceptions:

- **LCS/LCSD-030315**. The recoveries for all target analytes in the LCS fell within laboratory control limits. The recoveries for 2,4-dimethylphenol and carbazole fell below laboratory control limits in the LCS duplicate. As one batch QC sample was within laboratory control limits, the associated sample was not qualified for 2,4-dimethylphenol or carbazole.

Internal Standard Recoveries

The IS recoveries were within acceptance criteria.

Calibration Criteria

The ICAL was within acceptance criteria. The CCVs were within laboratory control limits with the following exception:

- **CCV 031415.** The recoveries for hexachlorocyclopentadiene and benzidine failed low. Benzidine was not a target analyte; no results were qualified for that analyte. The result for hexachlorocyclopentadiene in sample HC-MW-7S was qualified as estimated (J).

Diesel and Motor Oil Range Hydrocarbons

Analytical Methods

The sample was extracted following EPA Method 3510C. The sample was extracted again following EPA Method 3510 C, and the second extract was acid and silica gel cleaned following the NWTPH-Dx method. The sample extracts were analyzed by GC/FID following NWTPH-Dx method.

Sample Holding Times

The sample was originally prepared within the holding time limits. The sample was re-extracted past the holding time limits for the acid and silica gel cleanup analysis. The results for the re-extraction were qualified as estimated (J) due to the holding time exceedance.

Blank Contamination

No target analytes were detected in laboratory blanks.

Surrogate Recovery

Surrogate recoveries were within laboratory control limits.

Laboratory Control Sample Recovery

LCS recoveries were within laboratory control limits.

Calibration Criteria

The ICAL was within acceptance criteria. The CCVs were within laboratory control limits.

Conventional Analyses

Analytical Methods

TSS was determined by Standard Method 2540D.

Sample Holding Times

The sample met holding time limits.

Blank Contamination

No target analytes were detected in laboratory blanks.

Laboratory Control Sample Recovery

LCS recoveries for TSS were within laboratory control limits.

DATA VALIDATION REPORT
Pyron Environmental, Inc.

Data Validation Report

Jacobson Terminals Remedial Investigation
Seattle, Washington

Laboratory SDG Numbers:

ZM61, ZN93, ZO63, ZO64, ZO65,
ZP39, ZQ10, ZQ89, ZS52

Prepared for:

Hart Crowser, Inc.
1700 Westlake Ave N, Suite 200
Seattle, WA 98109-6212

Prepared by:

Pyron Environmental, Inc.
3530 32nd Way NW
Olympia, WA 98502

March 30, 2015

ACRONYMS

%D	Percent difference
%R	Percent recovery
%RSD	Percent relative standard deviation
AMU	Atomic mass unit
BFB	Bromofluorobenezene
CCB	Continuing calibration blank
CCV	Continuing calibration verification
CF	Calibration factor
CLP	U.S. EPA Contract Laboratory Program
COC	Chain-of-custody
CVAA	Cold vapor atomic absorption
EPA	U.S. Environmental Protection Agency
GC/MS	Gas chromatograph/mass spectrometer
ICAL	Initial calibration
ICB	Initial calibration blank
ICP/MS	Initial calibration verification
ICV	Initial calibration verification
LCS	Laboratory control sample
MDL	Method detection limit
MS	Matrix spike
MSD	Matrix spike duplicate
mg/L	Milligram per liter
µg/kg	Microgram per kilogram
µg/L	Microgram per liter
NFGs	CLP National Functional Guidelines for Data Review (EPA 2014a, 2014b)
PCBs	Polychlorinated biphenyls
QC	Quality control
RL	Reporting limit
RPD	Relative percent difference
SDG	Sample delivery group
SRM	Standard reference material
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon

TS	Total solids
TSS	Total suspended solids
TVS	Total volatile solids
VOCs	Volatile organic compounds

INTRODUCTION

This report presents and discusses findings of the data validation performed on analytical data for samples collected during November 2014 through January 2015 for the referenced project. The laboratory reports validated herein were submitted by Analytical Resources, Inc. (ARI) in nine sample delivery groups (SDGs): ZM61, ZN93, ZO63, ZO64, ZO65, ZP39, ZQ10, ZQ89, and ZS52.

A Level III validation (Stage 2B as defined in EPA 2009) was performed on all data reported herein. The validation followed the procedures specified in USEPA CLP Functional Guidelines ([NFGs], EPA 2014a & 2014b), 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 Sampling and Analysis Plan ([SAP], Hart Crowser, Inc., 2013) 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 for each QC parameter pertinent to each type of analyses evaluated. Qualified data with applied data qualifiers are summarized in the **Summary** section at the end of this report. Samples and the associated analyses validated herein are summarized as follows:

Field Sample ID	Lab Sample ID	Sampling Date	Matrix	Analysis				
				VOCs	PCBs	Metals	TPH	Miscelluneous
JT-6	ZM61A	11/25/14	Water	X	X	X		TSS
JT-5	ZM61B	11/25/14	Water	X	X	X		TSS
SRW-1	ZM61C	11/25/14	Water	X	X	X		TSS
JT-10	ZM61D	11/25/14	Water	X	X	X		TSS
JT-12	ZM61E	11/25/14	Water	X	X	X		TSS
SRW-2	ZM61F	11/25/14	Water	X	X	X		TSS
JT-7	ZM61G	11/26/14	Water	X	X	X		TSS
MW-200	ZM61H	11/26/14	Water	X	X	X		TSS
JT-9	ZM61I	11/26/14	Water	X	X	X		TSS
JT-3	ZM61J	11/26/14	Water	X	X	X		TSS
TRIP BLANKS (1)	ZM61K	11/25/14	Water	X				
TRIP BLANKS (2)	ZM61L	11/25/14	Water	X				
TRIP BLANKS (3)	ZM61M	11/25/14	Water	X				
JT-6	ZM61N	11/25/14	Water			X		

Field Sample ID	Lab Sample ID	Sampling Date	Matrix	Analysis				
				VOCs	PCBs	Metals	TPH	Miscelluneous
JT-5	ZM61O	11/25/14	Water			X		
SRW-1	ZM61P	11/25/14	Water			X		
JT-10	ZM61Q	11/25/14	Water			X		
JT-12	ZM61R	11/25/14	Water			X		
SRW-2	ZM61S	11/25/14	Water			X		
JT-7	ZM61T	11/26/14	Water			X		
MW-200	ZM61U	11/26/14	Water			X		
JT-9	ZM61V	11/26/14	Water			X		
JT-3	ZM61W	11/26/14	Water			X		
MW-100	ZN93A	12/05/14	Water	X	X	X		TSS
SRW-3	ZN93B	12/05/14	Water	X	X	X		TSS
JT-11	ZN93C	12/05/14	Water	X	X	X		TSS
JT-4	ZN93D	12/05/14	Water	X	X	X		TSS
JT-1100	ZN93E	12/05/14	Water	X	X			
JT-400	ZN93F	12/05/14	Water			X		
Trip Blank 1	ZN93G	12/05/14	Water	X				
MW-100	ZN93H	12/05/14	Water			X		
SRW-3	ZN93I	12/05/14	Water			X		
JT-11	ZN93J	12/05/14	Water			X		
JT-4	ZN93K	12/05/14	Water			X		
JT-400	ZN93L	12/05/14	Water			X		
JT-US-53-S1	ZO63A	12/08/14	Soil	X	X			
JT-US-53-S2	ZO63B	12/08/14	Soil	X	X	X	HC	
JT-US-53-S3	ZO63C	12/08/14	Soil	X	X		HC	
JT-US-53-S4	ZO63D	12/08/14	Soil	X	X			
JT-US-52-S2	ZO63E	12/08/14	Soil	X	X			
JT-US-52-S4	ZO63F	12/08/14	Soil	X	X			
JT-US-50-S1	ZO63G	12/08/14	Soil	X	X	X		
JT-US-50-S2	ZO63H	12/08/14	Soil	X	X			
JT-US-50-S3	ZO63I	12/08/14	Soil	X	X			
JT-US-51-S1	ZO63J	12/08/14	Soil	X	X	X	HC	
JT-US-51-S2	ZO63K	12/08/14	Soil	X	X		HC	
JT-US-51-S3	ZO63L	12/08/14	Soil	X	X			
JT-US-51-S4	ZO63M	12/08/14	Soil	X	X			
JT-US-45-S2	ZO63N	12/08/14	Soil	X	X	X		

Field Sample ID	Lab Sample ID	Sampling Date	Matrix	Analysis				
				VOCs	PCBs	Metals	TPH	Miscelluneous
JT-US-45-S4	ZO63O	12/08/14	Soil	X	X	X		
JT-US-44-S1	ZO63P	12/08/14	Soil	X	X	X		
JT-US-44-S2	ZO63Q	12/08/14	Soil	X	X	X		
JT-US-44-S3	ZO63R	12/08/14	Soil	X	X	X		
JT-US-46-S2	ZO64A	12/08/14	Soil	X	X			
JT-US-46-S4	ZO64B	12/08/14	Soil	X	X			
JT-US-47-S2	ZO64C	12/08/14	Soil	X	X			
JT-US-47-S3	ZO64D	12/08/14	Soil	X	X			
JT-US-47-S4	ZO64E	12/08/14	Soil	X	X			
JT-US-41-S2	ZO64F	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-49-S1	ZO64G	12/09/14	Soil	X	X			
JT-US-49-S2	ZO64H	12/09/14	Soil	X	X			
JT-US-49-S3	ZO64I	12/09/14	Soil	X	X			
JT-US-48-S2	ZO64J	12/09/14	Soil	X	X			
JT-US-48-S4	ZO64K	12/09/14	Soil	X	X			
JT-US-42-S2	ZO64L	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-42-S3	ZO64M	12/09/14	Soil	X	X			
JT-US-40-S2	ZO64N	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-40-S3	ZO64O	12/09/14	Soil	X	X	X		
JT-US-43-S2	ZO65A	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-43-S3	ZO65B	12/09/14	Soil	X	X			
JT-US-39-S1	ZO65C	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-39-S2	ZO65D	12/09/14	Soil	X	X	X	X	TOC,TS
JT-US-54-S2	ZO65E	12/09/14	Soil	X	X			
JT-US-54-S3	ZO65F	12/09/14	Soil	X	X			
JT-US-55-S1	ZO65G	12/10/14	Soil	X	X		X	TOC,TS
JT-US-55-S2	ZO65H	12/10/14	Soil	X	X		X	
JT-US-56-S2	ZO65I	12/10/14	Soil	X	X			
JT-US-56-S3	ZO65J	12/10/14	Soil	X	X			
JT-US-57-S1	ZO65K	12/10/14	Soil	X	X		HC	
JT-US-57-S2	ZO65L	12/10/14	Soil	X	X			
Trip Blank	ZO65M	12/10/14	Water	X				
MW-08S-S2	ZP39A	12/11/14	Soil	X	X	X		TOC,TS
MW-08S-S3	ZP39B	12/11/14	Soil	X	X	X		TOC,TS
MW-08S-S4	ZP39C	12/11/14	Soil	X	X	X		TOC,TS

Field Sample ID	Lab Sample ID	Sampling Date	Matrix	Analysis				
				VOCs	PCBs	Metals	TPH	Miscelluneous
MW-07S-S1	ZP39D	12/11/14	Soil	X	X	X	X	TOC,TS
JT-MW-07S-S2	ZP39E	12/12/14	Soil	X	X	X	X	TOC,TS
JT-MW-07S-S3	ZP39F	12/12/14	Soil	X	X	X	X	TOC,TS
JT-MW-07S-S4	ZP39G	12/12/14	Soil	X	X	X	X	TOC,TS
JT-MW-06D-S2	ZP39H	12/12/14	Soil	X	X			
JT-MW-06D-S3	ZP39I	12/12/14	Soil	X	X			
JT-MW-06D-S4	ZP39J	12/12/14	Soil	X	X			
JT-MW-06D-S5	ZP39K	12/12/14	Soil	X	X			
JT-MW-03D-S1	ZP39L	12/15/14	Soil	X	X	X	X	
JT-MW-03D-S2	ZP39M	12/15/14	Soil	X	X	X	X	
JT-MW-03D-S3	ZP39N	12/15/14	Soil	X	X	X		
JT-MW-03D-S4	ZP39O	12/15/14	Soil	X	X	X		
JT-MW-03D-S5	ZP39P	12/15/14	Soil	X	X			
TRIP BLANKS	ZP39Q	12/11/14	Water	X				
JT-MW-04D-S1	ZQ10A	12/16/14	Soil	X	X			
JT-MW-04D-S2	ZQ10B	12/16/14	Soil	X	X			
JT-MW-04D-S3	ZQ10C	12/16/14	Soil	X	X			
JT-MW-04D-S4	ZQ10D	12/16/14	Soil	X	X			
JT-MW-04D-S5	ZQ10E	12/16/14	Soil	X	X			
JT-MW-04D-S6	ZQ10F	12/16/14	Soil	X	X			
JT-MW-01S-S2	ZQ10G	12/16/14	Soil	X	X	X		TOC,TS
JT-MW-01S-S3	ZQ10H	12/16/14	Soil	X	X	X		TOC,TS
JT-MW-01S-S4	ZQ10I	12/16/14	Soil	X	X	X		TOC,TS
JT-MW-01S-S5	ZQ10J	12/16/14	Soil	X	X	X		TOC,TS
Trip Blank	ZQ10K	12/16/14	Water	X				
IW-5D-GW	ZQ89A	12/23/14	Water	X	X			TSS
MW-4-GW	ZQ89B	12/23/14	Water	X	X	X	X	TSS
MW-400-GW	ZQ89C	12/23/14	Water	X	X	X	X	
HC-MW-1-GW	ZQ89D	12/23/14	Water	X	X	X	X	TSS
JT-MW-07S-GW	ZQ89E	12/23/14	Water	X	X	X		NH_3,TSS
JT-MW-04D-GW	ZQ89F	12/23/14	Water	X	X	X		NH_3,TSS
JT-MW-08S-GW	ZQ89G	12/23/14	Water	X	X	X		TSS
JT-MW-01S-GW	ZQ89H	12/23/14	Water	X	X	X		TSS
JT-MW-06D-GW	ZQ89I	12/23/14	Water	X	X	X		TSS
JT-MW-05S-GW	ZQ89J	12/23/14	Water	X	X	X		TSS

Field Sample ID	Lab Sample ID	Sampling Date	Matrix	Analysis				
				VOCs	PCBs	Metals	TPH	Miscelluneous
HC-MW-2-GW	ZQ89K	12/24/14	Water	X	X	X	X	TSS
HC-MW-3-GW	ZQ89L	12/24/14	Water	X	X	X	X	TSS
IW-5S-GW	ZQ89M	12/24/14	Water	X	X			TSS
JT-MW-02S-GW	ZQ89N	12/24/14	Water	X	X	X		TSS
JT-MW-03D-GW	ZQ89O	12/24/14	Water	X	X	X		TSS
MW-4-GW	ZQ89P	12/23/14	Water			X		
MW-400-GW	ZQ89Q	12/23/14	Water			X		
HC-MW-1-GW	ZQ89R	12/23/14	Water			X		
JT-MW-07S-GW	ZQ89S	12/23/14	Water			X		
JT-MW-04D-GW	ZQ89T	12/23/14	Water			X		
JT-MW-08S-GW	ZQ89U	12/23/14	Water			X		
JT-MW-01S-GW	ZQ89V	12/23/14	Water			X		
JT-MW-06D-GW	ZQ89W	12/23/14	Water			X		
JT-MW-05S-GW	ZQ89X	12/23/14	Water			X		
HC-MW-2-GW	ZQ89Y	12/24/14	Water			X		
HC-MW-3-GW	ZQ89Z	12/24/14	Water			X		
JT-MW-02S-GW	ZQ89AA	12/24/14	Water			X		
JT-MW-03D-GW	ZQ89AB	12/24/14	Water			X		
TRIP BLANKS	ZQ89AC	12/23/14	Water	X				
JT-SS-06	ZS52A	01/12/15	Sediment	X	X	X		NH_3,TOC,TS,TVS, S^{-2}
JT-SS-07	ZS52B	01/12/15	Sediment	X	X	X		NH_3,TOC,TS,TVS, S^{-2}
JT-SS-08	ZS52C	01/12/15	Sediment	X	X	X		NH_3,TOC,TS,TVS, S^{-2}
JT-SS-09	ZS52D	01/12/15	Sediment	X	X	X		NH_3,TOC,TS,TVS, S^{-2}
JT-SS-10	ZS52E	01/12/15	Sediment	X	X	X		NH_3,TOC,TS,TVS, S^{-2}
TRIP BLANK	ZS52F	01/12/15	Water	X				

Notes:

HC: Hydrocarbon identification (HCID), gasoline, diesel, and lube oil ranges
Metals: Arsenic, cadmium, chromium, lead, mercury; total recoverable and dissolved for water samples.
NH_3: Ammonia
PCBs: Polychlorinated biphenyls
S^{-2}: Sulfide
TOC: Total organic carbon
TPH: Total petroleum hydrocarbon, diesel and lube oil ranges
TS: Total solids
TSS: Total suspended solids
TVS: Total volatile solids
VOCs: Volatile organic compounds
X: The analysis was requested and performed on the sample.

Analytical methods in respect to analytical parameters validated herein and the laboratory performing the analyses are summarized below:

Parameter	Analytical Method	Laboratory
Volatile Organic Compounds (VOCs)	SW846 Method 8260C	Analytical Resources, Inc. Tukwila, Washington
Polychlorinated Biphenyls (PCBs)	SW846 Method 8082A	
Metals (arsenic, cadmium, chromium, & lead)	EPA Method 200.8	
Mercury (Water/Soil)	SW846 Methods 7470A/7471A	
TPH-Diesel & Lube Oil	NWTPH-Dx	
Hydrocarbon Identification	NWTPH-HCID	
Ammonia (NH_3)	EPA Method 350.1 Modified	
Total Organic Carbon (TOC)	Plumb 1981	
Total Sulfide	SM Method $4500S^{-2}$ D	
Total Solids	SM Method 2540G	
Total Volatile Solids	SM Method 2540G	
Total Suspended Solids	SM Method 2540D	

Notes:

1. SW846 - *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.
2. EPA Method 200.8 - *Method 200.8: Determination of Trace Elements In Waters And Wastes by Inductively Coupled Plasma - Mass Spectrometry Revision 5.4*. 1995.
3. NWTPH Methods - *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602. Washington State Department of Ecology. June 1997.
4. Plumb 1981 - *Procedures for Handling and Chemical Analysis of Sediment and Water Samples.* Technical Report, EPA/CE-B1-1. U.S. Army Corps of Engineers. Plumb, R.H. 1981.
5. SM - *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, 20th Edition, 1995.

DATA VALIDATION FINDINGS

1. Volatile Organic Compounds (VOCs) by GC/MS (SW846 Method 8260C)

1.1 Sample Management and Holding Times

Temperature for two of the coolers was measured at 7.6°C and 10.4°C, greater than 6°C, upon receipt at the laboratory. VOCs samples in these coolers that were collected more than four hours prior to the laboratory receipt were considered affected. VOCs results for samples JT-6, JT-7, JT-12, SRW-1, SRW-2, and MW-200 were qualified (J) for detects and (UJ) for non-detects as estimated. No other anomalies were identified in relation to sample preservation, handling, and transport.

Soil and water samples should be preserved immediately and analyzed within 14 days. Unpreserved soil and water samples should be analyzed within two and seven days of collection, respectively. All samples were preserved and analyzed within the required holding times, except that samples JT-10, JT-12, and SRW-2 were analyzed one-day past the 14-day holding time due to laboratory power outage and sample SRW-3 was analyzed four days past the seven-day holding time (sample pH measured at 8 upon analysis). VOCs results for these samples were qualified (J) for detects and (UJ) for non-detects as estimated.

Samples JT-6, JT-11, and JT-1100 required dilution analyses for chlorobenzene. The dilution analyses were performed one to four days past the 14-day holding time. Chlorobenzene results for these samples were qualified (J) as estimated.

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 method requires that (1) if linear average response factors (RFs) is chosen as the quantitation option, the percent relative standard deviation (%RSD) of RFs be ≤20% for target compounds, (2) if least-square linear regression is chosen for quantitation, the correlation coefficient (r) be ≥0.99 and the recovery of lowest standard is within 70-130%, (3) if six-point non-linear (quadratic) curve is chosen for quantitation, the coefficient of determination (r^2) be ≥0.99, (4) compound RFs are ≥ the minimum RF specified in Method 8260C, Table 4, and (5) a second source standard (ICV) should be analyzed immediately after the initial calibration and the percent difference (%D) values for all target and surrogate compounds should be within ±30%.

The Initial calibration either met all the criteria or the outliers had no adverse effects on data usability *(e.g.,* %RSD >20% for a compound not detected in samples).

1.4 Calibration Verification

The method requires 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 values be within ±20%, (3) compound RFs are ≥ the minimum RF specified in Method 8260C, Table 4, and (4) the internal standards in the calibration verification standard changes by a factor of two (-50% to + 100%) from that in the mid-point standard level of the most recent initial calibration sequence. Calibration verification analyses either met the criteria or the outliers had no adverse effects on data usability (*e.g.,* biased-high %D value for a compound not detected in samples), except for the following:

Calibration Verification ID	Analyte	%D	Bias	Affected Sample	Data Qualifier
Instrument: NT3 12/3/14, 1008	Acrolein Hexachlorobutadiene	-27.4% -28.3%	Low	JT-6 JT-5 SRW-1 TRIP BLANKS (1) TRIP BLANKS (2) TRIP BLANKS (3)	**UJ**
Instrument: NT3 12/10/14, 1042	Hexachlorobutadiene	-24.7%	Low	JT-10 JT-12 SRW-2 JT-7 MW-200 JT-9 JT-3	**UJ**
Instrument: NT3 12/16/14, 1127	Chloromethane Bromomethane Acetone 2-Butanone Vinyl Acetate 4-Methyl-2-pentanone 2-Hexanone Acrolein Acrylonitrile 1,2-Dibromo-3-chloropropane *trans*-1,4-Dichloro-2-butene Hexachlorobutadiene	-22.8% -28.8% -28.0% -26.5% -32.0% -22.3% -21.0% -23.2% -27.2% -24.3% -20.7% -23.6%	Low	MW-100 SRW-3 JT-11 JT-1100	**UJ**

Calibration Verification ID	Analyte	%D	Bias	Affected Sample	Data Qualifier
Instrument: NT5 12/16/14, 0940	Chloromethane Bromomethane Iodomethane 2-Chloroethylvinylether 4-Methyl-2-pentanone 2-Hexanone Naphthalene	-26.3% -60.4% -35.9% -32.3% -22.4% -22.5% -21.2%	Low	JT-US-53-S1 JT-US-53-S2 JT-US-53-S3 JT-US-53-S4 JT-US-52-S4 JT-US-50-S1 JT-US-50-S2 JT-US-50-S3 JT-US-51-S1 JT-US-51-S2 JT-US-51-S3 JT-US-51-S4 JT-US-45-S2 JT-US-45-S4 JT-US-44-S1 JT-US-44-S2	**UJ**
Instrument: NT5 12/17/14, 1207	Chloromethane Vinyl Chloride Bromomethane Chloroethane Iodomethane	-32.4% -25.7% -67.2% -22.4% -61.0%	Low	JT-US-46-S2 JT-US-47-S2 JT-US-47-S3 JT-US-47-S4 JT-US-41-S2 JT-US-49-S1 JT-US-49-S2 JT-US-48-S2 JT-US-48-S4 JT-US-42-S2 JT-US-42-S3 JT-US-40-S2 JT-US-52-S2 JT-US-44-S2 JT-US-44-S3 JT-US-49-S3	**J/UJ**
Instrument: NT5 12/19/14, 0928	Chloromethane Vinyl Chloride Bromomethane Chloroethane Iodomethane 2-Chloroethylvinylether	-28.8% -20.9% -36.1% -21.1% -26.4% -22.2%	Low	JT-US-46-S4 JT-US-49-S3 JT-US-40-S3	**UJ**
Instrument: NT5 12/17/14, 1207	Acetone	52.7%	High	JT-US-46-S2 JT-US-47-S2 JT-US-47-S3 JT-US-47-S4 JT-US-49-S1 JT-US-48-S2 JT-US-42-S2 JT-US-42-S3 JT-US-40-S2 JT-US-52-S2 JT-US-49-S3	**J**

Calibration Verification ID	Analyte	%D	Bias	Affected Sample	Data Qualifier
Instrument: NT5 12/18/14, 1702	Chloromethane Bromomethane Chloroethane Iodomethane Methylene Chloride 2-Chloroethylvinylether	-26.0% -46.0% -20.6% -47.7% -31.2% -20.1%	Low	JT-US-43-S2 JT-US-43-S3 JT-US-39-S1 JT-US-39-S2 JT-US-54-S2 JT-US-54-S3 JT-US-55-S1 JT-US-55-S2 JT-US-56-S2 JT-US-56-S3	**UJ**
Instrument: NT5 12/18/14, 1702	2-Butanone	36.2%	High	JT-US-39-S2 JT-US-55-S2	**J**
Instrument: NT5 12/26/14, 1525	Chloromethane Vinyl Chloride Bromomethane Chloroethane Iodomethane 2-Chloroethylvinylether	-28.8% -20.9% -36.1% -21.1% -26.4% -22.2%	Low	JT-US-57-S1 JT-US-57-S2 Trip Blank	**UJ**
Instrument: NT5 12/19/14, 928	Bromomethane Acrolein 2-Butanone 2-Chloroethylvinylether	-20.7% -25.1% -20.8% -27.0%	Low	JT-MW-04D-S1 JT-MW-04D-S2 JT-MW-04D-S3 JT-MW-04D-S4 JT-MW-04D-S5 JT-MW-04D-S6 JT-MW-01S-S2 JT-MW-01S-S3 JT-MW-01S-S4 JT-MW-01S-S5 Trip Blank	**UJ**
Instrument: NT5 12/23/14, 0808	Acrolein Acetone Acrylonitrile Vinyl Acetate 2-Butanone 2-Chloroethylvinylether	-25.4% -23.8% -23.4% -27.3% -23.8% -24.8%	Low	MW-08S-S2 MW-08S-S3 MW-08S-S4 TRIP BLANKS	**UJ/JT/J**
Instrument: NT5 12/23/14, 2031	Chloroethane Acrolein	-20.7% -26.0%	Low	MW-07S-S1 JT-MW-07S-S3 JT-MW-07S-S4 JT-MW-06D-S2 JT-MW-06D-S3 JT-MW-06D-S4 JT-MW-06D-S5 JT-MW-03D-S1 JT-MW-03D-S2 JT-MW-03D-S3 JT-MW-03D-S4 JT-MW-03D-S5 JT-MW-07S-S2	**UJ**

Calibration Verification ID	Analyte	%D	Bias	Affected Sample	Data Qualifier
Instrument: NT2 1/2/15, 1318	2-Butanone 2-Hexanone 2-Chloroethylvinylether[(A)]	-22.9% -23.8% -26.3%	Low	IW-5D-GW IW-5S-GW MW-4-GW MW-400-GW HC-MW-1-GW JT-MW-07S-GW JT-MW-08S-GW JT-MW-01S-GW JT-MW-04D-GW JT-MW-06D-GW JT-MW-05S-GW HC-MW-2-GW HC-MW-3-GW JT-MW-02S-GW JT-MW-03D-GW TRIP BLANKS	**UJ/JT**
Instrument: NT5 1/15/15, 1046	2-Chloroethylvinylether 2-Hexanone Naphthalene 1,1,2,2-Tetrachloroethane	-55.4% -24.2% -22.3% -20.3%	Low	JT-SS-06 JT-SS-07 JT-SS-08 JT-SS-09 JT-SS-10 TRIP BLANK	**UJ**

Note:
[(A)] - 2-Chlorovinylether in water samples breaks down due to acidic preservation, and the results were qualified (R) and rejected for all water samples (see Section 1.12). No further data qualifiers were assigned to the 2-chlorovinylether results herein.

1.5 Blanks

Method Blanks: Method blanks were prepared and analyzed as required. Target analytes were detected in the method blanks at levels greater than their method detection limits (MDLs) but less than the reporting limits (RLs). Sample results greater than their MDLs but less than the RLs were qualified (U) as non-detected at their RLs. Sample results greater than their RLs but less than 5x the amount found in the method blank were qualified (U) as non-detected at the reported values. Sample results greater than 5x the level found in the method blank were considered not affected and no action was taken, except that methylene chloride was consistently present in samples at levels slightly above their RLs, comparable to those found in most method blanks. Methylene chloride results were qualified (U) at the reported values in these cases. Qualified data were presented as follows:

Blank ID	Compound	Blank	Affected Sample	Original Result	Adjusted Result	Unit
14-25981	Toluene	0.13 J	JT-7 JT-9	0.32 0.39	**0.32 U** **0.39 U**	µg/L
14-25981	1,2,4-Trimethylbenzene	0.11 J	JT-7	0.23	**0.23 U**	µg/L

Blank ID	Compound	Blank	Affected Sample	Original Result	Adjusted Result	Unit
14-25978	Methylene Chloride	0.76 J	TRIP BLANKS (1) TRIP BLANKS (2) TRIP BLANKS (3)	1.2 1.2 1.1	**1.2 U** **1.2 U** **1.1 U**	µg/L
14-26644	Methylene Chloride	0.66 J	Trip Blank 1	1.2	**1.2 U**	µg/L
14-27074 14-27075 14-27099 14-27106	Methylene Chloride	1.1 J 54 J 1.6 J 78 J	JT-US-53-S4 JT-US-52-S4 JT-US-50-S2 JT-US-50-S3 JT-US-51-S2 JT-US-51-S3 JT-US-51-S4 JT-US-45-S2 JT-US-45-S4 JT-US-44-S3	4.0 3.3 2.9 2.7 2.0 3.4 5.8 2.0 2.6 2.6	**4.0 U** **3.3 U** **2.9 U** **2.7 U** **2.0 U** **3.4 U** **5.8 U** **2.0 U** **2.6 U** **2.6 U**	µg/kg
14-27074 14-27075 14-27099 14-27106	Methylene Chloride	1.1 J 54 J 1.6 J 78 J	JT-US-46-S2 JT-US-46-S4 JT-US-47-S2 JT-US-47-S3 JT-US-47-S4 JT-US-41-S2 JT-US-49-S1 JT-US-49-S2 JT-US-49-S3 JT-US-48-S2 JT-US-48-S4 JT-US-42-S2 JT-US-42-S3 JT-US-40-S2	1.6 2.7 0.8 J 2.7 2.2 2.5 1.6 J 2.6 3.2 2.2 1.6 J 1 J 3.3 2.2	**1.6 U** **2.7 U** **1.8 U** **2.7 U** **2.2 U** **2.5 U** **2.0 U** **2.6 U** **3.2 U** **2.2 U** **1.8 U** **2.1 U** **3.3 U** **2.2 U**	µg/kg
14-27122 14-27124 14-27133 14-27132	Methylene Chloride	1.8 J 92 J 1.6 J 78 J	JT-US-43-S2 JT-US-43-S3 JT-US-39-S1 JT-US-39-S2 JT-US-54-S2 JT-US-54-S3 JT-US-55-S1 JT-US-55-S2 JT-US-56-S2 JT-US-56-S3 JT-US-57-S1 JT-US-57-S2 Trip Blank	1.8 5.4 11000 5.0 3.4 3.1 4.2 4.4 3.0 4.5 2.6 2.0 2.4	**1.8 U** **5.4 U** **11000 U** **5.0 U** **3.4 U** **3.1 U** **4.2 U** **4.4 U** **3.0 U** **4.5 U** **2.6 U** **2.0 U** **2.4 U**	µg/kg
14-28060	1,2,4-Trichlorobenzene	0.7 J	JT-MW-04D-S2	0.8 J	**4.5 U**	µg/kg
14-27581	Naphthalene	1.2 J	MW-08S-S3 MW-08S-S4	3.6 J 2.1 J	**4.1 U** **4.2 U**	µg/kg
14-27581	Methylene Chloride	(A)	MW-08S-S3 MW-08S-S4 TRIP BLANKS	0.9 J 1.0 J 1.0 J	**1.6 U** **1.7 U** **2.0 U**	µg/kg µg/kg µg/L

Blank ID	Compound	Blank	Affected Sample	Original Result	Adjusted Result	Unit
14-27584	Methylene Chloride	0.6 J	JT-MW-07S-S3 JT-MW-07S-S4 JT-MW-06D-S3 JT-MW-06D-S4 JT-MW-06D-S5 JT-MW-03D-S2 JT-MW-03D-S3 JT-MW-03D-S4 JT-MW-03D-S5 MW-07S-S1	0.8 J 2.7 1.0 J 2.1 J 1.9 0.9 J 2.0 1.8 J 2.3 0.7 J	**2.9 U** **2.7 U** **1.8 U** **2.1 U** **1.9 U** **2.0 U** **2.0 U** **2.0 U** **2.3 U** **1.8U**	µg/kg
14-27584	Naphthalene	1.1 J	MW-07S-S1 JT-MW-03D-S2 JT-MW-06D-S3 JT-MW-07S-S3	0.6 J 0.6 J 0.6 J 4.0 J	**4.4 U** **4.9 U** **4.5 U** **7.2 U**	µg/kg
14-28361	Methylene Chloride	0.77 J	JT-MW-06D-GW JT-MW-05S-GW TRIP BLANKS	0.57 J 0.62 J 1.5	**1 U** **1 U** **1.5 U**	µg/L
14-28361	Naphthalene	0.16 J	MW-4-GW	0.63	**0.63 U**	µg/L
15-422	Methylene Chloride	2.1 J	JT-SS-06 JT-SS-08 JT-SS-09 JT-SS-10 TRIP BLANK	14 9.5 48 12 3.3	**14 U** **9.5 U** **48 U** **12 U** **3.3 U**	µg/kg
15-422	Naphthalene	0.7 J	JT-SS-06 JT-SS-10	10 J 2.1 J	**12 U** **10 U**	µg/kg

Note: [(A)] - Not detected in method blank but detected in samples comparable to detections in method blanks in other batches.

Trip Blanks: Trip blanks were collected and submitted for VOCs analyses as required. Target analytes were detected in trip blanks at levels greater than their MDLs but less than the RLs. Sample results greater than their MDLs but less than the RLs were qualified (U) as non-detected at their RLs. Sample results greater than their RLs but less than 5x the amount found in the trip blank were qualified (U) as non-detected at the reported values. Sample results greater than 5x the level found in the trip blank were considered not affected and no action was taken. Qualified data were presented as follows:

Blank ID	Compound	Blank	Affected Sample	Original Result	Adjusted Result	Unit
ZO65M	Naphthalene	3.2 J	JT-US-56-S2 JT-US-57-S2	0.5 J 13	**4.2 U** **13 U**	µg/kg

Blank ID	Compound	Blank	Affected Sample	Original Result	Adjusted Result	Unit
ZQ10K	Methylene Chloride	1.0 J	JT-MW-04D-S1 JT-MW-04D-S2 JT-MW-04D-S3 JT-MW-04D-S4 JT-MW-04D-S5 JT-MW-04D-S6 JT-MW-01S-S2 JT-MW-01S-S3 JT-MW-01S-S4 JT-MW-01S-S5	2.4 2.3 1.5 J 1.3 J 1.2 J 1.2 J 2.3 J 2.5 2 J 1.9 J	**2.4 U** **2.3 U** **1.8 U** **1.6 U** **1.8 U** **1.5 U** **3.0 U** **2.5 U** **2.1 U** **1.9 U**	µg/kg

1.6 Surrogate Spikes

Surrogate spikes were added to all samples as required by the method. All surrogate percent recovery (%R) values were either within the laboratory control limits, or the outliers had no adverse effects on data quality (*e.g.,* biased-high surrogate spike %R and associated compounds were not detected), except that the %R value (73.0%) for one of the surrogate spikes, 1,2-dichloroethane-d_4, in sample JT-MW-07S-S2 was less than the lower control limit (80-120%) likely due to matrix interference. The sample was diluted and re-analyzed, and the surrogate spike recovery was within control limits confirming the presence of matrix interference. Since %R values for all other surrogate spikes were within control limits in this sample during the initial analysis, VOCs results for this sample was to be reported from the initial analysis without data qualifying.

1.7 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and/or LCSD analyses were performed as required by the method. All %R and relative percent difference (RPD) values met the laboratory control criteria, except for the following:

LCS/LCSD ID	Analyte	LCS %R	LCSD %R	Control Limit	RPD	Affected Sample	Data Qualifier
14-25978	Hexachlorobutadiene	73.5%	67.1%	80-135%	9.1%	JT-5 JT-6 SRW-1 TRIP BLANKS (1) TRIP BLANKS (2) TRIP BLANKS (3)	**UJ**
14-25981	Hexachlorobutadiene	80.8%	75.5%	80-135%	6.8%	JT-10 JT-12 SRW-2 JT-7 MW-200 JT-9 JT-3	**UJ**

LCS/LCSD ID	Analyte	LCS %R	LCSD %R	Control Limit	RPD	Affected Sample	Data Qualifier
14-26638	Hexachlorobutadiene	81.6%	70.5%	72-135%	14.6%	MW-100 SRW-3 JT-11 JT-1100	**UJ**
14-27078	Bromomethane Chloroethane	39.0% 123%	42.4% 79.0%	40-172% 53-154%	8.4% 43.3%	JT-US-52-S2 JT-US-44-S2 JT-US-44-S3	**UJ**
14-27078	Acetone	83.6%	164%	48-132%	64.7%	JT-US-52-S2	**J**

Note: RPD criteria is ≤30%.

1.8 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were performed on project samples at the adequate frequency (>5% of field samples). All %R and RPD values met the laboratory control criteria, except for the following:

Parent Sample ID	Analyte	MS %R	MSD %R	Control Limit	RPD	Affected Sample	Data Qualifier
JT-11	2-Chloroethylvinylether	0%	0%	20-157%	NA	JT-11 JT-1100	**R**
JT-US-44-S2	1,2,4-Trichlorobenzene	59.0%	71.5%	75-130%	19.1%	JT-US-44-S2	**UJ**

Notes:

Data were qualified only when both MS and MSD %R values were outside the control limits, or one of the %R values deviated >10% from the control limit.

RPD criteria is ≤30%.

NA: Not applicable

1.9 Internal Standards

The method requires that (1) proper internal standards be added to all samples and associated laboratory QC analyses, (2) internal standard retention time be within ±30 seconds from that of the associated 12-hour calibration standard, and (3) 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 Compound Quantitation and Method Reporting Limits

Selected samples contained target analytes at elevated levels that required dilution; the RLs were raised proportionally, including analytes that were not detected at or above the

MDLs. The elevated RLs were considered the best-possible quantitation limits for the samples, and were acceptable for use.

The detection of chlorobenzene in sample JT-5 was suspected as a result of carryover contamination. The RL was raised from 0.2 µg/L to 0.47 µg/L. The raised RL was significantly less than the screening level of 1600 µg/L (Work Plan, Table 2B). The raised RL is acceptable for use.

Detections of acetone and naphthalene reported in a number of samples did not meet the method requirements for ion abundance ratios and flagged (M) by the laboratory. These results were qualified (J) as estimated.

The RLs were supported with adequate ICAL calibration concentrations. Sample quantitation and reporting was correctly performed. The QAPP goals for quantitation limits were achieved.

1.11 Field Duplicates

Field duplicates were submitted for VOCs analyses as required. Sample results, RPD (or concentration difference) values, and data qualification for detected analytes were presented in **Appendix A**.

1.12 Overall Assessment of VOCs Data Usability

2-Chloroethylvinyl ether is known to break down in acidic environments. Water samples for VOCs analyses were acid-preserved, and may cause breakdown of this compound. 2-Chloroethylvinyl ether results for all water samples were qualified (R) and rejected.

Based on the information submitted by the laboratory, VOCs data are of known quality and acceptable for use, as qualified.

2. Polychlorinated Biphenyls (PCBs) Aroclors by GC/ECD (SW846 Method 8082A)

2.1 Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport.

Water and soil samples should be extracted within seven and 14 days of collection, respectively. Extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

2.2 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) %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 calibration approach to establish the ICAL curve; all %RSD values were ≤20%. The ICALs met the method requirements.

2.3 Calibration Verification

The method requires that (1) the ICAL be verified prior to and at the end of each 12-hour analysis sequence (or less than 20 samples), and (2) the %D or percent drift (%D_f) values be within ±20% to demonstrate the linearity of the ICAL.

Calibration verification analyses were performed at the required frequency. The %D and/or %D_f values either met the criteria or the outliers had no effects on associated data (*e.g.,* biased-high %D value for a compound not detected in the samples), except for the following:

Calibration Verification ID	Analyte	%D	Bias	Affected Sample	Data Qualifier
Instrument: ECD7 1/27/15, ZB5	Aroclor 1260	21.2%	High	MW-08S-S3 MW-08S-S4	**J**

2.4 Method Blanks

Method blanks were prepared and analyzed as required. Target analytes were not detected at or above the MDLs in the method blanks.

2.5 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, except for the following:

Sample ID	Surrogate Spike	%R	Control Limit	Associated Compound	Data Qualifier
JT-MW-01S-GW	Decachlorobiphenyl	28.2%	29-120%	Aroclor 1248 Aroclor 1254 Aroclor 1260 Aroclor 1262 Aroclor 1268	**UJ**

2.6 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

LCS and/or LCSD analyses were performed as required by the method. All %R and RPD values met the laboratory control criteria.

2.7 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD analyses were performed on project samples at the adequate frequency. All %R and RPD values for met the laboratory control criteria, except for the following:

Parent Sample ID	Analyte	MS %R	MSD %R	Control Limit	RPD	Affected Sample	Data Qualifier
JT-11	Aroclor 1260	274%	586%	58-120%	49.5%	JT-11	**J**

2.8 Target Compound Identification

Aroclor 1242, Aroclor 1248, Aroclor 1254, and/or Aroclor 1260 were reported at levels above the MRLs in selected samples. Sample chromatograms and peak responses indicated no anomalies in relation to Aroclor identification.

The dual column RPD values for Aroclors detections at or above their RLs were greater than 40% in selected samples; the results were qualified (J) as estimated.

2.9 Target Compound Quantitation and Method Reporting Limits

The MRLs were supported with adequate ICAL calibration concentrations. Sample quantitation and reporting was correctly performed. In some cases, RLs were raised exceeding the instrument calibration ranges (where analyte was not detected) due to matrix interference associated with samples. These RLs were flagged (UJ).

Selected samples contained target analytes at elevated levels that required dilution; the MDLs/RLs were raised proportionally, including analytes that were not detected at or above the MDLs. The QAPP goals for quantitation limits were achieved.

2.10 Field Duplicates

Field duplicates were submitted for PCBs analyses. Sample results, RPD (or concentration difference) values, and data qualification for detected analytes were presented in **Appendix A**.

2.11 Overall Assessment of PCB Aroclors Data Usability

Based on the information submitted by the laboratory, PCB Aroclors data are of known quality and acceptable for use as qualified.

3. Total and Dissolved Metals by ICP/MS and CVAA (EPA Methods 200.8 and SW846 Methods 7470A and 7471A)

3.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport.

Soil and Water samples should be analyzed within 180 days of collection for ICP/MS metals and 28 days for mercury. Samples were analyzed within the required holding times.

3.2 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 method criteria.

3.3 Initial Calibration (ICAL)

The ICP/MS method requires that (1) a blank and one calibration standard be used in establishing the analytical curve, (2) the average of replicate exposures be reported for all standards, QC, and sample analyses, and (3) if a blank and five calibration standards be employed to establish the analytical curve, the linearity of the calibration curve should meet the criteria of correlation coefficient ≥ 0.995. All ICALs met the method requirements.

The CVAA method requires that a blank and five calibration standards be employed to establish the analytical curve, the linearity of the calibration curve should meet the criteria of correlation coefficient ≥ 0.995. All ICALs met the method requirements.

3.4 Calibration Verification (ICV and CCV)

Initial calibration verifications (ICVs) and continuing calibration verifications (CCVs) for ICP/MS and CVAA were analyzed at the required frequency. The %R values met the control criteria (90 – 110% for ICP/MS; 80-120% for CVAA).

3.5 Blanks

Calibration Blanks: Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) were not analyzed after calibration verification standards. Target analytes were either not detected at or above the MDLs in the ICBs and CCBs, or the detections had no adverse effects on data quality (*e.g.*, sample results were qualified based on detections in associated method blank). Negative detections in ICBVs/CCBs were examined and determined to have no effects on data usability..

Preparation Blanks: Preparation blanks were prepared and analyzed as required. Target analytes were not detected at or above the MDLs in preparation blanks.

3.6 Laboratory Control Sample (LCS)

LCS analyses were performed as required by the method. All %R values were within the project control limits.

3.7 Laboratory Duplicate Analysis

Laboratory duplicate analyses were performed on project samples at the adequate frequency (>5% of field sample). The RPD or concentration difference values met the laboratory control criteria, except for the following:

Parent Sample	Analyte	%RSD	Control Limit	Affected Sample	Data Qualifier
MW-08S-S2	Lead, Total	21.5%	≤20%	MW-08S-S2	**J**

3.8 Matrix Spike (MS)

MS analyses were performed on project and batch QC samples at the adequate frequency. The %R values met the laboratory control criteria.

3.9 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 (60 - 125%).

3.10 ICP Serial Dilution

Serial dilution analysis was performed on project and batch QC samples at the required frequency. The %D values met the method control limits for all positive results in original analysis were greater than 100xMDLs for ICP/MS analyses.

3.11 ICP Interference Check Sample

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.

3.12 Method Reporting Limits

Sample-specific RLs were supported with adequate initial calibration concentrations, and achieved the QAPP goals for quantitation limits.

3.13 Field Duplicates

One pair of field duplicates were submitted for total recoverable and dissolved iron, magnesium, manganese, and potassium, and total recoverable arsenic. Sample results, RPD (or concentration difference) values, and data qualification were presented in **Appendix A**.

3.14 Overall Assessment of Metals Data Usability

Total recoverable metal concentrations were either greater or equal to those of dissolved metals; or the difference was within experimental errors (*i.e.,* %D value ≤10%) in each sample. No data qualifying action was taken in this regard.

Based on the information submitted by the laboratory, metals data are of known quality and acceptable for use, as qualified.

4. Diesel & Motor Oil Range Total Petroleum Hydrocarbon and Hydrocarbon Identification by GC/FID (Methods NWTPH-Dx and NWTPH-HCID)

4.1 Holding Times

Soil and acid-preserved water samples should be extracted within 14 days of collection; and extracts should be analyzed within 40 days of extraction. All samples were extracted and analyzed within the required holding times.

4.2 Initial Calibration (ICAL)

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 RLs, 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 values of RFs (%RSD ≤20%, according to EPA SW 846 Method 8000), and was acceptable for both diesel and motor oil range TPH.

4.3 Calibration Verification

The method requires that (1) a mid-range check standard be analyzed prior to and after each analytical batch, and (2) the %D_f value be within ±15% of the true value. Calibration verification was performed at required frequency. The %D_f met the ±15% criterion.

4.4 Method Blank

A method blank was prepared and analyzed as required by the method. TPH-Diesel and Motor Oil were not detected at or above the MDLs in the method blank.

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 (MS) and MS Duplicate (MSD)

MS/MSD analyses were performed on project samples at the adequate frequency (>5% of field samples). All %R and RPD values for met the laboratory control criteria, except for the following:

Parent Sample ID	Analyte	MS %R	MSD %R	Control Limit	RPD	Affected Sample	Data Qualifier
JT-US-39-S2	TPH-Diesel	187%	86.7%	62-120%	51.0%	JT-US-39-S2	J

4.7 Laboratory Control Samples (LCS) and LCS Duplicate (LCSD)

LCS and LCSD analyses were performed as required by the method, and in lieu of matrix spike and laboratory duplicate analyses because project sample-specific matrix spike or duplicate analyses were not performed in the preparation batch. All reported %R and RPD values met the laboratory control limits.

4.8 Target Compound Identification

The results were reported as diesel #2 (C12 - C24) and motor oil (C24 - C38), as specified by the method. Chromatographic patterns of the diesel and motor oil range TPH reported in samples resembled those for diesel and motor oil standards used for ICAL.

4.9 Reporting Limits

The RLs met the quantitation limit goals specified in the SAP for diesel and motor oil range TPHs. Sample-specific RLs were adjusted for sample moisture content and amount extracted as required.

4.10 Overall Assessment of TPH Data Usability

Based on the information submitted by the laboratory, all TPH data are of known quality and acceptable for use as qualified.

5. Conventional Parameters (TS, TSS, TVS, TOC, Ammonia, and Total Sulfide)

5.1 Sample Management and Holding Times

No anomalies were identified in relation to sample preservation, handling, and transport, except discussed in Section 1.1.

Sediment samples should be analyzed within 7 days for ammonia and sulfide, and 14 days for TS, TVS, and TOC. Water samples should be analyzed within 7 days for TSS. All samples were analyzed within the required holding times.

5.2 Instrument Calibration

The initial calibrations were established for TOC, ammonia, and total sulfide analyses using one blank and at least five levels of standards. The correlation coefficients (r) of the initial calibration curves were ≥0.995, and met the method criteria.

5.3 Calibration Verification

ICV and CCV analyses were performed for TOC, ammonia, and total sulfide as required by the methods. All ICV and CCV %R values were within the laboratory control limits (90 – 110%).

5.4 Blanks

Calibration Blanks: ICBs and CCBs were analyzed for TVS, TOC, ammonia, and total sulfide as required by the methods. No target analytes were positively reported in ICBs and CCBs at or above the MDLs.

Method Blanks: Method blanks were prepared and analyzed for TS TVS, TOC, ammonia, and total sulfide as required by the methods. No target analytes were detected at or above the RLs in method blanks.

5.5 Laboratory Replicate Analyses

Laboratory triplicate analyses were formed on project samples as requested. The RPD and %RSD values were within the project control criteria, except for the following:

Parent Sample	Analyte	%RSD	Control Limit	Affected Sample	Data Qualifier
JT-4	Total Suspended Solids	41.6%	≤20%	JT-4	**J**
JT-US-46-S2	TOC	53.5%	≤20%	JT-US-46-S2	**J**
JT-US-55-S1	TOC	71.9%	≤20%	JT-US-55-S1	**J**
JT-MW-01S-S5	TOC	34.3%	≤20%	JT-MW-01S-S5	**J**

5.6 Matrix Spike (MS)

MS analyses were performed on project samples as requested. The %R values were within the laboratory control limits, except for the following:

Parent Sample	Analyte	%R	Control Limit	Affected Sample	Data Qualifier
JT-US-46-S2	TOC	63.1%	75-125%	JT-US-46-S2	**J**
JT-US-55-S1	TOC	35.7%	75-125%	JT-US-55-S1	**J**
JT-MW-01S-S5	TOC	72.1%	75-125%	JT-MW-01S-S5	**J**

5.7 Laboratory Control Samples (LCS)

LCS analyses were performed as required by the methods. All LCS %R values were within the laboratory control limits.

5.8 Method Reporting Limits

The RLs were supported with adequate initial calibration concentrations. Sample-specific RLs achieved the project requirements for quantitation limits.

5.9 Field Duplicates

No field duplicates were submitted for conventional parameters analyses.

5.10 Overall Assessment of Conventional Parameters Data Usability

Conventional parameters data are of known quality and acceptable for use, as qualified.

SUMMARY

Table I. Summary of Qualified Data, Final Qualifiers, and Qualified Reasons

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-25978-ZM61A 14-25980-ZM61C 14-25982-ZM61E 14-25983-ZM61F 14-25984-ZM61G 14-25985-ZM61H	JT-6 SRW-1 JT-12 SRW-2 JT-7 MW-200	VOCs	**J/UJ**	TEMP
14-26639-ZN93B 14-25981-ZM61D 14-25982-ZM61E 14-25983-ZM61F	SRW-3 JT-10 JT-12 SRW-2	VOCs	**J/UJ**	HT
14-25978-ZM61A 14-26640-ZN93C 14-26642-ZN93E	JT-6 JT-11 JT-1100	Chlorobenzene	**J**	HT
14-25978-ZM61A	JT-6	Acrolein	**UJ**	Temp,CCVL
14-25978-ZM61A	JT-6	Hexachlorobutadiene	**UJ**	Temp,CCVL,BSL
14-25979-ZM61B	JT-5	Acrolein	**UJ**	CCVL
14-25979-ZM61B	JT-5	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25980-ZM61C	SRW-1	Acrolein	**UJ**	Temp,CCVL
14-25980-ZM61C	SRW-1	Hexachlorobutadiene	**UJ**	Temp,CCVL,BSL
14-25981-ZM61D	JT-10	Hexachlorobutadiene	**UJ**	HT,CCVL,BSL
14-25982-ZM61E	JT-12	Hexachlorobutadiene	**UJ**	Temp,HT,CCVL
14-25983-ZM61F	SRW-2	Hexachlorobutadiene	**UJ**	Temp,HT,CCVL
14-25984-ZM61G	JT-7	1,2,4-Trimethylbenzene	**UJ**	Temp,MB
14-25984-ZM61G	JT-7	Hexachlorobutadiene	**UJ**	Temp,CCVL,BSL
14-25984-ZM61G	JT-7	Toluene	**UJ**	Temp,MB
14-25985-ZM61H	MW-200	Hexachlorobutadiene	**UJ**	Temp,CCVL,BSL
14-25986-ZM61I	JT-9	1,2,4-Trichlorobenzene	**U**	MB
14-25986-ZM61I	JT-9	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25986-ZM61I	JT-9	Toluene	**U**	MB
14-25987-ZM61J	JT-3	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25988-ZM61K	TRIP BLANKS (1)	Acrolein	**UJ**	CCVL
14-25988-ZM61K	TRIP BLANKS (1)	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25988-ZM61K	TRIP BLANKS (1)	Methylene Chloride	**U**	MB
14-25989-ZM61L	TRIP BLANKS (2)	Acrolein	**UJ**	CCVL
14-25989-ZM61L	TRIP BLANKS (2)	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25989-ZM61L	TRIP BLANKS (2)	Methylene Chloride	**U**	MB
14-25990-ZM61M	TRIP BLANKS (3)	Acrolein	**UJ**	CCVL
14-25990-ZM61M	TRIP BLANKS (3)	Hexachlorobutadiene	**UJ**	CCVL,BSL
14-25990-ZM61M	TRIP BLANKS (3)	Methylene Chloride	**U**	MB
14-26638-ZN93A	MW-100	1,2-Dibromo-3-chloropropane	**UJ**	CCVL
14-26638-ZN93A	MW-100	2-Butanone	**UJ**	CCVL
14-26638-ZN93A	MW-100	2-Hexanone	**UJ**	CCVL
14-26638-ZN93A	MW-100	4-Methyl-2-pentanone	**UJ**	CCVL
14-26638-ZN93A	MW-100	Acetone	**UJ**	TB,CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-26638-ZN93A	MW-100	Acrolein	**UJ**	CCVL
14-26638-ZN93A	MW-100	Acrylonitrile	**UJ**	CCVL
14-26638-ZN93A	MW-100	Bromomethane	**UJ**	CCVL
14-26638-ZN93A	MW-100	Chloromethane	**UJ**	CCVL
14-26638-ZN93A	MW-100	Hexachlorobutadiene	**UJ**	BSDL,CCVL
14-26638-ZN93A	MW-100	*trans*-1,4-Dichloro-2-butene	**UJ**	CCVL
14-26638-ZN93A	MW-100	Vinyl Acetate	**UJ**	CCVL
14-26639-ZN93B	SRW-3	1,2-Dibromo-3-chloropropane	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	2-Butanone	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	2-Hexanone	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	4-Methyl-2-pentanone	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Acetone	**UJ**	HT,TB,CCVL
14-26639-ZN93B	SRW-3	Acrolein	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Acrylonitrile	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Bromomethane	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Chloromethane	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Hexachlorobutadiene	**UJ**	HT,BSDL,CCVL
14-26639-ZN93B	SRW-3	*trans*-1,4-Dichloro-2-butene	**UJ**	HT,CCVL
14-26639-ZN93B	SRW-3	Vinyl Acetate	**UJ**	HT,CCVL
14-26640-ZN93C	JT-11	1,2-Dibromo-3-chloropropane	**UJ**	CCVL
14-26640-ZN93C	JT-11	2-Butanone	**UJ**	CCVL
14-26640-ZN93C	JT-11	2-Hexanone	**UJ**	CCVL
14-26640-ZN93C	JT-11	4-Methyl-2-pentanone	**UJ**	CCVL
14-26640-ZN93C	JT-11	Acetone	**UJ**	CCVL
14-26640-ZN93C	JT-11	Acrolein	**UJ**	CCVL
14-26640-ZN93C	JT-11	Acrylonitrile	**UJ**	CCVL
14-26640-ZN93C	JT-11	Bromomethane	**UJ**	CCVL
14-26640-ZN93C	JT-11	Chloromethane	**UJ**	CCVL
14-26640-ZN93C	JT-11	Hexachlorobutadiene	**UJ**	BSDL,MSDL,CC VL
14-26640-ZN93C	JT-11	*trans*-1,4-Dichloro-2-butene	**UJ**	CCVL
14-26640-ZN93C	JT-11	Vinyl Acetate	**UJ**	CCVL
14-26642-ZN93E	JT-1100	1,2-Dibromo-3-chloropropane	**UJ**	CCVL
14-26642-ZN93E	JT-1100	2-Butanone	**UJ**	CCVL
14-26642-ZN93E	JT-1100	2-Hexanone	**UJ**	CCVL
14-26642-ZN93E	JT-1100	4-Methyl-2-pentanone	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Acetone	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Acrolein	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Acrylonitrile	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Bromomethane	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Chloromethane	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Hexachlorobutadiene	**UJ**	BSDL,CCVL
14-26642-ZN93E	JT-1100	*trans*-1,4-Dichloro-2-butene	**UJ**	CCVL
14-26642-ZN93E	JT-1100	Vinyl Acetate	**UJ**	CCVL
14-26644-ZN93G	Trip Blank 1	Acetone	**U**	TB
14-26644-ZN93G	Trip Blank 1	Methylene Chloride	**U**	MB
14-27074-ZO63A	JT-US-53-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27074-ZO63A	JT-US-53-S1	2-Hexanone	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27074-ZO63A	JT-US-53-S1	4-Methyl-2-pentanone	**UJ**	CCVL
14-27074-ZO63A	JT-US-53-S1	Bromomethane	**J**	CCVL
14-27074-ZO63A	JT-US-53-S1	Chloromethane	**UJ**	CCVL
14-27074-ZO63A	JT-US-53-S1	Iodomethane	**J**	CCVL
14-27074-ZO63A	JT-US-53-S1	Naphthalene	**J**	CCVL
14-27075-ZO63B	JT-US-53-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	2-Hexanone	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	4-Methyl-2-pentanone	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	Bromomethane	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	Chloromethane	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	Iodomethane	**UJ**	CCVL
14-27075-ZO63B	JT-US-53-S2	Naphthalene	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	2-Hexanone	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	4-Methyl-2-pentanone	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	Bromomethane	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	Chloromethane	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	Iodomethane	**UJ**	CCVL
14-27076-ZO63C	JT-US-53-S3	Naphthalene	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	2-Hexanone	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	4-Methyl-2-pentanone	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	Acetone	**J**	IAR
14-27077-ZO63D	JT-US-53-S4	Bromomethane	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	Chloromethane	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	Iodomethane	**UJ**	CCVL
14-27077-ZO63D	JT-US-53-S4	Methylene Chloride	**U**	MB
14-27077-ZO63D	JT-US-53-S4	Naphthalene	**JT**	CCVL
14-27078-ZO63E	JT-US-52-S2	Acetone	**J**	CCVH,BSH
14-27078-ZO63E	JT-US-52-S2	Bromoethane	**UJ**	CCVL,BSL
14-27078-ZO63E	JT-US-52-S2	Bromomethane	**UJ**	CCVL
14-27078-ZO63E	JT-US-52-S2	Chloroethane	**UJ**	CCVL,BSL
14-27078-ZO63E	JT-US-52-S2	Chloromethane	**UJ**	CCVL
14-27078-ZO63E	JT-US-52-S2	Iodomethane	**UJ**	CCVL
14-27078-ZO63E	JT-US-52-S2	Vinyl Chloride	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	2-Hexanone	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	4-Methyl-2-pentanone	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	Acetone	**J**	IAR
14-27079-ZO63F	JT-US-52-S4	Bromomethane	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	Chloromethane	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	Iodomethane	**UJ**	CCVL
14-27079-ZO63F	JT-US-52-S4	Methylene Chloride	**U**	MB
14-27079-ZO63F	JT-US-52-S4	Naphthalene	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	2-Hexanone	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	4-Methyl-2-pentanone	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	Bromomethane	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27080-ZO63G	JT-US-50-S1	Chloromethane	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	Iodomethane	**UJ**	CCVL
14-27080-ZO63G	JT-US-50-S1	Naphthalene	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	2-Hexanone	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	4-Methyl-2-pentanone	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	Acetone	**J**	IAR
14-27081-ZO63H	JT-US-50-S2	Bromomethane	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	Chloromethane	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	Iodomethane	**UJ**	CCVL
14-27081-ZO63H	JT-US-50-S2	Methylene Chloride	**U**	MB
14-27081-ZO63H	JT-US-50-S2	Naphthalene	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	2-Hexanone	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	4-Methyl-2-pentanone	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	Acetone	**J**	IAR
14-27082-ZO63I	JT-US-50-S3	Bromomethane	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	Chloromethane	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	Iodomethane	**UJ**	CCVL
14-27082-ZO63I	JT-US-50-S3	Methylene Chloride	**U**	MB
14-27082-ZO63I	JT-US-50-S3	Naphthalene	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	2-Hexanone	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	4-Methyl-2-pentanone	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	Bromomethane	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	Chloromethane	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	Iodomethane	**UJ**	CCVL
14-27083-ZO63J	JT-US-51-S1	Naphthalene	**J**	IAR,CCVL
14-27084-ZO63K	JT-US-51-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	2-Hexanone	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	4-Methyl-2-pentanone	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	Bromomethane	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	Chloromethane	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	Iodomethane	**UJ**	CCVL
14-27084-ZO63K	JT-US-51-S2	Methylene Chloride	**U**	MB
14-27084-ZO63K	JT-US-51-S2	Naphthalene	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	2-Hexanone	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	4-Methyl-2-pentanone	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	Bromomethane	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	Chloromethane	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	Iodomethane	**UJ**	CCVL
14-27085-ZO63L	JT-US-51-S3	Methylene Chloride	**U**	MB
14-27085-ZO63L	JT-US-51-S3	Naphthalene	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	2-Hexanone	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	4-Methyl-2-pentanone	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	Acetone	**J**	IAR

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27086-ZO63M	JT-US-51-S4	Bromomethane	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	Chloromethane	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	Iodomethane	**UJ**	CCVL
14-27086-ZO63M	JT-US-51-S4	Methylene Chloride	**U**	MB
14-27086-ZO63M	JT-US-51-S4	Naphthalene	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	2-Hexanone	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	4-Methyl-2-pentanone	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	Bromomethane	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	Chloromethane	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	Iodomethane	**UJ**	CCVL
14-27087-ZO63N	JT-US-45-S2	Methylene Chloride	**U**	MB
14-27087-ZO63N	JT-US-45-S2	Naphthalene	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	2-Hexanone	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	4-Methyl-2-pentanone	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	Acetone	**J**	IAR
14-27088-ZO63O	JT-US-45-S4	Bromomethane	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	Chloromethane	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	Iodomethane	**UJ**	CCVL
14-27088-ZO63O	JT-US-45-S4	Methylene Chloride	**U**	MB
14-27088-ZO63O	JT-US-45-S4	Naphthalene	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	2-Hexanone	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	4-Methyl-2-pentanone	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	Bromomethane	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	Chloromethane	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	Iodomethane	**UJ**	CCVL
14-27089-ZO63P	JT-US-44-S1	Naphthalene	**J**	CCVL
14-27090-ZO63Q	JT-US-44-S2	1,2,4-Trichlorobenzene	**UJ**	MSDL
14-27090-ZO63Q	JT-US-44-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	2-Hexanone	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	4-Methyl-2-pentanone	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	Bromoethane	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	Bromomethane	**UJ**	CCVL,BSL
14-27090-ZO63Q	JT-US-44-S2	Chloroethane	**UJ**	CCVL,BSL
14-27090-ZO63Q	JT-US-44-S2	Chloromethane	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	Iodomethane	**UJ**	CCVL
14-27090-ZO63Q	JT-US-44-S2	Naphthalene	**J**	CCVL
14-27090-ZO63Q	JT-US-44-S2	Vinyl Chloride	**UJ**	CCVL
14-27091-ZO63R	JT-US-44-S3	Bromoethane	**UJ**	CCVL
14-27091-ZO63R	JT-US-44-S3	Bromomethane	**UJ**	CCVL,BSL
14-27091-ZO63R	JT-US-44-S3	Chloroethane	**UJ**	CCVL,BSL
14-27091-ZO63R	JT-US-44-S3	Chloromethane	**UJ**	CCVL
14-27091-ZO63R	JT-US-44-S3	Iodomethane	**UJ**	CCVL
14-27091-ZO63R	JT-US-44-S3	Methylene Chloride	**U**	MB
14-27091-ZO63R	JT-US-44-S3	Vinyl Chloride	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Acetone	**J**	IAR,CCVH

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27098-ZO64A	JT-US-46-S2	Bromoethane	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Bromomethane	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Chloroethane	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Chloromethane	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Iodomethane	**UJ**	CCVL
14-27098-ZO64A	JT-US-46-S2	Methylene Chloride	**U**	MB
14-27098-ZO64A	JT-US-46-S2	Vinyl Chloride	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	Bromomethane	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	Chloroethane	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	Chloromethane	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	Iodomethane	**UJ**	CCVL
14-27099-ZO64B	JT-US-46-S4	Methylene Chloride	**U**	MB
14-27099-ZO64B	JT-US-46-S4	Vinyl Chloride	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Acetone	**J**	CCVH
14-27100-ZO64C	JT-US-47-S2	Bromoethane	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Bromomethane	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Chloroethane	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Chloromethane	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Iodomethane	**UJ**	CCVL
14-27100-ZO64C	JT-US-47-S2	Methylene Chloride	**U**	MB
14-27100-ZO64C	JT-US-47-S2	Vinyl Chloride	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Acetone	**J**	CCVH
14-27101-ZO64D	JT-US-47-S3	Bromoethane	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Bromomethane	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Chloroethane	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Chloromethane	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Iodomethane	**UJ**	CCVL
14-27101-ZO64D	JT-US-47-S3	Methylene Chloride	**U**	MB
14-27101-ZO64D	JT-US-47-S3	Vinyl Chloride	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Acetone	**J**	IAR,CCVH
14-27102-ZO64E	JT-US-47-S4	Bromoethane	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Bromomethane	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Chloroethane	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Chloromethane	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Iodomethane	**UJ**	CCVL
14-27102-ZO64E	JT-US-47-S4	Methylene Chloride	**U**	MB
14-27102-ZO64E	JT-US-47-S4	Vinyl Chloride	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Bromoethane	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Bromomethane	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Chloroethane	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Chloromethane	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Iodomethane	**UJ**	CCVL
14-27103-ZO64F	JT-US-41-S2	Methylene Chloride	**U**	MB
14-27103-ZO64F	JT-US-41-S2	Vinyl Chloride	**UJ**	CCVL
14-27104-ZO64G	JT-US-49-S1	Acetone	**J**	CCVH
14-27104-ZO64G	JT-US-49-S1	Bromoethane	**UJ**	CCVL
14-27104-ZO64G	JT-US-49-S1	Bromomethane	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27104-ZO64G	JT-US-49-S1	Chloroethane	**UJ**	CCVL
14-27104-ZO64G	JT-US-49-S1	Chloromethane	**UJ**	CCVL
14-27104-ZO64G	JT-US-49-S1	Iodomethane	**UJ**	CCVL
14-27104-ZO64G	JT-US-49-S1	Methylene Chloride	**U**	MB
14-27104-ZO64G	JT-US-49-S1	Vinyl Chloride	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Bromoethane	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Bromomethane	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Chloroethane	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Chloromethane	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Iodomethane	**UJ**	CCVL
14-27105-ZO64H	JT-US-49-S2	Methylene Chloride	**U**	MB
14-27105-ZO64H	JT-US-49-S2	Vinyl Chloride	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Acetone	**J**	CCVH
14-27106-ZO64I	JT-US-49-S3	Bromoethane	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Bromomethane	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Chloroethane	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Chloromethane	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Iodomethane	**UJ**	CCVL
14-27106-ZO64I	JT-US-49-S3	Methylene Chloride	**U**	MB
14-27106-ZO64I	JT-US-49-S3	Vinyl Chloride	**J**	CCVL
14-27107-ZO64J	JT-US-48-S2	Acetone	**J**	CCVH
14-27107-ZO64J	JT-US-48-S2	Bromoethane	**UJ**	CCVL
14-27107-ZO64J	JT-US-48-S2	Bromomethane	**UJ**	CCVL
14-27107-ZO64J	JT-US-48-S2	Chloroethane	**UJ**	CCVL
14-27107-ZO64J	JT-US-48-S2	Chloromethane	**UJ**	CCVL
14-27107-ZO64J	JT-US-48-S2	Iodomethane	**UJ**	CCVL
14-27107-ZO64J	JT-US-48-S2	Methylene Chloride	**U**	MB
14-27107-ZO64J	JT-US-48-S2	Vinyl Chloride	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Bromoethane	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Bromomethane	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Chloroethane	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Chloromethane	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Iodomethane	**UJ**	CCVL
14-27108-ZO64K	JT-US-48-S4	Methylene Chloride	**U**	MB
14-27108-ZO64K	JT-US-48-S4	Vinyl Chloride	**J**	CCVL
14-27109-ZO64L	JT-US-42-S2	Acetone	**J**	CCVH
14-27109-ZO64L	JT-US-42-S2	Bromoethane	**UJ**	CCVL
14-27109-ZO64L	JT-US-42-S2	Bromomethane	**UJ**	CCVL
14-27109-ZO64L	JT-US-42-S2	Chloroethane	**UJ**	CCVL
14-27109-ZO64L	JT-US-42-S2	Chloromethane	**UJ**	CCVL
14-27109-ZO64L	JT-US-42-S2	Iodomethane	**UJ**	CCVL
14-27109-ZO64L	JT-US-42-S2	Methylene Chloride	**U**	MB
14-27109-ZO64L	JT-US-42-S2	Vinyl Chloride	**UJ**	CCVL
14-27110-ZO64M	JT-US-42-S3	Acetone	**J**	IAR,CCVH
14-27110-ZO64M	JT-US-42-S3	Bromoethane	**UJ**	CCVL
14-27110-ZO64M	JT-US-42-S3	Bromomethane	**UJ**	CCVL
14-27110-ZO64M	JT-US-42-S3	Chloroethane	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27110-ZO64M	JT-US-42-S3	Chloromethane	**UJ**	CCVL
14-27110-ZO64M	JT-US-42-S3	Iodomethane	**UJ**	CCVL
14-27110-ZO64M	JT-US-42-S3	Methylene Chloride	**U**	MB
14-27110-ZO64M	JT-US-42-S3	Vinyl Chloride	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Acetone	**J**	CCVH
14-27111-ZO64N	JT-US-40-S2	Bromoethane	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Bromomethane	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Chloroethane	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Chloromethane	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Iodomethane	**UJ**	CCVL
14-27111-ZO64N	JT-US-40-S2	Methylene Chloride	**U**	MB
14-27111-ZO64N	JT-US-40-S2	Vinyl Chloride	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	Bromomethane	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	Chloroethane	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	Chloromethane	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	Iodomethane	**UJ**	CCVL
14-27112-ZO64O	JT-US-40-S3	Vinyl Chloride	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	Bromomethane	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	Chloroethane	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	Chloromethane	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	Iodomethane	**UJ**	CCVL
14-27122-ZO65A	JT-US-43-S2	Methylene Chloride	**UJ**	MB,CCVL
14-27123-ZO65B	JT-US-43-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27123-ZO65B	JT-US-43-S3	Bromomethane	**UJ**	CCVL
14-27123-ZO65B	JT-US-43-S3	Chloroethane	**UJ**	CCVL
14-27123-ZO65B	JT-US-43-S3	Chloromethane	**UJ**	CCVL
14-27123-ZO65B	JT-US-43-S3	Iodomethane	**UJ**	CCVL
14-27123-ZO65B	JT-US-43-S3	Methylene Chloride	**UJ**	MB,CCVL
14-27124-ZO65C	JT-US-39-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27124-ZO65C	JT-US-39-S1	Bromomethane	**UJ**	CCVL
14-27124-ZO65C	JT-US-39-S1	Chloroethane	**UJ**	CCVL
14-27124-ZO65C	JT-US-39-S1	Chloromethane	**UJ**	CCVL
14-27124-ZO65C	JT-US-39-S1	Iodomethane	**UJ**	CCVL
14-27124-ZO65C	JT-US-39-S1	Methylene Chloride	**UJ**	MB,CCVL
14-27125-ZO65D	JT-US-39-S2	2-Butanone	**J**	CCVH
14-27125-ZO65D	JT-US-39-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27125-ZO65D	JT-US-39-S2	Bromomethane	**UJ**	CCVL
14-27125-ZO65D	JT-US-39-S2	Chloroethane	**UJ**	CCVL
14-27125-ZO65D	JT-US-39-S2	Chloromethane	**UJ**	CCVL
14-27125-ZO65D	JT-US-39-S2	Iodomethane	**UJ**	CCVL
14-27125-ZO65D	JT-US-39-S2	Methylene Chloride	**UJ**	MB,CCVL
14-27126-ZO65E	JT-US-54-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27126-ZO65E	JT-US-54-S2	Bromomethane	**UJ**	CCVL
14-27126-ZO65E	JT-US-54-S2	Chloroethane	**UJ**	CCVL
14-27126-ZO65E	JT-US-54-S2	Chloromethane	**UJ**	CCVL
14-27126-ZO65E	JT-US-54-S2	Iodomethane	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27126-ZO65E	JT-US-54-S2	Methylene Chloride	**UJ**	MB,CCVL
14-27127-ZO65F	JT-US-54-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27127-ZO65F	JT-US-54-S3	Bromomethane	**UJ**	CCVL
14-27127-ZO65F	JT-US-54-S3	Chloroethane	**UJ**	CCVL
14-27127-ZO65F	JT-US-54-S3	Chloromethane	**UJ**	CCVL
14-27127-ZO65F	JT-US-54-S3	Iodomethane	**UJ**	CCVL
14-27127-ZO65F	JT-US-54-S3	Methylene Chloride	**UJ**	MB,CCVL
14-27128-ZO65G	JT-US-55-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27128-ZO65G	JT-US-55-S1	Bromomethane	**UJ**	CCVL
14-27128-ZO65G	JT-US-55-S1	Chloroethane	**UJ**	CCVL
14-27128-ZO65G	JT-US-55-S1	Chloromethane	**UJ**	CCVL
14-27128-ZO65G	JT-US-55-S1	Iodomethane	**UJ**	CCVL
14-27128-ZO65G	JT-US-55-S1	Methylene Chloride	**UJ**	MB,CCVL
14-27129-ZO65H	JT-US-55-S2	2-Butanone	**J**	CCVH
14-27129-ZO65H	JT-US-55-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27129-ZO65H	JT-US-55-S2	Bromomethane	**UJ**	CCVL
14-27129-ZO65H	JT-US-55-S2	Chloroethane	**UJ**	CCVL
14-27129-ZO65H	JT-US-55-S2	Chloromethane	**UJ**	CCVL
14-27129-ZO65H	JT-US-55-S2	Iodomethane	**UJ**	CCVL
14-27129-ZO65H	JT-US-55-S2	Methylene Chloride	**UJ**	MB,CCVL
14-27130-ZO65I	JT-US-56-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27130-ZO65I	JT-US-56-S2	Bromomethane	**UJ**	CCVL
14-27130-ZO65I	JT-US-56-S2	Chloroethane	**UJ**	CCVL
14-27130-ZO65I	JT-US-56-S2	Chloromethane	**UJ**	CCVL
14-27130-ZO65I	JT-US-56-S2	Iodomethane	**UJ**	CCVL
14-27130-ZO65I	JT-US-56-S2	Methylene Chloride	**UJ**	MB,CCVL
14-27130-ZO65I	JT-US-56-S2	Naphthalene	**U**	TB
14-27131-ZO65J	JT-US-56-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27131-ZO65J	JT-US-56-S3	Bromomethane	**UJ**	CCVL
14-27131-ZO65J	JT-US-56-S3	Chloroethane	**UJ**	CCVL
14-27131-ZO65J	JT-US-56-S3	Chloromethane	**UJ**	CCVL
14-27131-ZO65J	JT-US-56-S3	Iodomethane	**UJ**	CCVL
14-27131-ZO65J	JT-US-56-S3	Methylene Chloride	**UJ**	MB,CCVL
14-27132-ZO65K	JT-US-57-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-27132-ZO65K	JT-US-57-S1	Bromomethane	**UJ**	CCVL
14-27132-ZO65K	JT-US-57-S1	Chloroethane	**UJ**	CCVL
14-27132-ZO65K	JT-US-57-S1	Chloromethane	**UJ**	CCVL
14-27132-ZO65K	JT-US-57-S1	Iodomethane	**UJ**	CCVL
14-27132-ZO65K	JT-US-57-S1	Methylene Chloride	**U**	MB
14-27132-ZO65K	JT-US-57-S1	Vinyl Chloride	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	Bromomethane	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	Chloroethane	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	Chloromethane	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	Iodomethane	**UJ**	CCVL
14-27133-ZO65L	JT-US-57-S2	Methylene Chloride	**U**	MB
14-27133-ZO65L	JT-US-57-S2	Naphthalene	**U**	TB
14-27133-ZO65L	JT-US-57-S2	Vinyl Chloride	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27134-ZO65M	Trip Blank	2-Chloroethylvinylether	**UJ**	CCVL
14-27134-ZO65M	Trip Blank	Bromomethane	**UJ**	CCVL
14-27134-ZO65M	Trip Blank	Chloroethane	**UJ**	CCVL
14-27134-ZO65M	Trip Blank	Chloromethane	**UJ**	CCVL
14-27134-ZO65M	Trip Blank	Iodomethane	**UJ**	CCVL
14-27134-ZO65M	Trip Blank	Methylene Chloride	**U**	MB
14-27134-ZO65M	Trip Blank	Naphthalene	**U**	TB
14-27134-ZO65M	Trip Blank	Vinyl Chloride	**UJ**	CCVL
14-27581-ZP39A	MW-08S-S2	2-Butanone	**U**	CCVL
14-27581-ZP39A	MW-08S-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-27581-ZP39A	MW-08S-S2	Acetone	**J**	CCVL
14-27581-ZP39A	MW-08S-S2	Acrolein	**UJ**	CCVL
14-27581-ZP39A	MW-08S-S2	Acrylonitrile	**UJ**	CCVL
14-27581-ZP39A	MW-08S-S2	Vinyl Acetate	**UJ**	CCVL
14-27582-ZP39B	MW-08S-S3	2-Butanone	**JT**	CCVL
14-27582-ZP39B	MW-08S-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-27582-ZP39B	MW-08S-S3	Acetone	**J**	CCVL
14-27582-ZP39B	MW-08S-S3	Acrolein	**UJ**	CCVL
14-27582-ZP39B	MW-08S-S3	Acrylonitrile	**UJ**	CCVL
14-27582-ZP39B	MW-08S-S3	Methylene Chloride	**U**	MB
14-27582-ZP39B	MW-08S-S3	Naphthalene	**U**	MB
14-27582-ZP39B	MW-08S-S3	Vinyl Acetate	**UJ**	CCVL
14-27583-ZP39C	MW-08S-S4	2-Butanone	**JT**	CCVL
14-27583-ZP39C	MW-08S-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-27583-ZP39C	MW-08S-S4	Acetone	**J**	CCVL
14-27583-ZP39C	MW-08S-S4	Acrolein	**UJ**	CCVL
14-27583-ZP39C	MW-08S-S4	Acrylonitrile	**UJ**	CCVL
14-27583-ZP39C	MW-08S-S4	Methylene Chloride	**U**	MB
14-27583-ZP39C	MW-08S-S4	Naphthalene	**U**	MB
14-27583-ZP39C	MW-08S-S4	Vinyl Acetate	**UJ**	CCVL
14-27584-ZP39D	MW-07S-S1	Acrolein	**UJ**	CCVL
14-27584-ZP39D	MW-07S-S1	Chloroethane	**UJ**	CCVL
14-27584-ZP39D	MW-07S-S1	Methylene Chloride	**U**	MB
14-27584-ZP39D	MW-07S-S1	Naphthalene	**U**	MB
14-27585-ZP39E	JT-MW-07S-S2	Acrolein	**UJ**	CCVL
14-27585-ZP39E	JT-MW-07S-S2	Chloroethane	**UJ**	CCVL
14-27586-ZP39F	JT-MW-07S-S3	Acrolein	**UJ**	CCVL
14-27586-ZP39F	JT-MW-07S-S3	Chloroethane	**UJ**	CCVL
14-27586-ZP39F	JT-MW-07S-S3	Methylene Chloride	**U**	MB
14-27586-ZP39F	JT-MW-07S-S3	Naphthalene	**U**	MB
14-27587-ZP39G	JT-MW-07S-S4	Acrolein	**UJ**	CCVL
14-27587-ZP39G	JT-MW-07S-S4	Chloroethane	**UJ**	CCVL
14-27587-ZP39G	JT-MW-07S-S4	Methylene Chloride	**U**	MB
14-27588-ZP39H	JT-MW-06D-S2	Acrolein	**UJ**	CCVL
14-27588-ZP39H	JT-MW-06D-S2	Chloroethane	**UJ**	CCVL
14-27589-ZP39I	JT-MW-06D-S3	Acrolein	**UJ**	CCVL
14-27589-ZP39I	JT-MW-06D-S3	Chloroethane	**UJ**	CCVL
14-27589-ZP39I	JT-MW-06D-S3	Methylene Chloride	**U**	MB

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-27589-ZP39I	JT-MW-06D-S3	Naphthalene	**U**	MB
14-27590-ZP39J	JT-MW-06D-S4	Acrolein	**UJ**	CCVL
14-27590-ZP39J	JT-MW-06D-S4	Chloroethane	**UJ**	CCVL
14-27590-ZP39J	JT-MW-06D-S4	Methylene Chloride	**U**	MB
14-27591-ZP39K	JT-MW-06D-S5	Acrolein	**UJ**	CCVL
14-27591-ZP39K	JT-MW-06D-S5	Chloroethane	**UJ**	CCVL
14-27591-ZP39K	JT-MW-06D-S5	Methylene Chloride	**U**	MB
14-27592-ZP39L	JT-MW-03D-S1	Acrolein	**UJ**	CCVL
14-27592-ZP39L	JT-MW-03D-S1	Chloroethane	**UJ**	CCVL
14-27593-ZP39M	JT-MW-03D-S2	Acrolein	**UJ**	CCVL
14-27593-ZP39M	JT-MW-03D-S2	Chloroethane	**UJ**	CCVL
14-27593-ZP39M	JT-MW-03D-S2	Methylene Chloride	**U**	MB
14-27593-ZP39M	JT-MW-03D-S2	Naphthalene	**U**	MB
14-27594-ZP39N	JT-MW-03D-S3	Acrolein	**UJ**	CCVL
14-27594-ZP39N	JT-MW-03D-S3	Chloroethane	**UJ**	CCVL
14-27594-ZP39N	JT-MW-03D-S3	Methylene Chloride	**U**	MB
14-27595-ZP39O	JT-MW-03D-S4	Acrolein	**UJ**	CCVL
14-27595-ZP39O	JT-MW-03D-S4	Chloroethane	**UJ**	CCVL
14-27595-ZP39O	JT-MW-03D-S4	Methylene Chloride	**U**	MB
14-27596-ZP39P	JT-MW-03D-S5	Acrolein	**UJ**	CCVL
14-27596-ZP39P	JT-MW-03D-S5	Chloroethane	**UJ**	CCVL
14-27596-ZP39P	JT-MW-03D-S5	Methylene Chloride	**U**	MB
14-27597-ZP39Q	TRIP BLANKS	2-Butanone	**U**	CCVL
14-27597-ZP39Q	TRIP BLANKS	2-Chloroethylvinylether	**UJ**	CCVL
14-27597-ZP39Q	TRIP BLANKS	Acetone	**UJ**	CCVL
14-27597-ZP39Q	TRIP BLANKS	Acrolein	**UJ**	CCVL
14-27597-ZP39Q	TRIP BLANKS	Acrylonitrile	**UJ**	CCVL
14-27597-ZP39Q	TRIP BLANKS	Methylene Chloride	**U**	MB
14-27597-ZP39Q	TRIP BLANKS	Vinyl Acetate	**UJ**	CCVL
14-28060-ZQ10A	JT-MW-04D-S1	2-Butanone	**UJ**	CCVL
14-28060-ZQ10A	JT-MW-04D-S1	2-Chloroethylvinylether	**UJ**	CCVL
14-28060-ZQ10A	JT-MW-04D-S1	Acrolein	**UJ**	CCVL
14-28060-ZQ10A	JT-MW-04D-S1	Bromomethane	**UJ**	CCVL
14-28060-ZQ10A	JT-MW-04D-S1	Methylene Chloride	**U**	TB
14-28061-ZQ10B	JT-MW-04D-S2	1,2,4-Trichlorobenzene	**U**	MB
14-28061-ZQ10B	JT-MW-04D-S2	2-Butanone	**UJ**	CCVL
14-28061-ZQ10B	JT-MW-04D-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-28061-ZQ10B	JT-MW-04D-S2	Acrolein	**UJ**	CCVL
14-28061-ZQ10B	JT-MW-04D-S2	Bromomethane	**UJ**	CCVL
14-28061-ZQ10B	JT-MW-04D-S2	Methylene Chloride	**U**	TB
14-28062-ZQ10C	JT-MW-04D-S3	2-Butanone	**UJ**	CCVL
14-28062-ZQ10C	JT-MW-04D-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-28062-ZQ10C	JT-MW-04D-S3	Acrolein	**UJ**	CCVL
14-28062-ZQ10C	JT-MW-04D-S3	Bromomethane	**UJ**	CCVL
14-28062-ZQ10C	JT-MW-04D-S3	Methylene Chloride	**U**	TB
14-28063-ZQ10D	JT-MW-04D-S4	2-Butanone	**UJ**	CCVL
14-28063-ZQ10D	JT-MW-04D-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-28063-ZQ10D	JT-MW-04D-S4	Acrolein	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-28063-ZQ10D	JT-MW-04D-S4	Bromomethane	**UJ**	CCVL
14-28063-ZQ10D	JT-MW-04D-S4	Methylene Chloride	**U**	TB
14-28064-ZQ10E	JT-MW-04D-S5	2-Butanone	**UJ**	CCVL
14-28064-ZQ10E	JT-MW-04D-S5	2-Chloroethylvinylether	**UJ**	CCVL
14-28064-ZQ10E	JT-MW-04D-S5	Acrolein	**UJ**	CCVL
14-28064-ZQ10E	JT-MW-04D-S5	Bromomethane	**UJ**	CCVL
14-28064-ZQ10E	JT-MW-04D-S5	Methylene Chloride	**U**	TB
14-28065-ZQ10F	JT-MW-04D-S6	2-Butanone	**UJ**	CCVL
14-28065-ZQ10F	JT-MW-04D-S6	2-Chloroethylvinylether	**UJ**	CCVL
14-28065-ZQ10F	JT-MW-04D-S6	Acrolein	**UJ**	CCVL
14-28065-ZQ10F	JT-MW-04D-S6	Bromomethane	**UJ**	CCVL
14-28065-ZQ10F	JT-MW-04D-S6	Methylene Chloride	**U**	TB
14-28066-ZQ10G	JT-MW-01S-S2	2-Butanone	**UJ**	CCVL
14-28066-ZQ10G	JT-MW-01S-S2	2-Chloroethylvinylether	**UJ**	CCVL
14-28066-ZQ10G	JT-MW-01S-S2	Acrolein	**UJ**	CCVL
14-28066-ZQ10G	JT-MW-01S-S2	Bromomethane	**UJ**	CCVL
14-28066-ZQ10G	JT-MW-01S-S2	Methylene Chloride	**U**	TB
14-28067-ZQ10H	JT-MW-01S-S3	2-Butanone	**J**	CCVL
14-28067-ZQ10H	JT-MW-01S-S3	2-Chloroethylvinylether	**UJ**	CCVL
14-28067-ZQ10H	JT-MW-01S-S3	Acrolein	**UJ**	CCVL
14-28067-ZQ10H	JT-MW-01S-S3	Bromomethane	**UJ**	CCVL
14-28067-ZQ10H	JT-MW-01S-S3	Methylene Chloride	**U**	TB
14-28068-ZQ10I	JT-MW-01S-S4	2-Butanone	**UJ**	CCVL
14-28068-ZQ10I	JT-MW-01S-S4	2-Chloroethylvinylether	**UJ**	CCVL
14-28068-ZQ10I	JT-MW-01S-S4	Acrolein	**UJ**	CCVL
14-28068-ZQ10I	JT-MW-01S-S4	Bromomethane	**UJ**	CCVL
14-28068-ZQ10I	JT-MW-01S-S4	Methylene Chloride	**U**	TB
14-28069-ZQ10J	JT-MW-01S-S5	2-Butanone	**UJ**	CCVL
14-28069-ZQ10J	JT-MW-01S-S5	2-Chloroethylvinylether	**UJ**	CCVL
14-28069-ZQ10J	JT-MW-01S-S5	Acrolein	**UJ**	CCVL
14-28069-ZQ10J	JT-MW-01S-S5	Bromomethane	**UJ**	CCVL
14-28069-ZQ10J	JT-MW-01S-S5	Methylene Chloride	**U**	TB
14-28070-ZQ10K	Trip Blank	2-Butanone	**UJ**	CCVL
14-28070-ZQ10K	Trip Blank	2-Chloroethylvinylether	**UJ**	CCVL
14-28070-ZQ10K	Trip Blank	Acrolein	**UJ**	CCVL
14-28070-ZQ10K	Trip Blank	Bromomethane	**J**	CCVL
14-28070-ZQ10K	Trip Blank	Methylene Chloride	**U**	TB
14-28361-ZQ89A	IW-5D-GW	2-Butanone	**UJ**	CCVL
14-28361-ZQ89A	IW-5D-GW	2-Hexanone	**UJ**	CCVL
14-28362-ZQ89B	MW-4-GW	2-Butanone	**UJ**	CCVL
14-28362-ZQ89B	MW-4-GW	2-Hexanone	**UJ**	CCVL
14-28362-ZQ89B	MW-4-GW	Naphthalene	**U**	MB
14-28363-ZQ89C	MW-400-GW	2-Butanone	**UJ**	CCVL
14-28363-ZQ89C	MW-400-GW	2-Hexanone	**UJ**	CCVL
14-28364-ZQ89D	HC-MW-1-GW	2-Butanone	**UJ**	CCVL
14-28364-ZQ89D	HC-MW-1-GW	2-Hexanone	**UJ**	CCVL
14-28365-ZQ89E	JT-MW-07S-GW	2-Butanone	**UJ**	CCVL
14-28365-ZQ89E	JT-MW-07S-GW	2-Hexanone	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
14-28366-ZQ89F	JT-MW-04D-GW	2-Butanone	**UJ**	CCVL
14-28366-ZQ89F	JT-MW-04D-GW	2-Hexanone	**UJ**	CCVL
14-28367-ZQ89G	JT-MW-08S-GW	2-Butanone	**JT**	CCVL
14-28367-ZQ89G	JT-MW-08S-GW	2-Hexanone	**UJ**	CCVL
14-28368-ZQ89H	JT-MW-01S-GW	2-Butanone	**JT**	CCVL
14-28368-ZQ89H	JT-MW-01S-GW	2-Hexanone	**UJ**	CCVL
14-28369-ZQ89I	JT-MW-06D-GW	2-Butanone	**UJ**	CCVL
14-28369-ZQ89I	JT-MW-06D-GW	2-Hexanone	**UJ**	CCVL
14-28369-ZQ89I	JT-MW-06D-GW	Methylene Chloride	**U**	MB
14-28370-ZQ89J	JT-MW-05S-GW	2-Butanone	**UJ**	CCVL
14-28370-ZQ89J	JT-MW-05S-GW	2-Hexanone	**UJ**	CCVL
14-28370-ZQ89J	JT-MW-05S-GW	Methylene Chloride	**U**	MB
14-28371-ZQ89K	HC-MW-2-GW	2-Butanone	**UJ**	CCVL
14-28371-ZQ89K	HC-MW-2-GW	2-Hexanone	**UJ**	CCVL
14-28372-ZQ89L	HC-MW-3-GW	2-Butanone	**UJ**	CCVL
14-28372-ZQ89L	HC-MW-3-GW	2-Hexanone	**UJ**	CCVL
14-28373-ZQ89M	IW-5S-GW	2-Butanone	**JT**	CCVL
14-28373-ZQ89M	IW-5S-GW	2-Hexanone	**UJ**	CCVL
14-28374-ZQ89N	JT-MW-02S-GW	2-Butanone	**UJ**	CCVL
14-28374-ZQ89N	JT-MW-02S-GW	2-Hexanone	**UJ**	CCVL
14-28375-ZQ89O	JT-MW-03D-GW	2-Butanone	**UJ**	CCVL
14-28375-ZQ89O	JT-MW-03D-GW	2-Hexanone	**UJ**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	2-Butanone	**UJ**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	2-Hexanone	**UJ**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	Acetone	**U**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	Acrolein	**U**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	Acrylonitrile	**U**	CCVL
14-28389-ZQ89AC	TRIP BLANKS	Methylene Chloride	**U**	MB
14-28389-ZQ89AC	TRIP BLANKS	Vinyl Acetate	**U**	CCVL
15-422-ZS52A	JT-SS-06	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-422-ZS52A	JT-SS-06	2-Chloroethylvinylether	**UJ**	CCVL
15-422-ZS52A	JT-SS-06	2-Hexanone	**UJ**	CCVL
15-422-ZS52A	JT-SS-06	Methylene Chloride	**U**	MB
15-422-ZS52A	JT-SS-06	Naphthalene	**UJ**	MB,CCVL
15-423-ZS52B	JT-SS-07	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-423-ZS52B	JT-SS-07	2-Chloroethylvinylether	**UJ**	CCVL
15-423-ZS52B	JT-SS-07	2-Hexanone	**UJ**	CCVL
15-423-ZS52B	JT-SS-07	Naphthalene	**UJ**	CCVL
15-424-ZS52C	JT-SS-08	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-424-ZS52C	JT-SS-08	2-Chloroethylvinylether	**UJ**	CCVL
15-424-ZS52C	JT-SS-08	2-Hexanone	**UJ**	CCVL
15-424-ZS52C	JT-SS-08	Methylene Chloride	**U**	MB
15-424-ZS52C	JT-SS-08	Naphthalene	**UJ**	CCVL
15-425-ZS52D	JT-SS-09	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-425-ZS52D	JT-SS-09	2-Chloroethylvinylether	**UJ**	CCVL
15-425-ZS52D	JT-SS-09	2-Hexanone	**UJ**	CCVL
15-425-ZS52D	JT-SS-09	Methylene Chloride	**U**	MB
15-425-ZS52D	JT-SS-09	Naphthalene	**UJ**	CCVL

Laboratory ID	Sample ID	Analyte	Data Qualifier	Qualified Reasons
15-426-ZS52E	JT-SS-10	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-426-ZS52E	JT-SS-10	2-Chloroethylvinylether	**UJ**	CCVL
15-426-ZS52E	JT-SS-10	2-Hexanone	**UJ**	CCVL
15-426-ZS52E	JT-SS-10	Methylene Chloride	**U**	MB
15-426-ZS52E	JT-SS-10	Naphthalene	**UJ**	MB,CCVL
15-427-ZS52F	TRIP BLANK	1,1,2,2-Tetrachloroethane	**UJ**	CCVL
15-427-ZS52F	TRIP BLANK	2-Chloroethylvinylether	**UJ**	CCVL
15-427-ZS52F	TRIP BLANK	2-Hexanone	**UJ**	CCVL
15-427-ZS52F	TRIP BLANK	Methylene Chloride	**U**	MB
15-427-ZS52F	TRIP BLANK	Naphthalene	**UJ**	CCVL
14-25978-ZM61A	JT-6	Aroclor 1260	**JP**	Dual Column
14-25985-ZM61H	MW-200	Aroclor 1254	**UJ**	RL Over Range
14-26640-ZN93C	JT-11	Aroclor 1260	**J**	MSDH,RPD
14-27583-ZP39C	MW-08S-S4	Aroclor 1260	**JP**	Dual Column
14-27584-ZP39D	MW-07S-S1	Aroclor 1248	**UJ**	RL Over
14-27586-ZP39F	JT-MW-07S-S3	Aroclor 1254	**JP**	Dual Column
14-27586-ZP39F	JT-MW-07S-S3	Aroclor 1262	**JP**	Dual Column
14-28362-ZQ89B	MW-4-GW	Aroclor 1260	**J**	CCVH
14-28363-ZQ89C	MW-400-GW	Aroclor 1260	**J**	CCVH
14-28368-ZQ89H	JT-MW-01S-GW	Aroclor 1248	**UJ**	SSL
14-28368-ZQ89H	JT-MW-01S-GW	Aroclor 1254	**UJ**	SSL
14-28368-ZQ89H	JT-MW-01S-GW	Aroclor 1260	**UJ**	SSL
14-28368-ZQ89H	JT-MW-01S-GW	Aroclor 1262	**UJ**	SSL
14-28368-ZQ89H	JT-MW-01S-GW	Aroclor 1268	**UJ**	SSL
14-26641-ZN93D	JT-4	Chromium	**J**	FD
14-26641-ZN93D	JT-4	Lead	**J**	FD
14-26643-ZN93F	JT-400	Chromium	**J**	FD
14-26643-ZN93F	JT-400	Lead	**J**	FD
14-27581-ZP39A	MW-08S-S2	Lead	**J**	RPD
14-27103-ZO64F	JT-US-41-S2	Total Organic Carbon	**J**	MSH,RSD
14-27128-ZO65G	JT-US-55-S1	Total Organic Carbon	**J**	MSL,RSD
14-28069-ZQ10J	JT-MW-01S-S5	Total Organic Carbon	**J**	MSL,RSD
14-26641-ZN93D	JT-4	Total Suspended Solids	**J**	RPD

Notes:
%R: Percent recovery
Break Down: The compound breaks down in acidic preservation
BSDL: Blank spike duplicate, namely laboratory control sample duplicate (LCSD) %R value biased low
BSH: Blank spike, namely laboratory control sample (LCS) %R value biased high
BSL: Blank spike, or LCS %R value biased low
CCVH: Continuing calibration verification (CCV) percent difference (%D) value biased high
CCVL: CCV %D value biased low
Dual Column: Dual column RPD value was >40%
FD: Field duplicate RPD or concentration difference value did not meet the advisory criteria
HT: The analysis was performed past the required holding time
IAR: Ion abundance ratio did not meet the method criteria
J/UJ: Detects were qualified (J); nondetects were qualified (UJ)
MB: Analyte result was affected by the detection in the associated method blank
MSDL: Matrix spike duplicate (MSD) %R value biased low
MSH: Matrix spike (MS) %R value biased high

MSL: MS %R value biased low
RL: Reporting limit
RPD: Laboratory duplicate, MS/MSD, or LCS/LCSD relative percent difference value was outside the criteria
RSD: Laboratory triplicate analysis percent relative standard deviation (%RSD) was outside the criteria
SSL: Surrogate spike %R value biased low
TB: Analyte result was affected by the detection in the associated trip blank
TEMP: Sample result was affected by elevated cooler temperature
VOCs: Volatile organic compounds analyzed with SW846 Method 8260C

Table II. Data Qualifier Definitions

Qualifier	Description
J	Analyte present. Reported value may or may not be accurate or precise
P	Dual column relative percent difference value was >40%
R	The result was rejected
T	The value was less than reporting limit but greater than method detection limit
U	Analyte was not detected at or above the method detection limit
UJ	Not detected, quantitation limit may be inaccurate or imprecise

Approved By: ______________________ Date: ***March 30, 2015***

Mingta Lin

REFERENCES

United States Environmental Protection Agency (USEPA). 2014a. *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.* Office of Superfund Remediation and Technical Innovation. August 2014. EPA 540-R-013-001.

USEPA. 2014b. *Contract Laboratory Program National Functional Guidelines for Organic Superfund Data Review.* Office of Superfund Remediation and Technical Innovation. August 2014. EPA 540-R-014-002.

USEPA. 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*, January 13 2009, USEPA 540-R-08-005

USEPA. 1996. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, December 1996.

USEPA. 1995. *Method 200.8: Determination of Trace Elements in Waters And Wastes by Inductively Coupled Plasma - Mass Spectrometry Revision 5.4*. 1995.

USEPA. 1983. *Methods for Chemical Analysis of Water and Wastes,* EPA–600/4-79-020, March 1983 Revision.

American Public Health Association. 2012. *Standard Methods for the Examination of Water and Wastewater.* January 5, 2012.

Ecology (Washington State Department of). 2014. *Remedial Investigation Work Plan, Jacobson Terminals, Seattle, Washington.* Hart Crowser, Inc. November 2014.

Ecology. 1997. *Analytical Methods for Petroleum Hydrocarbons,* ECY 97-602. June 1997.

Appendix A

Field duplicate RPD is indicative of field and laboratory precision and sample homogeneity in combination. The EPA *CLP National Functional Guidelines* or *Sampling and Analysis Plan* do not specify criteria for field duplicate evaluation. An advisory criteria of 20% for inorganic and 30% for organic parameters were applied to evaluating the RPD values of field duplicate results that are ≥5xRL. For results that are <5xRL, an advisory criterion of ±2xRL was applied to evaluating the concentration differences. The RPD (or concentration difference as applicable) values and data qualification for detected compounds in field duplicates are presented as follows:

Analytes	Unit	MRL	Sample ID & Results		RPD	Concentration Difference	Data Qualifier
			JT-11	**JT-1100**			
Aroclor 1260	µg/L	0.01	0.1	0.13		0.03	
1,3-Dichlorobenzene	µg/L	0.2	0.74	0.75		0.01	
1,4-Dichlorobenzene	µg/L	0.2	1.3	1.4	7%		
Benzene	µg/L	0.2	5.6	5.6	0%		
Chlorobenzene	µg/L	2	160	170	6%		
Ethylbenzene	µg/L	0.2	0.11	ND		0.11	
Vinyl Chloride	µg/L	0.2	0.11	0.11		0	
			JT-4	**JT-400**			
Arsenic, Total	µg/L	0.2	41	40	2%		
Cadmium, Total	µg/L	0.1	ND	ND		0	
Chromium, Total	µg/L	1	8	3.9		5.1	**J/J**
Lead, Total	µg/L	0.1	2.3	1.1	71%		**J/J**
Mercury, Total	µg/L	0.1	ND	ND		0	
Arsenic, Dissolved	µg/L	0.2	37.5	36.6	2%		
Cadmium, Dissolved	µg/L	0.1	ND	ND		0	
Chromium, Dissolved	µg/L	1	ND	ND		0	
Lead, Dissolved	µg/L	0.1	ND	ND		0	
Mercury, Dissolved	µg/L	0.1	ND	ND		0	
			MW-4-GW	**MW-400-GW**			
Arsenic, Total	µg/L	0.2	0.4	0.4	0%	0	
Arsenic, Dissolved	µg/L	0.2	0.7	1.1		0.4	
TPH-Diesel	mg/L	0.1	0.68	0.73	7%		
TPH-Lube Oil	mg/L	0.2	0.29	0.33		0.04	
Aroclor 1260	µg/L	0.1	1.6	1.8	12%		
1,3-Dichlorobenzene	µg/L	0.2	0.6	0.58		0.02	
1,4-Dichlorobenzene	µg/L	0.2	0.71	0.67		0.04	
Acetone	µg/L	5	2.2	ND		2.2	
Benzene	µg/L	0.2	0.15	0.11		0.04	

Analytes	Unit	MRL	Sample ID & Results		RPD	Concentration Difference	Data Qualifier
Carbon Disulfide	µg/L	0.2	0.29	0.2		0.09	
Chlorobenzene	µg/L	0.2	3.3	2.8	16%		
Naphthalene	µg/L	0.5	0.63	0.5		0.13	

Notes:
RPD: Relative percent difference
Concentration Difference: Concentration difference between the field replicates
MRL: Method reporting limit
µg/L: micrograms per liter
mg/L: milligram per liter

LABORATORY REPORTS
Analytical Resources, Inc.

APPENDIX C
PCB Sediment Loading Calculations

APPENDIX C
PCB SEDIMENT LOADING CALCULATIONS

Sediment samples were collected to further evaluate potential environmental impacts in the portion of the Ship Canal adjacent to the site. PCBs were detected in sediment downgradient (southeast) of the historical upland release at concentrations exceeding the freshwater Sediment Management Standards (SMS) screening level of 110 micrograms per kilogram (µg/kg) during the 2013 to 2014 investigations. Sediment PCBs were reported by the laboratory as a mixture of Aroclors 1248, 1254, and 1260.

PCB sediment loading calculations were performed to determine whether migration from upland sources was sufficient to explain existing conditions or there were other potential sources of PCBs to sediment. Sediment loading calculations assumed:

- The groundwater-to-sediment plume is at equilibrium, and PCB concentrations in groundwater in shoreline wells accurately reflect PCB concentrations reaching sediment; and
- PCB concentrations do not attenuate between the shoreline wells and the sediment.

The input parameters below were used to calculate PCB loadings.

Parameter	Range	Value Used	Source
Groundwater depth	4 to 7 feet	4 feet	Aspect 2003 Hart Crowser RI/FS
Aquitard depth	16 to 18 feet	18 feet	Aspect 2003
Groundwater plume width	50 to 100 feet	100 feet	Aspect 2003
Soil porosity	NA	0.4	Aspect 2003
Groundwater flow	0.1 to 0.4 feet/day	0.4 feet/day	Aspect 2003
Groundwater PCB concentration	0.05 to 0.91 µg/L	0.33 µg/L	Hart Crowser RI/FS average value
PCB release date	NA	1950	Assumed
Sediment PCB concentration (0 to 1 foot depth)	58 to 346 µg/kg	222 µg/kg	Hart Crowser RI/FS average value
Sediment PCB concentration (0 to 10 cm depth)	401 to 1640 µg/kg	876 µg/kg	Hart Crowser RI/FS average value
Impacted sediment area	NA	4,775 sq feet	Hart Crowser RI/FS average value
Sediment density	NA	2.5 kg/L	Assumed

The volume of contaminated groundwater moving from the uplands to the sediment daily was calculated as follows:

Daily water volume = 100 ft long x 14 ft deep x 0.4 ft/day x 0.4 (porosity) x 28.3 L/ft^3 = 6,340 L/day

The estimated mass of PCBs released to sediment assuming the release began in 1950 is:

PCB mass = 6,340 L/day x 0.33 µg/L x 365 days/year x 65 years = 4.96 x 10^7 µg

The estimated sediment PCB concentrations are:

PCB concentration (0 – 10 cm) = 4.96 x 10^7 µg /(4,775 ft^2 x 0.33 ft x 28.3 L/ft^3 X 2.5 kg/L) = 445 µg/kg

PCB concentration (0 – 1 ft) = 4.96 x 10^7 µg /(4,775 ft^2 X 1 ft X 28.3 L/ft^3 X 2.5 kg/L) = 148 µg/kg

The average measured PCB concentrations in sediment for the 0 to 10 centimeter and 0 to 1 foot depth intervals were 876 and 222 µg/kg, respectively. The measured concentrations are about two times the estimated concentrations. However, there is relatively high uncertainty in the estimated value because input parameters are variable. There is relatively good agreement between measured and estimated sediment PCB concentrations considering the degree of variability in the input parameters.

Despite the apparent agreement between measured and estimated PCB content in sediment, the extent of PCB-impacted sediment adjacent to the Site is not fully delineated and the impacts likely come from multiple local and regional sources. To develop a more defensible model of PCB transport from upland soil to sediment, additional regional sediment and upland source data along the Ship Canal would need to be collected and evaluated.

REPORT OF TEST NO. 862-1 & 3
Northwestern Aquatic Sciences

REPORT

of

TEST NO. 862-1 & 3

Toxicity of Freshwater Sediments Using Sediment Bioassays as Part of the Remedial Investigation at the Jacobson Terminals in Seattle, Washington

Submitted to

Hart Crowser, Inc.
1700 Westlake Ave. North, Suite 200
Seattle, WA 98109

Submitted by

Northwestern Aquatic Sciences
3814 Yaquina Bay Road
P.O. Box 1437
Newport, OR 97365

March 19, 2015

EXECUTIVE SUMMARY OF SEDIMENT BIOASSAYS

Two freshwater sediment bioassays, a 28-day *Hyalella* amphipod survival and growth test and a 10-day *Chironomus dilutus* midge survival and growth test were conducted for Hart Crowser as part of the Remedial Investigation at the Jacobson Terminals property in Seattle, WA. Three test sediments were compared to the control sediment to assess sediment toxicity and to interpret organism response under the Washington State *Sediment Management Standards* (Chapter 173-204 WAC, Last Update: 2/25/13). The test and control sediments tested are listed in Table 1.

TEST AND CONTROL SEDIMENT INFORMATION

The test sediments were provided to Northwestern Aquatic Sciences by Hart Crowser personnel. The negative control sediment was collected by NAS personnel from an area approximately one mile east of the Highway 101 bridge at Beaver Creek, approximately 8 miles south of Newport, Oregon. All sediments were stored at 4°C in the dark until used. Sample identification and collection information is as follows:

Table 1. Sample identification and collection dates.

Sample description	Hart Crowser Sample Identification	NAS Sample Identification	Collection Date	Receipt Date
Beaver Creek Control*	Control	5195G	1-19-15	1-19-15
Test sediment	JT-SS-06	5192G	1-12-15	1-14-15
Test sediment	JT-SS-08	5193G	1-12-15	1-14-15
Test sediment	JT-SS-10	5194G	1-12-15	1-14-15

*Control used for data interpretation.

BIOASSAY INTERPRETATION CRITERIA

Biological test interpretation for freshwater sediments, as presented in the *Sediment Management Standards*, (SMS) uses biological criteria to identify sediments that have no adverse effects on biological resources, and correspond to no significant health risk to humans. The SMS includes Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) biological criteria. The Sediment Cleanup Objectives establish a no adverse effects level, including no acute or chronic adverse effect, to the benthic community. The Cleanup Screening Levels establish a minor adverse effects level, including acute or chronic effects, to the benthic community. The SCO biological criteria are exceeded when one of the biological tests results is above the SCO for that bioassay endpoint. The CSL biological criteria is exceeded when 1) any two bioassay test results are above the SCO criteria; or 2) when one of the bioassay test results is above the CSL criteria.

Sediment Cleanup Objectives Criteria

When any one of the biological test results shows a test sediment response that exceeds the bioassay-specific response guidelines presented below, and that response is statistically different ($p \leq 0.05$) from the control, the test sediment is judged to have exceeded the SCO.

In accordance with the SMS, the bioassay-specific response guidelines for evaluating an exceedance under the SCO criteria are as follows:

Amphipod 28-day Survival/Growth Bioassay. Mean mortality in the test sediment is greater than 10 percent over the mean control and statistically different from the control ($p \leq 0.05$). For the growth endpoint, a mean reduction in the biomass that is greater than 25 percent of the control sediment response and statistically different from the control ($p \leq 0.05$).

Midge 10-Day Survival/Growth Bioassay. Mean mortality in the test sediment is 20 percent over the control mortality and statistically different from control ($p \leq 0.05$). For the growth endpoint, a mean reduction in biomass that is greater than 20 percent compared to the control and statistically different from the control ($p \leq 0.05$).

Cleanup Screening Levels Criteria

When any two biological test results show test sediment responses that are above the SCO listed above, OR when any one of the biological test results is above the Cleanup Screening Level criteria listed below, that sediment is judged to have exceeded the CSL.

In accordance with the SMS, the bioassay-specific response guidelines for evaluating an exceedance under the CSL criteria are as follows:

Amphipod 28-day Survival/Growth Bioassay. Mean mortality in the test sediment is greater than 25 percent over the mean control and statistically different from the control ($p \leq 0.05$). For the growth endpoint, a mean reduction in the biomass that is greater than 40 percent from the control and statistically different from the control ($p \leq 0.05$).

Midge 10-Day Survival/Growth Bioassay. Mean mortality in the test sediment is 30 percent over the control mortality and statistically different from the control ($p \leq 0.05$). For the growth endpoint, a mean reduction in biomass that is greater than 30 percent from the control sediment response and statistically different from the control ($p \leq 0.05$).

RESULTS OF AMPHIPOD, *HYALELLA AZTECA* 28-DAY SURVIVAL TEST (862-1)

All water quality observations were within the protocol specified ranges (Table 1, Section A). The test met applicable test acceptability criteria. Although the reference toxicant (positive control) LC50 result was slightly outside the laboratory's control chart action limits (0.50 g/L; control chart mean ± 2 S.D. = 0.36 ± 0.12), a review of test conditions and procedures did not detect any unusual circumstances. (Section A).

The control sediment exhibited a mean mortality of 5.0% (Table 2). Mean mortality of test sediments JT-SS-06, JT-SS-08 and JT-SS-10 was 22.5%, 20.0% and 13.8%, respectively. None of these sediments exceeded the criteria for mortality for SCO or CSL. The biomass of test sediments JT-SS-06 and JT-SS-08 were both above that of the control sediment (Table 3). JT-SS-10 did result in an individual biomass of 0.28 mg that was statistically significantly lower than that of the control. However, JT-SS-10 did not exceed either the SCO or CSL criteria for growth.

RESULTS OF MIDGE, *CHIRONOMUS DILUTUS*, 10-DAY SURVIVAL AND GROWTH TEST (862-3)

All water quality observations were within the protocol specified ranges (Table 1, Section B). The test met all other applicable acceptability criteria including positive control performance (Section B).

The mean mortality in the control sediment in the *Chironomid* test was 6.3% (Table 4). Mean mortality of test sediments JT-SS-06, JT-SS-08 and JT-SS-10 was 10.0%, 15.0% and 8.8%, respectively. None of these were more than 20% over the control mortality. Therefore none of the sediments exceeded the SCO or CSL criteria for mortality. The control average individual ash-free dry weight was 1.22 mg (Table 5). All three test sediments resulted in growth that was statistically significantly lower than control growth. Two of the three test sediments, JT-SS-08 and JT-SS-10, resulted in exceedances under the SCO guidelines for growth with ash-free dry weights of 0.93 and 0.91 mg/individual, respectively. No test sediment failed the CSL criteria for growth.

SUMMARY OF SEDIMENT BIOASSAY RESULTS

The Sediment Management Standards includes Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) biological criteria to identify sediments that have adverse effects on biological resources. The SCO establishes a no adverse effects level, including no acute or chronic adverse effect, to the benthic community. The CSL establishes a minor adverse effects level, including acute or chronic effects, to the benthic community.

The SCO biological criteria are exceeded when one of the biological tests results is above the SCO for that bioassay endpoint. Two test sediments, JT-SS-08, and JT-SS-10, resulted in an exceedance under the SCO guidelines for growth in the *Chironomus* bioassay.

The CSL biological criteria is exceeded when 1) any two bioassay test results are above the SCO criteria; or 2) when one of the bioassay test results is above the CSL criteria. None of the test sediments exceeded the CSL criteria by resulting in either one test result that was a CSL exceedance or two test results that were SCO exceedances (Table 6).

STUDY APPROVAL

for Linda Nemeth 3-19-15
Assistant Laboratory Director Date

3-19-15
Project Manager Date

Table 2. Mortality results of *Hyalella* 28-day toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Percent mortality (Mean ± SD)	Significantly higher than control sediment at α=0.05?	Percent higher (absolute) than control sediment	Exceedance under SCO? [1]	Exceedance under one-test criteria for CSL? [2]
Control (NAS# 5195G)	5.0 ± 5.3	---	---	---	---
JT-SS-06 (NAS# 5192G)	22.5 ± 21.9	No	17.5	No	No
JT-SS-08 (NAS# 5193G)	20.0 ± 20.7	No	15.0	No	No
JT-SS-10 (NAS# 5194G)	13.8 ± 16.0	No	8.8	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >10%.
[2] Cleanup Screening Levels (CSL) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >25%.

Table 3. Growth results of *Hyalella* 28-day toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Average dry wt/amphipod (Mean ± SD)	Significantly lower than control sediment at α=0.05?	Percent lower (absolute) than control sediment	Exceedance under SCO? [1] $(MIG_C-MIG_T)/MIG_C>0.25$ and SD	Exceedance under one-test criteria for CSL? [2] $(MIG_C-MIG_T)/MIG_C>0.40$ and SD
Control (NAS# 5195G)	0.32 ± 0.03	---	---	---	---
JT-SS-06 (NAS# 5192G)	0.41 ± 0.08	No	-28.0	No	No
JT-SS-08 (NAS# 5193G)	0.37 ± 0.08	No	-15.6	No	No
JT-SS-10 (NAS# 5194G)	0.28 ± 0.04	Yes	12.5	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth and the difference is >25%.
[2] Cleanup Screening Levels (CSL) exceedance (one-test criteria) if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth and the difference is >40%.

Table 4. Mortality results of *Chironomus* toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Percent mortality (Mean ± SD)	Significantly higher than control sediment at α=0.05?	Percent higher (absolute) than control sediment	Exceedance under SCO? [1]	Exceedance under one-test criteria for CSL? [2]
Control (NAS# 5195G)	6.3 ± 5.2	---	---	---	---
JT-SS-06 (NAS# 5192G)	10.0 ± 14.1	No	3.7	No	No
JT-SS-08 (NAS# 5193G)	15.0 ± 16.9	No	8.7	No	No
JT-SS-10 (NAS# 5194G)	8.8 ± 11.3	No	2.5	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >20%.
[2] Cleanup Screening Levels (CSL) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >30%.

Table 5. Growth results of *Chironomus* toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Average ash-free dry wt/midge (mg)* (Mean ± SD)	Statistically significantly lower than control sediment at α=0.05?	Percent lower than control sediment	Exceedance under SCO?[1] (MIG_C-MIG_T/MIG_C>0.20)	Exceedance under one-test criteria for CSL?[2] (MIG_C-MIG_T/MIG_C>0.30)
Control (NAS# 5195G)	1.22 ± 0.09	---	---	---	---
JT-SS-06 (NAS# 5192G)	0.98 ± 0.11	Yes	19.7	No	No
JT-SS-08 (NAS# 5193G)	0.93 ± 0.15	Yes	23.8	**Yes**	No
JT-SS-10 (NAS# 5194G)	0.91 ± 0.12	Yes	25.4	**Yes**	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth and the difference is >20%.
[2] Cleanup Screening Level (CSL) exceedance (one-test criteria) if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth and the difference is >30%.

Table 6. Interpretation of bioassay test results for Jacobson Terminals Property based on Washington State Sediment Management Standards - Sediment Cleanup Objectives (SCO) and Cleanup Screening Level (CSL) criteria.

Sample Description	SCO Exceedance / CSL Exceedance[1] Test No. 862-1 *Hyalella* 28-day Survival	Test No. 862-1 *Hyalella* 28-day Growth	Test No. 862-3 *Chironomus* 10-day Survival	Test No. 862-3 *Chironomus* 10-day Growth	CSL Exceedance by two SCO Exceedances[2]
	SCO / CSL	SCO / CSL	SCO / CSL	SCO / CSL	CSL
Control (NAS# 5195G)	---	---	---	---	---
JT-SS-06 (NAS# 5192G)	No / No	No / No	No / No	No / No	No
JT-SS-08 (NAS# 5193G)	No / No	No / No	No / No	**Yes** / No	No
JT-SS-10 (NAS# 5194G)	No / No	No / No	No / No	**Yes** / No	No

[1]One test result must exceed an SCO or a CSO criterion. Two test sediments exceeded the SCO criterion for *Chironomus* growth. No other single criterion exceedances occurred under either SCO or CSO criteria.

[2]Two test results must exceed the SCO criteria to exceed the CSL under this interpretation. No test sediments exceeded the CSL by having two SCO exceedances.

SECTION A

Amphipod (*Hyalella azteca*) 28-day sediment bioassay 862-1 data report

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 862-1

Title: Toxicity of freshwater sediments using a 28-day amphipod, *Hyalella azteca*, sediment bioassay as part of the Remedial Investigation at the Jacobson Terminals Property in Seattle, WA.

Protocol No.: NAS-XXX-HA4c, February 11, 2000. Revision 3 (4-26-05). Based on ASTM 2001 (Standard test methods for measuring the toxicity of sediment-associated contaminants with fresh water invertebrates, E1706-00), Am. Soc. Test. Mat., Phila., PA, and EPA Method 100.1 (Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, EPA/600/R-99/064). Washington State Sediment Management Standards (SMS) (Chapter 173-204 WAC, Last Update: 2/25/13).

STUDY MANAGEMENT

Study Sponsor: Hart Crowser, Inc., 1700 Westlake Ave. North, Suite 200, Seattle, WA 98109.

Sponsor's Study Monitor: Mr. Philip Cordell

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365

Test Location: Newport laboratory

Laboratory's Study Personnel: G.J. Irissarri, B.S., Proj. Mngr./ Study Dir.; L.K. Nemeth, B.A., M.B.A., QA Officer; R.S. Caldwell, Ph.D., Sr. Aq. Toxicol.; G.A. Buhler, B.S., Aq. Toxicol.; J.B. Brown, B.S., D.V.M, Assoc. Aq. Toxicol.; Y. Nakahama, Sr. Tech.; L. Brady, Tech.

Study Schedule:

Test Beginning: 1-23-15, 0905 hrs.

Test Ending: 2-20-15, 1000 hrs.

Disposition of Study Records: All raw data, reports, and other study records are stored at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Test Sediments: Freshwater test sediments collected as part of the Remedial Investigation at the Jacobson Terminals Property in Seattle, WA. Details are as follows:

NAS Sample No.	5192G	5193G	5194G
Description	JT-SS-06	JT-SS-08	JT-SS-10
Collection Date	1/12/15	1/12/15	1/12/15
Receipt Date	1/14/15	1/14/15	1/14/15

Control Sediment: The negative control sediment (NAS#5195G) was collected on 1-19-15 from an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Treatments: Homogenized at test set up by mixing using stainless steel implements.

Storage: All test and control sediments were stored at 4°C in the dark in sealed containers until used.

TEST WATER

Source: Dechlorinated municipal tap water.

Dates of Preparation: 1-19-15 and 2-6-15

Water Quality:

pH: 7.7, 7.5

conductivity: 108, 119 µmhos/cm

hardness: 26, 26 mg/L as $CaCO_3$

alkalinity: 30, 30 mg/L as $CaCO_3$.

total chlorine: <0.02, <0.02 mg/L

Pretreatment: Dechlorinated and aerated ≥24 hr.

TEST ORGANISMS

Species: *Hyalella azteca,* amphipod.
Age/Size: 7-8 days old
Source: Chesapeake Cultures, Hayes, VA; received 1-21-15
Acclimation: Holding conditions for the three days prior to testing averaged: Temperature, 19.5 ± 1.7 °C; dissolved oxygen, 10.8 ± 3.7 mg/L; pH, 7.2 ± 0.4; conductivity, 358 ± 207 µmhos/cm; hardness, 111 ± 67 mg/L as $CaCO_3$; and alkalinity, 103 ± 67 mg/L as $CaCO_3$. Photoperiod, 16:8, L:D. Half of the water was replaced daily with dechlorinated municipal tap water during holding. Animals were fed YTC daily during holding.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 300 ml high-form glass beakers
Test Volumes: 100 ml sediment layer; 175 ml test water.
Replicates/Treatment: 8
Organisms/Treatment: 80
Water Volume Changes: 2 water volumes per day
Aeration: None.
Feeding: Animals are fed 1.0 ml of YTC suspension per beaker daily.
Acceptance Criteria: Results are valid if mean control mortality does not exceed 20%, and the mean individual dry weight at test termination is ≥ 0.15 mg.
Effects Criteria: 1) survival after 28 days, and 2) average individual dry weight after 28 days. Death is defined as no visible movement or response to tactile stimulation. Missing organisms were considered to be dead.
Water Quality and Other Test Conditions: The temperature, dissolved oxygen, conductivity, pH, hardness, alkalinity, and ammonia-nitrogen were measured in the overlying water of one replicate test container per treatment on days 0 and 28 of the test. Temperature was measured daily, pH and dissolved oxygen three times per week, and conductivity weekly, in the overlying water of one replicate test container per treatment. Hardness and alkalinity were measured with titrimetric methods. Ammonia-N was measured using Hach reagents based on the salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric method; samples were not distilled prior to analysis. The photoperiod was 16:8, L:D.

DATA ANALYSIS METHODS

Percent survival, percent mortality and average individual dry weight were calculated for each replicate as follows:

percent survival = 100 x (number surviving/initial number tested)
percent mortality = 100 x (number dead/initial number tested)

average individual dry weight = (final wt. - tare wt.)/number weighed,
where:
final wt. = tare wt. + dry weight of organisms recovered on day 28, in mg

Means and standard deviations for the biological endpoints described above, and for water quality data, were computed using Microsoft Excel 2010. Mean individual dry weight and mean percent mortality in each test sediment were statistically compared to the control sediment. Where appropriate, an arcsine square root transformation was performed on percent mortality data before analysis. Following determination of normality and homogeneity of variances, a one-tailed Student T-test, Mann-Whitney or Approximate T test was conducted at the 0.05 level of significance. The statistical software used was BioStat (version Feb 9, 2006 (EXCEL)) bioassay software developed by the U.S. Army Corps of Engineers, Seattle District.

PROTOCOL DEVIATIONS

None

REFERENCE TOXICANT TEST

The reference toxicant test is a multi-concentration toxicity test using potassium chloride, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. A summary of the reference toxicant test result is given below. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-3381
Reference Toxicant and Source: Potassium Chloride (KCl), Fisher Lot #114689.
Test Date: 1-23-15.
Dilution Water Used: Moderately hard synthetic water prepared from Milli-Q® deionized water.
Result: 96-hr LC50, 0.50 g/L. This result is slightly outside the laboratory's control chart action limits (0.25 – 0.48 g/L). A review of test organisms and test conditions and procedures indicated that there were no unusual circumstances that may have affected the test results.

TEST RESULTS

Observations of water quality in the overlying water throughout the test are summarized in Table 1. A detailed tabulation of the water quality results by sample and test day can be found in Appendix II. The means and standard deviations of percent mortality of *Hyalella* exposed for 28 days to sediments are summarized in Table 2. The means and standard deviations of average individual dry weight of *Hyalella* exposed for 28 days to sediments are summarized in Table 3. Detailed data organized by sample and replicate, and summary statistics for these observations, are given in Appendix II.

All water quality observations of overlying water temperature and dissolved oxygen were within the protocol specified ranges. Ammonia-N in the overlying water ranged between <0.1 and 0.9 mg/L for all day 0 and day 28 measurements.

The test met the acceptability criteria specified in the SMS with 5.0 % mean control mortality (≤20% required) and a final control sediment growth of 0.32 mg/individual (≥ 0.15 mg required). The reference toxicant (positive control) LC50 result was slightly outside the laboratory's control chart action limits (0.50 g/L; control chart mean ± 2 S.D. = 0.36 ± 0.12). A review of test conditions and procedures did not detect any unusual circumstances.

Interpretation was based on guidelines from the Washington State Sediment Management Standards (Chapter 173-204 WAC, Last Update: 2/25/13). The SMS includes Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) biological criteria. The Sediment Cleanup Objectives establish a no adverse effects level, including no acute or chronic adverse effect, to the benthic community. The Cleanup Screening Levels establish a minor adverse effects level, including acute or chronic effects, to the benthic community. To qualify as an adverse effect under the SCO for mortality the mean mortality in the test sediment is greater than 10 percent over the mean control and statistically different from the reference (p =0.05). For the growth endpoint, a mean reduction in the biomass that is greater than 25 percent of the control sediment response and statistically different from the control (p=0.05). For the CSL adverse effects criteria mean mortality in the test sediment is greater than 25 percent over the mean control and statistically different from the control (p = 0.05). For the growth endpoint, a mean reduction in the biomass that is greater than 40 percent from the control and statistically different from the control (p =0.05).

Although sediment JT-SS-10 resulted in mean dry weight that was statistically significantly lower than that of the control, the mean dry weight did not exceed either the SCO or CSL criteria. None of the test sediments resulted in an exceedance under either the SCO or the CSL of the SMS guidelines.

STUDY APPROVAL

3-19-15
Project Manager/Study Director Date

3-19-15
Quality Assurance Unit Date

for Linda Nemeth
Assistant Laboratory Director Date 3-19-15

Table 1. Summary of water quality conditions during tests of the amphipod, *Hyalella azteca*, exposed to freshwater sediments.

Water Quality Parameter	Mean ± S.D.	Minimum	Maximum	N
Temperature (°C)	22.4 ± 0.4	22.0	23.9	116
Dissolved oxygen (mg/L)	7.0 ± 0.5	6.1	8.5	52
Conductivity (μmhos/cm)	123 ± 22	110	219	24
pH	7.2 ± 0.2	6.6	8.0	52
Hardness (mg/L as $CaCO_3$)	32 ± 4	26	34	8
Alkalinity (mg/L as $CaCO_3$)	35 ± 5	30	40	8
Total ammonia (mg/L)	---	<0.1	0.9	8

Table 2. Mortality results of *Hyalella* 28-day toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Percent mortality (Mean ± SD)	Significantly higher than the control sediment at α=0.05?	Percent higher (absolute) than control sediment	Exceedance under SCO?[1]	Exceedance under one-test criteria for CSL[2]
Control (NAS# 5195G)	5.0 ± 5.3	---	---	---	---
JT-SS-06 (NAS# 5192G)	22.5 ± 21.9	No	17.5	No	No
JT-SS-08 (NAS# 5193G)	20.0 ± 20.7	No	15.0	No	No
JT-SS-10 (NAS# 5194G)	13.8 ± 16.0	No	8.8	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >10%.
[2] Cleanup Screening Levels (CSL) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >25%.

Table 3. Growth results of *Hyalella* 28-day toxicity test and data interpretation using guidelines from the Washington State SMS (2013).

Sample description	Average Individual Dry Weight (mg) (Mean ± SD)[1]	Statistically significantly lower than control sediment at α=0.05?	Percent lower than control sediment	Exceedance under SCO?[1] (MIG_C-MIG_T/MIG_C>0.25)	Exceedance under one-test criteria for CSL?[2] (MIG_C-MIG_T/MIG_C>0.40)
Control (NAS# 5195G)	0.32 ± 0.03	---	---	---	---
JT-SS-06 (NAS# 5192G)	0.41 ± 0.08	No	-28.0	No	No
JT-SS-08 (NAS# 5193G)	0.37 ± 0.08	No	-15.6	No	No
JT-SS-10 (NAS# 5194G)	0.28 ± 0.04	Yes	12.5	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth, and the difference is >25%.
[2] Cleanup Screening Levels (CSL) exceedance (one-test criteria) if the test sediment mean individual growth in significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth, and the difference is >40%.

APPENDIX I

PROTOCOL

TEST PROTOCOL

FRESHWATER AMPHIPOD, *HYALELLA AZTECA*, 28-DAY SEDIMENT SURVIVAL AND GROWTH TEST

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to characterize the chronic toxicity of freshwater sediments using a 28-day exposure and survival and growth endpoints with the amphipod, *Hyalella azteca*.

1.2 Referenced Method: This protocol is based on ASTM Method E 1706-00 (ASTM 2001) and EPA Method 100.1 (EPA/600/R-99/064)

1.3 Summary of Method: A summary of test conditions for the amphipod 28-day sediment survival and growth test is tabulated below. The test with *Hyalella azteca* is conducted at 23 ± 1°C with a 16L:8D photoperiod at an illuminance of about 100-1000 lux. Test chambers are 300-mL high-form lipless beakers containing 100 mL of sediment and 175 mL of overlying water. Ten 7-8day old amphipods are used in each replicate. The number of replicates/treatment depends on the objective of the test. Eight replicates are recommended for routine testing. Amphipods in each test chamber are fed 1.0 mL of YCT food daily. Each chamber receives two volume additions per day of overlying water. Test endpoints include survival and growth.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

____
____
____
____

2.2 Sponsor's Study Monitor:

____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
3814 Yaquina Bay Road, P.O. Box 1437
Newport, OR 97365.

2.4 Test Location:

____

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: ____________________
Quality Assurance Unit: ____________________
Aquatic Toxicologist: ____________________
Aquatic Toxicologist: ____________________

2.6 Proposed Testing Schedule: Tests are normally begun within 14 days of sample collection. Reference toxicant test to be run concurrently.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are freshwater sediments. The control, reference, and test sediments are placed in solvent cleaned 1 L glass jars fitted with PTFE-lined screw caps. At the laboratory the samples are stored at 4°C in the dark. The original sealed containers may be stored for up to 8 weeks prior to testing, depending on the testing requirements. If jars are not full when received or if sediment is removed for testing, headspaces should be filled with nitrogen to retard deterioration. A negative control sediment is collected from a clean site. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, may be employed as a comparison station.

4. TEST WATER

Test water (overlying water) at NAS is normally dechlorinated tap water or moderately hard synthetic water. Synthetic dilution water is prepared from Milli-Q reagent grade water and reagent grade chemicals. Test water may also be well water, surface water, site water, or other water depending on the study design. The hardness or other water quality parameters of the dilution water may need to be adjusted to meet the study design.

5. TEST ORGANISMS

5.1 Species: amphipod, *Hyalella azteca.*

5.2 Source: Cultured at NAS. Alternatively, animals may be purchased from a reputable commercial supplier.

5.3 Age: 7-8 days old at start of test

5.4 Acclimation and Pretest Observation: Cultures are maintained at 23 ± 1°C under a 16:8 L:D photoperiod. Cultured amphipods are fed dried maple leaves with YTC. Rabbit chow, Tetramin® or TetraFin-® flakes may also be used. Acclimation of test organisms to the test water may be desirable, depending on culture water, but it is not required. If test organisms are to be acclimated, fifty percent of the holding water is changed daily with the addition of test water.

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 300-mL high-form lipless glass beakers. Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or by placement in a temperature-controlled room. Aeration is not empolyed unless dissolved oxygen drops below 2.5 mg/L. The test is conducted under an illuminance of 100-1000 lux with a 16L:8D photoperiod.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027F. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The test involves exposure of amphipods to test, control, and reference sediments. The sediments are placed on the bottom of the test containers and are overlain with test water. The test exposure is for 28 days. The renewal of overlying water consists of two volume additions per day, either continuous or intermittent. Each treatment consists of eight replicate test containers, each containing 10 organisms. Test chamber positions are completely randomized. Test organisms are randomly distributed to the test chambers. Blind testing is normally used.

7.2 Setup of Test Containers: Sediments are homogenized and placed in test chambers on the day before addition of test organisms. Sediment (100 ml) is placed into each of eight replicate beakers. After addition of the sediment, 175 ml of test water is gently added to each beaker in a manner to prevent resuspension. The overlying water is replaced twice daily. The test begins when amphipods are introduced to the test chambers. Initial water quality measurements are taken prior to the addition of test organisms.

7.3 Effect Criterion: The effect criteria used in the 28-day amphipod bioassay are mortality and growth. Death is defined as the lack of movement of body or appendages on response to tactile stimulation. Growth is measured as change in dry weight.

7.4 Test Conditions: No aeration is employed unless dissoved oxygen falls below 2.5 mg/L. The test temperature employed is 23 ± 1°C. A 16:8, L:D photoperiod is used. Illumination is supplied by daylight fluorescent lamps at 100-1000lux. The overlying water is replaced twice daily.

7.5 Beginning the Test: On the day the test begins, amphipods are impartially counted into small containers of test water (10/container). The test is begun by rinsing test organisms into the equilibrated test containers. For the growth endpoint, time-zero weight data should be collected.

7.6 Feeding: Amphipods are fed 1.0 mL of YCT daily per test chamber. A feeding may be skipped if there is a build up of excess food. However, all beakers must be treated similarly.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the toxicity test is 28 days. The type and frequency of observations to be made are summarized as follows:

TYPE OF OBSERVATION	TIMES OF OBSERVATION
BIOLOGICAL DATA	
Survival, growth	Day 28
PHYSICAL AND CHEMICAL DATA	
Hardness, alkalinity, conductivity, and ammonia-N	Beginning and end of test in overlying water of one replicate beaker from each treatment.
Temperature	Daily in overlying water of one replicate beaker from each treatment.
Conductivity	Weekly
Dissolved oxygen and pH	3X/week
Optional pore water ammonia and/or sulfide	In test sediments prior to initiating the tests. Optionally in sediments from sacrificial test chambers at test beginning and/or end.

Dissolved oxygen is measured using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. The pH is measured using a pH probe and a properly calibrated meter with scale divisions of 0.1 pH units. Temperature is measured with a calibrated mercury thermometer or telethermometer. Conductivity is measured with a conductivity meter. Hardness and alkalinity are measured using titrometric methods. Total soluble sulfide and total ammonia-N were measured using Hach test kits based on the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis.

Overlying water should be sampled just before water renewal from about 1 to 2 cm above the sediment surface using a pipet. It may be necessay to pool water samples from individual replicates. The pipet should be checked to make sure no organisms are removed during sampling of overlying water.

7.8 Test Termination: At test termination, the contents of each test container are sieved through a #35 (500 μm mesh) sieve to recover the amphipods. Amphipods from each replicate are put into a 30 mL plastic cup, rinsed with DI water, gently blotted and place into the appropriate tared aluminum weighing pan. The number of survivors for each container is recorded on the datasheet.

7.9 Growth Measurement: Growth is measured as average dry weight of animals in a test replicate at the end of the test on day 28. Pooled animals from each test replicate are gently blotted and placed into tared aluminum weigh pans. The pans are dried at 60-90°C to constant weight. The dried amphipods are placed into a dessicator and weighed as soon as possible to the nearest 0.01 mg (desirable to use 0.001 mg). The total weight of the dried amphipods in each pan is divided by the number of amphipods weighed to obtain an average dry weight per surviving amphipod per replicate.

8. CRITERIA OF TEST ACCEPTANCE

The test results are acceptable if the minimum survival of organisms in the control treatment at the end of the test is at least 80%.

9. DATA ANALYSIS

The endpoints of the toxicity test are survival and growth. Survival is obtained as a direct count of living organisms in each test container at the end of the test. Average amphipod dry weight, also measured at the end of the test, may be used to compare growth between treatment sediments and the control or reference sediment. Ordinarily the following data analysis is performed. Due to special requirements, alternative methods may be used. The means and standard deviations are calculated for each treatment level. Identification of toxic sediments is established by statistical comparison of test endpoints between test and control or reference sediments. Between treatment comparisons may be made using a Student's t-test or Wilcoxon's Two-Sample test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons.

10. REPORTING

The final report of the test results must include all of the following standard information at a minimum: name and identification of the test; the investigator and laboratory; date and time of test beginning and end; information on the test material; information on the source and quality of the overlying/test water; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including feeding, if any, and water quality; definition of the effect criteria and other observations; responses, if any, in the control treatment; tabulation and statistical analysis of measured responses and a summary table of endpoints; a description of the statistical methods used; any unusual information about the test or deviations from procedures; reference toxicant testing information.

11. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

12. REFERENCE TOXICANT

The reference toxicant test is a standard multi-concentration toxicity test using a specified chemical toxicant to evaluate the performance of test organisms used in the study. Reference toxicant tests are 96-hour, water only exposures, not 28-day sediment exposures. The reference toxicant test is run concurrently. Performance is evaluated by comparing the results of the reference toxicant test with historical results (e.g., control charts) obtained at the laboratory.

13. REFERENCED GUIDELINES

ASTM. 2001. Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates. ASTM Standard Method No. E 1706-00. Am. Soc. Test. Mat., Philadelphia, PA.

U.S. EPA. 2000. Section 11, Test Method 100.1, *Hyalella azteca* 10-d Survival and Growth Test for Sediments, pp. 47-54 In: Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates (Second Edition). EPA/600/R-99/064.

Weber, C.I. (Ed.) 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027F.

14. APPROVALS

______________________________ for ______________________________
Name Date

______________________________ for **Northwestern Aquatic Sciences**
Name Date

Appendix A
Test Conditions Summary

1. Test type	whole sediment toxicity test with renewal of overlying water
2. Test duration	28 days
3. Temperature	23 ± 1°C
4. Light quality	daylight fluorescent light
5. Illuminance	100-1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beakers, (Pyrex® 1040 or equivalent)
8. Sediment volume	100 mL
9. Overlying water volume	175 mL
10. Renewal overlying water	2 volume additions/day (continuous or intermittent)
11. Age of test organisms	7-8 days old at test initiation
12. Organisms per test chamber	10
13. Replicates per treatment	8 recommended for routine testing (depends on design)
14. Organisms per treatment	80
15. Feeding regime	YCT food, fed 1.0 mL daily/chamber
16. Cleaning	if screens are used, clean as needed
17. Aeration	None, unless DO falls below 2.5 mg/L
18. Overlying (test) water	Dechlorinated tap water, culture water, well water, surface water, site water or reconstituted water, depending on study design.
19. Water quality	Hardness, alkalinity, conductivity, ammonia-N beginning and end; temperature daily; conductivity weekly; DO & pH 3X/wk
20. Endpoints	Survival & growth (based on weight)
21. Test acceptability criteria	Minimum control survival of 80%
22. Sample holding	14 days at 4°C in the dark (recommended)
23. Sample volume required	1L (800 mL per sediment)
24. Reference toxicant	Concurrent testing required

APPENDIX II

RAW DATA

TEST DESCRIPTION, MONITORING, AND RESULTS BENCHSHEETS

Test No. 862-1 Client Hart Crowser Investigator ______

STUDY MANAGEMENT

Client: Hart Crowser, Inc., 1700 Westlake Ave. North, Suite 200, Seattle, WA 98109
Client's Study Monitor: Mr. Philip Cordell
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. G.J. Irissarri GJI
QA Officer L.K. Nemeth

1. Yves Katakura [illegible] 2. G.A. Buhler GAB
3. J. Brown JB 4. Lauren Brady LB
5. ______ 6. R.C.S. Caldwell RCC
7. ______ 8. ______

Study Schedule:
Test Beginning: 1-23-15 0905 Test Ending: 2-20-15 1000

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	5192G	5193G	5194G		
Description:	JT-SS-06	JT-SS-08	JT-SS-10		
Collection Date:	1/12/15	1/12/15	1/12/15		
Receipt Date:	1/14/15	1/14/15	1/14/15		
______:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
______:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
______:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
______:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
______:					

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with corrrect date
4) error found in measurement; measurement repeated

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-1 Client Hart Crowser Investigator ______

SEDIMENT DESCRIPTIONS -- SUPPLEMENTAL NOTES

Sample No.	Description
5195G	FINE BLACK MUD
5192G	Dark Brown sandy mud w/ woody fragments, some plastic film
5193G	Watery sandy black mud w/ wood fragments
5194G	BLACK MUDDY SAND w/ WOOD FRAGMENTS, BLACK PLASTIC FILM, ALUMINUM FOIL

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-1 Client Hart Crowser Investigator ________

TEST WATER

Source: Dechlorinated Newport, OR tap water

Date of Collection/Preparation: 1-19-15, 2-6-15

pH 7.8, 7.5

Cond (umhos/cm2) 108, 119

Hardness (mg/La0 26, 26

Alkalinity (mg/L) 30, 30

Total Chlorine (mg/l) <0.02, <0.02

Treatments: Aerated ≥ 24 hrs

TEST ORGANISMS

Species: *Hyalella azteca* Age: 7-8 DAYS Date received: 1-21-15

Source: Chesapeake Cultures, Hayes, VA

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond. umhos/cm	Hardness (mg/L)	Alkalinity (mg/L)	Feeding Amount	Feeding description	Water changes
1-21-15	17.5	6.8	>15.0	596	188	180	10 mls	YTC	rec'd date - yes ≥ 50%
1-22-15	20.2	7.3	8.9	255	77	70	"	"	"
1-23-15	20.7	7.5	8.4	223	68	60	"	"	
Mean	19.5	7.2	10.8	358	111	103			
S.D.	1.7	0.4	3.7	207	67	67			
(N)	3	3	3	3	3	3			

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test chambers: 300 ml glass beakers

Test volumes: 100 ml of test sediment; 275 ml total volume

Replicates/treatment: (8) 8 Organisms/treatment: (80) 80 (10/REP)

Test water changes: Twice daily

Aeration: only if DO falls below 2.5 mg/L

Feeding: everyday beginning with day zero

Test temperature (deg.C): 23

Beaker placement: Total randomization

Photoperiod: 16:8, L:D

Control Sediment:

Source: From an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Date collected: 1/19/15

Sieved through 0.5 -mm screen

Storage: 4°C in the dark in closed containers. NAS# 5195G

MISCELLANEOUS NOTES

Test No. 862-1 Client Hart Crowser Investigator ________

Test conducted in (circle one): (room 1) room 2 trailer water bath other: ________

Randomization chart: TOP SHELF

5	10	15	20	25	30				
4	9	14	19	24	29				
3	8	13	18	23	28				
2	7	12	17	22	27	32			
1	6	11	16	21	26	31			

FRONT

Randomization chart:

Randomization chart:

Randomization chart:

Test No. 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 0 (1/23/15) GB/GSJ

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
3	22.2	7.6	219	6.8	34	30		Each beaker fed 1.0 ml
7	22.2	7.7	113	6.6	34	30		YTC suspension
17	22.3	7.6	133	6.6	34	40		Initials: GB
18	22.3	7.6	115	6.6	34	40		
								Water changed in all
								beakers.
								Time: 0515
								Initials: GB
								Water changed in all
								beakers.
								Time: 1600
								Initials: LB

*Water quality measurements to be taken.

Day 1 (1/24/15) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.2							Each beaker fed 1.0 ml
7	22.3							YTC suspension
17	22.2							Initials: GB
18	22.2							
								Water changed in all
								beakers.
								Time: 0515
								Initials: GB
								Water changed in all
								beakers.
								Time: 1630
								Initials: LB

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 2 (1 /25/15) GJL

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.2							Each beaker fed 1.0 ml
7	22.2							YTC suspension
17	22.1							Initials: GJL
18	22.1							
								Water changed in all
								beakers.
								Time: 0450
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1620
								Initials: GJL

*Water quality measurements to be taken.

Day 3 (1 /26/15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.3	7.0		7.1				Each beaker fed 1.0 ml
7	22.2	7.0		7.1				YTC suspension
17	22.1	7.0		7.1				Initials: GJL
18	22.1	7.2		7.2				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1625
								Initials: [illegible]

*Water quality measurements to be taken.

Test No. 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 4 (1/27/15)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.6							Each beaker fed 1.0 ml
7	22.4							YTC suspension
17	22.2							Initials:
18	22.2							
								Water changed in all
								beakers.
								Time: 0520
								Initials:
								Water changed in all
								beakers.
								Time: 1645
								Initials:

*Water quality measurements to be taken.

Day 5 (1/28/15)

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	23.0	7.3	139	7.2				Each beaker fed 1.0 ml
7	22.8	7.1	124	7.2				YTC suspension
17	22.7	7.1	124	7.2				Initials:
18	22.7	7.1	120	7.2				
								Water changed in all
								beakers.
								Time: 0520
								Initials:
								Water changed in all
								beakers.
								Time: 1650
								Initials:

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator

DAILY RECORD SHEET

Day 6 (11/29/15) YV

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	23.1							Each beaker fed 1.0 ml
7	23.0							YTC suspension
17	22.8							Initials: YV
18	22.8							
								Water changed in all
								beakers.
								Time: 0525
								Initials: YV
								Water changed in all
								beakers.
								Time: 1615
								Initials: JS

*Water quality measurements to be taken.

Day 7 (11/30/15) YV

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.5	7.3		7.1				Each beaker fed 1.0 ml
7	22.4	6.9		7.0				YTC suspension
17	22.2	6.7		7.0				Initials: GB
18	22.2	6.8		7.1				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GB
								Water changed in all
								beakers.
								Time: 1615
								Initials: LS

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 8 (1/31/15) GAB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.5							Each beaker fed 1.0 ml
7	22.2							YTC suspension
17	22.2							Initials: GB
18	22.3							
								Water changed in all
								beakers.
								Time: 0515
								Initials: GAB
								Water changed in all
								beakers.
								Time: 1700
								Initials: YS

*Water quality measurements to be taken.

Day 9 (2/1/15) GSL

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.3							Each beaker fed 1.0 ml
7	22.1							YTC suspension
17	22.0							Initials: GSL
18	22.1							
								Water changed in all
								beakers.
								Time: 0500
								Initials: GSL
								Water changed in all
								beakers.
								Time: 1610
								Initials: GSL

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 10 (2/2/15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.4	7.4		7.2				Each beaker fed 1.0 ml
7	22.2	7.4		7.1				YTC suspension
17	22.1	7.0		7.1				Initials: GJL
18	22.1	7.1		7.1				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1655
								Initials: LS

*Water quality measurements to be taken.

Day 11 (2/3/15) LS

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.6							Each beaker fed 1.0 ml
7	22.7							YTC suspension
17	22.5							Initials:
18	22.5							
								Water changed in all
								beakers.
								Time: 0515
								Initials: Y
								Water changed in all
								beakers.
								Time: 1640
								Initials: LS

*Water quality measurements to be taken.

Test No. 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 12 (2/4/15) LB

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.6	6.3	126	7.1				Each beaker fed 1.0 ml
7	22.6	6.3	119	7.0				YTC suspension
17	22.4	6.1	122	7.0				Initials: LB
18	22.4	6.2	119	7.0				
								Water changed in all
								beakers.
								Time: 0510
								Initials: LB
								Water changed in all
								beakers.
								Time: 1605
								Initials: [illegible]

*Water quality measurements to be taken.

Day 13 (2/5/15) [illegible]

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	23.0							Each beaker fed 1.0 ml
7	23.1							YTC suspension
17	23.1							Initials: [illegible]
18	23.1							
								Water changed in all
								beakers.
								Time: 0500
								Initials: [illegible]
								Water changed in all
								beakers.
								Time: 1610
								Initials: LB

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 14 (2/6/15) YV/GSS

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	23.9	7.0		7.6				Each beaker fed 1.0 ml
7	23.6	6.7		7.3				YTC suspension
17	23.4	6.6		7.3				Initials: GB
18	23.4	6.7		7.3				
								Water changed in all
								beakers.
								Time: 0505
								Initials: GB
								Water changed in all
								beakers.
								Time: 1610
								Initials: YV

*Water quality measurements to be taken.

Day 15 (2/7/15) GB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.4							Each beaker fed 1.0 ml
7	22.5							YTC suspension
17	22.3							Initials: GB
18	22.3							
								Water changed in all
								beakers.
								Time: 0510
								Initials: GB
								Water changed in all
								beakers.
								Time: 1615
								Initials: VB

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 16 (2 /8 /15) GJL

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.2							Each beaker fed 1.0 ml
7	22.1							YTC suspension
17	22.1							Initials: GJL
18	22.0							
								Water changed in all
								beakers.
								Time: 0505
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1605
								Initials: YC

*Water quality measurements to be taken.

Day 17 (2 /9 /15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.6	6.8		7.3				Each beaker fed 1.0 ml
7	22.4	6.6		7.1				YTC suspension
17	22.3	6.6		7.1				Initials: GJL
18	22.3	6.9		7.1				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1610
								Initials: YC

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator

DAILY RECORD SHEET

Day 18 (2/10/15) [initials]

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.2							Each beaker fed 1.0 ml
7	22.0							YTC suspension
17	22.0							Initials: [initials]
18	22.0							
								Water changed in all
								beakers.
								Time: 0505
								Initials: [initials]
								Water changed in all
								beakers.
								Time: 1620
								Initials: [initials]

*Water quality measurements to be taken.

Day 19 (2/11/15) GB

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.1	6.8	117	7.2				Each beaker fed 1.0 ml
7	22.1	6.6	111	7.3				YTC suspension
17	22.2	6.7	113	7.3				Initials: GB
18	22.2	6.6	110	7.2				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GB
								Water changed in all
								beakers.
								Time: 1605
								Initials: [initials]

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 20 (2/12/15)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.0							Each beaker fed 1.0 ml
7	22.0							YTC suspension
17	22.0							Initials: [illegible]
18	22.0							
								Water changed in all
								beakers.
								Time: 0510
								Initials: [illegible]
								Water changed in all
								beakers.
								Time: 1630
								Initials: [illegible]

*Water quality measurements to be taken.

Day 21 (2/13/15)

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.7	7.3		7.5				Each beaker fed 1.0 ml
7	22.6	7.1		7.2				YTC suspension
17	22.4	6.7		7.2				Initials: [illegible]
18	22.3	7.1		7.2				
								Water changed in all
								beakers.
								Time: 0505
								Initials: [illegible]
								Water changed in all
								beakers.
								Time: 1615
								Initials: [illegible]

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 22 (2/14/15 GB)

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.1							Each beaker fed 1.0 ml
7	22.1							YTC suspension
17	22.0							Initials: GB
18	22.0							
								Water changed in all
								beakers.
								Time: 0520
								Initials: GB
								Water changed in all
								beakers.
								Time: 1630
								Initials: JB

*Water quality measurements to be taken.

Day 23 (2/15/15) GJ1

GJ1 2-15-15 ①

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.3							Each beaker fed 1.0 ml
7	~~22.3~~	22.4						YTC suspension
17	22.3							Initials: GJ1
18	22.2							
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJ1
								Water changed in all
								beakers.
								Time: 1620
								Initials: GJ1

*Water quality measurements to be taken.

Test No. 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 24 (2/16/15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.4	6.9		7.4				Each beaker fed 1.0 ml
7	22.2	6.6		7.2				YTC suspension
17	22.2	6.6		7.2				Initials: GJL
18	22.1	6.8		7.2				
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1600
								Initials: LB

*Water quality measurements to be taken.

Day 25 (2/17/15) YL/LB

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.7							Each beaker fed 1.0 ml
7	22.4							YTC suspension
17	22.4							Initials: YL
18	22.2							
								Water changed in all
								beakers.
								Time: 0540
								Initials: YL
								Water changed in all
								beakers.
								Time: 1610
								Initials: GJL

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 26 (2/18/15) LS

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.9	7.2	118	7.2				Each beaker fed 1.0 ml
7	22.9	6.4	114	7.1				YTC suspension
17	22.8	6.3	115	7.1				Initials: GD
18	22.9	6.9	112	7.2				
								Water changed in all
								beakers.
								Time: 0505
								Initials: JB
								Water changed in all
								beakers.
								Time: 16:40
								Initials: LS

*Water quality measurements to be taken.

Day 27 (2/19/15) Y

Beaker No.	Temp.* (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
3	22.0							Each beaker fed 1.0 ml
7	22.4							YTC suspension
17	22.4							Initials: Y
18	22.3							
								Water changed in all
								beakers.
								Time: 0505
								Initials: Y
								Water changed in all
								beakers.
								Time: 1610
								Initials: JB

*Water quality measurements to be taken.

Test No 862-1 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 28 (2/20/15) CB/YL/CB

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
3	22.7	8.5	122	8.0	34	30		
7	22.6	7.5	113	7.3	26	30		
17	22.6	7.5	118	7.3	34	40		
18	22.5	8.1	113	7.5	26	40		
								Water changed in all
								beakers.
								Time: 0500
								Initials: CB

*Water quality measurements to be taken.

Day ______(/ /)

Beaker No.	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments

*Water quality measurements to be taken.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-HA4c
HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-1 Client Hart Crowser Investigator ________

DAY 28 TEST TERMINATION SHEET

Beaker No.	Number of survivors	Initials
1	10	CAB
2	9	CAB
3	10	CAB
4	10	CAB
5	9	CAB
6	4	CAB
7	10	CAB
8	9	CAB
9	9	YL
10	10	YL
11	9	CAB
12	8	CAB
13	10	CAB
14	10	CAB
15	10	YL
16	8	YL
17	5	CAB
18	7	CAB
19	8	YL
20	9	YL
21	10	CAB
22	8	CAB
23	7	CAB
24	10	CAB
25	9	YL
26	4	YL
27	6	CAB
28	10	CAB
29	7	CAB
30	10	CAB
31	9	YL
32	7	YL

Beaker No.	Number of survivors	Initials

Test No. 862-1 Client Hart Crowser Investigator ________

ZERO-TIME WEIGHING DATA SHEET

Tare: Date 1-22-15 Oven temp (C.) 61 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.007 100mg: 100.014

Final: Date 1-26-15 Oven temp (C.) 62 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.008 100mg: 100.015

Equip. used: Oven: Blue m #1 Balance: Sartorius M3P

(Dry overnight at 60-90 degrees C)

Pan #	Tare wt. (mg)	Total wt. (mg)	#weighed	Comments
1	32.244	32.891	10	
2	30.550	31.202	10	
3	41.342	42.029	10	
4	35.318	35.956	10	
5	29.978	30.727	10	

NORTHWESTERN AQUATIC SCIENCES | PROTOCOL NO. NAS-XXX-HA4c

HYALELLA AZTECA 28-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-1 Client Hart Crowser Investigator ______

WEIGHING DATA SHEET

Tare: Date 1-22-15 Oven temp (C.) 61 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.007 100mg: 100.014

Final #1: Date 2-3-15 Oven temp (C.) 62 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.008 100mg: 100.019

Final #2: Date 2-24-15 Oven temp (C.) 64 Drying time (hr.) 24 Initials JRF
Standard Weights: 10 mg: 10.007 100mg: 100.018

Equip. used: Oven BLUE M #1 Balance Sartorius M3P
(Dry overnight at 60-90 degrees C)

Bkr. #	Pan #	Tare wt. (mg)	Total wt. (mg) 1	Total wt. (mg) 2	no. weighed	put into pans-initials	Comments
1	1	34.035	JF ~~106.04~~ 37.127	37.049	10	LB	
2	2	33.915	JF ~~97.~~ 36.436	36.374	9	LB	
3	3	32.674	JF ~~36.43~~ 35.888	35.812	10	LB	
4	4	33.239	37.387	37.301	10	LB	~~.141 35.883~~ JF
5	5	32.927	36.~~34~~141	36.075	9	LB	
6	6	31.841	34.039	33.992	4	LB	
7	7	32.235	35.172	35.104	10	LB	
8	8	31.388	34.274	34.219	9	LB	
9	9	32.283	34.618	34.580	9	LB	
10	10	31.860	35.142	35.088	10	LB	
11	11	32.240	35.003	34.951	9	LB	
12	12	32.070	34.617	34.577	8	LB	
13	13	33.570	36.182	36.144	10	LB	
14	14	33.263	36.391	36.367	10	LB	
15	15	36.412	40.377	40.319	10	LB	
16	16	31.668	34.408	34.388	8	LB	
17	17	34.924	36.554	36.534	5	LB	
18	18	35.345	37.587	37.558	7	LB	
19	19	28.557	30.975	30.941	8	LB	
20	20	33.640	36.293	36.258	9	LB	
21	21	34.089	38.001	37.952	10	LB	
22	22	32.079	34.675	34.646	8	LB	
23	23	32.435	36.005	35.941	7	LB	
24	24	34.733	37.900	37.854	10	LB	
25	25	36.924	39.485	39.454	9	LB	
26	26	33.049	34.931	34.913	4	LB	
27	27	38.156	41.077	41.043	6	LB	
28	28	34.510	37.985	37.923	10	LB	
29	29	32.536	35.698	35.627	7	LB	
30	30	34.453	37.205	37.139	10	LB	
31	31	30.870	33.051	32.997	9	LB	
32	32	34.577	37.923	37.857	7	LB	

Chesapeake Cultures

P.O. Box 507 Hayes, VA 23072 (804)693-4046 (804)694-4704 fax
www.c-cultures.com
growfish@c-cultures.com

NAS

Shipment Information

Rcvd 1-21-15

Species Hyalella azteca Date 1/20/15

Age ~4-5d.; ~1.5 mm P.O. No. verbal

Quantity 530+ Invoice No. 8585

Temperature 24°C Salinity — pH 7.88

Notes Thank you!

Biologist [signature]

Please inspect shipment and report any problem immediately

TEST DATA ANALYSIS RECORDS

Test Number: P862-1

Freshwater Sediment Test
28-day Hyalella azteca

data entry verified against laboratory benchsheets 3-9-15 JRF

Endpoints Data Entry and Calculations File

BKR=beaker number
INIT=initial number
SURV=number survivors
MORT=number dead=INIT-SURV
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)

TARE WT= ashed weight of pan used for that replicate at test termination (mg), or dry weight of pan if ash-free dry weight is not an endpoint
WT COUNT= number of test organisms weighed at test end
DRY WT= TARE WT + dry weight of test organisms recovered at test termination (mg)
TWT=total biomass=DRY WT-TARE WT
WT=average individual biomass=TWT/WT COUNT

INITIAL WEIGHT				
pan #	tare wt (mg)	final wt (mg)	wt count	avg. wt/ organism
1	32.244	32.891	10	0.0647
2	30.550	31.202	10	0.0652
3	41.342	42.029	10	0.0687
4	35.318	35.956	10	0.0638
5	29.978	30.727	10	0.0749
			Mean	0.067

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	TWT (mg)	WT (mg)		SURV	MORT	PSURV	PMORT	WT
1	24	5195G	Contol	1		10	10	0	100.0	0.0	34.733	10	37.854	3.12	0.31						
2	11	5195G	Contol	2		10	9	1	90.0	10.0	32.240	9	34.951	2.71	0.30						
3	2	5195G	Contol	3		10	9	1	90.0	10.0	33.915	9	36.374	2.46	0.27						
4	5	5195G	Contol	4		10	9	1	90.0	10.0	32.927	9	36.075	3.15	0.35						
5	8	5195G	Contol	5		10	9	1	90.0	10.0	31.388	9	34.219	2.83	0.31	Mean	9.5	0.5	95.0	5.0	0.32
6	21	5195G	Contol	6		10	10	0	100.0	0.0	34.089	10	37.952	3.86	0.39	SD	0.5	0.5	5.3	5.3	0.03
7	1	5195G	Contol	7		10	10	0	100.0	0.0	34.035	10	37.049	3.01	0.30	n	8	8	8	8	8
8	3	5195G	Contol	8	wq replicate	10	10	0	100.0	0.0	32.674	10	35.812	3.14	0.31						
9	28	5192G	JT-SS-06	1		10	10	0	100.0	0.0	34.510	10	37.923	3.41	0.34						
10	27	5192G	JT-SS-06	2		10	6	4	60.0	40.0	38.156	6	41.043	2.89	0.48						
11	26	5192G	JT-SS-06	3		10	4	6	40.0	60.0	33.049	4	34.913	1.86	0.47						
12	32	5192G	JT-SS-06	4		10	7	3	70.0	30.0	34.577	7	37.857	3.28	0.47						
13	12	5192G	JT-SS-06	5		10	8	2	80.0	20.0	32.070	8	34.577	2.51	0.31	Mean	7.8	2.3	77.5	22.5	0.41
14	4	5192G	JT-SS-06	6		10	10	0	100.0	0.0	33.239	10	37.301	4.06	0.41	SD	2.2	2.2	21.9	21.9	0.08
15	23	5192G	JT-SS-06	7		10	7	3	70.0	30.0	32.435	7	35.941	3.51	0.50	n	8	8	8	8	8
16	7	5192G	JT-SS-06	8	wq replicate	10	10	0	100.0	0.0	32.235	10	35.104	2.87	0.29						
17	22	5193G	JT-SS-08	1		10	8	2	80.0	20.0	32.079	8	34.646	2.57	0.32						
18	19	5193G	JT-SS-08	2		10	8	2	80.0	20.0	28.557	8	30.941	2.38	0.30						
19	15	5193G	JT-SS-08	3		10	10	0	100.0	0.0	36.412	10	40.319	3.91	0.39						
20	29	5193G	JT-SS-08	4		10	7	3	70.0	30.0	32.536	7	35.627	3.09	0.44						
21	10	5193G	JT-SS-08	5		10	10	0	100.0	0.0	31.860	10	35.088	3.23	0.32	Mean	8.0	2.0	80.0	20.0	0.37
22	14	5193G	JT-SS-08	6		10	10	0	100.0	0.0	33.263	10	36.367	3.10	0.31	SD	2.1	2.1	20.7	20.7	0.08
23	6	5193G	JT-SS-08	7		10	4	6	40.0	60.0	31.841	4	33.992	2.15	0.54	n	8	8	8	8	8
24	18	5193G	JT-SS-08	8	wq replicate	10	7	3	70.0	30.0	35.345	7	37.558	2.21	0.32						
25	20	5194G	JT-SS-10	1		10	9	1	90.0	10.0	33.640	9	36.258	2.62	0.29						
26	30	5194G	JT-SS-10	2		10	10	0	100.0	0.0	34.453	10	37.139	2.69	0.27						
27	25	5194G	JT-SS-10	3		10	9	1	90.0	10.0	36.924	9	39.454	2.53	0.28						
28	13	5194G	JT-SS-10	4		10	10	0	100.0	0.0	33.570	10	36.144	2.57	0.26						
29	9	5194G	JT-SS-10	5		10	9	1	90.0	10.0	32.283	9	34.580	2.30	0.26	Mean	8.6	1.4	86.3	13.8	0.28
30	16	5194G	JT-SS-10	6		10	8	2	80.0	20.0	31.668	8	34.388	2.72	0.34	SD	1.6	1.6	16.0	16.0	0.04
31	31	5194G	JT-SS-10	7		10	9	1	90.0	10.0	30.870	9	32.997	2.13	0.24	n	8	8	8	8	8
32	17	5194G	JT-SS-10	8	wq replicate	10	5	5	50.0	50.0	34.924	5	36.534	1.61	0.32						

Project Name: P862-1 Hyalella % Mortality

Sample:	x1
Samp ID:	JT-SS-06
Alias:	NAS# 5192G
Replicates:	8
Mean:	22.5
SD:	21.876
Tr Mean:	22.873
Trans SD:	20.152

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	5
SD:	5.345
Tr Mean:	9.217
Trans SD:	9.854

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	13.616
SS:	3522.352
K:	8
b:	56.462
Alpha Level:	0.05
Calculated Value:	0.9051
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	17.155
Test Residual SD:	8.352
Ref. Residual Mean:	9.217
Ref. Residual SD:	0
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	2.688
Critical Value:	>= 1.761
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 <= x2
Alternate:	x1 > x2

Degrees of Freedom:	10
Experimental Alpha Level:	0.05
Calculated Value:	1.7219
Critical Value:	>= 1.812
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0	0	0	0	22.873	9.217			-22.873
2	40	39.232	10	18.435	16.358	9.217			-22.873
3	60	50.768	10	18.435	27.895	9.217			-22.873
4	30	33.211	10	18.435	10.338	9.217			-9.217
5	20	26.565	10	18.435	3.692	9.217			-9.217
6	0	0	0	0	22.873	9.217			-9.217
7	30	33.211	0	0	10.338	9.217			-9.217
8	0	0	0	0	22.873	9.217			3.692
9									9.217
10									9.217
11									9.217
12									9.217
13									10.338
14									10.338
15									16.358
16									27.895

The percent mortality in test sediment JT-SS-06 was not significantly higher that that of the control sediment at α=0.05.

Project Name: P862-1 Hyalella % Mortality

Sample:	x1
Samp ID:	JT-SS-08
Alias:	NAS# 5193G
Replicates:	8
Mean:	20
SD:	20.702
Tr Mean:	21.29
Trans SD:	19.156

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	5
SD:	5.345
Tr Mean:	9.217
Trans SD:	9.854

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	13.075
SS:	3248.336
K:	8
b:	54.155
Alpha Level:	0.05
Calculated Value:	0.9029
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	15.968
Test Residual SD:	8.693
Ref. Residual Mean:	9.217
Ref. Residual SD:	0
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	2.1963
Critical Value:	>= 1.761
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 <= x2
Alternate:	x1 > x2
Degrees of Freedom:	10
Experimental Alpha Level:	0.05
Calculated Value:	1.5851
Critical Value:	>= 1.812
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	20	26.565	0	0	5.275	9.217			-21.29
2	20	26.565	10	18.435	5.275	9.217			-21.29
3	0	0	10	18.435	21.29	9.217			-21.29
4	30	33.211	10	18.435	11.921	9.217			-9.217
5	0	0	10	18.435	21.29	9.217			-9.217
6	0	0	0	0	21.29	9.217			-9.217
7	60	50.768	0	0	29.478	9.217			-9.217
8	30	33.211	0	0	11.921	9.217			5.275
9									5.275
10									9.217
11									9.217
12									9.217
13									9.217
14									11.921
15									11.921
16									29.478

The percent mortality in test sediment JT-SS-08 was not significantly higher that that of the control sediment at α=0.05. – 631

Project Name: P862-1 Hyalella % Mortality

Sample:	x1
Samp ID:	JT-SS-10
Alias:	NAS# 5194G
Replicates:	8
Mean:	13.75
SD:	15.98
Tr Mean:	18.163
Trans SD:	14.397

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	5
SD:	5.345
Tr Mean:	9.217
Trans SD:	9.854

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	10.589
SS:	2130.599
K:	8
b:	44.42
Alpha Level:	0.05
Calculated Value:	0.9261
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	9.082
Test Residual SD:	10.631
Ref. Residual Mean:	9.217
Ref. Residual SD:	0
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	0.0362
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 <= x2
Alternate:	x1 > x2
Degrees of Freedom:	14
Experimental Alpha Level:	0.05
Calculated Value:	1.4503
Critical Value:	>= 1.761
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	10	18.435	0	0	0.272	9.217			-18.163
2	0	0	10	18.435	18.163	9.217			-18.163
3	10	18.435	10	18.435	0.272	9.217			-9.217
4	0	0	10	18.435	18.163	9.217			-9.217
5	10	18.435	10	18.435	0.272	9.217			-9.217
6	20	26.565	0	0	8.402	9.217			-9.217
7	10	18.435	0	0	0.272	9.217			0.272
8	50	45	0	0	26.837	9.217			0.272
9									0.272
10									0.272
11									8.402
12									9.217
13									9.217
14									9.217
15									9.217
16									26.837

The percent mortality in test sediment JT-SS-10 was not significantly higher that that of the control sediment at α=0.05. — 6 31

Project Name: P862-1 Hyalella Growth (dry wt)

Sample:	x1
Samp ID:	JT-SS-06
Alias:	NAS# 5192G
Replicates:	8
Mean:	0.409
SD:	0.084
Tr Mean:	0.409
Trans SD:	0.084

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	0.318
SD:	0.037
Tr Mean:	0.318
Trans SD:	0.037

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.056
SS:	0.059
K:	8
b:	0.236
Alpha Level:	0.05
Calculated Value:	0.9453
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.072
Test Residual SD:	0.035
Ref. Residual Mean:	0.026
Ref. Residual SD:	0.023
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	3.0506
Critical Value:	>= 1.761
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	No Transformation

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom:	10
Experimental Alpha Level:	0.05
Calculated Value:	-2.8151
Critical Value:	>= 1.812
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shapiro-Wilk Residuals
1	0.34	0.34	0.31	0.31	0.069	0.008			-0.119
2	0.48	0.48	0.3	0.3	0.071	0.018			-0.099
3	0.47	0.47	0.27	0.27	0.061	0.048			-0.069
4	0.47	0.47	0.35	0.35	0.061	0.033			-0.048
5	0.31	0.31	0.31	0.31	0.099	0.008			-0.018
6	0.41	0.41	0.39	0.39	0.001	0.073			-0.018
7	0.5	0.5	0.3	0.3	0.091	0.018			-0.008
8	0.29	0.29	0.31	0.31	0.119	0.008			-0.008
9									-0.008
10									0.001
11									0.033
12									0.061
13									0.061
14									0.071
15									0.073
16									0.091

Average individual growth (dry wt) in test sediment JT-SS-06 is not significantly less than that in the control sediment at α=0.05. —651

Project Name: P862-1 Hyalella Growth (dry wt)

Sample:	x1
Samp ID:	JT-SS-08
Alias:	NAS# 5193G
Replicates:	8
Mean:	0.368
SD:	0.085
Tr Mean:	0.413
Trans SD:	0.884

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	0.318
SD:	0.037
Tr Mean:	-0.413
Trans SD:	0.862

Shapiro-Wilk Results:

Residual Mean:	
Residual SD:	
SS:	
K:	
b:	
Alpha Level:	N/A
Calculated Value:	N/A
Critical Value:	N/A
Normally Distributed:	N/A
Override Option:	Not Invoked

Levene's Results:

Test Residual Mean:	0.672
Test Residual SD:	0.515
Ref. Residual Mean:	0.638
Ref. Residual SD:	0.527
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	0.1307
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	Rankits
Experimental Hypothesis	
Null:	x1 >= x2
Alternate:	x1 < x2
Degrees of Freedom:	14
Experimental Alpha Level:	0.05
Calculated Value:	-1.8911
Critical Value:	>= 1.761
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.32	0.236	0.31	-0.319	0.177	0.094		-1.766	
2	0.3	-1.013	0.3	-1.013	1.425	0.6		-1.013	
3	0.39	0.877	0.27	-1.766	0.464	1.353		-1.013	
4	0.44	1.285	0.35	0.57	0.872	0.983		-1.013	
5	0.32	0.236	0.31	-0.319	0.177	0.094		-0.319	
6	0.31	-0.319	0.39	0.877	0.732	1.289		-0.319	
7	0.54	1.766	0.3	-1.013	1.353	0.6		-0.319	
8	0.32	0.236	0.31	-0.319	0.177	0.094		-0.319	
9								0.236	
10								0.236	
11								0.236	
12								0.57	
13								0.877	
14								0.877	
15								1.285	
16								1.766	

Average individual growth (dry wt) in test sediment JT-SS-08 is not significantly less than that in the control sediment at α=0.05. –631

Project Name: P862-1 Hyalella Growth (dry wt)

Sample:	x1
Samp ID:	JT-SS-10
Alias:	NAS# 5194G
Replicates:	8
Mean:	0.283
SD:	0.033
Tr Mean:	0.283
Trans SD:	0.033

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	0.318
SD:	0.037
Tr Mean:	0.318
Trans SD:	0.037

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.03
SS:	0.017
K:	8
b:	0.125
Alpha Level:	0.05
Calculated Value:	0.9106
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.026
Test Residual SD:	0.019
Ref. Residual Mean:	0.026
Ref. Residual SD:	0.023
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	0.0588
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	No Transformation

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2
Degrees of Freedom:	14
Experimental Alpha Level:	0.05
Calculated Value:	2.0029
Critical Value:	>= 1.761
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.29	0.29	0.31	0.31	0.007	0.008			-0.048
2	0.27	0.27	0.3	0.3	0.013	0.018			-0.043
3	0.28	0.28	0.27	0.27	0.003	0.048			-0.023
4	0.26	0.26	0.35	0.35	0.023	0.033			-0.023
5	0.26	0.26	0.31	0.31	0.023	0.008			-0.018
6	0.34	0.34	0.39	0.39	0.058	0.073			-0.018
7	0.24	0.24	0.3	0.3	0.043	0.018			-0.013
8	0.32	0.32	0.31	0.31	0.038	0.008			-0.008
9									-0.008
10									-0.008
11									-0.003
12									0.007
13									0.033
14									0.038
15									0.058
16									0.073

Average individual growth (dry wt) in test sediment JT-SS-10 is significantly less than that in the control sediment at α=0.05. —GSJ data entry verified against laboratory bench sheets 3-9-15 JRF

Water Quality Data

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	Overlying water TEMP	DO	COND	pH	NH3	HARD	ALK
3	5195G	Control	8	0	22.2	7.6	219	6.8	0.9	34	30
7	5192G	JT-SS-06	8	0	22.2	7.7	113	6.6	0.2	34	30
17	5194G	JT-SS-10	8	0	22.3	7.6	133	6.6	0.3	34	40
18	5193G	JT-SS-08	8	0	22.3	7.6	115	6.6	0.1	34	40
3	5195G	Control	8	1	22.2						
7	5192G	JT-SS-06	8	1	22.3						
17	5194G	JT-SS-10	8	1	22.2						
18	5193G	JT-SS-08	8	1	22.2						
3	5195G	Control	8	2	22.2						
7	5192G	JT-SS-06	8	2	22.2						
17	5194G	JT-SS-10	8	2	22.1						
18	5193G	JT-SS-08	8	2	22.1						
3	5195G	Control	8	3	22.3	7.0		7.1			
7	5192G	JT-SS-06	8	3	22.2	7.0		7.1			
17	5194G	JT-SS-10	8	3	22.1	7.0		7.1			
18	5193G	JT-SS-08	8	3	22.1	7.2		7.2			
3	5195G	Control	8	4	22.6						
7	5192G	JT-SS-06	8	4	22.4						
17	5194G	JT-SS-10	8	4	22.2						
18	5193G	JT-SS-08	8	4	22.2						
3	5195G	Control	8	5	23.0	7.3	139	7.2			
7	5192G	JT-SS-06	8	5	22.8	7.1	124	7.2			
17	5194G	JT-SS-10	8	5	22.7	7.1	124	7.2			
18	5193G	JT-SS-08	8	5	22.7	7.1	120	7.2			
3	5195G	Control	8	6	23.1						
7	5192G	JT-SS-06	8	6	23.0						
17	5194G	JT-SS-10	8	6	22.8						
18	5193G	JT-SS-08	8	6	22.8						
3	5195G	Control	8	7	22.5	7.3		7.1			
7	5192G	JT-SS-06	8	7	22.4	6.9		7.0			
17	5194G	JT-SS-10	8	7	22.2	6.7		7.0			
18	5193G	JT-SS-08	8	7	22.2	6.8		7.1			
3	5195G	Control	8	8	22.5						
7	5192G	JT-SS-06	8	8	22.2						
17	5194G	JT-SS-10	8	8	22.2						
18	5193G	JT-SS-08	8	8	22.3						
3	5195G	Control	8	9	22.3						
7	5192G	JT-SS-06	8	9	22.1						
17	5194G	JT-SS-10	8	9	22.0						
18	5193G	JT-SS-08	8	9	22.1						
3	5195G	Control	8	10	22.4	7.4		7.2			
7	5192G	JT-SS-06	8	10	22.2	7.4		7.1			
17	5194G	JT-SS-10	8	10	22.1	7.0		7.1			
18	5193G	JT-SS-08	8	10	22.1	7.1		7.1			
3	5195G	Control	8	11	22.6						
7	5192G	JT-SS-06	8	11	22.7						
17	5194G	JT-SS-10	8	11	22.5						
18	5193G	JT-SS-08	8	11	22.5						

3	5195G	Control	8	12	22.6	6.3	126	7.1
7	5192G	JT-SS-06	8	12	22.6	6.3	119	7.0
17	5194G	JT-SS-10	8	12	22.4	6.1	122	7.0
18	5193G	JT-SS-08	8	12	22.4	6.2	119	7.0
3	5195G	Control	8	13	23.0			
7	5192G	JT-SS-06	8	13	23.1			
17	5194G	JT-SS-10	8	13	23.1			
18	5193G	JT-SS-08	8	13	23.1			
3	5195G	Control	8	14	23.9	7.0		7.6
7	5192G	JT-SS-06	8	14	23.6	6.7		7.3
17	5194G	JT-SS-10	8	14	23.4	6.6		7.3
18	5193G	JT-SS-08	8	14	23.4	6.7		7.3
3	5195G	Control	8	15	22.4			
7	5192G	JT-SS-06	8	15	22.5			
17	5194G	JT-SS-10	8	15	22.3			
18	5193G	JT-SS-08	8	15	22.3			
3	5195G	Control	8	16	22.2			
7	5192G	JT-SS-06	8	16	22.1			
17	5194G	JT-SS-10	8	16	22.1			
18	5193G	JT-SS-08	8	16	22.0			
3	5195G	Control	8	17	22.6	6.8		7.3
7	5192G	JT-SS-06	8	17	22.4	6.6		7.1
17	5194G	JT-SS-10	8	17	22.3	6.6		7.1
18	5193G	JT-SS-08	8	17	22.3	6.9		7.1
3	5195G	Control	8	18	22.2			
7	5192G	JT-SS-06	8	18	22.0			
17	5194G	JT-SS-10	8	18	22.0			
18	5193G	JT-SS-08	8	18	22.0			
3	5195G	Control	8	19	22.1	6.8	117	7.2
7	5192G	JT-SS-06	8	19	22.1	6.6	111	7.3
17	5194G	JT-SS-10	8	19	22.2	6.7	113	7.3
18	5193G	JT-SS-08	8	19	22.2	6.6	110	7.2
3	5195G	Control	8	20	22.0			
7	5192G	JT-SS-06	8	20	22.0			
17	5194G	JT-SS-10	8	20	22.0			
18	5193G	JT-SS-08	8	20	22.0			
3	5195G	Control	8	21	22.7	7.3		7.5
7	5192G	JT-SS-06	8	21	22.6	7.1		7.2
17	5194G	JT-SS-10	8	21	22.4	6.7		7.2
18	5193G	JT-SS-08	8	21	22.3	7.1		7.2
3	5195G	Control	8	22	22.1			
7	5192G	JT-SS-06	8	22	22.1			
17	5194G	JT-SS-10	8	22	22.0			
18	5193G	JT-SS-08	8	22	22.0			
3	5195G	Control	8	23	22.3			
7	5192G	JT-SS-06	8	23	22.4			
17	5194G	JT-SS-10	8	23	22.3			
18	5193G	JT-SS-08	8	23	22.2			
3	5195G	Control	8	24	22.4	6.9		7.4
7	5192G	JT-SS-06	8	24	22.2	6.6		7.2
17	5194G	JT-SS-10	8	24	22.2	6.6		7.2
18	5193G	JT-SS-08	8	24	22.1	6.8		7.2

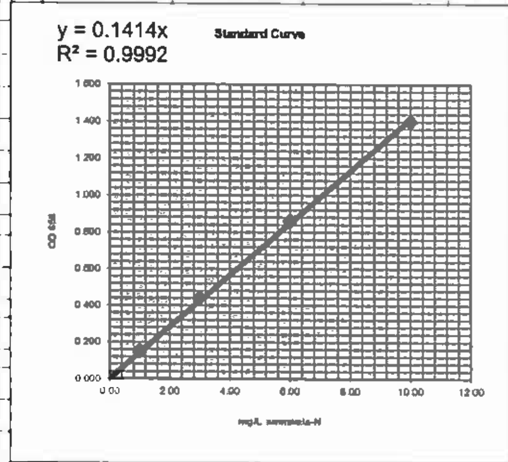
3	5195G	Control	8	25	22.7						
7	5192G	JT-SS-06	8	25	22.4						
17	5194G	JT-SS-10	8	25	22.4						
18	5193G	JT-SS-08	8	25	22.2						
3	5195G	Control	8	26	22.9	7.2	118	7.2			
7	5192G	JT-SS-06	8	26	22.9	6.4	114	7.1			
17	5194G	JT-SS-10	8	26	22.8	6.3	115	7.1			
18	5193G	JT-SS-08	8	26	22.9	6.9	112	7.2			
3	5195G	Control	8	27	22.0						
7	5192G	JT-SS-06	8	27	22.4						
17	5194G	JT-SS-10	8	27	22.4						
18	5193G	JT-SS-08	8	27	22.3						
3	5195G	Control	8	28	22.7	8.5	122	8.0	<0.1	34	30
7	5192G	JT-SS-06	8	28	22.6	7.5	113	7.3	<0.1	26	30
17	5194G	JT-SS-10	8	28	22.6	7.5	118	7.3	<0.1	34	40
18	5193G	JT-SS-08	8	28	22.5	8.1	113	7.5	<0.1	26	40
				Mean	22.4	7.0	123	7.2	---	32	35
				SD	0.4	0.5	22	0.2	---	4	5
				n	116	52	24	52	8	8	8
				Min	22.0	6.1	110	6.6	<0.1	26	30
				Max	23.9	8.5	219	8.0	0.9	34	40

AMMONIA EXPOSURE BENCHSHEETS AND ANALYSIS

Total Ammonia-N in Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	0.151	1.00		
	3.0 mg/L NH3-N Std.	-----	0.440	3.00		
	6.0 mg/L NH3-N Std.	-----	0.862	6.00		
	10.0 mg/L NH3-N Std.	-----	1.400	10.00		
	3.0 mg/L spike	-----	0.449	3.17		
	3.0 mg/L spike dupl.	-----	0.440	3.11		
	5.0 mg/L 2nd source		0.710	5.02		
1	Day 0 (1-23-15)					
2	3	1	0.120	0.85		
3	7	1	0.023	0.16		
4	17	1	0.040	0.28		
5	18	1	0.020	0.14		
6						
7	Day 28 (2-20-15)					
8	3	1	0.009	ND		
9	7	1	0.002	ND		
10	17	1	0.000	ND		
11	18	1	0.000	ND		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						



Reporting limit (mg/L) =	0.10
Recovery (%) =	104.8
Precision (RPD) =	2.02
2nd source (%) =	100.4
Sample volume (ml):	0.50
Dilution factor	1

Sample Set Description:
Test No.: 862-1
Test Day: 0,& 28
Species: *Hyalella*

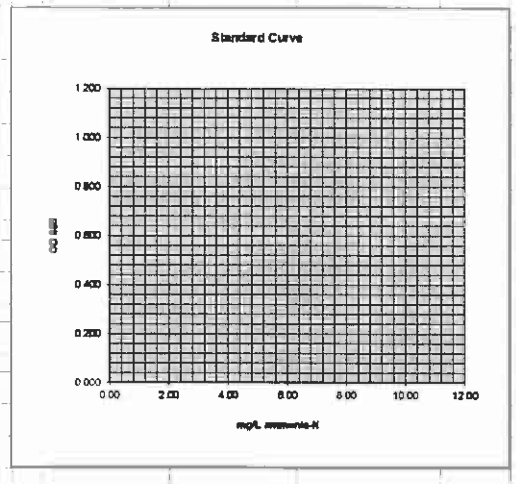
Sample Type (check)
Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: JB
Date analysed: 2/20/2015

Total Ammonia-N in Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	-----	.151	1.00		
	3.0 mg/L NH3-N Std.	-----	.440	3.00		
	6.0 mg/L NH3-N Std.	-----	.862	6.00		
	10.0 mg/L NH3-N Std.	-----	1.4	10.00		
	3.0 mg/L spike	-----	.449			
	3.0 mg/L spike dupl.	-----	.440			
	5.0 mg/L 2nd source		.710			
1	Day 0 (1-23-15)					
2	3	1	.012			
3	7	1	.023			
4	17	1	.040			
5	18	1	.020			
6						
7	Day 28 (2-20-15)					
8	3	1	.009			
9	7	1	.002			
10	17	1	.000			
11	18	1	.000			
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						



Reporting limit (mg/L) = 0.10

Recovery (%) = #VALUE!
Precision (RPD) = #VALUE!
2nd source (%) = #VALUE!

Sample volume (ml): 0.50
Dilution factor 1

Sample Set Description:
Test No.: 862-1
Test Day: 0,& 28
Species: *Hyalella*

Sample Type (check)
Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: JB
Date analysed: 2/20/2015

CHAIN-OF-CUSTODY RECORDS

Sample Custody Record

Samples Shipped to: NW Aquatic Sciences

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

HARTCROWSER

JOB 17800-56 LAB NUMBER

PROJECT NAME Jacobson Terminals

HART CROWSER CONTACT Phil Cordell

SAMPLED BY: PRC

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	* 10-day Chironomus dilutus survival and growth	28-day Hyalella azteca survival and growth	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	JT-SS-06	5192G	1/12/15	1159	Sediment	X	X	4	4 liters sediment
	JT-SS-08	5193G	↓	1058	↓	X	X	4	" "
	JT-SS-10	5194G	↓	1400	↓	X	X	4	" "

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE [signature]	1/13/15	SIGNATURE [signature]	1-14-15
PRINT NAME Phil Cordell	TIME 1000	PRINT NAME GERALD IRISSARRI	TIME 1140
COMPANY HC		COMPANY NAS	
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS: [scribbled out]

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ______ for Other Contract Requirements

12 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☒YES ☐NO ☐N/A
GOOD CONDITION ☒YES ☐NO
TEMPERATURE 2.5°C
SHIPMENT METHOD: ☐HAND ☐COURIER ☒OVERNIGHT

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

From: (206) 826-4527
Phil Cordell
Hart Crowser, Inc
1700 Westlake Avenue North
Suite 200
Seattle, WA 98109

Origin ID LKEA

FedEx. Express

E

SHIP TO: (206) 324-9530 BILL SENDER
Gerald Irissarri
Northwest Aquatics Scientists
3814 Yakima Rd

NEWPORT, OR 97365

Ship Date 13JAN15
ActWgt 75 0 LB
CAD 4596184/INET3550

Delivery Address Bar Code

Ref # 17800-56-02
Invoice #
PO #
Dept #

WED - 14 JAN AM
STANDARD OVERNIGHT

TRK# 7725 6121 8674
0201

97365
OR-US
PDX

86 ONPA

522G1/BF15/8AC9

Rcvd 1130 1-14-15

After printing this label
1 Use the 'Print' button on this page to print your label to your laser or inkjet printer
2. Fold the printed page along the horizontal line.
3 Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned

Warning Use only the printed original label for shipping Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss. Maximum for items of extraordinary value is $1,000, e g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

CUSTODY SEAL CUSTODY SEAL CUSTODY SEAL CUSTODY SEAL

Date 1/13/15

Initials

37 of 37

APPENDIX III

RAW DATA – REFERENCE TOXICANT TEST

ACUTE TOXICITY TEST (ALL SPECIES)

REVIEWED PAGES 1-8 GJI

Test No. 999-3381 Client: QC Test Investigator
Test Type (rangefinding/definitive) Test Length (hr) 96
Species *Hyalella azteca*

STUDY MANAGEMENT

Client: QC test
Client's Study Monitor: QC test
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. G.J. Irissarri GJI
QA Officer L. K. Nemeth
1. Yves Nakahara YN 2. GA Buhler GAB
3. 4.
Test Beginning: 1-23-15 0915 Test Ending: 1-27-15 1030

TEST MATERIAL

Description: Potassium Chloride Crystals - Lot No.: Fisher 114689

NAS Sample No.				
Date of Collection:				
Date of Receipt:				
Temperature (deg C):				
Dissolved oxygen (mg/L):				
pH:				
Conductivity (umhos/cm):				
Hardness (mg/L):				
Alkalinity (mg/L):				
Salinity (ppt):				
Total chlorine (mg/L):				
Total ammonia-N (mg/L):				
:				

DILUTION WATER

Description: Moderately hard synthetic water
Date of Preparation/Collection: 1-15-15
Water Quality: Cond. (umhos/cm): 283 Salinity (ppt) pH 7.5
Hardness (mg/L as $CaCO_3$): 77 Alkalinity (mg/L as $CaCO_3$): 70
Treatments: Aerated ≥ 24 hrs

TEST LOCATION

Test conducted in (circle one): (room 1) room 2 trailer water bath other:

Randomization chart:

0.5	0.125	0.063	1.0	0.25	∅				
0.125	0.25	∅	0.063	0.5	1.0				

Error codes: 1) Correction of handwriting error
2) Written in wrong location; entry deleted
3) Wrong date deleted; replaced with correct date
4) Error found in measurement; measurement repeated

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3381 Client QC Test Investigator

TEST ORGANISMS

Species: *Hyalella azteca* Age: 7-8 DAYS Size:
Source: Chesapeake Cultures, Hayes, VA Date received: 1-21-15

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond. umhos/cm	Hardness (mg/L)	Alkalinity (mg/L)	Feeding Amount	Feeding description	Water changes
1-21-15	17.5	6.8	>15.0	596	188	180	10mLs	YTC	Rec'd daily - [illegible]
1-22-15	20.2	7.3	8.9	255	77	70	"	"	"
1-23-15	20.7	7.5	8.4	223	68	60	"	"	
Mean	19.5	7.2	10.8	358	111	103			
S.D.	1.7	0.4	3.7	207	67	67			
(N)	3	3	3	3	3	3			

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 1, 0.5, 0.25, 0.125, 0.063 0 g/L

Test chamber: 250 ml glass beakers Test volume: 100 ml
Replicates/treatment: 2 Organisms/treatment: 20 (10/rep)
Test water changes: None Aeration during test: None
Feeding: 0.5 ml YTC suspension per beaker on days 0 and 2

Duration: 24-hr, 48-hr, (96-hr) Test temperature (deg.C): (23 ± 1) or 20 ± 1
Beaker placement: Stratified randomization Photoperiod: 16:8, L:D

MISCELLANEOUS NOTES

Test solution preparation:
Working stock: Dissolve 0.5g KCl crystals in dilution water and dilute to 500 mL.
Final conc.: 1.0 g/L.

1-23-15 [illegible]

Test concentration (g/L)	KCl working stock (ml/200ml)	Dilution water
1	200	Brought up to final volume of 200 ml with dilution water and distributed evenly between two replicates
0.5	100	
0.25	50	
0.125	25	
0.063	12.5	
0	0	

Test No. 999-3381 Client QC Test

DAILY RECORD SHEET

Day 0 (1/23/15) GB/GJL

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	22.7	7.6	1990	8.5	86	70	10	10
2. 0.5	22.7	7.4	1160	8.6			10	10
3. 0.25	22.7	7.3	728	8.7			10	10
4. 0.125	22.8	7.3	510	8.6			10	10
5. 0.063	22.7	7.1	395	8.6			10	10
6. 0	22.4	7.1	282	8.5	86	60	10	10

Each beaker fed 0.5 ml YTC suspension. Initials: GB

Day 1 (1/24/15) GB

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	23.2	7.7	1980	8.2			4(6D)	5(5D)
2. 0.5	23.2	7.6	1208	8.2			10	8(2D)
3. 0.25	23.2	7.6	747	8.5			10	10
4. 0.125	23.2	7.6	521	8.3			10	10
5. 0.063	23.1	7.6	412	8.4			10	10
6. 0	23.0	7.5	300	8.2			10	10

Day 2 (1/25/15) GJL

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	23.3	7.8	2080	8.0			Ø (4D)	Ø (5D)
2. 0.5	23.4	7.8	1264	8.0			7(3D)	4(4D)
3. 0.25	23.3	7.9	793	8.1			10	10
4. 0.125	23.4	7.7	555	8.1			10	10
5. 0.063	23.4	7.7	442	8.2			10	10
6. 0	23.3	7.5	309	8.2			10	10

Each beaker fed 0.5 ml YTC suspension. Initials: GJL

Day 3 (1/26/15) GJL

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	—	—	—	—				
2. 0.5	23.6	7.7	1282	7.6			INADVERTENTLY	
3. 0.25	23.6	7.7	804	7.6			NOT ASSESSED	
4. 0.125	23.6	7.6	560	7.6			-GJL	
5. 0.063	23.5	7.6	454	7.7				
6. 0	23.4	7.5	316	7.8				

Day 4 (1/27/15)

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Survivors A	Survivors B
1. 1	—	—	—	—	—	—	0	0
2. 0.5	23.3	7.9	1269	8.1			7	3(1D)
3. 0.25	23.2	7.9	785	8.1			10	10
4. 0.125	23.2	7.7	536	8.1			10	10
5. 0.063	23.3	7.8	446	8.1			10	10
6. 0	23.1	7.6	338	8.1	86	70	10	10

Mean
SD
n

(SEE PAGE 5)

Chesapeake Cultures

P.O. Box 507 Hayes, VA 23072 (804)693-4046 (804)694-4704 fax
www.c-cultures.com
growfish@c-cultures.com

NAS

Shipment Information

Rcvd 1-21-15

Species Hyalella azteca

Date 1/20/15

Age ~4-5d.; ~1.5 mm

P.O. No. verbal

Quantity 530+

Invoice No. 8585

Temperature 24°C Salinity – pH 7.88

Notes Thank you!

Biologist [signature]

* *Please inspect shipment and report any problem immediately* *

Water Quality Data - test #999-338 Hyalella KCl QC test							
Day	Concentration (g/L)	Temperature	pH	Conductivity	DO	Hardness	Alkalinity
0	1	22.7	7.6	1990	8.5	86	70
0	0.5	22.7	7.4	1160	8.6		
0	0.25	22.7	7.3	728	8.7		
0	0.125	22.8	7.3	510	8.6		
0	0.063	22.7	7.1	395	8.6		
0	0	22.4	7.1	282	8.5	86	60
1	1	23.2	7.7	1980	8.2		
1	0.5	23.2	7.6	1208	8.2		
1	0.25	23.2	7.6	747	8.5		
1	0.125	23.2	7.6	521	8.3		
1	0.063	23.1	7.6	412	8.4		
1	0	23.0	7.5	300	8.2		
2	1	23.3	7.8	2080	8.0		
2	0.5	23.4	7.8	1264	8.0		
2	0.25	23.3	7.8	793	8.1		
2	0.125	23.4	7.7	555	8.1		
2	0.063	23.4	7.7	442	8.2		
2	0	23.3	7.5	309	8.2		
3	1						
3	0.5	23.6	7.7	1282	7.6		
3	0.25	23.6	7.7	804	7.6		
3	0.125	23.6	7.6	560	7.6		
3	0.063	23.5	7.6	454	7.7		
3	0	23.4	7.5	316	7.8		
4	1						
4	0.5	23.3	7.9	1269	8.1		
4	0.25	23.2	7.9	785	8.1		
4	0.125	23.2	7.7	536	8.1		
4	0.063	23.3	7.8	446	8.1		
4	0	23.1	7.6	338	8.1	86	70
	MEAN	23.2	7.6		8.2	86	67
	SD	0.3	0.2		0.3	0	6
	N	28	28		28	3	3
	MIN	22.4	7.1		7.6	86	60
	MAX	23.6	7.9		8.7	86	70
		MEAN 1.0 g/L		2017			
		SD					
		N		3			
		MEAN 0 g/L		309			
		SD		21			
		N		5			

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	1/23/2015 09:15	Test ID:	999-3381	Sample ID:	REF-Ref Toxicant
End Date:	1/27/2015 10:30	Lab ID:	ORNAS-Northwestern Aquati	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	NASXXXHA1-Hyalella azteca	Test Species:	HA-Hyalella azteca
Comments:					

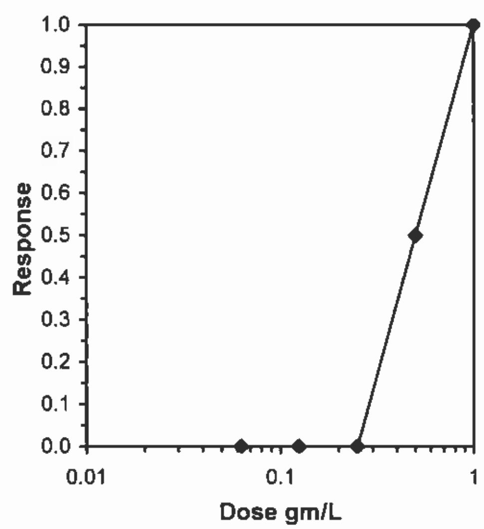
Conc-gm/L	1	2
D-Control	1.0000	1.0000
0.063	1.0000	1.0000
0.125	1.0000	1.0000
0.25	1.0000	1.0000
0.5	0.7000	0.3000
1	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.063	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.125	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
0.5	0.5000	0.5000	0.7854	0.5796	0.9912	37.050	2	10	20
1	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	0.5000	0.4282	0.5838
5.0%	0.5000	0.4209	0.5940
10.0%	0.5000	0.4119	0.6069
20.0%	0.5000	0.3862	0.6474
Auto-0.0%	0.5000	0.4282	0.5838

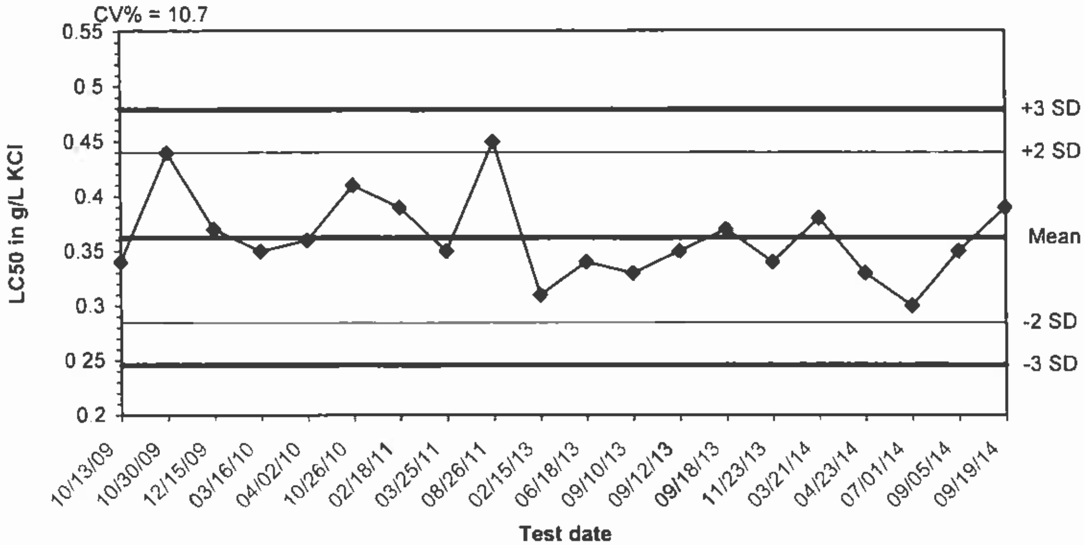


Test: AT-Acute 96-hr Toxicity Test	Test ID: 999-3381
Species: HA-Hyalella azteca	Protocol: NASXXXHA1-Hyalella azteca acute
Sample ID: REF-Ref Toxicant	Sample Type: KCL-Potassium chloride
Start Date: 1/23/2015 09:15 End Date: 1/27/2015 10:3	Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				10	
	2	2	D-Control	10				10	
	3	1	0.063	10				10	
	4	2	0.063	10				10	
	5	1	0.125	10				10	
	6	2	0.125	10				10	
	7	1	0.250	10				10	
	8	2	0.250	10				10	
	9	1	0.500	10				7	
	10	2	0.500	10				3	
	11	1	1.000	10				0	
	12	2	1.000	10				0	

Comments: data entry verified against laboratory bench sheets 3-5-15 JRF

Amphipod, Hyalella azteca, acute reference toxicant test



Dates	Values	Mean	-2 SD	-3 SD	+2 SD	+3 SD
10/13/09	0.3400	0.3625	0.2847	0.2458	0.4403	0.4792
10/30/09	0.4400	0.3625	0.2847	0.2458	0.4403	0.4792
12/15/09	0.3700	0.3625	0.2847	0.2458	0.4403	0.4792
03/16/10	0.3500	0.3625	0.2847	0.2458	0.4403	0.4792
04/02/10	0.3600	0.3625	0.2847	0.2458	0.4403	0.4792
10/26/10	0.4100	0.3625	0.2847	0.2458	0.4403	0.4792
02/18/11	0.3900	0.3625	0.2847	0.2458	0.4403	0.4792
03/25/11	0.3500	0.3625	0.2847	0.2458	0.4403	0.4792
08/26/11	0.4500	0.3625	0.2847	0.2458	0.4403	0.4792
02/15/13	0.3100	0.3625	0.2847	0.2458	0.4403	0.4792
06/18/13	0.3400	0.3625	0.2847	0.2458	0.4403	0.4792
09/10/13	0.3300	0.3625	0.2847	0.2458	0.4403	0.4792
09/12/13	0.3500	0.3625	0.2847	0.2458	0.4403	0.4792
09/18/13	0.3700	0.3625	0.2847	0.2458	0.4403	0.4792
11/23/13	0.3400	0.3625	0.2847	0.2458	0.4403	0.4792
03/21/14	0.3800	0.3625	0.2847	0.2458	0.4403	0.4792
04/23/14	0.3300	0.3625	0.2847	0.2458	0.4403	0.4792
07/01/14	0.3000	0.3625	0.2847	0.2458	0.4403	0.4792
09/05/14	0.3500	0.3625	0.2847	0.2458	0.4403	0.4792
09/19/14	0.3900	0.3625	0.2847	0.2458	0.4403	0.4792

SECTION B

Midge (*Chironomus dilutus*) 10-day sediment bioassay 862-3 data report

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 862-3

Title: Toxicity of freshwater sediments using a 10-day midge, *Chironomus dilutus*, sediment bioassay as part of the Remedial Investigation at the Jacobson Terminals Property in Seattle, WA

Protocol No.: NAS-XXX-CT4b, April 7, 1998. Revision 1 (10-28-03). Based on ASTM 2001 (Standard test methods for measuring the toxicity of sediment-associated contaminants with fresh water invertebrates, E1706-00), Am. Soc. Test. Mat., Phila., PA, and EPA Method 100.2 (Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, EPA/600/R-99/064). Washington State Sediment Management Standards (SMS) (Chapter 173-204 WAC, Last Update: 2/25/13).

STUDY MANAGEMENT

Study Sponsor: Hart Crowser, Inc., 1700 Westlake Ave. North, Suite 200, Seattle, WA 98109.

Sponsor's Study Monitor: Mr. Philip Cordell

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365

Test Location: Newport laboratory

Laboratory's Study Personnel: G.J. Irissarri, B.S., Proj. Mngr./ Study Dir.; L.K. Nemeth, B.A., M.B.A., QA Officer; R.S. Caldwell, Ph.D., Sr. Aq. Toxicol.; G.A. Buhler, B.S., Aq. Toxicol.; J.B. Brown, B.S., D.V.M, Assoc. Aq. Toxicol.; Y. Nakahama, Sr. Tech.; L. Brady, Tech.

Study Schedule:

Test Beginning: 2-6-15, 1005 hrs.

Test Ending: 2-16-15, 1045 hrs.

Disposition of Study Records: All raw data, reports, and other study records are stored at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Test Sediments: Freshwater test sediments collected as part of the Remedial Investigation at the Jacobson Terminals Property in Seattle, WA. Details are as follows:

NAS Sample No.	5192G	5193G	5194G
Description	JT-SS-06	JT-SS-08	JT-SS-10
Collection Date	1/12/15	1/12/15	1/12/15
Receipt Date	1/14/15	1/14/15	1/14/15

Control Sediment: The negative control sediment (NAS#5195G) was collected on 1-19-15 from an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.

Treatments: Homogenized at test set up by mixing using stainless steel implements.

Storage: All test and control sediments were stored at 4°C in the dark in sealed containers until used.

TEST WATER

Source: Dechlorinated municipal tap water.

Dates of Preparation: 1-19-15 and 2-6-15

Water Quality:

pH: 7.7, 7.5

conductivity: 108, 119 µmhos/cm

hardness: 26, 26 mg/L as $CaCO_3$

alkalinity: 30, 30 mg/L as $CaCO_3$.

total chlorine: <0.02, <0.02 mg/L

Pretreatment: Dechlorinated and aerated ≥24 hr.

TEST ORGANISMS

Species: *Chironomus dilutus* (formerly *C. tentans*), midge.
Size: 2nd to 3rd instar, mean initial wt: 0.21 ± 0.01 mg
Source: Aquatic BioSystems, Fort Collins, CO
Acclimation: Holding conditions prior to testing averaged: Temperature, 22.7 °C; dissolved oxygen, 6.5 mg/L; pH, 7.3; conductivity, 376 µmhos/cm; hardness, 129 mg/L as $CaCO_3$; and alkalinity, 90 mg/L as $CaCO_3$. Photoperiod was 16:8, L:D. Half of the water in culture tanks was replaced with dechlorinated municipal tap water during holding. Animals were fed Tetra Fin suspension and *Selenastrum*.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 300 ml high-form glass beakers
Test Volumes: 100 ml sediment layer; 175 ml test water.
Replicates/Treatment: 8
Organisms/Treatment: 80
Water Volume Changes: 2 water volumes per day
Aeration: None.
Feeding: Animals were fed 1.5 ml of Tetra Fin suspension (1.5 ml contains 6 mg dry solids) per beaker daily.
Acceptance Criteria: Results are valid if mean control mortality does not exceed 30%, and the mean individual ash-free dry weight at test termination is ≥ 0.48 mg.
Effects Criteria: 1) survival after 10 days, and 2) average individual biomass (based on ash-free dry weight) after 10 days. Death is defined as no visible movement or response to tactile stimulation. Missing organisms were considered to be dead.
Water Quality and Other Test Conditions: The temperature, dissolved oxygen, conductivity, pH, hardness, alkalinity and ammonia-nitrogen were measured in the overlying water of one replicate test container per treatment on days 0 and 10 of the test. Temperature and dissolved oxygen were measured daily in the overlying water of one replicate test container per treatment. Hardness and alkalinity were measured with titrimetric methods. Ammonia-N was measured using Hach reagents based on the salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric method; samples were not distilled prior to analysis. The photoperiod was 16:8, L:D.

DATA ANALYSIS METHODS

Percent survival and average individual ash-free dry weight were calculated for each replicate as follows:

percent survival = 100 x (number surviving/initial number tested)
average individual ash-free dry wt. = (ash-free dry wt.)/number weighed,
where:
ash-free dry wt. = dry weight of organisms recovered on day 10 – ashed dry weight, in mg

Means and standard deviations for the biological endpoints described above, and for water quality data, were computed using Microsoft Excel 2010. The values for mortality and individual ash-free dry wt for the test sediment were statistically compared against the reference sediment. Where appropriate, an arcsine square root transformation was performed on proportional mortality data before analysis. Following determination of normality and homogeneity of variances, a one-tailed Student T-test, Mann-Whitney or Approximate T test was conducted at the 0.05 level of significance. The statistical software used was BioStat (version Feb 9, 2006 (EXCEL)) bioassay software developed by the U.S. Army Corps of Engineers, Seattle District.

PROTOCOL DEVIATIONS

None

REFERENCE TOXICANT TEST

The reference toxicant test is a multi-concentration toxicity test using potassium chloride, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. A summary of the reference toxicant test result is given below. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-3391
Reference Toxicant and Source: Potassium Chloride (KCl), Fisher Lot #114689.
Test Date: 2-6-15.
Dilution Water Used: Moderately hard synthetic water prepared from Milli-Q® deionized water.
Result: 96-hr LC50, 5.74 g/L. This result is within the laboratory's control chart warning limits (2.71 –7.48 g/L).

TEST RESULTS

Observations of water quality in the overlying water throughout the test are summarized in Table 1. A detailed tabulation of the water quality results by sample and test day can be found in Appendix II. The means and standard deviations of percent mortality and growth (ash-free dry wt.) of midges exposed for 10 days to sediments are summarized in Tables 2 and 3. Detailed data organized by sample and replicate, and summary statistics for these observations, are given in Appendix II.

All water quality observations of overlying water temperature and dissolved oxygen were within the protocol specified ranges. Ammonia-N in the overlying water ranged between <0.1 and 0.3 mg/L for all day 0 and day 10 measurements.

The test met the acceptability criteria specified in the SMS with 6.3% mean control mortality (≤30% required) and a control mean ash-free dry weight of 1.22 mg per larvae (≥0.48 mg required). The reference toxicant (positive control) EC50 result was within the laboratory's control chart limits (5.74 g/L; control chart mean ± 2 S.D. = 5.10 ± 2.39).

Interpretation was based on guidelines from the Washington State Sediment Management Standards (SMS) (Chapter 173-204 WAC, Last Update: 2/25/13). The SMS includes Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) biological criteria. The Sediment Cleanup Objectives establish a no adverse effects level, including no acute or chronic adverse effect, to the benthic community. The Cleanup Screening Levels establish a minor adverse effects level, including acute or chronic effects, to the benthic community. To qualify as an adverse effect under the SCO for mortality the mean mortality in the test sediment is greater than 20 percent over the mean control and statistically different from the control (p =0.05). For the growth endpoint, a mean reduction in the biomass that is greater than 20 percent of the control sediment response and statistically different from the control (p=0.05). For the CSL adverse effects criteria mean mortality in the test sediment is greater than 30 percent over the mean control and statistically different from the control (p = 0.05). For the growth endpoint, a mean reduction in the biomass that is greater than 30 percent and statistically different from the control (p =0.05).

Mean mortality of test sediments JT-SS-06, JT-SS-08 and JT-SS-10 was 10.0%, 15.0% and 8.8%, respectively. None of these were more than 20% above the control mortality; therefore none of the sediments exceeded the SCO or CSL criteria for mortality. For the growth endpoint, all three test sediments were significantly different from the control, but only two test sediments, JT-SS-08, and JT-SS-10, resulted in and exceeded under the SCO guidelines with ash-free dry weights of 0.93 and 0.91 mg/individual, respectively. No sediment failed the CSL criteria for growth since none were >30% different from the control.

STUDY APPROVAL

3-19-15
Project Manager/Study Director Date

3-19-15
Quality Assurance Unit Date

for Linda Nemeth
Assistant Laboratory Director Date
3-19-15

Table 1. Summary of water quality conditions during tests of the midge, *Chironomus dilutus*, exposed to freshwater sediments.

Water Quality Parameter	Mean ± S.D.	Minimum	Maximum	N
Temperature (°C)	22.7 ± 0.5	22.0	24.0	44
Dissolved oxygen (mg/L)	6.1 ± 0.7	4.5	7.4	44
Conductivity (µmhos/cm)	129 ± 29	108	217	12
pH	7.2 ± 0.1	7.1	7.4	12
Hardness (mg/L as $CaCO_3$)	29 ± 4	26	34	8
Alkalinity (mg/L as $CaCO_3$)	36 ± 7	30	50	8
Total ammonia (mg/L)	---	<0.1	0.3	8

Table 2. Mortality results of *Chironomus* toxicity test and data interpretation using guidelines from the Washington State SMS.

Sample description	Percent mortality (Mean ± SD)	Significantly higher than the control sediment at α=0.05?	Percent higher (absolute) than control sediment	Exceedance under SCO?[1]	Exceedance under one-test criteria for CSL[2]
Control (NAS# 5195G)	6.3 ± 5.2	---	---	---	---
JT-SS-06 (NAS# 5192G)	10.0 ± 14.1	No	3.7	No	No
JT-SS-08 (NAS# 5193G)	15.0 ± 16.9	No	8.7	No	No
JT-SS-10 (NAS# 5194G)	8.8 ± 11.3	No	2.5	No	No

[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >20%.
[2] Cleanup Screening Levels (CSL) exceedance if the test sediment mean mortality is significantly higher (1-tailed t-test at P≤0.05) than the control sediment mean mortality and the absolute difference is >30%.

Table 3. Growth results of *Chironomus* toxicity test and data interpretation using guidelines from the Washington State SMS.

Sample description	Average ash-free dry wt/midge (mg)* (Mean ± SD)	Statistically significantly lower than control sediment at α=0.05?	Percent lower than control sediment	Exceedance under SCO?[1] (MIG_C-MIG_T/MIG_C>0.20)	Exceedance under one-test criteria for CSL?[2] (MIG_C-MIG_T/MIG_C>0.30)
Control (NAS# 5195G)	1.22 ± 0.09	---	---	---	---
JT-SS-06 (NAS# 5192G)	0.98 ± 0.11	Yes	19.7	No	No
JT-SS-08 (NAS# 5193G)	0.93 ± 0.15	Yes	23.8	Yes	No
JT-SS-10 (NAS# 5194G)	0.91 ± 0.12	Yes	25.4	Yes	No

* Pupae were not included in the sample to estimate ash-free dry weight (as per EPA/600/R-99/064, p. 59, section 12.3.8.2)
[1] Sediment Cleanup Objectives (SCO) exceedance if the test sediment mean growth is significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth, and the difference is >20%.
[2] Cleanup Screening Levels (CSL) exceedance (one-test criteria) if the test sediment mean individual growth in significantly lower (1-tailed t-test at P≤0.05) than the control sediment mean growth, and the difference is >30%.

APPENDIX I

PROTOCOL

TEST PROTOCOL

FRESHWATER MIDGE, *CHIRONOMUS TENTANS*, 10-DAY SEDIMENT TOXICITY TEST

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to characterize the toxicity of freshwater sediments based on midge survival and growth using the midge, *Chironomus tentans*.

1.2 Referenced Method: This protocol is based on EPA Method 100.2 (EPA/600/R-99/064) and ASTM Method E 1706-00 (ASTM 2001).

1.3 Summary of Method: A summary of test conditions for the midge 10-day sediment toxicity test is tabulated below. The 10-day sediment toxicity test with *Chironomus tentans* is conducted at 23°C with a 16L:8D photoperiod at an illuminance of about100-1000 lux. Test chambers are 300-mL high-form lipless beakers containing 100 mL of sediment and 175 mL of overlying water. Ten second to third-instar midges are used in each replicate (all organisms must be third instar or younger and at least 50% of the larvae must be third instar). The number of replicates/treatment depends on the objective of the test. Eight replicates are recommended for routine testing. Midges in each test chamber are fed 1.5 mL of a 4 g/L fish food flakes suspension daily. Each chamber receives two volume additions per day of overlying water. Overlying water can be culture water, well water, surface water, site water, or reconstituted water. Test endpoints include survival and/or growth.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:
____
____
____
____

2.2 Sponsor's Study Monitor:
____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
3814 Yaquina Bay Road, P.O. Box 1437
Newport, OR 97365.

2.4 Test Location: ______________________________

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: ______________________
Quality Assurance Unit: ______________________
Aquatic Toxicologist: ______________________
Aquatic Toxicologist: ______________________

2.6 Proposed Testing Schedule: Tests are to begin within 14 days of sample collection. Eight week holding times may apply in some circumstances. Reference toxicant test to be run concurrently.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are freshwater sediments. The control, reference, and test sediments are placed in solvent cleaned 1 L glass jars fitted with PTFE-lined screw caps. At the laboratory the samples are stored at 4°C in the dark. The original sealed containers may be stored for up to 14 days prior to testing. Eight week holding times may apply in some circumstances. If jars are not full when received or if sediment is removed for testing, headspaces should be filled with nitrogen to retard deterioration. A negative control sediment is collected from a clean site. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, may be employed as a comparison station.

4. TEST WATER

Test water (overlying water) at NAS is normally *C. tentans* culture water, which is moderately hard synthetic water at a hardness of 80-100 mg/L as $CaCO_3$ and alkalinity of 60-70 mg/L as $CaCO_3$. Dilution water is prepared from Milli-Q reagent grade water and reagent grade chemicals. Test water may also be well water, surface water or site water depending on the study design.

5. TEST ORGANISMS

5.1 Species: midge, *Chironomus tentans*.

5.2 Source: Cultured at NAS (Originally obtained from U.S. EPA Environmental Research Lab, Duluth, MN) or purchased from a reputable commercial supplier.

5.3 Age: Third instar or younger larvae (at least 50% of the larvae must be in the third instar at the start of the test). Third instar is normally 9 to 11 days after hatching; head capsule widths range from 0.33 to 0.45 mm; or length ranges from 4-6 mm; or dry weight ranges 0.08 to 0.23 mg/individual.

5.4 Acclimation and Pretest Observation: Cultures are maintained at 23 ± 1°C under a 16:8 L:D photoperiod. The culture water is moderately hard synthetic water. Midge are fed finely ground Tetrafin flakes in suspension (10g Tetrafin in 100 mL Milli-Q water). Mortality during the 48-hr prior to testing should not be excessive.

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 300-mL high-form lipless glass beakers (Pyrex® 1040 or equivalent). Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or by placement in a temperature-controlled room. Aeration is not empolyed unless dissolved oxygen drops below 2.5 mg/L. The test is conducted under an illuminance of 100 to 1000 lux with a 16L:8D photoperiod.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027F. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The test involves exposure of midge larvae to test, control, and reference sediments. The sediments are placed on the bottom of the test containers and are overlain with test water. The test exposure is for 10 days. The renewal of overlying water consists of two volume additions per day, either continuous or intermittent. Each treatment consists of eight replicate test containers, each containing 10 organisms. Test chamber positions are completely randomized. Test organisms are randomly distributed to the test chambers. Blind testing is normally used.

7.2 Setup of Test Containers: Sediments are homogenized and placed in test chambers on the day before addition of test organisms. Sediment (100 ml) is placed into each of eight replicate beakers. After addition of the sediment, 175 ml of test water is gently added to each beaker in a manner to prevent resuspension. The overlying water is replaced twice daily. The test begins when midges are introduced to the test chambers. Initial water quality measurements are taken prior to the addition of test organisms.

7.3 Effect Criterion: The acute effect criterion used in the midge bioassay is mortality, defined as the lack of movement of body or appendages on response to tactile stimulation. The optional chronic effect criterion is growth which is determined by using dry weight measurements.

7.4 Test Conditions: No aeration is employed unless dissoved oxygen falls below 2.5 mg/L. The test temperature employed is 23°C (range of ± 1°C). A 16:8, L:D photoperiod is used. Illumination is supplied by daylight fluorescent lamps at 100-1000 lux. The overlying water is replaced twice daily.

7.5 Beginning the Test: The test is begun by adding the organisms to the equilibrated test containers as previously described. Three extra replicates of midge larvae should be counted out and randomly selected for drying to determine initial average weight and instar data.

7.6 Feeding: Midge larvae are fed 1.5 mL daily per test chamber (1.5 mL contains 6.0 mg of dry solids). A feeding may be skipped if there is a build up of excess food. However, all beakers must be treated similarly.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the acute toxicity test is 10 days. The type and frequency of observations to be made are summarized as follows:

Type Of Observation	Times Of Observation
Biological Data	
Survival, growth	Day 10
Physical And Chemical Data	
Hardness, alkalinity, ammonia-N, conductivity, pH, dissolved oxygen, and temperature	Beginning and end of test in overlying water of one replicate beaker from each treatment.
Dissolved oxygen, temperature	Daily in overlying water of one replicate beaker from each treatment.

Dissolved oxygen is measured using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. The pH is measured using a pH probe and a properly calibrated meter with scale divisions of 0.1 pH units. Temperature is measured with a calibrated mercury thermometer or telethermometer. Conductivity is measured with a conductivity meter. Hardness and alkalinity are measured using titrometric methods. Ammonia-nitrogen is measured using the salicylate colerimetric method (Clin. Chim. Acta 14:403, 1996).

7.8 Growth Measurement: Growth is measured as ash-free dry weight (AFDW) of animals in a test replicate at the end of the test on day 10. Pooled animals from each test replicate are rinsed with deionized water, gently blotted and placed into tared aluminum weigh pans. The pans are dried at 60-90°C to constant weight. The dried organisms are placed into a dessicator and weighed as soon as possible to the nearest 0.01 mg (desirable to use

0.001 mg). The total weight of the dried midge in each pan is divided by the number of midge weighed to obtain an average dry weight per midge. The dried larvae in the pan are then ashed at 550°C for two hours. The pan with the ashed larvae is then reweighed and the tissue mass of the larvae is determined as the difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan. Pupae or adult organisms are not included in the sample to estimate AFDW.

8. CRITERIA OF TEST ACCEPTANCE:

The test results are acceptable if the minimum survival of organisms in the control treatment at the end of the test is at least 70% and the average ash-free dry weight of *C. tentans* in the surviving controls is at least 0.48 mg.

9. DATA ANALYSIS

The endpoints of the toxicity test are survival and growth. Survival is obtained as a direct count of living organisms in each test container at the end of the test. Average midge ash-free dry weight, also measured at the end of the test, may be used to compare growth between treatment sediments and the control or reference sediment. Ordinarily the following data analysis is performed. Due to special requirements, alternative methods may be used. The means and standard deviations are calculated for each treatment level. Identification of toxic sediments is established by statistical comparison of test endpoints between test and control or reference sediments. Between treatment comparisons may be made using a Student's t-test or Wilcoxon's Two-Sample test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons.

10. REPORTING

The final report of the test results must include all of the following standard information at a minimum: name and identification of the test; the investigator and laboratory; date and time of test beginning and end; information on the test material; information on the source and quality of the overlying/test water; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including feeding, if any, and water quality; definition of the effect criteria and other observations; responses, if any, in the control treatment; tabulation and statistical analysis of measured responses and a summary table of endpoints; a description of the statistical methods used; any unusual information about the test or deviations from procedures; reference toxicant testing information.

11. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

12. REFERENCE TOXICANT

The reference toxicant test is a standard multi-concentration toxicity test using a specified chemical toxicant to evaluate the performance of test organisms used in the study. Reference toxicant tests are 96-hour, water only exposures, not 10-day sediment exposures. The reference toxicant test is run concurrently. Performance is evaluated by comparing the results of the reference toxicant test with historical results (e.g., control charts) obtained at the laboratory.

13. REFERENCED GUIDELINES

ASTM. 2001. Standard Test Methods for Measuring the Toxicity of Sediment-associated Contaminants with Fresh water Invertebrates. ASTM Standard Method No. E 1706-00. Am. Soc. Test. Mat., Philadelphia, PA.

U.S. EPA. 2000. Section 12, Test Method 100.2, *Chironomus tentans* 10-d Survival and Gowth Test for Sediments, pp. 55-62. In: Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates (Second Edition). EPA/600/R-99/064.

Weber, C.I. (Ed.) 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027F.

14. APPROVALS

______________________________________ for ______________________________
Name Date

______________________________________ for **Northwestern Aquatic Sciences**
Name Date

Appendix A
Test Conditions Summary

1. Test type	whole sediment toxicity test with renewal of overlying water
2. Test duration	10 days
3. Temperature	23 ± 1°C
4. Light quality	daylight flourescent light
5. Illuminance	100-1000 lux
6. Photoperiod	16L:8D
7. Test chamber size	300-mL high-form lipless beakers (Pyrex® 1040 or equivalent)
8. Sediment volume	100 mL
9. Overlying water volume	175 mL
10. Renewal overlying water	2 volume additions/day (continuous or intermittent)
11. Age of test organisms	2nd to 3rd instar or younger larvae (≥ 50% of organisms must be 3rd instar)
12. Organisms per test chamber	10
13. Replicates per treatment	8 recommended for routine (depends on design)
14. Organisms per treatment	80
15. Feeding regime	Fish food flakes, fed 1.5 mL chamber (1.5 mL contains 6.0 mg of dry solids) daily on days 0 - 9.
16. Aeration	None, unless DO falls below 2.5 mg/L.
17. Overlying (test) water	**Culture water**, well water, surface water, site water or reconstituted water
18. Water quality	Hardness, alkalinity, conductivity, pH, ammonia-N beginning and end; temperature and DO daily
19. Endpoints	Survival and growth (dry weight)
20. Test acceptability criteria	Minimum control survival of 70%; mean weight of surviving control organisms 0.48 mg AFDW
21. Sample holding	≤14 days at 4°C in the dark Longer under certain conditions
22. Sample volume required	1L (800 mL per sediment)
23. Reference toxicant	Concurrent testing required

APPENDIX II

RAW DATA

TEST DESCRIPTION, MONITORING, AND RESULTS BENCHSHEETS

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator

STUDY MANAGEMENT

Client: Hart Crowser, Inc., 1700 Westlake Ave. North, Suite 200, Seattle, WA 98109
Client's Study Monitor: Mr. Philip Cordell
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. G.J. Irissarri GJI
QA Officer L.K. Nemeth

1. K.L. Nakahara 2. GA Buhler
3. J. Brown JB 4. Lauren Brady LB
5. R.S. Caldwell RSC 6.
7. 8.

Study Schedule:
Test Beginning: 2-6-15 1005 Test Ending: 2-16-15 1045

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	5192G	5193G	5194G		
Description:	JT-SS-06	JT-SS-08	JT-SS-10		
Collection Date:	1/12/15	1/12/15	1/12/15		
Receipt Date:	1/14/15	1/14/15	1/14/15		
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
:					

Error codes: 1) correction of handwriting error
2) written in wrong location; entry deleted
3) wrong date deleted, replaced with corrrect date
4) error found in measurement; measurement repeated

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator ________

SEDIMENT DESCRIPTIONS -- SUPPLEMENTAL NOTES

Sample No.	Description
5195G	FINE BLACK MUD
5192G	DARK BROWN SANDY MUD W/ WOODY FRAGMENTS, SOME PLASTIC FILM
5193G	WATERY SANDY BLACK MUD W/ WOODY FRAGMENTS
5194G	BLACK MUDDY SAND W/ WOOD FRAGMENTS, BLACK PLASTIC FILM, ALUMINUM FOIL

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator ____

TEST WATER

Source: Dechlorinated municipal tap water
Date of Collection: 1-19-15, 2-6-15
pH 7.7, 7.5
Cond (umhos/cm2) 108, 119
Hardness (mg/L) 26, 26
Alkalinity (mg/L) 30, 30
Total Chlorine (mg/L) <0.02, <0.02
Treatments: Dechlorinated, aerated

TEST ORGANISMS

Species: *Chironomus dilutus* Age: 2ND TO 3rd instar
Source: ~~NAS cultures~~ AQUATIC BIOSYSTEMS Date received: 2-5-15

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond. umhos/cm	Hardness (mg/L)	Alkalinity (mg/L)	Feeding	Water changes
2-5-15	20.6	6.9	6.2	436	171	110	Animals fed Tetra Fin	YES
2-6-15	24.8	7.6	6.7	316	86	70	and *Selenastrum*	
							Details recorded on	
							Chironomid culture	
							data sheets	
Mean	22.7	7.3	6.5	376	129	90		
S.D.	—	—	—	—	—	—		
(N)	2	2	2	2	2	2		

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test chambers: 300 ml glass beakers
Test volumes: 100 ml of test sediment; 275 ml total volume
Replicates/treatment: (8) 8 Organisms/treatment: (80) 80 (10/REP)
Test water changes: Twice daily
Aeration: only if DO falls below 2.5 mg/L
Feeding: everyday beginning with day zero
Test temperature (°C): 23 ± 1
Beaker placement: Total randomization
Photoperiod: 16:8, L:D

Control Sediment:

Source: From an area approximately one mile east of the Hwy. 101 bridge at Beaver Creek, approx. 8 miles south of Newport, OR.
Date collected: 1/19/15
Sieved through 0.5 -mm screen
Storage: darkness at 4°C, in sealed containers NAS# 5195G

MISCELLANEOUS NOTES

Test No. 862-3 Client Hart Crowser Investigator ______

Test conducted in (circle one): (room 1) room 2 trailer water bath other: ______

Randomization chart: TOP SHELF

6	12	18	24	30					
5	11	17	23	29					
4	10	16	22	28					
3	9	15	21	27					
2	8	14	20	26	32				
1	7	13	19	25	31				

FRONT

Randomization chart:

Randomization chart:

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 0 (2/6/15) [illegible]

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
9	23.6	7.0	118	7.1	26	30		Each beaker fed 1.5 ml
12	24.0	7.4	217	7.4	26	30		Tetra Fin suspension
16	23.8	7.2	120	7.3	34	30		Initials: GJL
28	24.0	6.7	136	7.2	34	30		
								Water changed in all
								beakers.
								Time: 0505
								Initials: GJB
								Water changed in all
								beakers.
								Time: 1610
								Initials: KO

*Water quality measurements to be taken.

Day 1 (2/7/15) GJB

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.2	6.6						Each beaker fed 1.5 ml
12	22.6	6.8						Tetra Fin suspension
16	22.3	6.8						Initials: GJB
28	23.0	6.4						
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJB
								Water changed in all
								beakers.
								Time: 1615
								Initials: KO

*Water quality measurements to be taken.

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 2 (2/18/15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.2	6.7						Each beaker fed 1.5 ml
12	22.6	6.4						Tetra Fin suspension
16	22.4	6.8						Initials: GJL
28	22.9	6.8						
								Water changed in all
								beakers.
								Time: 0505
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1605
								Initials: YL

*Water quality measurements to be taken.

Day 3 (2/19/15) GJL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.4	6.5						Each beaker fed 1.5 ml
12	22.9	6.1						Tetra Fin suspension
16	22.7	6.2						Initials: GJL
28	23.2	6.1						
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJL
								Water changed in all
								beakers.
								Time: 1610
								Initials: LS

*Water quality measurements to be taken.

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 4 (2/10/15) [initials]

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.1	6.5						Each beaker fed 1.5 ml
12	22.4	6.1						Tetra Fin suspension
16	22.2	6.3						Initials: [initials]
28	22.7	6.7						
								Water changed in all
								beakers.
								Time: 0505
								Initials: [initials]
								Water changed in all
								beakers.
								Time: 1620
								Initials: [initials]

*Water quality measurements to be taken.

Day 5 (2/11/15) [initials]

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.0	6.6	108	7.2				Each beaker fed 1.5 ml
12	22.4	6.3	139	7.1				Tetra Fin suspension
16	22.2	6.2	112	7.2				Initials: [initials]
28	22.5	6.6	117	7.1				
								Water changed in all
								beakers.
								Time: 0510
								Initials: [initials]
								Water changed in all
								beakers.
								Time: 1605
								Initials: [initials]

*Water quality measurements to be taken.

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 6 (2/14/15)

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.1	4.8						Each beaker fed 1.5 ml
12	22.8	4.6						Tetra Fin suspension
16	22.4	4.6						Initials:
28	23.4	4.5						
								Water changed in all
								beakers.
								Time: 0510
								Initials:
								Water changed in all
								beakers.
								Time: 1630
								Initials:

*Water quality measurements to be taken.

Day 7 (2/13/15)

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.6	5.5						Each beaker fed 1.5 ml
12	23.1	5.3						Tetra Fin suspension
16	22.8	5.3						Initials:
28	23.6	5.9						
								Water changed in all
								beakers.
								Time: 0505
								Initials:
								Water changed in all
								beakers.
								Time: 1615
								Initials:

*Water quality measurements to be taken.

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 8 (2/14/15) GB

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.1	5.4						Each beaker fed 1.5 ml
12	22.6	5.6						Tetra Fin suspension
16	22.3	5.7						Initials: 0500 GB
28	22.9	5.9						
								Water changed in all
								beakers.
								Time: GB
								Initials: 0500
								Water changed in all
								beakers.
								Time: 1630
								Initials: JB

*Water quality measurements to be taken.

Day 9 (2/15/15) GSL

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments
9	22.4	5.6						Each beaker fed 1.5 ml
12	22.8	5.4						Tetra Fin suspension
16	22.6	5.4						Initials: GSL
28	23.2	5.3						
								Water changed in all
								beakers.
								Time: 0510
								Initials: GSL
								Water changed in all
								beakers.
								Time: 1620
								Initials: GSL

*Water quality measurements to be taken.

Test No. 862-3 Client Hart Crowser Investigator ______

DAILY RECORD SHEET

Day 10 (2 /16 /15) GJI

Beaker No.	Temp.* (deg.C)	DO* (ppm)	Cond.* (umhos/cm)	pH*	Hardness* (mg/L)	Alkalinity* (mg/L)	NH3* (ppm)	Comments
9	22.3	6.5	116	7.1	26	40		
12	22.9	6.3	129	7.1	26	40		
16	22.6	6.4	117	7.1	26	50		
28	23.4	6.2	123	7.1	34	40		
								Water changed in all
								beakers.
								Time: 0510
								Initials: GJI

*Water quality measurements to be taken.

Day ______(/ /)

Beaker No.	Temp. (deg.C)	DO (ppm)	Cond. (umhos/cm)	pH	Hardness (mg/L)	Alkalinity (mg/L)	NH3 (ppm)	Comments

*Water quality measurements to be taken.

Test No. 862-3 Client Hart Crowser Investigator ________

DAY 10 TEST TERMINATION SHEET

Beaker No.	Number of survivors	Initials
1	9	GJL
2	9	GJL
3	10	GJL
4	9	GJL
5	10	GJL
6	10	GJL
7	9	GJL
8	10	GJL
9	10	GJL
10	10	GJL
11	6	GJL
12	10	GJL
13	7	GJL
14	10	GJL
15	9	GJL
16	6	GJL
17	10	GJL
18	9	GJL
19	10	GJL
20	10	GJL
21	9	GJL
22	10	GJL
23	10	GJL
24	8	GJL
25	9	GJL
26	9	GJL
27	10	GJL
28	8	GJL
29	9	GJL
30	8	GJL
31	6	GJL
32	~~10~~ 9 GJL 2-16-10	GJL

9 GJS

Beaker No.	Number of survivors	Initials

Test No. 862-3 Client Hart Crowser Investigator ________

Tare: Date 2-6-15 Oven temp (C.) 550 Drying time (hr.) 2 Initials GJL
Standard Weights: 10 mg: 10.006 100mg: 100.016

Final: #1 Date 2-9-15 Oven temp (C.) 62 Drying time (hr.) 24 Initials GJL
Standard Weights: 10 mg: 10.007 100mg: 100.015

Final: #2 Date 2-11-15 Oven temp (C.) 63 Drying time (hr.) 24 Initials GJL
Standard Weights: 10 mg: 10.006 100mg: 10.016

Ashed Date 2-12-15 Oven temp (C.) 555 Drying time (hr.) 2 Initials GJL
Standard Weights: 10 mg: 10.007 100mg: 100.015

Equip. used: Oven: BLUE M #1, FISHER ISOTEMP MUFFLE FURNACE Balance: SARTORIUS M3P

(Dry overnight at 60-90 °C, ash for 2 hrs at 550°C)

Pan #	Tare wt. (mg)	Total wt. (mg)		Ashed total wt. (mg)	#Weighed	Comments
		1	2			
1	50.59	52.65	52.61	50.75	10	
2	45.38	47.68	47.68	45.52	10	
3	47.92	50.08	50.03	48.06	10	
4	48.84	50.81	50.78	49.00	10	
5	41.81	43.80	43.79	41.96	10	

CHIRONOMUS DILUTUS 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 862-3 Client Hart Crowser Investigator

WEIGHING DATA SHEET

Tare: Date 2-9-15 Oven temp (C.) 550 Drying time (hr.) 2 Initials JRF
Standard Weights: 10 mg: 10.007 100mg: 100.009

Final #1: Date 2-17-15 Oven temp (C.) 62 Drying time (hr.) 24 Initials GJI
Standard Weights: 10 mg: 10.007 100mg: 100.017

Final #2: Date 2-18-15 Oven temp (C.) 61 Drying time (hr.) 22 Initials GJI
Standard Weights: 10 mg: 10.005 100mg: 100.015

Final #3: Date 2-19-15 Oven temp (C.) 550 Drying time (hr.) 2 Initials JRF
Standard Weights: 10 mg: 10.006 100mg: 100.008

Equip. used: Oven BLUE M#1, FISHER ISOTEMP MUFFLE FURNACE Balance Sartorius M3P

(Dry overnight at 60-90 degrees C) **(Final ashing is at 550 degrees C for 2 hours)**

Bkr. #	Pan #	Tare wt. (mg)	Dry total wt. (mg) 1	Dry total wt. (mg) 2	no. weighed	put into pans-initials	Ash weight (mg)	Comments
1	1	91.57	99.16	99.12	9	LB	93.18	
2	2	94.72	110.65	110.59	9	LB	99.34	
3	3	91.38	104.78	104.72	10	LB	94.54	
4	4	95.13	110.63	110.57	9	LB	99.60	
5	5	97.48	112.61	112.47	10	LB	101.97	
6	6	86.54	97.96	97.91	10	LB	89.22	
7	7	102.37	119.25	119.18	9	LB	107.17	
8	8	97.82	108.74	108.69	10	LB	100.38	
9	9	95.79	107.71	107.66	10	LB	98.43	
10	10	86.88	96.42	96.39	10	LB	89.04	
11	11	60.69	69.14	69.11	6	LB	62.54	
12	12	91.27	107.62	107.57	10	LB	96.15	
13	13	103.87	111.46	111.44	7	LB	105.52	
14	14	89.36	106.79	106.74	10	LB	94.24	
15	15	92.85	106.20	106.15	9	LB	95.78	
16	16	92.47	101.20	101.14	6	LB	94.32	
17	17	89.93	101.72	101.64	10	LB	92.78	
18	18	93.05	108.27	108.20	9	LB	97.35	
19	19	90.24	102.97	102.91	10	LB	93.19	
20	20	96.56	109.33	109.27	10	LB	99.53	
21	21	95.31	107.66	107.61	9	LB	98.38	
22	22	91.56	104.09	104.05	10	LB	94.44	
23	23	85.64	99.39	99.35	10	LB	88.84	
24	24	95.40	106.30	106.27	8	LB	97.95	
25	25	88.72	105.18	105.13	9	LB	93.38	
26	26	95.60	104.35	104.33	9	LB	97.60	
27	27	94.09	106.45	106.40	10	LB	97.20	
28	28	93.17	102.93	102.89	8	LB	95.36	
29	29	94.74	105.63	105.60	9	LB	97.34	
30	30	101.96	112.46	112.43	8	LB	104.36	
31	31	94.64	102.47	102.45	6	LB	96.44	
32	32	93.81	103.85	103.84	9	LB	96.14	

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel:970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 2/4/2015

SPECIES: *Chironomus dilutus (formerly C. tentans)*

AGE: Deposited 1/24/2015

LIFE STAGE: Second Instar 2/4/2015

HATCH DATE: Emergent date 2/17/2015

BEGAN FEEDING: Immediately

FOOD: *Selenastrum* sp., Flake slurry

RECEIVED 2-5-15
-WL

Water Chemistry Record:	Current	Range
TEMPERATURE:	22°C	22-26°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	190 mg/l	100-190 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	60 mg/l	50-90 mg/l
pH:	7.50	7.50-8.20

Comments:

Facility Supervisor

TEST DATA ANALYSIS RECORDS

data entry verified against laboratory bench sheets 3-17-15 JRF

Endpoints Data Entry and Calculations File

BKR=beaker number
INIT=initial number
SURV=number survivors
MORT=number dead=INIT-SURV
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)

TARE WT= ashed weight of pan used for that replicate at test termination (mg), or dry weight of pan if ash-free dry weight is not an endpoint
WT COUNT= number of test organisms weighed at test end
DRY WT= TARE WT + dry weight of test organisms recovered at test termination (mg)
TWT=total biomass=DRY WT-TARE WT
WT=average individual biomass=TWT/WT COUNT

ASHED DRY WT= weight of ashed pan + weight of ashed test organisms recovered at test termination
TAFDW=DRY WT - ASHED DRY WT= total ash-free organism weight for given replicate
AFDW=average individual ash-free biomass=TAFDW/WT COUNT

INITIAL WEIGHT						
pan #	tare wt (mg)	final wt (mg)	wt count	avg. wt/ organism	ashed wt (mg)	avg. AFDW/ organism
1	50.59	52.61	10	0.20	50.75	0.19
2	45.38	47.68	10	0.23	45.52	0.22
3	47.92	50.03	10	0.21	48.06	0.20
4	48.84	50.78	10	0.19	49.00	0.18
5	41.81	43.79	10	0.20	41.96	0.18
			Mean	0.21		0.19
			SD	0.01		0.02

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	INIT	SURV	MORT	PSURV	PMORT	TARE WT (mg)	WT COUNT	DRY WT (mg)	ASHED DRY WT (mg)	TWT (mg)	WT (mg)	TAFDW (mg)	AFDW (mg)		SURV	MORT	PSURV	PMORT	WT	AFDW
1	5	5195G	Control	1	10	10	0	100.0	0.0	97.48	10	112.47	101.97	14.99	1.50	10.50	1.05							
2	4	5195G	Control	2	10	9	1	90.0	10.0	95.13	9	110.57	99.60	15.44	1.72	10.97	1.22							
3	25	5195G	Control	3	10	9	1	90.0	10.0	88.72	9	105.13	93.38	16.41	1.82	11.75	1.31							
4	14	5195G	Control	4	10	10	0	100.0	0.0	89.36	10	106.74	94.24	17.38	1.74	12.50	1.25							
5	2	5195G	Control	5	10	9	1	90.0	10.0	94.72	9	110.59	99.34	15.87	1.76	11.25	1.25	Mean	9.4	0.6	93.8	6.3	1.72	1.22
6	18	5195G	Control	6	10	9	1	90.0	10.0	93.05	9	108.20	97.35	15.15	1.68	10.85	1.21	SD	0.5	0.5	5.2	5.2	0.12	0.09
7	7	5195G	Control	7	10	9	1	90.0	10.0	102.37	9	119.18	107.17	16.81	1.87	12.01	1.33	n	8	8	8	8	8	8
8	12	5195G	Control	8 wq replicate	10	10	0	100.0	0.0	91.27	10	107.57	96.15	16.30	1.63	11.42	1.14							
9	8	5192G	JT-SS-06	1	10	10	0	100.0	0.0	97.82	10	108.69	100.38	10.87	1.09	8.31	0.83							
10	31	5192G	JT-SS-06	2	10	6	4	60.0	40.0	94.64	6	102.45	96.44	7.81	1.30	6.01	1.00							
11	24	5192G	JT-SS-06	3	10	8	2	80.0	20.0	95.40	8	106.27	97.95	10.87	1.36	8.32	1.04							
12	23	5192G	JT-SS-06	4	10	10	0	100.0	0.0	85.64	10	99.35	88.84	13.71	1.37	10.51	1.05							
13	19	5192G	JT-SS-06	5	10	10	0	100.0	0.0	90.24	10	102.91	93.19	12.67	1.27	9.72	0.97	Mean	9.0	1.0	90.0	10.0	1.27	0.98
14	32	5192G	JT-SS-06	6	10	9	1	90.0	10.0	93.81	9	103.84	96.14	10.03	1.11	7.70	0.86	SD	1.4	1.4	14.1	14.1	0.13	0.11
15	15	5192G	JT-SS-06	7	10	9	1	90.0	10.0	92.85	9	106.15	95.78	13.30	1.48	10.37	1.15	n	8	8	8	8	8	8
16	9	5192G	JT-SS-06	8 wq replicate	10	10	0	100.0	0.0	95.79	10	107.66	98.43	11.87	1.19	9.23	0.92							
17	30	5193G	JT-SS-08	1	10	8	2	80.0	20.0	101.96	8	112.43	104.36	10.47	1.31	8.07	1.01							
18	29	5193G	JT-SS-08	2	10	9	1	90.0	10.0	94.74	9	105.60	97.34	10.86	1.21	8.26	0.92							
19	10	5193G	JT-SS-08	3	10	10	0	100.0	0.0	86.88	10	96.39	89.04	9.51	0.95	7.35	0.73							
20	26	5193G	JT-SS-08	4	10	9	1	90.0	10.0	95.60	9	104.33	97.60	8.73	0.97	6.73	0.75							
21	11	5193G	JT-SS-08	5	10	6	4	60.0	40.0	60.69	6	69.11	62.54	8.42	1.40	6.57	1.10	Mean	8.5	1.5	85.0	15.0	1.21	0.93
22	6	5193G	JT-SS-08	6	10	10	0	100.0	0.0	86.54	10	97.91	89.22	11.37	1.14	8.69	0.87	SD	1.7	1.7	16.9	16.9	0.18	0.15
23	27	5193G	JT-SS-08	7	10	10	0	100.0	0.0	94.09	10	106.40	97.20	12.31	1.23	9.20	0.92	n	8	8	8	8	8	8
24	16	5193G	JT-SS-08	8 wq replicate	10	6	4	60.0	40.0	92.47	6	101.14	94.32	8.67	1.45	6.82	1.14							
25	13	5194G	JT-SS-10	1	10	7	3	70.0	30.0	103.87	7	111.44	105.52	7.57	1.08	5.92	0.85							
26	21	5194G	JT-SS-10	2	10	9	1	90.0	10.0	95.31	9	107.61	98.38	12.30	1.37	9.23	1.03							
27	17	5194G	JT-SS-10	3	10	10	0	100.0	0.0	89.93	10	101.64	92.78	11.71	1.17	8.86	0.89							
28	1	5194G	JT-SS-10	4	10	9	1	90.0	10.0	91.57	9	99.12	93.18	7.55	0.84	5.94	0.66							
29	20	5194G	JT-SS-10	5	10	10	0	100.0	0.0	96.56	10	109.27	99.53	12.71	1.27	9.74	0.97	Mean	9.1	0.9	91.3	8.8	1.19	0.91
30	3	5194G	JT-SS-10	6	10	10	0	100.0	0.0	91.38	10	104.72	94.54	13.34	1.33	10.18	1.02	SD	1.1	1.1	11.3	11.3	0.17	0.12
31	22	5194G	JT-SS-10	7	10	10	0	100.0	0.0	91.56	10	104.05	94.44	12.49	1.25	9.61	0.96	n	8	8	8	8	8	8
32	28	5194G	JT-SS-10	8 wq replicate	10	8	2	80.0	20.0	93.17	8	102.89	95.36	9.72	1.22	7.53	0.94							

Project Name: P862-3 Chironomus % Mortality

Sample:	x1
Samp ID:	JT-SS-06
Alias:	NAS# 5192G
Replicates:	8
Mean:	10
SD:	14.142
Tr Mean:	N/A
Trans SD:	N/A

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	6.25
SD:	5.175
Tr Mean:	N/A
Trans SD:	N/A

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	10.868
SS:	2244.172
K:	8
b:	42.996
Alpha Level:	0.05
Calculated Value:	0.8237
Critical Value:	<= 0.887
Normally Distributed:	No
Override Option:	Not Invoked

Levene's Results:

Test Residual Mean:	12.833
Test Residual SD:	6.43
Ref. Residual Mean:	8.641
Ref. Residual SD:	2.385
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	1.7288
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Mann-Whitney
Balanced Design:	Yes
Transformation:	rank-order
Experimental Hypothesis	
Null:	x1 <= x2
Alternate:	x1 > x2
Mann-Whitney N1:	8
Mann-Whitney N2:	8
Degrees of Freedom:	
Experimental Alpha Level:	0.05
Calculated Value:	33
Critical Value:	>= 49.000
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0	4	0	4	12.833	11.522	4		-12.833
2	40	16	10	11	26.398	6.913	4		-12.833
3	20	15	10	11	13.732	6.913	4		-12.833
4	0	4	0	4	12.833	11.522	4		-12.833
5	0	4	10	11	12.833	6.913	4		-11.522
6	10	11	10	11	5.602	6.913	4		-11.522
7	10	11	10	11	5.602	6.913	4		-11.522
8	0	4	0	4	12.833	11.522	11		5.602
9							11		5.602
10							11		6.913
11							11		6.913
12							11		6.913
13							11		6.913
14							11		6.913
15							15		13.732
16							16		26.398

The percent mortality in test sediment JT-SS-06 was not significantly higher that that of the control sediment at α=0.05. –6S1

Project Name: P862-3 Chironomus % Mortality

Sample:	x1
Samp ID:	JT-SS-08
Alias:	NAS# 5193G
Replicates:	8
Mean:	15
SD:	16.903
Tr Mean:	17.737
Trans SD:	16.677

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	6.25
SD:	5.175
Tr Mean:	11.522
Trans SD:	9.541

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	11.662
SS:	2583.955
K:	8
b:	48.025
Alpha Level:	0.05
Calculated Value:	0.8926
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	13.303
Test Residual SD:	8.71
Ref. Residual Mean:	8.641
Ref. Residual SD:	2.385
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	1.4601
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 <= x2
Alternate:	x1 > x2

Degrees of Freedom:	14
Experimental Alpha Level:	0.05
Calculated Value:	0.915
Critical Value:	>= 1.761
Accept Null Hypothesis:	Yes
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	20	26.565	0	0	8.828	11.522			-17.737
2	10	18.435	10	18.435	0.698	6.913			-17.737
3	0	0	10	18.435	17.737	6.913			-17.737
4	10	18.435	0	0	0.698	11.522			-11.522
5	40	39.232	10	18.435	21.494	6.913			-11.522
6	0	0	10	18.435	17.737	6.913			-11.522
7	0	0	10	18.435	17.737	6.913			0.698
8	40	39.232	0	0	21.494	11.522			0.698
9									6.913
10									6.913
11									6.913
12									6.913
13									6.913
14									8.828
15									21.494
16									21.494

The percent mortality in test sediment JT-SS-08 was not significantly higher that that of the control sediment at α=0.05. -631

Project Name: P862-3 Chironomus % Mortality

Sample:	x1
Samp ID:	JT-SS-10
Alias:	NAS# 5194G
Replicates:	8
Mean:	8.75
SD:	11.26
Tr Mean:	0.058
Trans SD:	1.072

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	6.25
SD:	5.175
Tr Mean:	-0.058
Trans SD:	0.662

Shapiro-Wilk Results:

Residual Mean:
Residual SD:
SS:
K:
b:

Alpha Level: N/A
Calculated Value: N/A
Critical Value: N/A

Normally Distributed: N/A

Override Option: Not Invoked

Levene's Results:

Test Residual Mean: 0.916
Test Residual SD: 0.436
Ref. Residual Mean: 0.6
Ref. Residual SD: 0.166
Deg. of Freedom: 14

Alpha Level: 0.1
Calculated Value: 1.9139
Critical Value: >= 1.761

Variances Homogeneous: No

Test Results:

Statistic: Approximate t
Balanced Design: Yes
Transformation: Rankits

Experimental Hypothesis
Null: x1 <= x2
Alternate: x1 > x2

Degrees of Freedom: 12
Experimental Alpha Level: 0.05
Calculated Value: 0.2603
Critical Value: >= 1.782
Accept Null Hypothesis: Yes

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	30	1.766	0	-0.858	1.708	0.8		-0.858	
2	10	0.422	10	0.422	0.364	0.48		-0.858	
3	0	-0.858	10	0.422	0.916	0.48		-0.858	
4	10	0.422	0	-0.858	0.364	0.8		-0.858	
5	0	-0.858	10	0.422	0.916	0.48		-0.858	
6	0	-0.858	10	0.422	0.916	0.48		-0.858	
7	0	-0.858	10	0.422	0.916	0.48		-0.858	
8	20	1.285	0	-0.858	1.227	0.8		0.422	
9								0.422	
10								0.422	
11								0.422	
12								0.422	
13								0.422	
14								0.422	
15								1.285	
16								1.766	

The percent mortality in test sediment JT-SS-10 was not significantly higher that that of the control sediment at α=0.05. -651

Project Name: P862-3 Chironomus Growth (AFDW)

Sample:	x1
Samp ID:	JT-SS-06
Alias:	NAS# 5192G
Replicates:	8
Mean:	0.978
SD:	0.106
Tr Mean:	0.978
Trans SD:	0.106

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	1.22
SD:	0.091
Tr Mean:	1.22
Trans SD:	0.091

Shapiro-Wilk Results:

Residual Mean: 0
Residual SD: 0.085
SS: 0.136
K: 8
b: 0.364

Alpha Level: 0.05
Calculated Value: 0.975
Critical Value: <= 0.887

Normally Distributed: Yes

Override Option: N/A

Levene's Results:

Test Residual Mean: 0.083
Test Residual SD: 0.058
Ref. Residual Mean: 0.065
Ref. Residual SD: 0.058
Deg. of Freedom: 14

Alpha Level: 0.1
Calculated Value: 0.6009
Critical Value: >= 1.761

Variances Homogeneous: Yes

Test Results:

Statistic: Student's t
Balanced Design: Yes
Transformation: No Transformation

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom: 14
Experimental Alpha Level: 0.05
Calculated Value: 4.9253
Critical Value: >= 1.761
Accept Null Hypothesis: No

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.83	0.83	1.05	1.05	0.148	0.17			-0.17
2	1	1	1.22	1.22	0.023	0			-0.148
3	1.04	1.04	1.31	1.31	0.063	0.09			-0.118
4	1.05	1.05	1.25	1.25	0.073	0.03			-0.08
5	0.97	0.97	1.25	1.25	0.008	0.03			-0.058
6	0.86	0.86	1.21	1.21	0.118	0.01			-0.01
7	1.15	1.15	1.33	1.33	0.173	0.11			-0.008
8	0.92	0.92	1.14	1.14	0.058	0.08			0
9									0.023
10									0.03
11									0.03
12									0.063
13									0.073
14									0.09
15									0.11
16									0.173

Average individual growth (AFDW) in test sediment JT-SS-06 is significantly less than that in the control sediment at α=0.05. --6) 1

Project Name: P862-3 Chironomus Growth (AFDW)

Sample:	x1
Samp ID:	JT-SS-08
Alias:	NAS# 5193G
Replicates:	8
Mean:	0.93
SD:	0.149
Tr Mean:	0.93
Trans SD:	0.149

Ref Samp:	x2
Ref ID:	Control
Alias:	NAS# 5195G
Replicates:	8
Mean:	1.22
SD:	0.091
Tr Mean:	1.22
Trans SD:	0.091

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.106
SS:	0.213
K:	8
b:	0.453
Alpha Level:	0.05
Calculated Value:	0.9628
Critical Value:	<= 0.887
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.115
Test Residual SD:	0.084
Ref. Residual Mean:	0.065
Ref. Residual SD:	0.058
Deg. of Freedom:	14
Alpha Level:	0.1
Calculated Value:	1.3811
Critical Value:	>= 1.761
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	No Transformation

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom:	14
Experimental Alpha Level:	0.05
Calculated Value:	4.7022
Critical Value:	>= 1.761
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	1.01	1.01	1.05	1.05	0.08	0.17			-0.2
2	0.92	0.92	1.22	1.22	0.01	0			-0.18
3	0.73	0.73	1.31	1.31	0.2	0.09			-0.17
4	0.75	0.75	1.25	1.25	0.18	0.03			-0.08
5	1.1	1.1	1.25	1.25	0.17	0.03			-0.06
6	0.87	0.87	1.21	1.21	0.06	0.01			-0.01
7	0.92	0.92	1.33	1.33	0.01	0.11			-0.01
8	1.14	1.14	1.14	1.14	0.21	0.08			-0.01
9									0
10									0.03
11									0.03
12									0.08
13									0.09
14									0.11
15									0.17
16									0.21

Average individual growth (AFDW) in test sediment JT-SS-08 is significantly less than that in the control sediment at α=0.05.

– 6)2

Water Quality Data

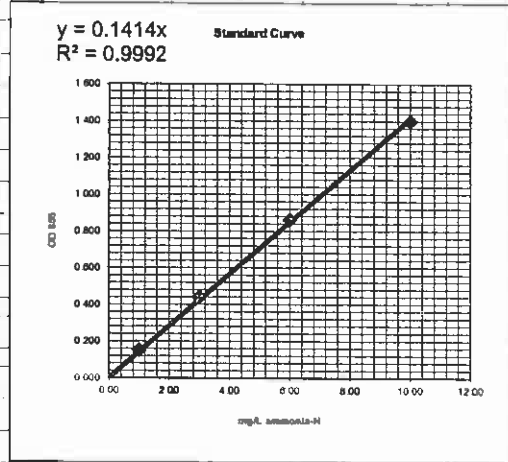
	NAS	CLIENT			Overlying water						
BKR	SMPL	DESCRIP	REPL	DAY	TEMP	DO	COND	pH	NH3	HARD	ALK
9	5192G	JT-SS-06	8	0	23.6	7.0	118	7.1	<0.1	26	30
12	5195G	Control	8	0	24.0	7.4	217	7.4	0.3	26	30
16	5193G	JT-SS-08	8	0	23.8	7.2	120	7.3	0.1	34	30
28	5194G	JT-SS-10	8	0	24.0	6.7	136	7.2	0.2	34	30
9	5192G	JT-SS-06	8	1	22.2	6.6					
12	5195G	Control	8	1	22.6	6.8					
16	5193G	JT-SS-08	8	1	22.3	6.8					
28	5194G	JT-SS-10	8	1	23.0	6.4					
9	5192G	JT-SS-06	8	2	22.2	6.7					
12	5195G	Control	8	2	22.6	6.4					
16	5193G	JT-SS-08	8	2	22.4	6.8					
28	5194G	JT-SS-10	8	2	22.9	6.8					
9	5192G	JT-SS-06	8	3	22.4	6.5					
12	5195G	Control	8	3	22.9	6.1					
16	5193G	JT-SS-08	8	3	22.7	6.2					
28	5194G	JT-SS-10	8	3	23.2	6.1					
9	5192G	JT-SS-06	8	4	22.1	6.5					
12	5195G	Control	8	4	22.4	6.1					
16	5193G	JT-SS-08	8	4	22.2	6.3					
28	5194G	JT-SS-10	8	4	22.7	6.7					
9	5192G	JT-SS-06	8	5	22.0	6.6	108	7.2			
12	5195G	Control	8	5	22.4	6.3	139	7.1			
16	5193G	JT-SS-08	8	5	22.2	6.2	112	7.2			
28	5194G	JT-SS-10	8	5	22.5	6.6	117	7.1			
9	5192G	JT-SS-06	8	6	22.1	4.8					
12	5195G	Control	8	6	22.8	4.6					
16	5193G	JT-SS-08	8	6	22.4	4.6					
28	5194G	JT-SS-10	8	6	23.4	4.5					
9	5192G	JT-SS-06	8	7	22.6	5.5					
12	5195G	Control	8	7	23.1	5.3					
16	5193G	JT-SS-08	8	7	22.8	5.3					
28	5194G	JT-SS-10	8	7	23.6	5.9					
9	5192G	JT-SS-06	8	8	22.1	5.4					
12	5195G	Control	8	8	22.6	5.6					
16	5193G	JT-SS-08	8	8	22.3	5.7					
28	5194G	JT-SS-10	8	8	22.9	5.9					
9	5192G	JT-SS-06	8	9	22.4	5.6					
12	5195G	Control	8	9	22.8	5.4					
16	5193G	JT-SS-08	8	9	22.6	5.4					
28	5194G	JT-SS-10	8	9	23.2	5.3					
9	5192G	JT-SS-06	8	10	22.3	6.5	116	7.1	0.2	26	40
12	5195G	Control	8	10	22.9	6.3	129	7.1	0.1	26	40
16	5193G	JT-SS-08	8	10	22.6	6.4	117	7.1	0.1	26	50
28	5194G	JT-SS-10	8	10	23.4	6.2	123	7.1	0.2	34	40
				Mean	22.7	6.1	129	7.2	—	29	36
				SD	0.5	0.7	29	0.1	—	4	7
				n	44	44	12	12	8	8	8
				Min	22.0	4.5	108	7.1	<0.1	26	30
				Max	24.0	7.4	217	7.4	0.3	34	50

AMMONIA EXPOSURE BENCHSHEETS AND ANALYSIS

Total Ammonia-N in Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	-----	-----	-----		
	1.0 mg/L NH3-N Std.	----	0.151	1.00		
	3.0 mg/L NH3-N Std.	-----	0.440	3.00		
	6.0 mg/L NH3-N Std.	----	0.862	6.00		
	10.0 mg/L NH3-N Std.	----	1.400	10.00		
	3.0 mg/L spike	-----	0.449	3.17		
	3.0 mg/L spike dupl.	----	0.440	3.11		
	5.0 mg/L 2nd source		0.710	5.02		
1	Day 0 (2-6-15)					
2	9	1	0.014	ND		
3	12	1	0.044	0.31		
4	16	1	0.020	0.14		
5	28	1	0.029	0.21		
6						
7	Day 10 (2-16-15)					
8	9	1	0.022	0.16		
9	12	1	0.019	0.13		
10	16	1	0.019	0.13		
11	28	1	0.021	0.15		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						



Reporting limit (mg/L) =	0.10
Recovery (%) =	104.8
Precision (RPD) =	2.02
2nd source (%) =	100.4
Sample volume (ml):	0.50
Dilution factor	1

Sample Set Description:

Test No.: 862-3
Test Day: 0 & 10
Species: *Chironomus*

Sample Type (check)

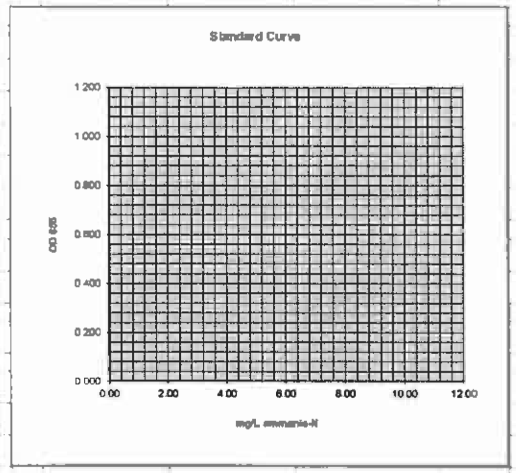
- Bulk Sediment Porewaters
- Test Beaker Porewaters
- X Overlying Water

Analyst: JB
Date analysed: 2/20/2015

Total Ammonia-N in Water: Computation Worksheet
Salicylate Method (SOP #5492)

Result

	Sample description	Dilution factor	OD655	NH3-N (mg/L)	pH	Salinity (ppt)
	Blank	—	—	—		
	1.0 mg/L NH3-N Std.	-----	.151	1.00		
	3.0 mg/L NH3-N Std.	-----	.440	3.00		
	6.0 mg/L NH3-N Std.	-----	.862	6.00		
	10.0 mg/L NH3-N Std.	-----	1.4	10.00		
	3.0 mg/L spike	-----	.449			
	3.0 mg/L spike dupl.	-----	.440			
	5.0 mg/L 2nd source		.710			
1	Day 0 (2-6-15)					
2	9	1	.014			
3	12	1	.044			
4	16	1	.020			
5	28	1	.029			
6						
7	Day 10 (2-16-15)					
8	9	1	.022			
9	12	1	.019			
10	16	1	.019			
11	28		.021			
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						



Reporting limit (mg/L) = 0.10

Recovery (%) = #VALUE!
Precision (RPD) = #VALUE!
2nd source (%) = #VALUE!

Sample volume (ml): 0.50
Dilution factor 1

Sample Set Description:
Test No.: 862-3
Test Day: 0 & 10
Species: *Chironomus*

Sample Type (check)
Bulk Sediment Porewaters
Test Beaker Porewaters
X Overlying Water

Analyst: JB
Date analysed: 2/20/2015

CHAIN-OF-CUSTODY RECORDS

Sample Custody Record

Samples Shipped to: New Aquatic Sciences

HARTCROWSER

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

JOB 17800-56 LAB NUMBER ______

PROJECT NAME Jacobson Terminals

HART CROWSER CONTACT Phil Cordell

SAMPLED BY: PRC

REQUESTED ANALYSIS: * 10-day Chironomus dilutus survival and growth; * 28-day Hyalella azteca survival and growth

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	10-day Chironomus dilutus survival and growth	28-day Hyalella azteca survival and growth	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	JT-SS-06	5192G	1/12/15	1159	Sediment	X	X	4	4 liters sediment
	JT-SS-08	5193G	↓	1058	↓	X	X	4	" "
	JT-SS-10	5194G	↓	1400	↓	X	X	4	" "

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE [signature]	1/13/15	SIGNATURE [signature]	1-14-15
PRINT NAME Phil Cordell	TIME 1000	PRINT NAME GERALD IRISSARRI	TIME 1140
COMPANY HC		COMPANY NAS	

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

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ______ for Other Contract Requirements

12 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☒YES ☐NO ☐N/A
GOOD CONDITION ☒YES ☐NO
TEMPERATURE 2.5°C
SHIPMENT METHOD: ☐HAND ☐COURIER ☒OVERNIGHT

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

From (206) 826-4527 Origin ID LKEA
Phil Cordell
Hart Crowser, Inc
1700 Westlake Avenue North
Suite 200
Seattle WA 98109

FedEx Express

E

J142214032333uv

Ship Date 13JAN15
ActWgt 75 0 LB
CAD 4598164/INET3550

Delivery Address Bar Code

SHIP TO. (206) 324-9530 BILL SENDER
Gerald Irissarri
Northwest Aquatics Scientists
3814 Yakima Rd

NEWPORT, OR 97365

Ref # 17800-56-02
Invoice #
PO #
Dept #

WED - 14 JAN AM
STANDARD OVERNIGHT

TRK# 7725 6121 8674
0201

97365
OR-US
PDX

86 ONPA

522G1/6F15/8AC0

Rcvd 1130 1-14-15

After printing this label:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

Warning: Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim. Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss. Maximum for items of extraordinary value is $1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

CUSTODY SEAL CUSTODY SEAL CUSTODY SEAL CUSTODY SEAL

Date 1/13/15

Initials [signature]

26 of 26

APPENDIX III

RAW DATA – REFERENCE TOXICANT TEST

REVIEWED PAGES 1-8 -GJI

Test No. 999-3391 Client: QC Test Investigator ______
Test Type (rangefinding/definitive) ______ Test Length (hr) 96
Species *Chironomus dilutus*

STUDY MANAGEMENT

Client: QC test
Client's Study Monitor: QC test
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. G.J. Irissarri GJI
QA Officer L. K. Nemeth
1. Yvet Nakahara 2. [illegible]
3. ______ 4. ______
Study Schedule:
Test Beginning: 2-6-15 0945 Test Ending: 2-10-15 1045

TEST MATERIAL

Description: Potassium Chloride Crystals - Fisher Lot No.: 114689
NAS Sample No.
Date of Collection:
Date of Receipt:
Temperature (deg C):
Dissolved oxygen (mg/L):
pH:
Conductivity (umhos/cm):
Hardness (mg/L):
Alkalinity (mg/L):
Salinity (ppt):
Total chlorine (mg/L):
Total ammonia-N (mg/L):
______:

DILUTION WATER

Description: Moderately hard synthetic water
Date of Preparation/Collection: 1-30-15
Water Quality: Cond. (umhos/cm): 248 Salinity (ppt) ______ pH 8.1
Hardness (mg/L as $CaCO_3$): 86 Alkalinity (mg/L as $CaCO_3$): 70
Treatments: Aerated ≥ 24 hrs

TEST LOCATION

Test conducted in (circle one): (room 1) room 2 trailer water bath other:______
Randomization chart:

5	20	2.5	1.25	Ø	5	5	10	0	0
Ø	5	5	5	20	10	2.5	1.25	20	10
2.5	10	10	Ø	10	20	Ø	Ø	1.25	5
1.25	Ø	1.25	20	1.25	1.25	1.25	5	10	2.5
10	2.5	20	10	5	Ø	10	2.5	5	1.25
20	1.25	Ø	2.5	2.5	2.5	20	20	2.5	20

Error codes: 1) Correction of handwriting error
2) Written in wrong location; entry deleted
3) Wrong date deleted; replaced with correct date
4) Error found in measurement; measurement repeated

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-__________

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-3391 Client QC Test Investigator ____________

TEST ORGANISMS

Species: *Chironomus dilutus*

Age: 2ND ~~and~~ TO 3rd instar

Source: ~~NAS cultures~~ AQUATIC BIOSYSTEMS, FORT COLLINS, CO

Date received: 2-5-15

Acclimation Data:

Date	Temp. (deg.C)	pH	DO (mg/L)	Cond. umhos/cm	Hardness (mg/L)	Alkalinity (mg/L)	Feeding	Water changes
2-5-15	20.6	6.9	6.2	436	171	110	Animals fed Tetra Fin	YES
2-6-15	24.8	7.6	6.7	316	86	70	and *Selenastrum*	–
							~~Details recorded on~~	
							~~Chironomid culture~~	
							~~data sheets~~	
Mean	22.7	7.3	6.5	376	129	90		
S.D.	–	–	–	–	–	–		
(N)	2	2	2	2	2	2		

Photoperiod during acclimation: 16:8, L:D

TEST PROCEDURES AND CONDITIONS

Test concentrations (50% series recommended): 20, 10, 5, 2.5, 1.25, 0 g/L

Test chamber: 30 ml plastic cups Test volume: 20 ml

Replicates/treatment: 10 Organisms/treatment: 10 (1/rep)

Test water changes: None Aeration during test: None

Feeding: 0.25 ml Prime Tropical Flakes (4g/L) suspension per cup on days 0 and 2

Duration: 24-hr, 48-hr, (96-hr) Test temperature (deg.C): 23 ± 1

Beaker placement: Stratified randomization Photoperiod: 16:8, L:D

MISCELLANEOUS NOTES

Test solution preparation:

Working stock: Dissolve 10g KCl crystals in dilution water and dilute to 500 mL.
Final conc.: 20 g/L.

2-6-15 UAT

Test concentration (g/L)	KCl working stock (ml/200ml)	ml of dilution water per 200 ml
20	200	0
10	100	100
5	50	150
2.5	25	175
1.25	12.5	187.5
0	0	0

 Revised 12-5-01

Test No. 999-3391 Client QC Test

DAILY RECORD SHEET

Day 0 (2 / 6 /15) ✓/GSI Temp Beaker (°C): 23.3

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 20	23.4	7.9	>20,000	8.4	86	60	
2. 10	23.4	8.0	14380	8.3			
3. 5	23.4	8.0	7830	8.3			
4. 2.5	23.4	8.0	4220	8.3			
5. 1.25	23.5	8.0	2320	8.4			
6. 0	23.5	7.9	273	8.4	86	70	
Each replicate fed 0.25 ml Tetra Fin suspension. Initials: GSI							

Day 1 (2 / 7 /15) GSI Temp Beaker (°C): 22.9

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 20							
2. 10							
3. 5							
4. 2.5							
5. 1.25							
6. 0							

Day 2 (2 / 8 /15) GSI Temp Beaker (°C): 22.6

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 20							
2. 10							
3. 5							
4. 2.5							
5. 1.25							
6. 0							
Each replicate fed 0.25 ml Tetra Fin suspension. Initials: GSI							

Day 3 (2 / 9 /15) GSI Temp Beaker (°C): 23.0

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 20							
2. 10							
3. 5							
4. 2.5							
5. 1.25							
6. 0							

Day 4 (2 /10/15) ✓ Temp Beaker (°C): 22.6

Conc. (g/L)	Temp. (deg.C)	pH	Cond. (umhos/cm)	DO (ppm)	Hardness (mg/L)	Alkalinity (mg/L)	Comments
1. 20	—	—	—	—	—	—	
2. 10	—	—	—	—			
3. 5	23.1	7.8	8960	8.0			
4. 2.5	23.2	7.8	5120	8.1			
5. 1.25	23.5	7.9	2800	8.2			
6. 0	23.3	7.9	364	8.1	94	80	
Mean	23.4	7.9	CONTROL 319	8.3	89	70	
SD	0.1	0.1	—	0.1	5	10	
n	10	10	2	10	3	3	

Test No. 999-3391 Client QC Test Investigator ________

DAILY RECORD SHEET - Survivors

Day 0 (2/6/15) GJL

Conc. (g/L)	Survivors in Replicate: 1	2	3	4	5	6	7	8	9	10	Total
1. 20	1	1	1	1	1	1	1	1	1	1	10
2. 10	1	1	1	1	1	1	1	1	1	1	10
3. 5	1	1	1	1	1	1	1	1	1	1	10
4. 2.5	1	1	1	1	1	1	1	1	1	1	10
5. 1.25	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 1 (2/7/15)

Conc. (g/L)	Survivors in Replicate: 1	2	3	4	5	6	7	8	9	10	Total
1. 20	1	1	1	1	1	1	1	1	1	1	10
2. 10	1	1	1	1	1	1	1	1	1	1	10
3. 5	1	1	1	1	1	1	1	1	1	1	10
4. 2.5	1	1	1	1	1	1	1	1	1	1	10
5. 1.25	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 2 (2/8/15) GJL

Conc. (g/L)	Survivors in Replicate: 1	2	3	4	5	6	7	8	9	10	Total
1. 20	0	0	0	0	0	0	0	0	0	0	Ø (10D)
2. 10	0	0	0	0	0	0	0	0	0	0	Ø (10D)
3. 5	1	1	1	1	1	1	1	1	1	1	10
4. 2.5	1	1	1	1	1	1	1	1	1	1	10
5. 1.25	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 3 (2/9/15) GJL

Conc. (g/L)	Survivors in Replicate: 1	2	3	4	5	6	7	8	9	10	Total
1. 20	0	0	0	0	0	0	0	0	0	0	Ø
2. 10	0	0	0	0	0	0	0	0	0	0	Ø
3. 5	1	1	0	1	1	1	1	1	1	1	9 (1D)
4. 2.5	1	1	1	1	1	1	1	1	1	1	10
5. 1.25	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

Day 4 (2/10/15) GJL

Conc. (g/L)	Survivors in Replicate: 1	2	3	4	5	6	7	8	9	10	Total
1. 20	0	0	0	0	0	0	0	0	0	0	Ø
2. 10	0	0	0	0	0	0	0	0	0	0	Ø
3. 5	1	1	0	1	0	0	1	1	1	1	7 (2D)
4. 2.5	1	1	1	1	1	1	1	1	1	1	10
5. 1.25	1	1	1	1	1	1	1	1	1	1	10
6. 0	1	1	1	1	1	1	1	1	1	1	10

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS INC.

Toll Free: 800/331-5916
Tel:970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 2/4/2015

SPECIES: *Chironomus dilutus (formerly C. tentans)*

AGE: Deposited 1/24/2015

LIFE STAGE: Second Instar 2/4/2015

HATCH DATE: Emergent date 2/17/2015

BEGAN FEEDING: Immediately

FOOD: *Selenastrum* sp., Flake slurry

RECEIVED 2-5-15
-GJL

Water Chemistry Record:	Current	Range
TEMPERATURE:	22°C	22-26°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	190 mg/l	100-190 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	60 mg/l	50-90 mg/l
pH:	7.50	7.50-8.20

Comments:

Facility Supervisor

Aquatic BioSystems, Inc • Quality Research Organisms

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	2/6/2015 09:45	Test ID:	999-3391	Sample ID:	REF-Ref Toxicant
End Date:	2/10/2015 10:45	Lab ID:	ORNAS-Northwestern Aquati	Sample Type:	KCL-Potassium chloride
Sample Date:		Protocol:	EPAF 91-EPA Freshwater	Test Species:	CT-Chironomus tentans
Comments:					

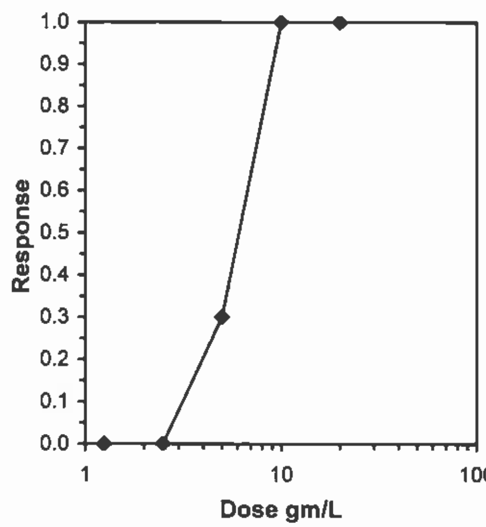
Conc-gm/L	1
D-Control	1.0000
1.25	1.0000
2.5	1.0000
5	0.7000
10	0.0000
20	0.0000

Conc-gm/L	Mean	N-Mean	Resp	Not Resp	Total	N	Fisher's Exact P	1-Tailed Critical	Number Resp	Total Number
D-Control	1.0000	1.0000	0	10	10	1			0	10
1.25	1.0000	1.0000	0	10	10	1	1.0000	0.0500	0	10
2.5	1.0000	1.0000	0	10	10	1	1.0000	0.0500	0	10
5	0.7000	0.7000	3	7	10	1	0.1053	0.0500	3	10
10	0.0000	0.0000	10	0	10	1			10	10
20	0.0000	0.0000	10	0	10	1			10	10

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Fisher's Exact Test	5	10	7.07107	

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	5.7435	4.6982	7.0214
5.0%	5.8220	4.6455	7.2964
10.0%	5.8972	4.5356	7.6674
20.0%	6.0284	4.0589	8.9534
Auto-0.0%	5.7435	4.6982	7.0214

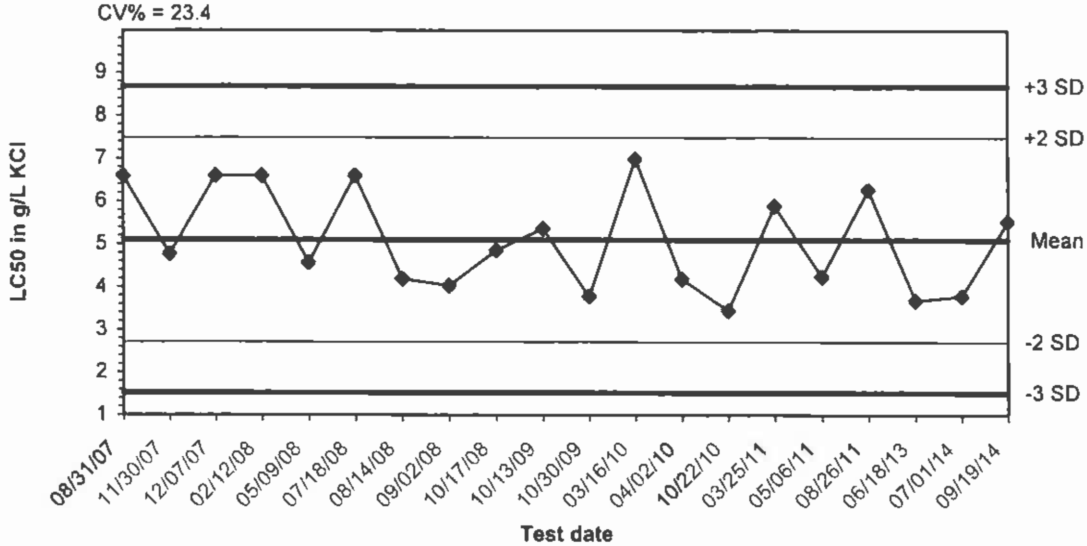


Test: AT-Acute 96-hr Toxicity Test	Test ID: 999-3391
Species: CT-Chironomus tentans	Protocol: EPAF 91-EPA Freshwater
Sample ID: REF-Ref Toxicant	Sample Type: KCL-Potassium chloride
Start Date: 2/6/2015 09:45 End Date: 2/10/2015 10:45	Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				10	
	2	1	1.250	10				10	
	3	1	2.500	10				10	
	4	1	5.000	10				7	
	5	1	10.000	10				0	
	6	1	20.000	10				0	

Comments: data entry verified against laboratory bench sheets 3-5-15 JDF

Third instar midge larvae, Chironomus dilutus, acute reference toxicant test



Dates	Values	Mean	-2 SD	-3 SD	+2 SD	+3 SD
08/31/07	6.6000	5.0980	2.7119	1.5188	7.4841	8.6772
11/30/07	4.7700	5.0980	2.7119	1.5188	7.4841	8.6772
12/07/07	6.6000	5.0980	2.7119	1.5188	7.4841	8.6772
02/12/08	6.6000	5.0980	2.7119	1.5188	7.4841	8.6772
05/09/08	4.5600	5.0980	2.7119	1.5188	7.4841	8.6772
07/18/08	6.6000	5.0980	2.7119	1.5188	7.4841	8.6772
08/14/08	4.1900	5.0980	2.7119	1.5188	7.4841	8.6772
09/02/08	4.0300	5.0980	2.7119	1.5188	7.4841	8.6772
10/17/08	4.8500	5.0980	2.7119	1.5188	7.4841	8.6772
10/13/09	5.3600	5.0980	2.7119	1.5188	7.4841	8.6772
10/30/09	3.7700	5.0980	2.7119	1.5188	7.4841	8.6772
03/16/10	6.9900	5.0980	2.7119	1.5188	7.4841	8.6772
04/02/10	4.1900	5.0980	2.7119	1.5188	7.4841	8.6772
10/22/10	3.4500	5.0980	2.7119	1.5188	7.4841	8.6772
03/25/11	5.8900	5.0980	2.7119	1.5188	7.4841	8.6772
05/06/11	4.2400	5.0980	2.7119	1.5188	7.4841	8.6772
08/26/11	6.2700	5.0980	2.7119	1.5188	7.4841	8.6772
06/18/13	3.6800	5.0980	2.7119	1.5188	7.4841	8.6772
07/01/14	3.7900	5.0980	2.7119	1.5188	7.4841	8.6772
09/19/14	5.5300	5.0980	2.7119	1.5188	7.4841	8.6772

APPENDIX D
Remediation Alternative Cost Estimates

Table D-1 – Summary of Remediation Alternative Estimated Costs

Location: Jacobson Terminals
Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

DESCRIPTION	TOTAL NET PRESENT VALUE	INCREMENTAL COST	COST TABLE REFERENCE
Alternative 1	$427,000	Baseline Cost	Table A-2
Alternative 2	$1,910,000	$1,483,000	Table A-3
Alternative 3	$5,490,000	$5,063,000	Table A-4
Alternative 4	$14,800,000	$14,373,000	Table A-5
Alternative 5 (no treatment wall)	$1,910,000	$2,337,000	Table A-6a
Alternative 5 (with treatment wall)	$6,730,000	$6,303,000	Table A-6b

Table D-2 – Remediation Alternative 1 Estimated Costs

Location: Jacobson Terminals, Seattle, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2014 **Date:** February 2016	**Description:** Alternative 1 consists of monitored natural attenuation, institutional controls, and compliance monitoring for 20 years.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring					
Planning documents	1	LS	$ 10,000	$ 10,000	Work plan, SAP, HASP. Based on similar project experience.
Monitoring well installation	1	LS	$ 21,279	$ 21,279	5 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 31,279**	
Contingency	30%	--	--	**$ 9,384**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project management	20%	--	--	$ 8,133	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial design	20%	--	--	$ 8,133	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction management	8%	--	--	$ 3,253	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 19,518**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 71,686**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring					
Compliance monitoring	1	YR	$ 2,425	$ 2,425	Includes MNA performance monitoring. See Table A-7.
Laboratory analysis	1	YR	$ 3,550	$ 3,550	See Table A-7.
Subtotal				**$ 5,975**	
Contingency	15%	--	--	**$ 896**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 1,031	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 1,374	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7.
Subtotal				**$ 7,553**	
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 18,156**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Professional/Technical Services					
5-year reviews & reporting	1	EA	$ 5,000	$ 5,000	Years 5, 10, 15, 20. Engineer's estimate.
Subtotal				**$ 5,000**	
Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Years 5, 10, 15, 20. See Table A-7.
Subtotal				**$ 4,922**	

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 20

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 71,686	$ 71,686	1.000	$ 71,686	
Annual O&M	1 - 20	$ 363,124	$ 18,156	17.687	$ 321,134	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
Periodic	10	$ 9,922	$ 9,922	0.888	$ 8,807	
Periodic	15	$ 9,922	$ 9,922	0.836	$ 8,297	
Periodic	20	$ 9,922	$ 9,922	0.788	$ 7,816	
		$ 474,498			$ 427,087	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 1					**$ 427,000**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-3 – Remediation Alternative 2 Estimated Costs

Location: Jacobson Terminals, Seattle, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2014 **Date:** February 2016	**Description:** Alternative 2 includes soil hot spot excavation, institutional controls, and compliance monitoring for 20 years.

CAPITAL COSTS **DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Site Preparation					
Submittals/implementation plans	1	LS	$ 25,000	$ 25,000	Pre- and post-construction contractor submittals, work plan, HASP, etc. Based on similar project experience.
Mobilization/demobilization	1	LS	$ 10,156	$ 10,156	RACER 2013.
Remove pavement	1	LS	$ 9,332	$ 9,332	RACER 2013.
Remove underground utilities	1	LS	$ 1,392	$ 1,392	RACER 2013.
Well abandonment	1	LS	$ 5,544	$ 5,544	2 wells. RACER 2013.
TESC measures	1	LS	$ 10,000	$ 10,000	Engineer's estimate.
Subtotal				**$ 61,424**	
Excavation and Disposal					
Dewatering, treatment, sewer discharge	1	LS	$ 73,372	$ 73,372	RACER 2013 and King Co. 2014 discharge rates.
Excavation, loading, backfilling	1	LS	$ 158,450	$ 158,450	RACER 2013.
Transportation, disposal	2,968	TON	$ 200	$ 593,689	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7.
Performance sampling and analysis	1	LS	$ 6,124	$ 6,124	See Table A-7.
Add backfill soil amendment	724	SF	$ 2.78	$ 2,013	Add amendment to enhance in situ bioremediation. Based on similar project experience.
Subtotal				**$ 833,648**	
Site Restoration					
Restore underground utilities	1	LS	$ 7,121	$ 7,121	RACER 2013.
Repave excavated areas	1	LS	$ 15,975	$ 15,975	RACER 2013.
Replace monitoring wells	1	LS	$ 9,074	$ 9,074	2 wells, 20-ft depth, 10-ft screen. RACER 2013.
Install compliance monitoring wells	1	LS	$ 10,378	$ 10,378	2 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 42,548**	
Contingency	30%	--	--	**$ 281,286**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project Management	9%	--	--	$ 109,702	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial Design	12%	--	--	$ 146,269	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction Management	10%	--	--	$ 121,891	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 377,861**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 1,608,272**	

ANNUAL O&M COSTS **DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Monitoring					
Compliance monitoring	1	YR	$ 1,923	$ 1,923	See Table A-7.
Laboratory analysis	1	YR	$ 2,130	$ 2,130	See Table A-7.
Subtotal				**$ 4,053**	
Contingency	15%	--	--	**$ 608**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 699	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 932	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7.
Subtotal				**$ 6,779**	
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 15,172**	

PERIODIC COSTS **DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Professional/Technical Services					
5-year reviews & reporting	1	EA	$ 5,000	$ 5,000	Years 5, 10, 15, 20. Engineer's estimate.
Subtotal				**$ 5,000**	
Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Years 5, 10, 15, 20. See Table A-7.
Subtotal				**$ 4,922**	

Table D-3 – Remediation Alternative 2 Estimated Costs

Location:	Jacobson Terminals Seattle, WA	**Description:** Alternative 2 includes soil hot spot excavation, institutional controls, and compliance monitoring for 20 years.
Phase:	Feasibility Study (-35% to +50%)	
Base Year:	2014	
Date:	February 2016	

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 20

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 1,608,272	$ 1,608,272	1.000	$ 1,608,272	
Annual O&M	1 - 20	$ 303,430	$ 15,172	17.687	$ 268,343	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
Periodic	10	$ 9,922	$ 9,922	0.888	$ 8,807	
Periodic	15	$ 9,922	$ 9,922	0.836	$ 8,297	
Periodic	20	$ 9,922	$ 9,922	0.788	$ 7,816	
		$ 1,951,391			$ 1,910,882	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 2					**$ 1,910,000**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-4 – Remediation Alternative 3 Estimated Costs

Location: Jacobson Terminals
Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

Description: Alternative 3 includes in situ groundwater treatment using a permeable reactive/sorptive barrier, institutional controls, and compliance monitoring for 20 years. The barrier would contain zero-valent iron (ZVI) to break down dissolved contaminant mass and granular activated carbon (GAC) to adsorb contaminants that are not amenable to treatment with ZVI.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
CAPITAL COSTS					
Site Preparation					
Submittals/implementation plans	1	LS	$ 25,000	$ 25,000	Pre- and post-construction contractor submittals, work plan, HASP, etc. Based on similar project experience.
Mobilization/demobilization	1	LS	$ 10,156	$ 10,156	RACER 2013.
Remove pavement	1	LS	$ 2,248	$ 2,248	RACER 2013.
TESC measures	1	LS	$ 10,000	$ 10,000	Engineer's estimate.
Subtotal				**$ 47,404**	
Permeable Reactive Barrier Installation					
Barrier earthwork	1	LS	$ 410,288	$ 410,288	RACER 2013.
Loading, transportation, disposal	1,047	TON	$ 200	$ 209,440	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7.
Construction water treatment, discharge	1	LS	$ 104,573	$ 104,573	RACER 2013 and King Co. 2014 discharge rates.
Barrier material import, placement	1	LS	$ 1,058,925	$ 1,058,925	ZVI, GAC, sand, fill. RACER 2013.
Subtotal				**$ 1,783,225**	
Site Restoration					
Repave excavated area	1	LS	$ 7,970	$ 7,970	RACER 2013.
Install compliance monitoring wells	1	LS	$ 15,965	$ 15,965	4 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 23,935**	
Contingency	30%	--	--	**$ 556,369**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project management	10%	--	--	$ 241,093	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial design	9%	--	--	$ 216,984	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction management	10%	--	--	$ 241,093	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 699,171**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 3,121,609**	
ANNUAL O&M COSTS					
DESCRIPTION	**QUANTITY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Monitoring					
Performance monitoring	1	YR	$ 2,425	$ 2,425	See Table A-7.
Compliance monitoring	1	YR	$ 1,693	$ 1,693	See Table A-7.
Laboratory analysis	1	YR	$ 4,970	$ 4,970	See Table A-7.
Subtotal				**$ 9,088**	
Contingency	15%	--	--	**$ 1,363**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 1,568	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 2,090	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7.
Subtotal				**$ 8,806**	
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 22,988**	
PERIODIC COSTS					
DESCRIPTION	**QUANTITY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Permeable Reactive Barrier Maintenance					
Replace treatment media	1	EA	$ 1,838,599	$ 1,838,599	Year 20. Derived from capital costs above.
Contingency	20%	--	--	$ 367,720	
Project management	4%	--	--	$ 88,253	
Design	2%	--	--	$ 44,126	
Construction management	5%	--	--	$ 110,316	
Subtotal				**$ 2,449,014**	
Professional/Technical Services					
5-year reviews & reporting	1	EA	$ 5,000	$ 5,000	Years 5, 10, 15, 20. Engineer's estimate.
Subtotal				**$ 5,000**	

Table D-4 – Remediation Alternative 3 Estimated Costs

Location: Jacobson Terminals, Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

Description: Alternative 3 includes in situ groundwater treatment using a permeable reactive/sorptive barrier, institutional controls, and compliance monitoring for 20 years. The barrier would contain zero-valent iron (ZVI) to break down dissolved contaminant mass and granular activated carbon (GAC) to adsorb contaminants that are not amenable to treatment with ZVI.

Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Years 5, 10, 15, 20. See Table A-7.
Subtotal				**$ 4,922**	

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 20

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 3,121,609	$ 3,121,609	1.000	$ 3,121,609	
Annual O&M	1 - 20	$ 459,767	$ 22,988	17.687	$ 406,602	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
Periodic	10	$ 9,922	$ 9,922	0.888	$ 8,807	
Periodic	15	$ 9,922	$ 9,922	0.836	$ 8,297	
Periodic	20	$ 2,458,936	$ 2,458,936	0.788	$ 1,937,033	
		$ 6,070,079			$ 5,491,694	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 3					**$ 5,490,000**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-5 – Remediation Alternative 4 Estimated Costs

Location: Jacobson Terminals, Seattle, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2014 **Date:** February 2016	**Description:** Alternative 4 consists of full-site excavation, institutional controls, and compliance monitoring for 5 years. Under this alternative, the entire site would be excavated except for soil under buildings. Shoring would be used along the buildings and shoreline to maintain stability of the excavation walls during construction.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Submittals/implementation plans	1	LS	$ 50,000	$ 50,000	Pre- and post-construction contractor submittals, work plan, HASP, etc. Based on similar project experience.
Mobilization/demobilization	1	LS	$ 20,313	$ 20,313	RACER 2013.
Remove pavement	1	LS	$ 92,163	$ 92,163	RACER 2013.
Remove underground utilities	1	LS	$ 38,088	$ 38,088	RACER 2013.
Well abandonment	23	EA	$ 720	$ 16,558	RACER 2013.
TESC measures	1	LS	$ 20,000	$ 20,000	Engineer's estimate.
Subtotal				**$ 237,122**	
Excavation and Disposal					
Dewatering, treatment, sewer discharge	1	LS	$ 158,778	$ 158,778	RACER 2013 and King Co. 2014 discharge rates.
Excavation, loading, backfilling	1	LS	$ 1,821,570	$ 1,821,570	RACER 2013.
Transportation, disposal	38,258	TON	$ 200	$ 7,651,600	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7.
Performance sampling and analysis	1	LS	$ 32,155	$ 32,155	See Table A-7.
Add backfill soil amendment	3,000	SF	$ 2.78	$ 8,340	Add amendment to enhance in situ bioremediation. Based on similar project experience.
Subtotal				**$ 9,672,443**	
Site Restoration					
Restore underground utilities	1	LS	$ 99,645	$ 99,645	RACER 2013.
Repave excavated areas	1	LS	$ 173,320	$ 173,320	RACER 2013.
Install compliance monitoring wells	1	LS	$ 21,279	$ 21,279	5 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 294,244**	
Contingency	30%	--	--	**$ 3,061,143**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project management	4%	--	--	$ 530,598	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial design	2%	--	--	$ 265,299	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction management	5%	--	--	$ 663,248	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 1,459,145**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 14,735,601**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring					
Compliance monitoring	1	YR	$ 1,808	$ 1,808	See Table A-7.
Laboratory analysis	1	YR	$ 1,775	$ 1,775	See Table A-7.
Subtotal				**$ 3,583**	
Contingency	15%	--	--	**$ 537**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 618	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 824	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7.
Subtotal				**$ 6,590**	
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 14,442**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Professional/Technical Services					
5-year review & reporting	1	EA	$ 5,000	$ 5,000	Year 5. Engineer's estimate.
Subtotal				**$ 5,000**	
Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Year 5. See Table A-7.
Subtotal				**$ 4,922**	

Table D-5 – Remediation Alternative 4 Estimated Costs

Location:	Jacobson Terminals Seattle, WA
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2014
Date:	February 2016

Description: Alternative 4 consists of full-site excavation, institutional controls, and compliance monitoring for 5 years. Under this alternative, the entire site would be excavated except for soil under buildings. Shoring would be used along the buildings and shoreline to maintain stability of the excavation walls during construction.

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 5

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 14,735,601	$ 14,735,601	1.000	$ 14,735,601	
Annual O&M	1 - 5	$ 72,209	$ 14,442	4.825	$ 69,681	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
		$ 14,817,732			$ 14,814,629	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 4					**$ 14,800,000**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-6a – Remediation Alternative 5 Estimated Costs (w/o Treatment Wall)

Location: Jacobson Terminals, Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

Description: Cost estimate for variant of Alternative 5 that excludes installation of a treatment wall. This variant of Alternative 5 includes soil hot spot excavation, institutional controls, and compliance monitoring for 20 years.

CAPITAL COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Submittals/implementation plans	1	LS	$ 25,000	$ 25,000	Pre- and post-construction contractor submittals, work plan, HASP, etc. Based on similar project experience.
Mobilization/demobilization	1	LS	$ 10,156	$ 10,156	RACER 2013.
Remove pavement	1	LS	$ 9,332	$ 9,332	RACER 2013.
Remove underground utilities	1	LS	$ 1,392	$ 1,392	RACER 2013.
Well abandonment	1	LS	$ 5,544	$ 5,544	2 wells. RACER 2013.
TESC measures	1	LS	$ 10,000	$ 10,000	Engineer's estimate.
Subtotal				**$ 61,424**	
Excavation and Disposal					
Dewatering, treatment, sewer discharge	1	LS	$ 73,372	$ 73,372	RACER 2013 and King Co. 2014 discharge rates.
Excavation, loading, backfilling	1	LS	$ 158,450	$ 158,450	RACER 2013.
Transportation, disposal	2,968	TON	$ 200	$ 593,689	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7 in RIFS.
Performance sampling and analysis	1	LS	$ 6,124	$ 6,124	See Table A-7 in RIFS.
Add backfill soil amendment	724	SF	$ 2.78	$ 2,013	Add amendment to enhance in situ bioremediation. Based on similar project experience.
Subtotal				**$ 833,648**	
Site Restoration					
Restore underground utilities	1	LS	$ 7,121	$ 7,121	RACER 2013.
Repave excavated areas	1	LS	$ 15,975	$ 15,975	RACER 2013.
Replace monitoring wells	1	LS	$ 9,074	$ 9,074	2 wells, 20-ft depth, 10-ft screen. RACER 2013.
Install compliance monitoring wells	1	LS	$ 10,378	$ 10,378	2 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 42,548**	
Contingency	30%	--	--	**$ 281,286**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project management	9%	--	--	$ 109,702	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial design	12%	--	--	$ 146,269	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction management	10%	--	--	$ 121,891	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 377,861**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7 in RIFS.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 1,608,272**	

ANNUAL O&M COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring					
Compliance monitoring	1	YR	$ 1,923	$ 1,923	See Table A-7 in RIFS.
Laboratory analysis	1	YR	$ 2,130	$ 2,130	See Table A-7 in RIFS.
Subtotal				**$ 4,053**	
Contingency	15%	--	--	**$ 608**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 699	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 932	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7 in RIFS.
Subtotal				**$ 6,779**	
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7 in RIFS.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 15,172**	

Table D-6a – Remediation Alternative 5 Estimated Costs (w/o Treatment Wall)

Location: Jacobson Terminals, Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

Description: Cost estimate for variant of Alternative 5 that excludes installation of a treatment wall. This variant of Alternative 5 includes soil hot spot excavation, institutional controls, and compliance monitoring for 20 years.

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Professional/Technical Services					
5-year reviews & reporting	1	EA	$ 5,000	$ 5,000	Years 5, 10, 15, 20. Engineer's estimate.
Subtotal				**$ 5,000**	
Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Years 5, 10, 15, 20. See Table A-7 in RIFS.
Subtotal				**$ 4,922**	

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 20

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 1,608,272	$ 1,608,272	1.000	$ 1,608,272	
Annual O&M	1 - 20	$ 303,430	$ 15,172	17.687	$ 268,343	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
Periodic	10	$ 9,922	$ 9,922	0.888	$ 8,807	
Periodic	15	$ 9,922	$ 9,922	0.836	$ 8,297	
Periodic	20	$ 9,922	$ 9,922	0.788	$ 7,816	
		$ 1,951,391			$ 1,910,882	

TOTAL NET PRESENT VALUE OF ALTERNATIVE 5 w/o PRB **$ 1,910,000**

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-6b – Remediation Alternative 5 Estimated Costs (w/ Treatment Wall)

Location: Jacobson Terminals, Seattle, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2014
Date: February 2016

Description: Alternative 5 includes soil hot spot excavation and in situ groundwater treatment using a permeable reactive/sorptive barrier, institutional controls, and compliance monitoring for 20 years. The barrier would contain zero-valent iron (ZVI) to break down dissolved contaminant mass and granular activated carbon (GAC) to adsorb contaminants that are not amenable to treatment with ZVI.

CAPITAL COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Submittals/implementation plans	1	LS	$ 30,000	$ 30,000	Pre- and post-construction contractor submittals, work plan, HASP, etc. Based on similar project experience.
Mobilization/demobilization	1	LS	$ 20,313	$ 20,313	RACER 2013. For two separate events.
Remove pavement	1	LS	$ 11,579	$ 11,579	RACER 2013.
Remove underground utilities	1	LS	$ 1,392	$ 1,392	RACER 2013.
Well abandonment	1	LS	$ 5,544	$ 5,544	2 wells. RACER 2013.
TESC measures	1	LS	$ 10,000	$ 10,000	Engineer's estimate.
Subtotal				**$ 78,828**	
Excavation and Disposal					
Dewatering, treatment, sewer discharge	1	LS	$ 127,806	$ 127,806	RACER 2013 and King Co. 2014 discharge rates. Includes management of water from PRB installation.
Excavation, loading, backfilling	1	LS	$ 158,450	$ 158,450	RACER 2013.
Transportation, disposal	2,968	TON	$ 200	$ 593,689	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7 in RIFS.
Performance sampling and analysis	1	LS	$ 6,124	$ 6,124	See Table A-7 in RIFS.
Add backfill soil amendment	724	SF	$ 2.78	$ 2,013	Add amendment to enhance in situ bioremediation. Based on similar project experience.
Subtotal				**$ 888,082**	
Permeable Reactive Barrier Installation					
Barrier earthwork	1	LS	$ 410,288	$ 410,288	RACER 2013.
Loading, transportation, disposal	1,047	TON	$ 200	$ 209,440	Disposal at Subtitle C landfill. Waste Management 2/21/2014 quote. See Table A-7 in RIFS.
Barrier material import, placement	1	LS	$ 1,058,925	$ 1,058,925	ZVI, GAC, sand, fill. RACER 2013.
Subtotal				**$ 1,678,652**	
Site Restoration					
Restore underground utilities	1	LS	$ 7,121	$ 7,121	RACER 2013.
Repave excavated areas	1	LS	$ 23,945	$ 23,945	RACER 2013.
Replace monitoring wells	1	LS	$ 9,074	$ 9,074	2 wells, 20-ft depth, 10-ft screen. RACER 2013.
Install compliance monitoring wells	1	LS	$ 15,965	$ 15,965	4 wells, 30-ft depth, 10-ft screen. RACER 2013.
Subtotal				**$ 56,105**	
Contingency	30%	--	--	**$ 810,500**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project management	5%	--	--	$ 175,608	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial design	8%	--	--	$ 280,973	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction management	6%	--	--	$ 210,730	Percentage of capital cost + contingency. EPA 540-R-00-002.
Subtotal				**$ 667,312**	
Institutional Controls					
Institutional controls plan	1	LS	$ 4,788	$ 4,788	See Table A-7 in RIFS.
Restrictive covenant	1	LS	$ 6,716	$ 6,716	RACER 2013.
Subtotal				**$ 11,504**	
TOTAL CAPITAL COST				**$ 4,190,984**	

ANNUAL O&M COSTS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitoring					
Performance monitoring	1	YR	$ 2,425	$ 2,425	See Table A-7 in RIFS.
Compliance monitoring	1	YR	$ 3,615	$ 3,615	See Table A-7 in RIFS.
Laboratory analysis	1	YR	$ 7,100	$ 7,100	See Table A-7 in RIFS.
Subtotal				**$ 13,140**	
Contingency	15%	--	--	**$ 1,971**	Scope and bid contingency. Percentage of annual costs.
Professional/Technical Services					
Project management	15%	--	--	$ 2,267	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical support	20%	--	--	$ 3,022	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 5,148	$ 5,148	Compliance and MNA performance monitoring. See Table A-7 in RIFS.
Subtotal				**$ 10,437**	

Table D-6b – Remediation Alternative 5 Estimated Costs (w/ Treatment Wall)

Location: Jacobson Terminals, Seattle, WA **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2014 **Date:** February 2016	**Description:** Alternative 5 includes soil hot spot excavation and in situ groundwater treatment using a permeable reactive/sorptive barrier, institutional controls, and compliance monitoring for 20 years. The barrier would contain zero-valent iron (ZVI) to break down dissolved contaminant mass and granular activated carbon (GAC) to adsorb contaminants that are not amenable to treatment with ZVI.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Site database maintenance	1	YR	$ 3,732	$ 3,732	See Table A-7 in RIFS.
Subtotal				**$ 3,732**	
TOTAL ANNUAL O&M COST				**$ 29,280**	
PERIODIC COSTS					
Permeable Reactive Barrier Maintenance					
Replace treatment media	1	EA	$ 1,892,408	$ 1,892,408	Year 20. Derived from capital costs above.
Contingency	20%	--	--	$ 378,482	
Project management	4%	--	--	$ 90,836	
Design	2%	--	--	$ 45,418	
Construction management	5%	--	--	$ 113,544	
Subtotal				**$ 2,520,687**	
Professional/Technical Services					
5-year reviews & reporting	1	EA	$ 5,000	$ 5,000	Years 5, 10, 15, 20. Engineer's estimate.
Subtotal				**$ 5,000**	
Institutional Controls					
Restrictive covenant update	1	EA	$ 4,922	$ 4,922	Years 5, 10, 15, 20. See Table A-7 in RIFS.
Subtotal				**$ 4,922**	

PRESENT VALUE ANALYSIS

Discount rate 1.2%
Total years 20

COST TYPE	YEAR	TOTAL COST	TOTAL ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 4,190,984	$ 4,190,984	1.000	$ 4,190,984	
Annual O&M	1 - 20	$ 585,597	$ 29,280	17.687	$ 517,881	
Periodic	5	$ 9,922	$ 9,922	0.942	$ 9,348	
Periodic	10	$ 9,922	$ 9,922	0.888	$ 8,807	
Periodic	15	$ 9,922	$ 9,922	0.836	$ 8,297	
Periodic	20	$ 2,530,609	$ 2,530,609	0.788	$ 1,993,493	
		$ 7,336,956			$ 6,728,809	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 5					**$ 6,730,000**	

Notes:
Cost estimate does not include sales tax.
Present value analysis uses a 20-year discount rate of 1.2 percent (www.whitehouse.gov/omb/circulars_a094/a94_appx-c).

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
RS Means Adjustment Factors					
Historical cost index 2014	204.9	--	--	--	
Historical cost index 2013	201.2	--	--	--	
Cost conversion factor, 2013 to 2014 dollars	1.018	--	--	--	Adjustment for RACER cost data. Assume 2014 dollars for cost basis.
Additional Site Characterization – Soil Monitoring – Alternative 5					Delineate limits of hot spot excavation areas.
Hot spot areas total quantity	4	ea	--	--	
Soil boring quantity per hot spot area	8	ea/area	--	--	6 to 10 borings per area (8 average).
Total soil borings	32	ea	--	--	
Well installation borings	3	ea	--	--	See below.
Total borings	35	ea	--	--	
Samples per boring	5	ea	--	--	
PCB hot spot areas	4	ea	--	--	
TPH-D hot spot areas	1	ea	--	--	
Metals hot spot areas	1	ea	--	--	
PCB soil samples	175	ea	--	--	
TPH-D soil samples	55	ea	--	--	
Metals soil samples	55	ea	--	--	
Labor					
Sr. project	8	hr	$ 150	$ 1,200	
Sr. staff	74	hr	$ 115	$ 8,510	
Staff	2	hr	$ 95	$ 190	
Subtotal				$ 9,900	
Soil borings (excluding new wells)					Explorations to 20 ft bgs. Well installation borings costed separately.
Mob/demob crew and rig	1	LS	$ 3,320	$ 3,320	RACER 2013.
Direct-push rig	8	day	$ 1,660	$ 13,281	RACER 2013.
Subtotal				$ 16,602	
Equipment/supplies	1	LS	$ 250	$ 250	
Travel	7.5	day	$ 85	$ 638	Truck rental.
Sample shipping	1	LS	$ 300	$ 300	
Subtotal				$ 1,188	
Laboratory analysis (soil)					Assume standard turnaround time.
PCBs	175	ea	$ 90	$ 15,750	EPA 8082A.
TPH-D	55	ea	$ 75	$ 4,125	NWTPH-Dx.
Metals (As, Cd, Hg, Pb)	55	ea	$ 80	$ 4,400	EPA 6020A/200.8.
Subtotal				$ 24,275	
Total				$51,964	
Additional Site Characterization – Groundwater Monitoring – Alternative 5					
Well quantity					
Existing	2	ea	--	--	
New	3	ea	--	--	
Total	5	ea	--	--	
Labor – groundwater sampling					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	8.5	hr	$ 115	$ 978	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,373	
Labor – slug testing					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	9.5	hr	$ 115	$ 1,093	
Subtotal				$ 1,393	
Equipment/supplies	1	LS	$ 250	$ 250	
Travel	1	day	$ 85	$ 85	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	
Subtotal				$ 435	
Laboratory analysis (groundwater)					Assume standard turnaround time.
Sample preparation	5	ea	$ 50	$ 250	Remove suspended solids/colloids. Lab quote 9/21/15.
PCBs - EPA 1668	5	ea	$ 800	$ 4,000	PCB congener analysis. Lab quote 9/21/15.
PCBs - EPA 8082	5	ea	$ 180	$ 900	
Lab reporting fee	5	ea	$ 50	$ 250	Data package & EIM EDD. Lab quote 9/21/15.
Subtotal				$ 5,400	
Total				$8,600	

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
Additional Site Characterization – Sediment, Pore Water, and Surface Water Monitoring – Alternative 5					
Sediment core locations	1	ea	--	--	
Sediment sampling locations	8	ea	--	--	
Pore water sampling locations	8	ea	--	--	Assume pore water sample collected from sediment sample location.
Surface water sampling locations	0	ea	--	--	Background/reference locations.
Total samples	16	ea	--	--	
Labor – determine pore water sampling locations					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	10.5	hr	$ 115	$ 1,208	
Subtotal				$ 1,508	
Labor – sediment, pore water, surface water sampling					Includes sediment core collection.
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	11.5	hr	$ 115	$ 1,323	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,718	
Labor – sediment trap processing					Assume trap deployment/collection included in labor hours above.
Sr. project	1	hr	$ 150	$ 150	
Sr. staff	6	hr	$ 115	$ 690	
Subtotal				$ 840	
Sediment sampling contractor	2	day	$ 2,000	$ 4,000	Water craft with crew for in-water sampling work.
Equipment/supplies	2	ea	$ 250	$ 500	
Travel	2	day	$ 85	$ 170	Truck rental.
Sample shipping	1	LS	$ 500	$ 500	
Subtotal				$ 5,170	
Laboratory analysis (sediment, pore water, surface water)					Assume standard turnaround time.
Sample preparation (water)	8	ea	$ 50	$ 400	Remove suspended solids/colloids. Lab quote 9/21/15.
PCBs - EPA 1668 (water)	8	ea	$ 800	$ 6,400	PCB congener analysis. Lab quote 9/21/15.
PCBs - EPA 8082 (water)	10	ea	$ 120	$ 1,200	
PCBs - EPA 1668 (sediment)	8	ea	$ 825	$ 6,600	PCB congener analysis. Lab quote 9/21/15.
PCBs - EPA 8082 (sediment)	8	ea	$ 120	$ 960	
Sediment TOC	8	ea	$ 55	$ 440	EPA 9060A.
Sediment black carbon (soot)	8	ea	$ 150	$ 1,200	Lab estimate 9/21/15.
Sediment core radiochemical dating	1	ea	$ 2,500	$ 2,500	
Lab reporting fee	16	ea	$ 50	$ 800	Data package & EIM EDD. Lab quote 9/21/15.
Subtotal				$ 20,500	
Total				$29,735	
Additional Site Characterization – Interpretation and Reporting – Alternative 5					
Labor					
Principal	6	hr	$ 220	$ 1,320	
Sr. associate	8	hr	$ 192	$ 1,536	
Sr. project	32	hr	$ 150	$ 4,800	
Sr. staff	32	hr	$ 115	$ 3,680	
Staff	12	hr	$ 95	$ 1,140	
Drafter	8	hr	$ 98	$ 784	
Project assistant	8	hr	$ 78	$ 624	
Total				$ 13,884	
Institutional Controls – Capital Costs					
Prepare institutional control plan					Assume HC rates.
Principal	2	hr	$ 220	$ 440	
Sr. project	8	hr	$ 150	$ 1,200	
Sr. staff	16	hr	$ 115	$ 1,840	
Staff	8	hr	$ 95	$ 760	
Drafter	4	hr	$ 98	$ 392	
Project assistant	2	hr	$ 78	$ 156	
Total				$ 4,788	
Institutional Controls – Annual Costs					
Site information database - annual update and maintenance					Assume HC rates.
Principal	1	hr	$ 220	$ 220	
Sr. project	4	hr	$ 150	$ 600	
Sr. staff	16	hr	$ 115	$ 1,840	
Staff	8	hr	$ 95	$ 760	
Project assistant	4	hr	$ 78	$ 312	
Total				$ 3,732	
Institutional Controls – Periodic Costs					

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
Restrictive covenant periodic update and maintenance					Assume HC rates. Includes attorney fees.
Attorney fees	8	hr	$ 309	$ 2,472	RACER 2013.
Paralegal fees	4	hr	$ 63	$ 254	RACER 2013.
Principal	2	hr	$ 220	$ 440	
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	8	hr	$ 115	$ 920	
Staff	4	hr	$ 95	$ 380	
Project assistant	2	hr	$ 78	$ 156	
Total				$ 4,922	
Compliance Monitoring – Groundwater Sampling and Analysis – Alternative 1					
Well quantity					
Existing	5	ea	--	--	
New	5	ea	--	--	
Total	10	ea	--	--	
Labor per monitoring event					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	13.5	hr	$ 115	$ 1,553	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,948	
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	1.5	day	$ 85	$ 128	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 478	
Total				$ 2,425	
Laboratory analysis (groundwater)					Assume standard turnaround time.
PCBs	10	ea	$ 90	$ 900	EPA 8082A.
TPH-D	10	ea	$ 75	$ 750	NWTPH-Dx.
Metals (As)	10	ea	$ 20	$ 200	EPA 6020A/200.8.
VOCs	10	ea	$ 170	$ 1,700	EPA 8260C.
Total				$ 3,550	
Compliance Monitoring – Groundwater Sampling and Analysis – Alternative 2					
Well quantity					
Existing	4	ea	--	--	
New	2	ea	--	--	
Total	6	ea	--	--	
Labor per monitoring event					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	9.5	hr	$ 115	$ 1,093	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,488	
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	1	day	$ 85	$ 85	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 435	
Total				$ 1,923	
Laboratory analysis (groundwater)					Assume standard turnaround time.
PCBs	6	ea	$ 90	$ 540	EPA 8082A.
TPH-D	6	ea	$ 75	$ 450	NWTPH-Dx.
Metals (As)	6	ea	$ 20	$ 120	EPA 6020A/200.8.
VOCs	6	ea	$ 170	$ 1,020	EPA 8260C.
Total				$ 2,130	
Compliance Monitoring – Groundwater Sampling and Analysis – Alternative 3					
Well quantity					
Existing	0	ea	--	--	
New	4	ea	--	--	
Total	4	ea	--	--	
Labor per monitoring event					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	7.5	hr	$ 115	$ 863	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,258	

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	1	day	$ 85	$ 85	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 435	
Total				$ 1,693	
Laboratory analysis (groundwater)					Assume standard turnaround time.
PCBs	4	ea	$ 90	$ 360	EPA 8082A.
TPH-D	4	ea	$ 75	$ 300	NWTPH-Dx.
Metals (As)	4	ea	$ 20	$ 80	EPA 6020A/200.8.
VOCs	4	ea	$ 170	$ 680	EPA 8260C.
Total				$ 1,420	
Compliance Monitoring – Groundwater Sampling and Analysis – Alternative 4					
Well quantity					
Existing	0	ea	--	--	
New	5	ea	--	--	
Total	5	ea	--	--	
Labor per monitoring event					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	8.5	hr	$ 115	$ 978	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,373	
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	1	day	$ 85	$ 85	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 435	
Total				$ 1,808	
Laboratory analysis (groundwater)					Assume standard turnaround time.
PCBs	5	ea	$ 90	$ 450	EPA 8082A.
TPH-D	5	ea	$ 75	$ 375	NWTPH-Dx.
Metals (As)	5	ea	$ 20	$ 100	EPA 6020A/200.8.
VOCs	5	ea	$ 170	$ 850	EPA 8260C.
Total				$ 1,775	
Compliance Monitoring – Reporting					
Labor per monitoring event					
Principal	4	hr	$ 220	$ 880	
Sr. project	8	hr	$ 150	$ 1,200	
Sr. staff	12	hr	$ 115	$ 1,380	
Staff	12	hr	$ 95	$ 1,140	
Drafter	4	hr	$ 98	$ 392	
Project assistant	2	hr	$ 78	$ 156	
Total				$ 5,148	
Alternatives 2 and 5 – Hotspot Excavation Parameters					
Area #1					
Footprint area	1,894	SF	--	--	
Depth	10	ft	--	--	
Volume	701	CY	--	--	
Perimeter	175	ft	--	--	
Area #2					
Footprint area	724	SF	--	--	
Depth	8	ft	--	--	
Volume	215	CY	--	--	
Perimeter	112	ft	--	--	
Area #3					
Footprint area	1,150	SF	--	--	
Depth	18	ft	--	--	
Volume	767	CY	--	--	
Perimeter	136	ft	--	--	
Area #4					
Footprint area	1,000	SF	--	--	
Depth	8	ft	--	--	
Volume	296	CY	--	--	
Perimeter	140	ft	--	--	
Total volume	1,979	CY	--	--	
Bulk density	1.5	ton/CY	--	--	
Total mass	2,968	ton	--	--	

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
Alternatives 2 and 5 – Excavation Performance Monitoring					
Performance soil sample collection density					
Wall samples	50	ft	--	--	Collect sample per length of wall (minimum one sample per wall).
Floor samples	500	SF	--	--	Collect sample per square footage of floor.
Sample quantity					
Area #1					
Wall samples	4	ea	--	--	
Floor samples	4	ea	--	--	
Total	8	ea	--	--	
Area #2					
Wall samples	4	ea	--	--	
Floor samples	2	ea	--	--	
Total	6	ea	--	--	
Area #3					
Wall samples	4	ea	--	--	
Floor samples	3	ea	--	--	
Total	7	ea	--	--	
Area #4					
Wall samples	4	ea	--	--	
Floor samples	2	ea	--	--	
Total	6	ea	--	--	
Labor per monitoring event					
Sr. project	4	hr	$ 150	$ 600	
Sr. staff	11	hr	$ 115	$ 1,294	
Staff	2	hr	$ 95	$ 190	
Subtotal				$ 2,084	
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	2	day	$ 85	$ 170	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 520	
Laboratory analysis (soil)					Assume standard turnaround time.
Area #1					
PCBs	8	ea	$ 90	$ 720	EPA 8082A.
Metals (As, Cd, Hg, Pb)	8	ea	$ 80	$ 640	EPA 6020A/200.8.
Subtotal				$ 1,360	
Area #2					
PCBs	6	ea	$ 90	$ 540	EPA 8082A.
TPH-D	6	ea	$ 75	$ 450	NWTPH-Dx.
Subtotal				$ 990	
Area #3					
PCBs	7	ea	$ 90	$ 630	EPA 8082A.
Subtotal				$ 630	
Area #4					
PCBs	6	ea	$ 90	$ 540	EPA 8082A.
Subtotal				$ 540	
Total				$ 6,124	
Alternatives 3 and 5 – Permeable Reactive Barrier					
PRB dimensions					PRB design parameters based on those of existing walls at site.
Lenth	476	ft	--	--	
Minimum width	2	ft	--	--	
Total depth	18	ft	--	--	
Treatment depth	14	ft	--	--	
PRB composition (treatment section)					
Zero-valent iron (ZVI)	33%	--	--	--	
Granular activated carbon (GAC)	30%	--	--	--	
Sand	37%	--	--	--	

Table D-7 – Cost Estimate Backup Calculations

Description	Qty.	Unit	Unit Cost	Total Cost	Notes and Assumptions
Earthwork calculations					
Trench width	2.2	ft	--	--	
Trench depth	18	ft	--	--	
Trench footprint area	1,047	SF	--	--	
Trench volume	698	CY	--	--	
Bulk density	1.5	ton/CY	--	--	
Total excavated mass	1,047	ton	--	--	
Treatment volume	543	CY	--	--	
Volume ZVI	179	CY	--	--	
Volume GAC	209	CY	--	--	
Volume sand	258	CY	--	--	
Volume fill	51	CY	--	--	Fill placed between treatment media and ground surface.
Alternatives 3 and 5 – Performance Monitoring – Groundwater Sampling and Analysis					
Well quantity	10	ea	--	--	
Labor per monitoring event					
Sr. project	2	hr	$ 150	$ 300	
Sr. staff	13.5	hr	$ 115	$ 1,553	
Staff	1	hr	$ 95	$ 95	
Subtotal				$ 1,948	
Equipment/supplies	1	LS	$ 250	$ 250	Based on similar project experience.
Travel	1.5	day	$ 85	$ 128	Truck rental.
Sample shipping	1	LS	$ 100	$ 100	Courier samples to lab.
Subtotal				$ 478	
Total				$ 2,425	
Laboratory analysis (groundwater)					Assume standard turnaround time.
PCBs	10	ea	$ 90	$ 900	EPA 8082A.
TPH-D	10	ea	$ 75	$ 750	NWTPH-Dx.
Metals (As)	10	ea	$ 20	$ 200	EPA 6020A/200.8.
VOCs	10	ea	$ 170	$ 1,700	EPA 8260C.
Total				$ 3,550	
Alternative 4 – Excavation Parameters					
Footprint area	57,387	SF	--	--	
Average depth	12	ft	--	--	
Total volume	25,505	CY	--	--	
Bulk density	1.5	ton/CY	--	--	
Total mass	38,258	ton	--	--	
Total perimeter	2,376	ft	--	--	For determining performance sample quantity.
Shored perimeter	1,662	ft	--	--	
Alternative 4 – Excavation Performance Monitoring					
Performance soil sample collection density					
Wall samples	50	ft	--	--	Collect sample per length of wall (minimum one sample per wall).
Floor samples	1,000	SF	--	--	Collect sample per square footage of floor.
Sample quantity					
Wall samples	48	ea	--	--	
Floor samples	58	ea	--	--	
Total	106	ea	--	--	
Labor per monitoring event					
Sr. project	8	hr	$ 150	$ 1,200	
Sr. staff	31	hr	$ 115	$ 3,565	
Staff	4	hr	$ 95	$ 380	
Subtotal				$ 5,145	
Equipment/supplies	1	LS	$ 500	$ 500	Based on similar project experience.
Travel	4	day	$ 85	$ 340	Truck rental.
Sample shipping	1	LS	$ 200	$ 200	Courier samples to lab.
Subtotal				$ 1,040	
Laboratory analysis (soil)					Assume standard turnaround time.
Area #1					
PCBs	106	ea	$ 90	$ 9,540	EPA 8082A.
TPH-D	106	ea	$ 75	$ 7,950	NWTPH-Dx.
Metals (As, Cd, Hg, Pb)	106	ea	$ 80	$ 8,480	EPA 6020A/200.8.
Subtotal				$ 25,970	
Total				$ 32,155	