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Transmittal

To: Mr. Nick Acklam (VCP Unit Supervisor)
Washington State Department of Ecology
SWRO Toxics Cleanup Program
PO Box 47775
Olympia, Washington 98504

Date: February 9, 2017

Project No.: 240581

Project: **Annual 2016 Groundwater Monitoring Report** - Former Cummings Oil Lease Site, Winlock, Washington

We have enclosed 2 copy(s) of:

☐ B/W Prints ☐ Reproducible ☐ CD ☒ Report
☐ Specifications ☐ Memorandum ☐ Check

Description	Rev. #	Date

Mr. Acklam,

Enclosed please find two hard copies of the *Annual 2016 Groundwater Monitoring Report*, dated February 9, 2017 for the BNSF Former Cummings Oil Lease Site located in Winlock, Washington (VCP No. SW0775).

Please let me know if you have any questions regarding this submittal.

Regards, Keith

Sent Via:

☐ Messenger ☒ 1st Class Mail ☐ FedEx ☐ Cal Overnight

CC: Scott MacDonald, BNSF (email only)

Very truly yours,
TRC

Keith Woodburne, L.G.
Senior Project Manager

TRC
Results you can rely on

ANNUAL 2016 GROUNDWATER MONITORING STATUS REPORT

Former Cummings Oil Lease Site
Winlock, Washington
VCP No. SW0775

Prepared for:

BNSF Railway Company
605 Puyallup Avenue South
Tacoma, Washington 98421

Prepared by:

TRC

February 2017

ANNUAL 2016 GROUNDWATER MONITORING STATUS REPORT

February 9, 2017

Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington
VCP No. SW0775

TRC Project No. 240581

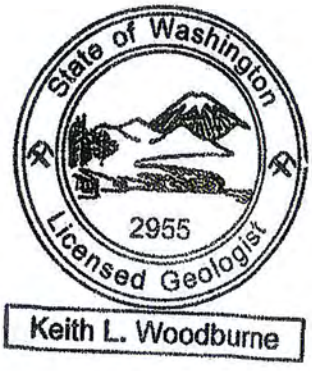
Prepared For:

BNSF Railway Company
605 Puyallup Avenue South
Tacoma, Washington 98421

By:

Amanda Meugniot
Senior Staff Geologist

Keith Woodburne L.G.
Senior Project Manager



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1.0 INTRODUCTION

On behalf of the BNSF Railway Company (BNSF), TRC presents this *Annual 2016 Groundwater Monitoring Status Report.* This report summarizes the groundwater monitoring activities conducted at the Former Cummings Oil Lease (Site) in Winlock, Washington (Figure 1) on December 23, 2015, March 28, 2016, and August 18, 2016.

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

The Site is located at 908 Northwest Kerron Avenue in Winlock, Lewis County, Washington (Figure 1). The Site was used as a bulk fuel storage plant from approximately 1925 through 1976. Shell Oil Company leased the Site from BNSF for use as a bulk fuel storage facility when the Site was developed in 1925. Cummings Oil Company served as operators of the bulk fuel storage facility from 1970 until approximately 1976. All buildings and other features have been removed and the Site is currently undeveloped and unoccupied (Figure 2).

The previous remedial activities at the Site were performed under the Voluntary Cleanup Program (VCP) in accordance with the Model Toxics Control Act (MTCA), as established in Chapter 173-340 of the Washington Administrative Code, and the *Cleanup Action Work Plan, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington* dated December 18, 2008, (Farallon, 2008). The Site entered into the VCP in 2006 and was assigned VCP Identification No. SW0775 under Washington State Department of Ecology's (Ecology) Toxics Cleanup Program.

2.2 PREVIOUS INVESTIGATIONS

Previous site investigations and remedial actions, including tank removal and soil excavation, confirmed that concentrations of the following Site-related contaminants were released to the subsurface as a result of historical activities at the Site:

- Total petroleum hydrocarbons as gasoline-range organics (GRO);
    - *GRO was detected consistently in one Site monitoring well (MW-2), however, concentrations were always below MTCA Method A cleanup levels. Analyses for GRO were discontinued in 2014*.
- Total petroleum hydrocarbons as diesel-range organics (DRO);
- Total petroleum hydrocarbons as oil-range organics (ORO); and
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX).
    - *Benzene is the only BTEX constituent that has been detected above MTCA Method A cleanup levels*.

A *Cleanup Action Work Plan* was approved in 2008 (Farallon, 2008) that outlined the selected remedial approach and specified the standards and associated requirements for the remedial activities. The selected remedial activities for the Site were implemented by Farallon in conjunction with tank closure activities conducted at the Site between March 10 and August 1, 2008.

The tank closure and remedial activities included removal of two underground storage tanks (USTs) and four aboveground storage tanks (ASTs), excavation and off-site disposal of soil containing petroleum hydrocarbon constituents at concentrations exceeding MTCA cleanup levels, and installation of monitoring wells to delineate the extent of Site-related contaminants in the groundwater and to monitor natural attenuation processes (Figure 2). A summary of the tank closure and remedial actions are included the *Tank Closure Report, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington* (Farallon, 2010). The result of Farallon's initial natural attenuation assessment was that the groundwater chemistry is favorable for natural attenuation.

On December 27, 2010, Farallon conducted an additional assessment of the potential for natural attenuation to reduce residual concentrations of Site-related contaminants in the groundwater (Farallon, 2011). The additional geochemical indicators that were analyzed for during the groundwater monitoring event were evaluated against the criteria established in Ecology's *Guidance on Remediation of Petroleum Contaminated Groundwater by Natural Attenuation* (Ecology, 2005). The result of Farallon's assessment was that natural attenuation is occurring. Additionally, Farallon evaluated concentration trends using the Mann-Kendall statistical test, a log-linear regression analysis, to develop an estimated timeline for the decrease of Site-related contaminant concentrations to below MTCA Method A cleanup levels, Based on the statistical analysis, Farallon determined that DRO, ORO, and benzene concentrations were stable or decreasing, and projected with an 85 percent confidence interval that DRO concentrations will be below MTCA Method A cleanup levels by March 2013. ORO and benzene projections were not evaluated, as more data was required to support regression analysis.

Continued groundwater monitoring activities were performed annually after 2010 as part of an ongoing assessment of natural attenuation of Site-related contaminants. Site-related contaminant concentrations continued to fluctuate and did not attenuate as rapidly as predicted in the assessment. On August 1, 2013, past the projected date of MTCA Method A cleanup level compliance, DRO and/or ORO were detected at concentrations exceeding the cleanup levels in groundwater samples collected from monitoring wells MW-2 and MW-3. Additionally, benzene was detected at concentrations exceeding MTCA Method A cleanup levels in groundwater samples collected from monitoring well MW-2 on August 1, 2013.

On August 12, 2013, Ecology issued an *Opinion on Proposed Cleanup of the BNSF – Winlock Site, 908 Northwest Kerron Avenue, Winlock, Washington*, stating that further remedial action would be necessary to clean up contamination at the Site. Ecology concluded that there was inadequate Site characterization to support selection of monitored natural attenuation as the cleanup alternative or to meet the full requirements of a cleanup action under MTCA.

In August 2014, a supplemental subsurface investigation was performed in response to Ecology's Opinion letter, in addition to the routine annual groundwater monitoring event (Farallon, 2014).

The purpose of the subsurface investigation was to further delineate the western extent of the plume, evaluate potential for natural attenuation, and evaluate the potential for preferential pathways to transport Site-related contaminants via groundwater flow diversion through sanitary sewer conveyance line or the stormwater conveyance line backfill materials. The conclusions of the supplemental subsurface investigation and annual groundwater monitoring event were as follows:

- No preferential pathways were directing groundwater to the south away from Site monitoring wells,
- Natural attenuation is still occurring, and
- Site-related contaminants were not being transported west of Northwest Kerron Avenue.

Annual groundwater monitoring for DRO, ORO, and BTEX has been conducted at the Site from 2010 through 2015 to assess the progress of natural attenuation of Site-related contaminants and to estimate a restoration time frame for monitoring well locations at the Site. The sampling locations include monitoring wells MW-1 through MW-7. Based on cumulative historical analytical groundwater data, BNSF discontinued analysis of monitoring well MW-4 for Site-related contaminants after 2014 due to the consistent absence of those contaminants in groundwater.

Beginning in the third quarter of 2015, and based on results from the August 2015 annual monitoring event, BNSF temporarily increased the sampling frequency to quarterly monitoring to document achieved reductions in Site-related contaminant concentrations and evaluate if the concentrations of those Site-related contaminants remained below MTCA Method A cleanup levels during seasonal variations in groundwater elevation.

3.0 GROUNDWATER MONITORING

Groundwater monitoring activities covered in this Annual report include monitoring events conducted on December 23, 2015 (by Farallon), on March 28, 2016 (by Farallon), and on August 18, 2016 (by TRC). Groundwater sampling was conducted in accordance with either Farallon or TRC Standard Operating Procedures (SOP). A copy of TRC's Groundwater Monitoring SOP is included in Appendix A.

3.1 GROUNDWATER ELEVATIONS

Depth to water and total well depth were measured in each of the wells using an oil/water interface probe accurate to 0.01 feet. At a minimum of 15 minutes prior to measuring and recording depth to water, monitoring wells MW-1 through MW-7 were opened to allow the water levels to reach atmospheric pressure. For consistency, the measurement reference point for each well is the northern edge of each well casing. Additionally, prior to measurement at each well, the interface probe was cleaned with non-phosphate soap and rinsed in deionized water. The field notes from the three events are included in Appendix B and the groundwater measurements and calculated groundwater elevations for each well are summarized in Table 1.

Groundwater elevations have been relatively consistent from the beginning of the investigations in 2005 to the most current monitoring event in August 2016. Based on groundwater elevations recorded during the December 2015, March 2016, and August 2016 monitoring events, the groundwater flow direction is generally to the west-southwest (Figures 3, 4 and 5).

The groundwater flow direction trends are consistent with previous monitoring results. The groundwater gradient across the Site is approximately 0.05.

3.2 GROUNDWATER SAMPLING ACTIVITIES

During each of the three (3) monitoring events, samples were collected from six (6) of the seven (7) Site monitoring wells using low flow sampling techniques in accordance with either the Farallon or TRC SOP. Site wells were purged using a peristaltic pump and dedicated polyethylene tubing, at flow rates between 100 and 150 milliliters per minute. During the purging process, temperature, pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), and turbidity were measured and recorded using a water quality meter equipped with a flow-through cell. A Horiba U-50 water quality meter was used for the December 2015 and March 2016 events and a YSI DSS Pro water quality meter was used for the August 2016 event. Once water quality parameters stabilized in accordance with EPA guidelines for low flow sampling, final water quality parameters were recorded and samples were collected. Groundwater monitoring field data sheets for the three sampling events are included in Appendix B.

The groundwater samples were sealed, labeled, and transported in a cooler on ice to TestAmerica of Tacoma, Washington for analysis of the following Site-related contaminants;

- DRO and ORO by Northwest Method NWTPH-Dx, with silica gel cleanup, and
- BTEX by EPA Method 8260B (only benzene was reported during the March 2016 monitoring event)

Copies of the laboratory analytical reports and chain-of-custody documentation are provided in Appendix C and results are summarized in Table 2 and Figure 6.

3.3 GROUNDWATER MONITORING RESULTS

3.1.1 December 2015 Analytical Results

DRO concentrations in groundwater samples collected from Site monitoring wells during the December 2015 monitoring event ranged from below laboratory reporting limits (< 110 micrograms per liter [µg/L]) to a maximum of 290 µg/L in monitoring well MW-6 (Table 2, Figure 6).

All DRO detections were below the MTCA Method A cleanup level of 500 µg/L.
ORO was not detected at or above laboratory reporting limits from samples collected during the December 2015 monitoring event.

BTEX compounds were not detected at or above their respective laboratory reporting limits in groundwater samples from Site monitoring wells during the December 2015 monitoring event, with the exception of one benzene detection of 5.9 µg/L in monitoring well MW-2, which exceeded the MTCA Method A cleanup level of 5.0 µg/L.

3.1.2 March 2016 Analytical Results

DRO concentrations in groundwater samples collected during the March 2016 monitoring event ranged from below laboratory reporting limits (< 110 µg/L) to a maximum of 980 µg/L in monitoring well MW-6 (Table 2, Figure 6). The DRO concentration in monitoring well MW-2 increased to 900 µg/L, the maximum concentration historically reported in MW-2. The DRO concentration in monitoring well MW-3 was 500 µg/L. The remaining three wells were either not detected at or above laboratory reporting limits or below the MTCA Method A cleanup level of 500 µg/L.

ORO concentrations in groundwater samples collected ranged from below laboratory reporting limits (< 250 µg/L) to a maximum of 470 µg/L in monitoring well MW-6 (Table 2, Figure 6). ORO concentrations from all samples collected were below the MTCA Method A cleanup level of 500 µg/L.

Benzene was the only BTEX compound reported in samples collected during the March 2016 event. Benzene was detected at concentrations of 13 µg/L in MW-2 and 17 µg/L in MW-6, which both exceeded the MTCA Method A cleanup level. Benzene was not reported at concentrations at or above the laboratory reporting limit (< 2.0 µg/L) in wells MW-1, MW-3, MW-5, and MW-7.

3.1.3 August 2016 Analytical Results

DRO concentrations in groundwater samples collected during the monitoring event ranged from below laboratory reporting limits (<110 µg/L) to a maximum of 650 µg/L in monitoring well MW-2 (Table 2, Figure 6). DRO concentrations of samples collected from monitoring wells MW-3 and MW-6 (580 µg/L and 640 µg/L, respectively) also exceeded the MTCA Method A cleanup level (of 500 µg/L)..

ORO concentrations in groundwater samples collected during the monitoring event ranged from below laboratory reporting limits (< 250 µg/L) to a maximum of 400 µg/L in monitoring well MW-3 (Table 2, Figure 6). ORO concentrations from all samples collected were below MTCA Method A cleanup level of 500 µg/L.

BTEX was not detected at or above laboratory reporting limits in any of the groundwater samples from Site monitoring wells during the monitoring event with exception of toluene and xylene detections in monitoring well MW-2 (Table 2, Figure 6). However, these detections appear to be a potential laboratory error, as a duplicate sample submitted showed no detections at standard reporting limits, while the original sample with minor detections had elevated reporting limits due to dilution. Both detections were significantly below MTCA Method A cleanup levels.

3.1.4 Site-Related Contaminant Concentration Trends

Trend graphs showing groundwater elevations and dissolved phase concentrations for DRO, ORO, and benzene over time for monitoring wells with historical exceedances of MTCA Method A cleanup levels are presented in Figures 7 through 12.

DRO concentrations in the wells generally exhibit an overall decreasing trend. ORO concentrations in these wells were generally stable and were all below MTCA Method A cleanup level. Other than the two peak exceedances described above, historical ORO concentrations from monitoring well MW-3 have been either not detected at or above laboratory reporting limits or below the ORO MTCA Method A cleanup level of 500 µg/L.

Of the BTEX constituents analyzed, only benzene has exceeded its corresponding MTCA A cleanup level. Benzene exceedances have been limited to monitoring wells MW-2 and MW-6. Benzene concentrations in monitoring well MW-2 exhibit a decreasing trend, with no results from the most recent sampling event at or above laboratory reporting limits. Benzene concentrations in monitoring well MW-6 have not been detected above laboratory reporting limits with exception of the March 2016 event.

3.1.5 Field Water Quality Parameters

Field parameters including DO, ORP, pH and temperature are measured during each semi-annual sampling event. Field parameter data collected from Site groundwater to date suggest that Site conditions are anaerobic, with DO concentrations in groundwater below 2.08 mg/L in all wells analyzed (Table 3). ORP values, ranging from -101.7 to 98.8 millivolt (mV) are also indicative anaerobic conditions (Table 3). Groundwater pH and temperature measurements were within a range deemed adequate for hydrocarbon-degrading microbial populations.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Semi-annual groundwater monitoring was conducted in December 2015, March 2016, and August 2016. Key conclusions based on the monitoring data are summarized below.

Concentrations of DRO, ORO, and benzene in Site groundwater are generally stable or decreasing. This conclusion is based on the following observations:

- Despite short-term fluctuations in dissolved-phase concentrations of DRO, ORO, and benzene (possibly due to increased groundwater elevations during those months), concentrations in key wells (MW-1, MW-2, MW-3, and MW-6) exhibit long-term stable and/or decreasing trends (Figures 7 through 12).
- The Ecology Statistical Tool Package Mann- Kendall trend analysis confirmed that concentrations of DRO, ORO, and benzene in impacted wells are stable and/or decreasing (Appendix D).
- Sentry monitoring well MW-5, located approximately 50 feet downgradient from the Site and wells MW-2 and MW-6 has had only two reported detections of Site-related contaminants above laboratory reporting limits since monitoring

began in 2008. Both detections were below the MTCA Method A cleanup levels.

- Benzene was not detected at or above the laboratory reporting limits in any of the groundwater samples collected during the most recent August 2016 monitoring event.
    - Benzene has historically been detected above MTCA Method A cleanup levels in only monitoring well MW-2. Since 2005, benzene concentrations in samples collected from monitoring well MW-2 have steadily decreased (Figure 11).
    - In March 2016, benzene was detected for the first time in a sample collected from monitoring well MW-6, which is located in close proximity to MW-2.
- Decreasing concentration trends and field parameter data supports the previous conclusion that petroleum hydrocarbon degradation is capable of occurring at the Site under natural and biological conditions.
- Recent minor increases in groundwater elevations appear to be positively correlated with DRO, ORO, and benzene concentrations, in MW-1, MW-2, and MW-3.

Based on the historical water quality data presented in this report and the results of Farallon's natural attenuation assessments (Farallon, 2010 and 2011), TRC concludes that biodegradation of Site-related contaminants is capable of occurring under natural conditions present at the Site. To further evaluate and confirm natural attenuation is occurring, subsequent groundwater monitoring events will include sampling and analysis of the following natural attenuation parameters:

- Iron and Manganese by EPA Method 6010B
- Ferrous Iron by EPA Method SM 3500
- Nitrate/Nitrite/Sulfate by EPA Method 300.0 / SW 9056
- Sulfide by EPA Method 376.2 / SW 9035
- Methane by Method RSK 175
- Alkalinity by EPA Method 310.1

During the December 2015 and March 2016 monitoring events, DRO and benzene concentrations increased in wells MW-2 and MW-6, with reported concentrations above MTCA Method A cleanup levels. Based on the groundwater monitoring results from these two events, conducted off-season from the traditional annual monitoring event in August, a semi-annual groundwater monitoring schedule is appropriate for further evaluation of Site-related contaminants in groundwater, with sampling events conducted during the third and first quarters, and an annual report issued following completion of the third quarter (second semi-annual) monitoring event.

If concentrations of DRO, ORO, and benzene are reported below the MTCA Method A cleanup levels for two consecutive semi-annual groundwater monitoring events, a No Further Action determination will be requested from Ecology for the Site.

5.0 REFERENCES

Farallon, 2008, *Cleanup Action Work Plan, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington.* December 18.

Farallon, 2010, *Tank Closure Report, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington.* March 11.

Farallon, 2011, *Groundwater Monitoring Status Report, December 2010, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington.* May 4.

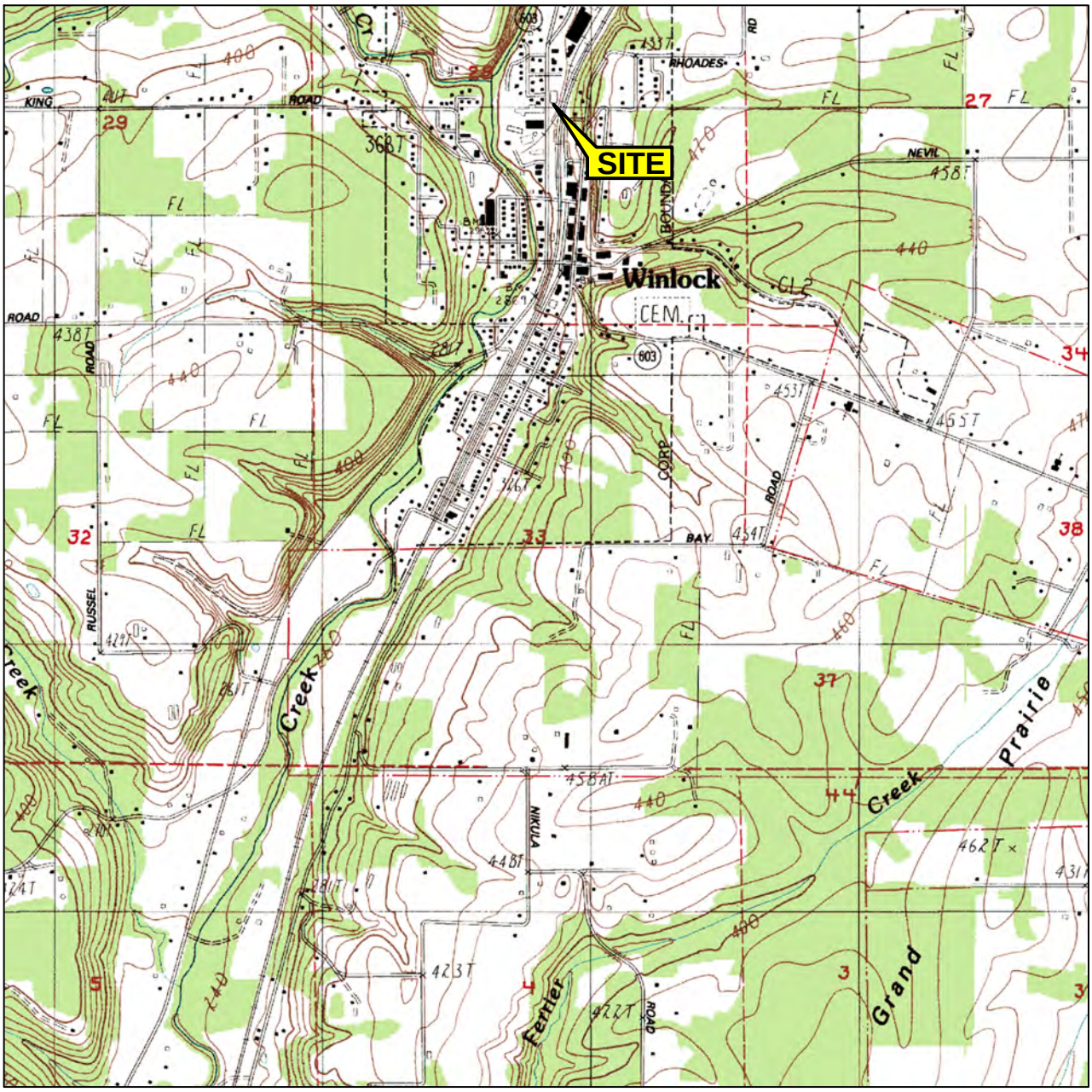
Farallon, 2014, *Supplemental Subsurface Investigation Work Plan, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington.* June 26.

Farallon, 2015, *2014 Annual Groundwater Monitoring and Supplemental Subsurface Investigation Report, Former Cummings Oil Lease Site, 908 Northwest Kerron Avenue, Winlock, Washington.* January 19.

Washington State Department of Ecology, 2005. *Guidance on Remediation of Petroleum-Contaminated Groundwater by Natural Attenuation, Version 1.0.* Publication No. 05-09-091. July.

Washington State Department of Ecology, 2013. Letter Regarding Opinion on Proposed Cleanup of the BNSF – Winlock Site, 908 Northwest Kerron Avenue, Winlock, Washington. From Thomas Middleton. To Stacy D. Patterson, Farallon Consulting, L.L.C. August 12.

FIGURES



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United States Geological Survey
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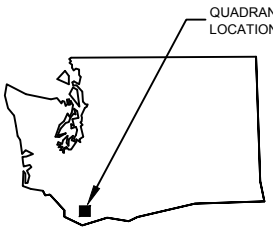
Winlock Quadrangles, Washington



VICINITY MAP

Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC | 240581 | **FIGURE 1**

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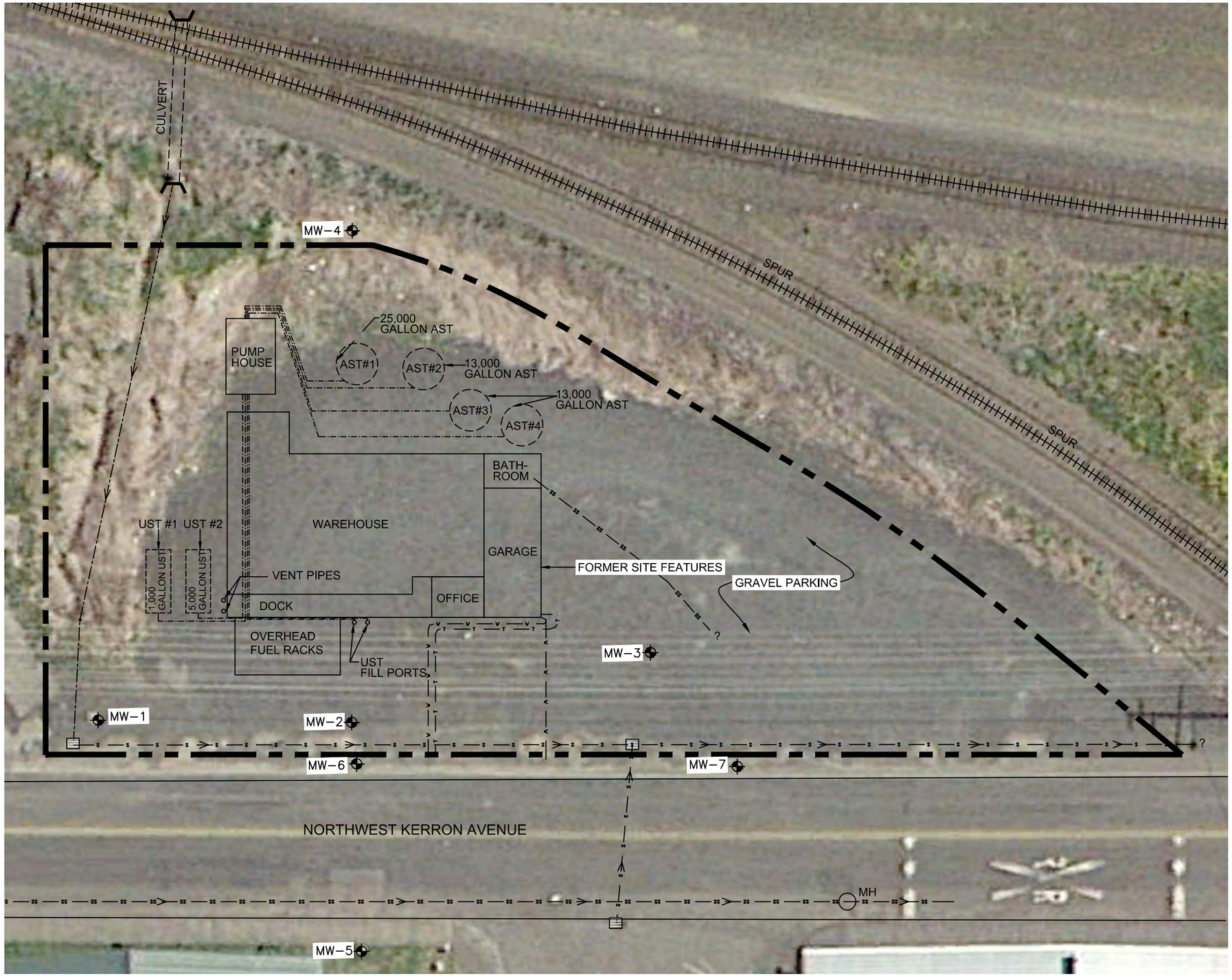

LEGEND

- PROPERTY BOUNDARY
- RAILROAD TRACKS
- STORM LINE
- SANITARY SEWER
- FORMER LOCATION OF WATER LINE
- FORMER LOCATION OF TELEPHONE LINE
- FORMER LOCATION OF APPROXIMATE LOCATION OF ABOVE GROUND PIPING AT SITE
- DITCH AND DIRECTION OF FLOW
- MW–3 MONITORING WELL
- 1,000 GALLON UST FORMER UNDERGROUND STORAGE TANK LOCATIONS
- AST#1 FORMER LOCATION OF ABOVEGROUND STORAGE TANK
- CATCH BASIN

SOURCE:
Aerial base map provided by Google Earth Professional, dated 7/5/2012. Base map provided by Farallon Consulting, 12/10/2015. Survey provided by Bluhm & Associates Land Surveyors Inc., 8/14/2014.

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SITE PLAN

Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC 240581 **FIGURE 2**

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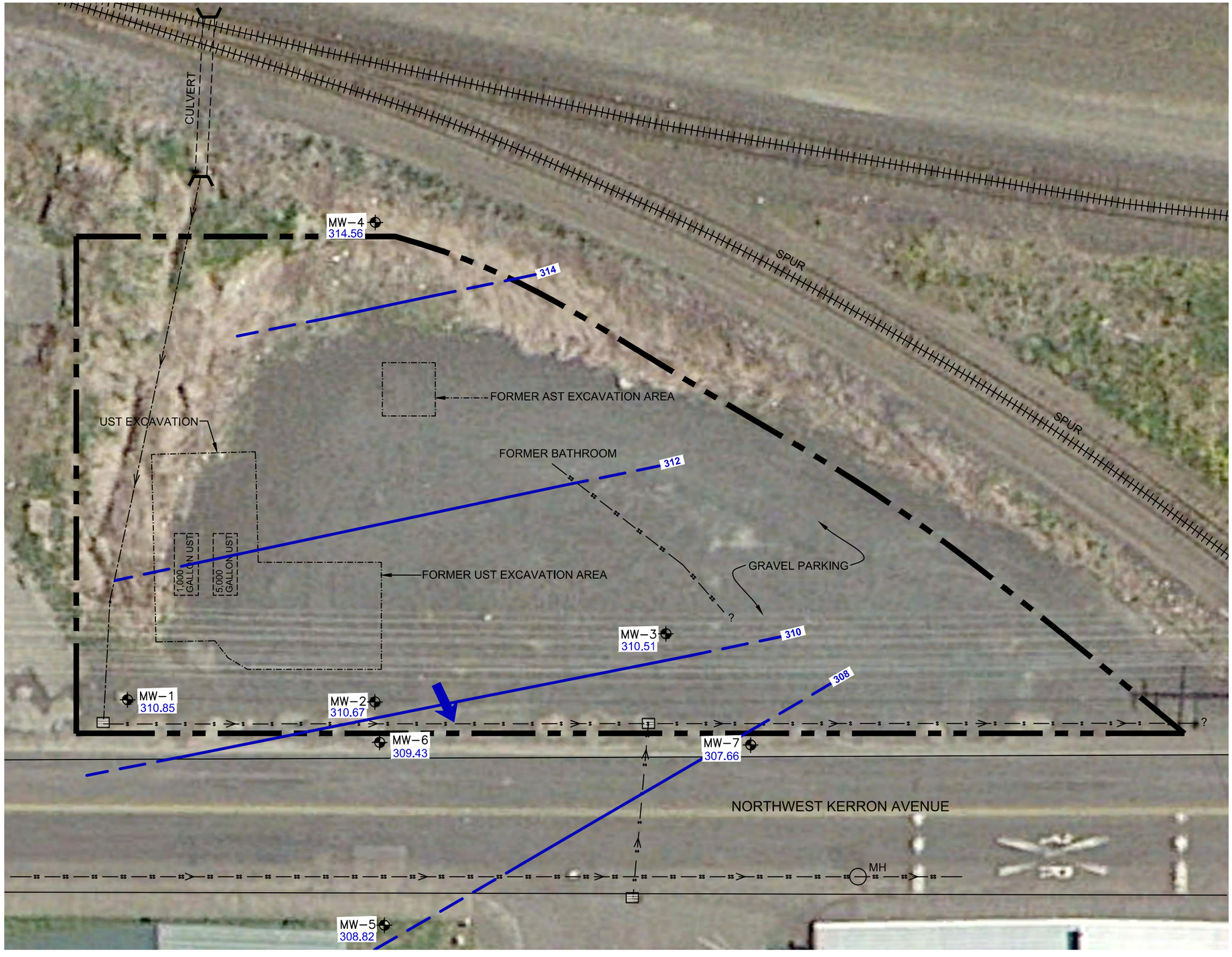

LEGEND

- PROPERTY BOUNDARY
- RAILROAD TRACKS
- DRAINAGE DITCH AND DIRECTION OF FLOW
- STORM SEWER LINE AND DIRECTION OF FLOW
- SANITARY SEWER AND DIRECTION OF FLOW
- MH — MANHOLE
- MW–3 — MONITORING WELL (FARALLON 2006 AND 2014)
- 314.56 — GROUNDWATER ELEVATION (DECEMBER 2015)
- 314 — GROUNDWATER ELEVATION CONTOUR LINE, DASHED WHERE INFERRED
- GENERAL DIRECTION OF GROUNDWATER GRADIENT
- CATCH BASIN
- BGS — BELOW GROUND SURFACE

SOURCE:
Aerial base map provided by Google Earth Professional, dated 7/5/2012. Base map provided by Farallon Consulting, 12/10/2015. Survey provided by Bluhm & Associates Land Surveyors Inc., 8/14/2014.

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SCALE (FEET)

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GROUNDWATER ELEVATION CONTOUR MAP
December 2015
Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC 240581 **FIGURE 3**

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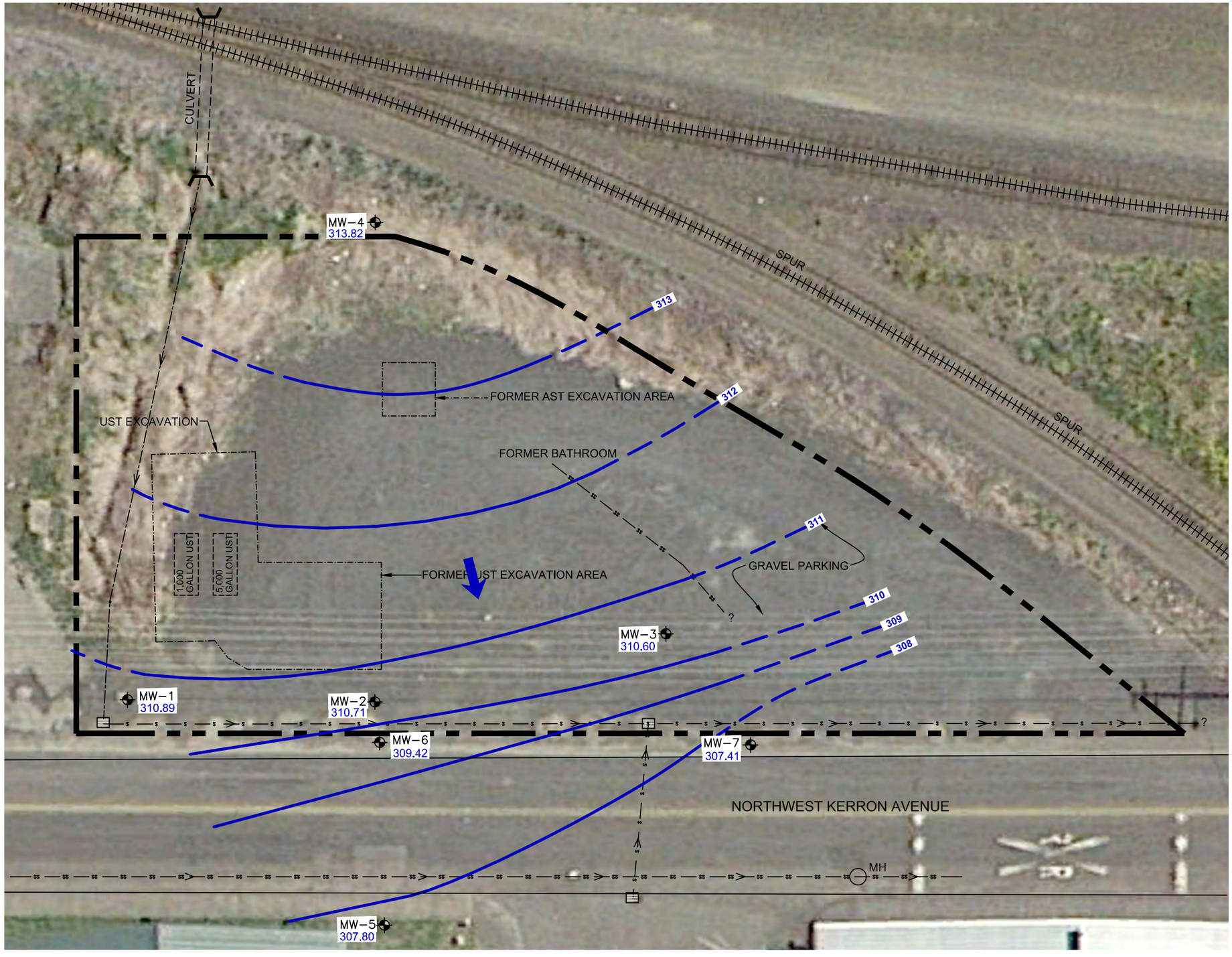

LEGEND

- PROPERTY BOUNDARY
- RAILROAD TRACKS
- DRAINAGE DITCH AND DIRECTION OF FLOW
- STORM SEWER LINE AND DIRECTION OF FLOW
- SANITARY SEWER AND DIRECTION OF FLOW
- MH — MANHOLE
- MW–3 — MONITORING WELL (FARALLON 2006 AND 2014)
- 313.82 — GROUNDWATER ELEVATION (MARCH 2016)
- 313 — GROUNDWATER ELEVATION CONTOUR LINE, DASHED WHERE INFERRED
- GENERAL DIRECTION OF GROUNDWATER GRADIENT
- CATCH BASIN
- BGS — BELOW GROUND SURFACE

SOURCE:
Aerial base map provided by Google Earth Professional, dated 7/5/2012. Base map provided by Farallon Consulting, 12/10/2015. Survey provided by Bluhm & Associates Land Surveyors Inc., 8/14/2014.

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SCALE (FEET)

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GROUNDWATER ELEVATION CONTOUR MAP
March 2016
Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC 240581 **FIGURE 4**

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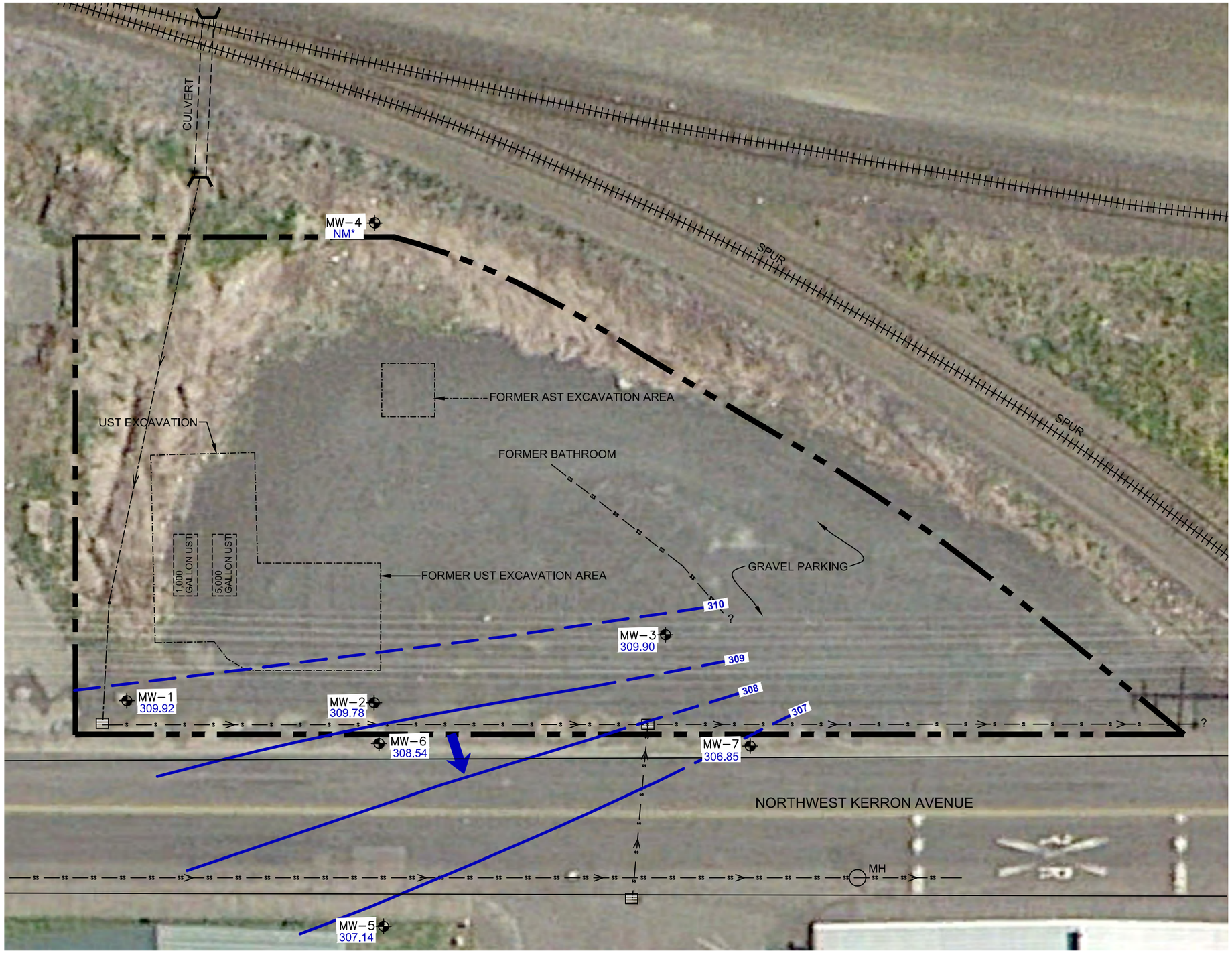

LEGEND

- PROPERTY BOUNDARY
- RAILROAD TRACKS
- DRAINAGE DITCH AND DIRECTION OF FLOW
- STORM SEWER LINE AND DIRECTION OF FLOW
- SANITARY SEWER AND DIRECTION OF FLOW
- MH — MANHOLE
- MW–3 — MONITORING WELL (FARALLON 2006 AND 2014)
- 309.90 — GROUNDWATER ELEVATION (AUGUST 2016)
- 310 — GROUNDWATER ELEVATION CONTOUR LINE, DASHED WHERE INFERRED
- GENERAL DIRECTION OF GROUNDWATER GRADIENT
- CATCH BASIN
- BGS — BELOW GROUND SURFACE

NOTES:

NM = Not measured. Monitoring well MW-4 unable to be located.*

SOURCE:
Aerial base map provided by Google Earth Professional, dated 7/5/2012. Base map provided by Farallon Consulting, 12/10/2015. Survey provided by Bluhm & Associates Land Surveyors Inc., 8/14/2014.

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SCALE (FEET)

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GROUNDWATER ELEVATION CONTOUR MAP
August 2016
Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC | 240581 | **FIGURE 5**

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MW-1						
Date	DRO	ORO	B	T	E	X
12/23/2015	260	<250	<2.0	<2.0	<3.0	<3.0
3/28/2016	380	270	<2.0	--	--	--
8/18/2016	470	370	<2.0	<2.0	<3.0	<3.0

MW-2 / MW-2 DUP						
Date	DRO	ORO	B	T	E	X
12/23/2015	220	<280	**5.9**	<2.0	<3.0	<3.0
3/28/2016	**900**	360	**13**	--	--	--
8/18/2016	**610**	310	<20	27	<30	36
8/18/2016	**650**	360	<2.0	<2.0	<3.0	<3.0

MW-3						
Date	DRO	ORO	B	T	E	X
12/23/2015	<120	<270	<2.0	<2.0	<3.0	<3.0
3/28/2016	500	340	<2.0	--	--	--
8/18/2016	**580**	400	<2.0	<2.0	<3.0	<3.0

MW-5						
Date	DRO	ORO	B	T	E	X
12/23/2015	<110	<250	<2.0	<2.0	<3.0	<3.0
3/28/2016	<110	<250	<2.0	--	--	--
8/18/2016	150	<260	<2.0	<2.0	<3.0	<3.0

MW-6						
Date	DRO	ORO	B	T	E	X
12/23/2015	290	<260	<2.0	<2.0	<3.0	<3.0
3/28/2016	**980**	470	**17**	--	--	--
8/18/2016	**640**	<250	<2.0	<2.0	<3.0	<3.0

MW-7						
Date	DRO	ORO	B	T	E	X
12/23/2015	<110	<250	<2.0	<2.0	<3.0	<3.0
3/28/2016	<110	<250	<2.0	--	--	--
8/18/2016	<110	<250	<2.0	<2.0	<3.0	<3.0

LEGEND

- PROPERTY BOUNDARY
- RAILROAD TRACKS
- DRAINAGE DITCH AND DIRECTION OF FLOW
- STORM SEWER LINE AND DIRECTION OF FLOW
- SANITARY SEWER AND DIRECTION OF FLOW
- MH — MANHOLE
- MW–3 — MONITORING WELL (FARALLON 2006 AND 2014)
- CATCH BASIN
- BGS — BELOW GROUND SURFACE

ALL RESULTS IN MICROGRAMS PER LITER (µg/L)

DRO = TOTAL PETROLEUM HYDROCARBONS (TPH) AS DIESEL-RANGE ORGANICS.

ORO = TPH AS OIL RANGE ORGANICS.

BTEX = BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES.

< = DENOTES ANALYTE NOT DETECTED AT OR EXCEEDING LABORATORY REPORTING LIMIT LISTED.

RESULTS IN **BOLD** DENOTE CONCENTRATIONS EXCEEDING APPLICABLE CLEANUP LEVELS.

NS* = NOT SAMPLED. SAMPLING MONITORING WELL MW-4 DISCONTINUED IN 2014.

SOURCE:
Aerial base map provided by Google Earth Professional, dated 7/16/2014. Base map provided by Farallon Consulting, 12/10/2015. Survey provided by Bluhm & Associates Land Surveyors Inc., 8/14/2014.

N

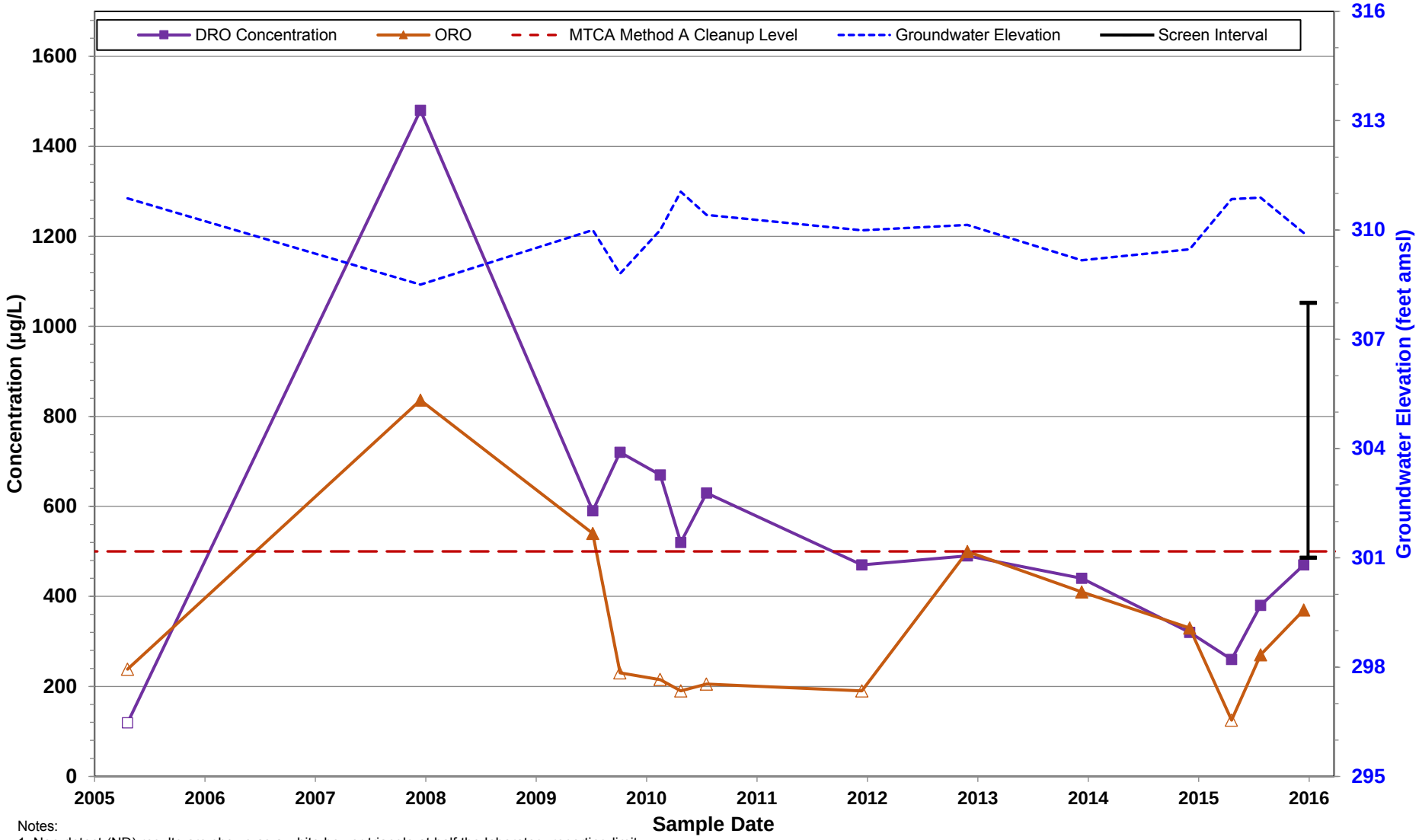
SCALE (FEET)
0 20 40

DISSOLVED-PHASE CONCENTRATIONS
December 2015, March 2016, and August 2016
Former Cummings Oil Lease Site
908 Northwest Kerron Avenue
Winlock, Washington

TRC 240581 **FIGURE 6**

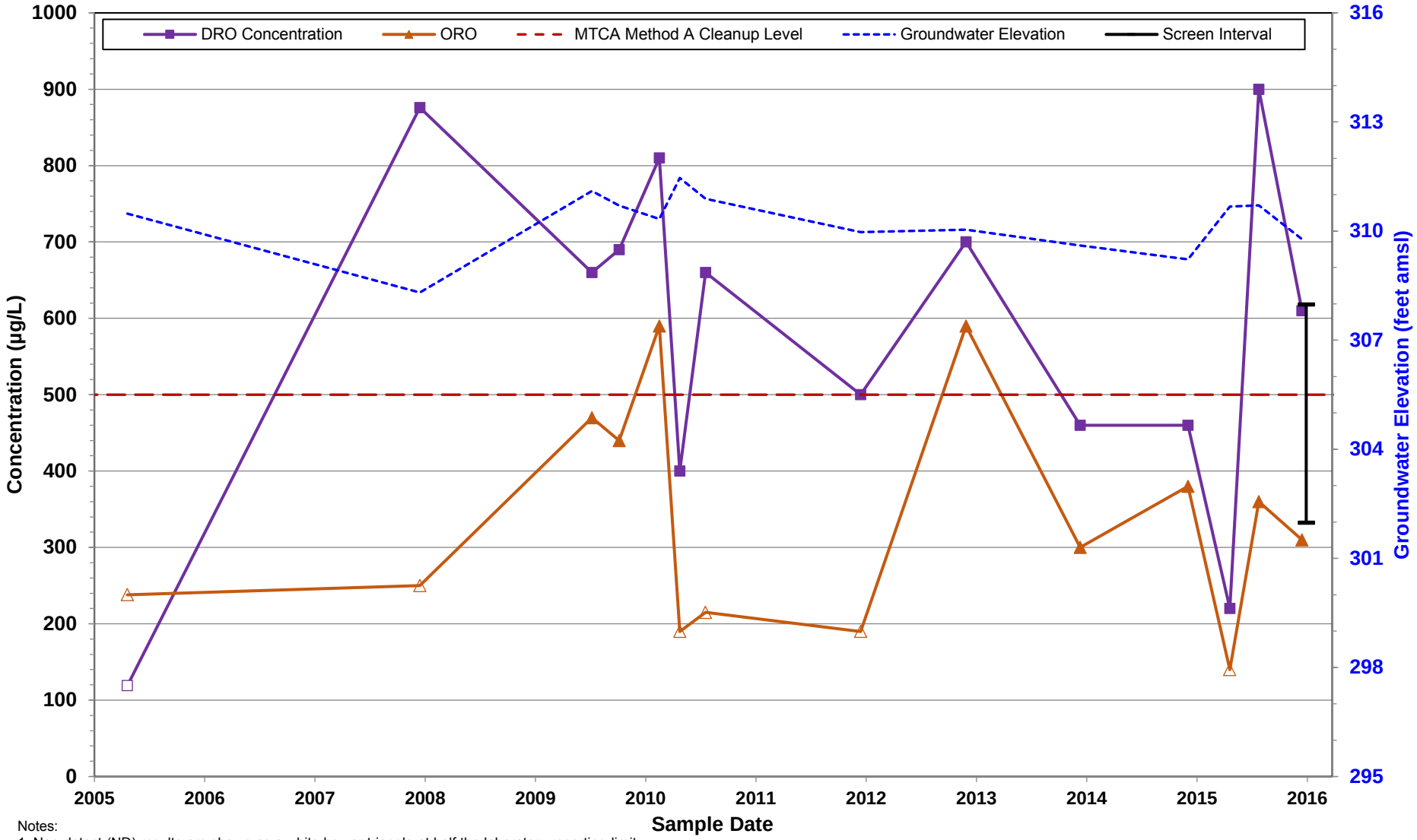
FILE NAME: L:\Graphics\ProjectsbyName\BNSF Winlock\240581-TA02\Winlock_Fig6_TPHd_Dec2015-Aug2016.dwg | Layout Tab: 11x17_L

Figure 7
Groundwater Elevation versus DRO and ORO - MW-1
Former Cummings Oil Lease Site
Winlock, Washington



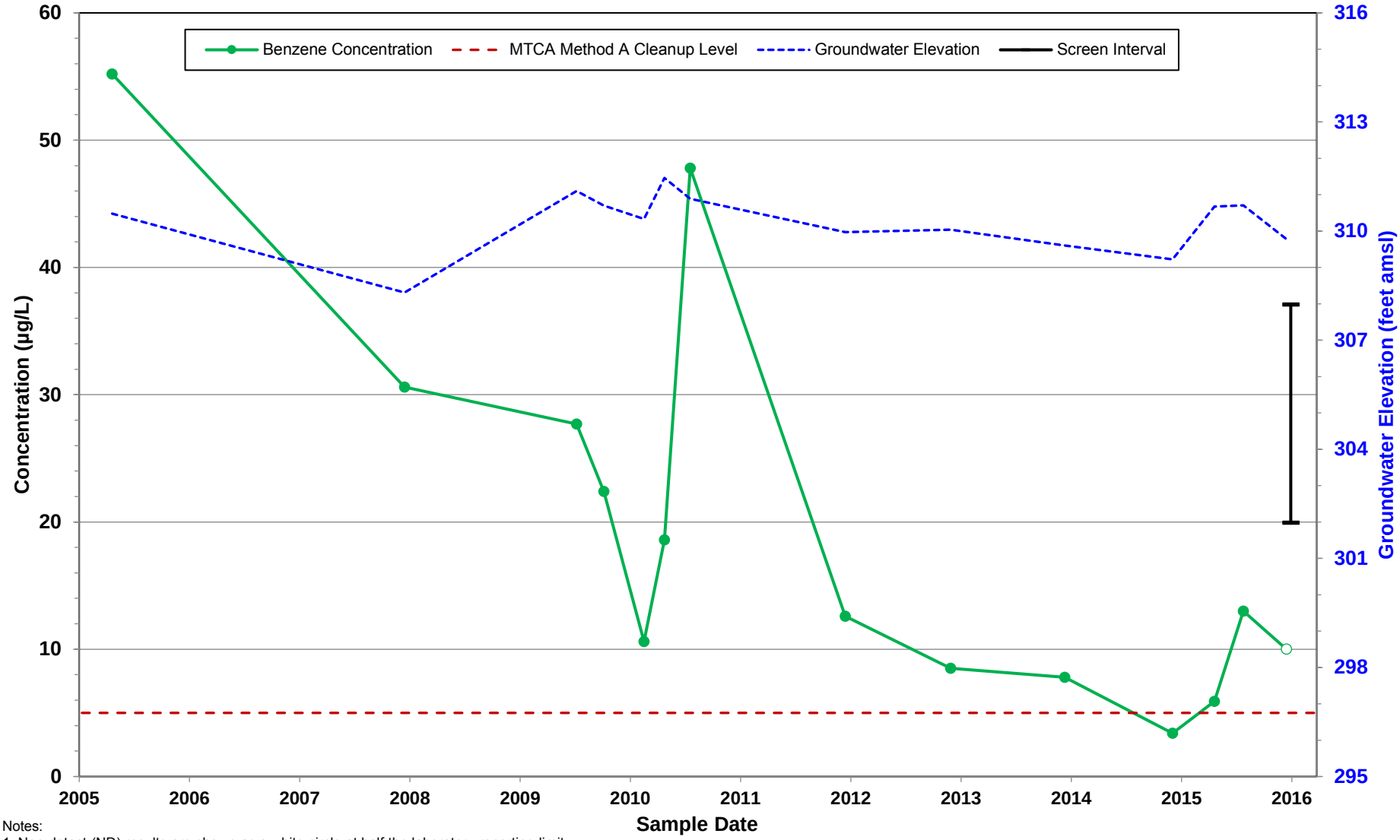
Notes:
1. Non-detect (ND) results are shown as a white box or triangle at half the laboratory reporting limit.
2. MTCA Cleanup level for Diesel Range Organic (DRO) is 500 micrograms per liter (µg/L).

Figure 8
Groundwater Elevation versus DRO and ORO - MW-2
Former Cummings Oil Lease Site
Winlock, Washington



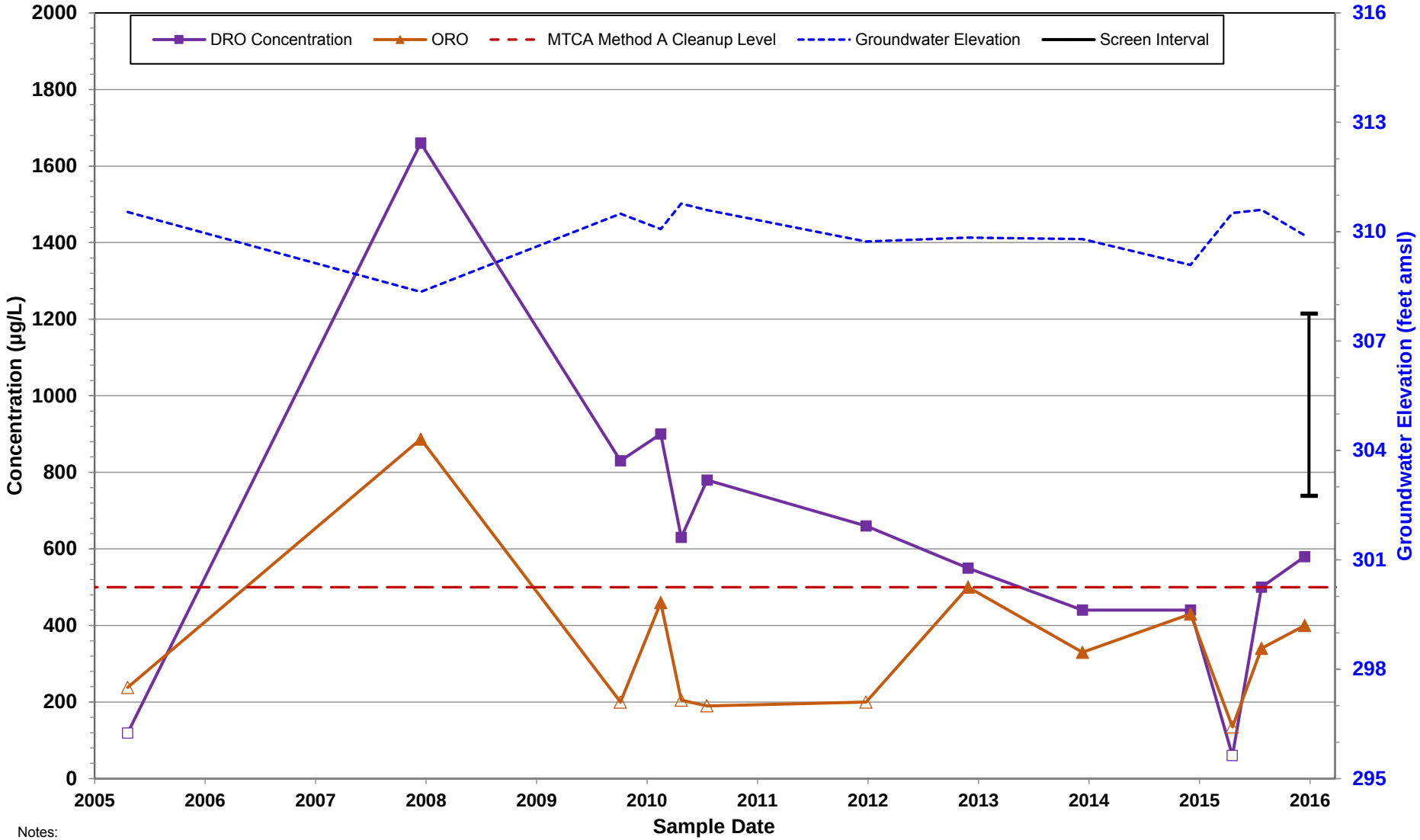
Notes:
1. Non-detect (ND) results are shown as a white box or triangle at half the laboratory reporting limit.
2. MTCA Cleanup level for Diesel Range Organic (DRO) is 500 micrograms per liter (µg/L).

Figure 9
Groundwater Elevation versus Benzene - MW-2
Former Cummings Oil Lease Site
Winlock, Washington



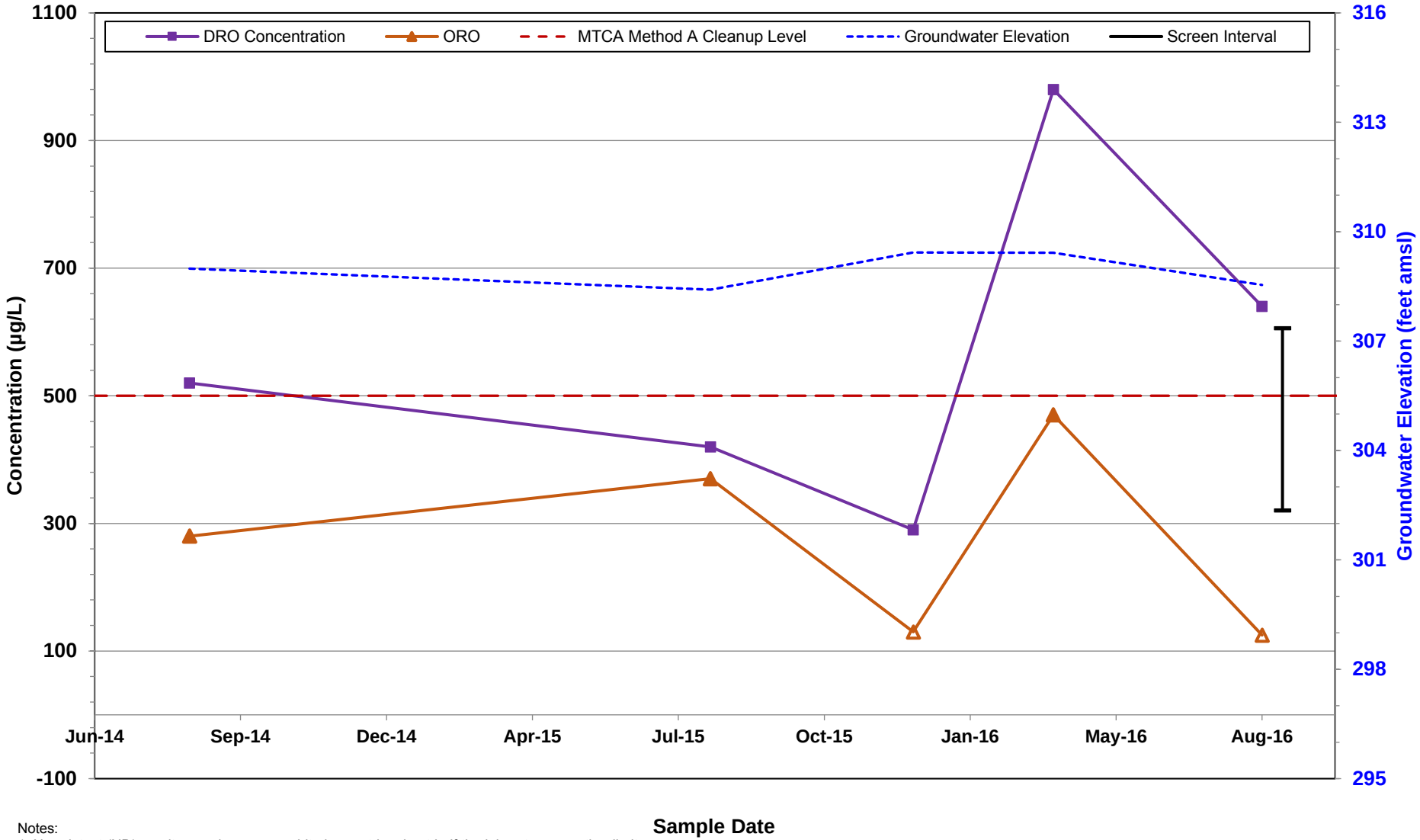
Notes:
1. Non-detect (ND) results are shown as a white circle at half the laboratory reporting limit.
2. MTCA Cleanup level for benzene is 5 micrograms per liter (µg/L).

Figure 10
Groundwater Elevation versus DRO and ORO - MW-3
Former Cummings Oil Lease Site
Winlock, Washington



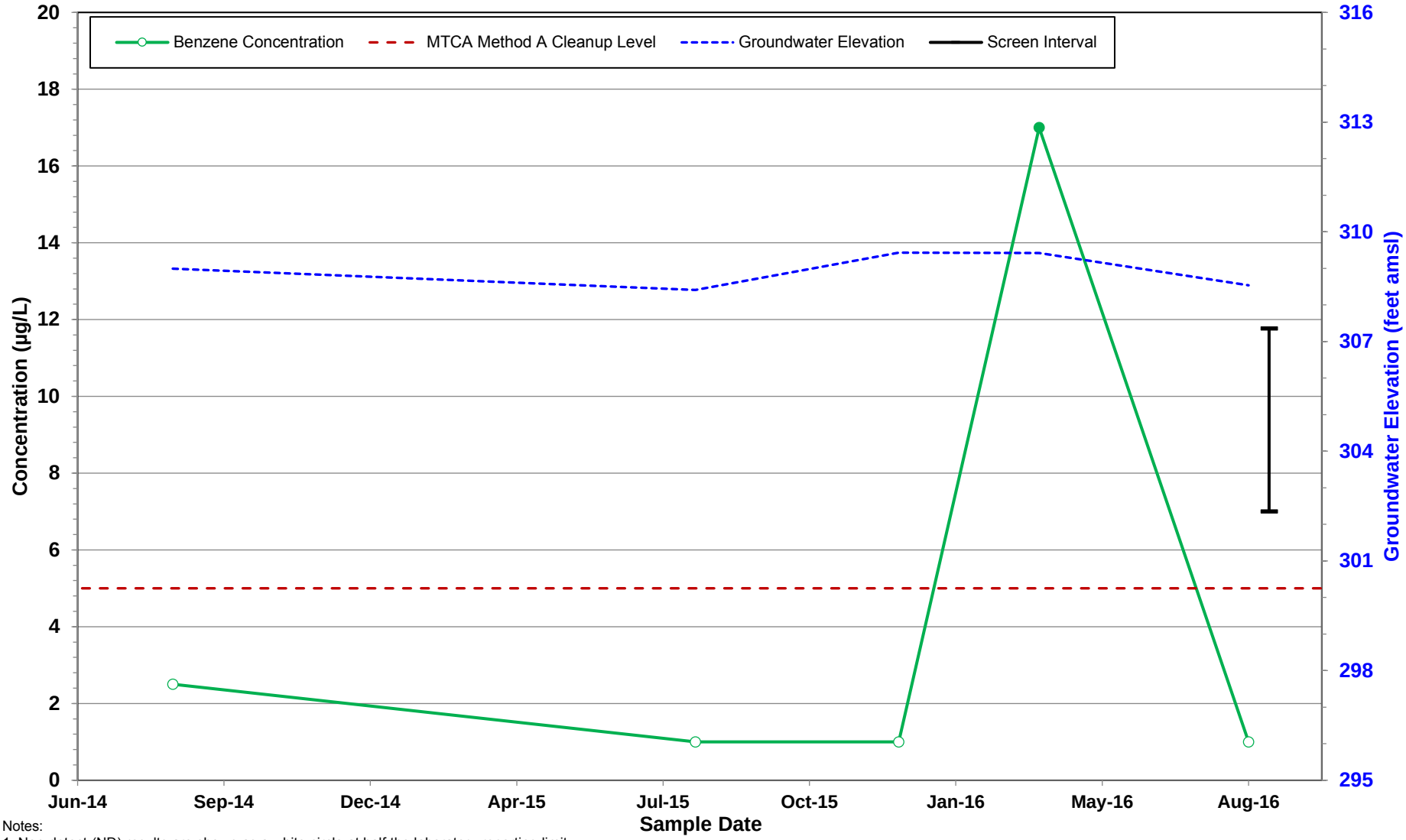
Notes:
1. Non-detect (ND) results are shown as a white box or triangle at half the laboratory reporting limit.
2. MTCA Cleanup level for Diesel Range Organic (DRO) is 500 micrograms per liter (µg/L).

Figure 11
Groundwater Elevation versus DRO and ORO - MW-6
Former Cummings Oil Lease Site
Winlock, Washington



Notes:
1. Non-detect (ND) results are shown as a white box or triangle at half the laboratory reporting limit.
2. MTCA Cleanup level for Diesel Range Organic (DRO) is 500 micrograms per liter (µg/L).

Figure 12
Groundwater Elevation versus Benzene - MW-6
Former Cummings Oil Lease Site
Winlock, Washington



Notes:
1. Non-detect (ND) results are shown as a white circle at half the laboratory reporting limit.
2. MTCA Cleanup level for benzene is 5 micrograms per liter (µg/L).

TABLES

Table 1
Summary of Groundwater Elevation Data
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Measured	Depth of Monitoring Well (ft bgs)	Monitoring Well Screen Interval (ft bgs)	Wellhead Elevation[1] (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
MW-1	12/23/2005	12	5-12	313.00	2.13	310.87
	8/18/2008				4.50	308.50
	3/11/2010				3.00	310.00
	6/8/2010				4.20	308.80
	10/20/2010				3.00	310.00
	12/27/2010				1.95	311.05
	3/22/2011				2.59	310.41
	8/17/2012				3.01	309.99
	8/1/2013				2.86	310.14
	8/14/2014				3.83	309.17
	8/6/2015				3.53	309.47
	12/23/2015				2.15	310.85
	3/28/2016				2.11	310.89
	8/18/2016				3.08	309.92
MW-2	12/23/2005	11	5-11	312.98	2.50	310.48
	8/18/2008				4.67	308.31
	3/11/2010				1.88	311.10
	6/8/2010				2.28	310.70
	10/20/2010				2.65	310.33
	12/27/2010				1.52	311.46
	3/22/2011				2.09	310.89
	8/17/2012				3.01	309.97
	8/1/2013				2.94	310.04
	8/14/2014				3.38	309.60
	8/6/2015				3.76	309.22
	12/23/2015				2.31	310.67
	3/28/2016				2.27	310.71
	8/18/2016				3.20	309.78
MW-3	12/23/2005	10	5-10	312.75	2.21	310.54
	8/18/2008				4.40	308.35
	3/11/2010				--	--
	6/8/2010				2.26	310.49
	10/20/2010				2.68	310.07
	12/27/2010				1.98	310.77
	3/22/2011				2.16	310.59
	8/29/2012				3.02	309.73
	8/1/2013				2.91	309.84
	8/14/2014				2.95	309.80
	8/6/2015				3.66	309.09
	12/23/2015				2.24	310.51
	3/28/2016				2.15	310.60
	8/18/2016				2.85	309.90

Table 1
Summary of Groundwater Elevation Data
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Measured	Depth of Monitoring Well (ft bgs)	Monitoring Well Screen Interval (ft bgs)	Wellhead Elevation[1] (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
MW-4	12/23/2005	12	5-12	314.89	0.50	314.39
	8/18/2008				5.02	309.87
	3/11/2010				1.9	312.99
	6/8/2010				1.45	313.44
	10/20/2010				2.40	312.49
	12/27/2010				0.48	314.41
	3/22/2011				1.33	313.56
	8/29/2012				3.48	311.41
	8/1/2013				3.31	311.58
	8/14/2014				4.24	310.65
	8/6/2015				4.13	310.76
	12/23/2015				0.33	314.56
	3/28/2016				1.07	313.82
	8/18/2016				--	--
MW-5	8/18/2008	10	5-10	312.45	5.54	306.91
	3/11/2010				3.29	309.16
	6/8/2010				4.00	308.45
	10/20/2010				5.25	307.20
	12/27/2010				3.17	309.28
	3/22/2011				4.51	307.94
	8/17/2012				5.47	306.98
	8/1/2013				5.52	306.93
	8/14/2014				5.12	307.33
	8/6/2015				5.68	306.77
	12/23/2015				3.63	308.82
	3/28/2016				4.65	307.80
	8/18/2016				5.31	307.14
MW-6	8/14/2014	10	5-10	312.35	3.36	308.99
	8/6/2015				3.94	308.41
	12/23/2015				2.92	309.43
	3/28/2016				2.93	309.42
	8/18/2016				3.81	308.54
MW-7	8/14/2014	9	5-9	312.41	5.51	306.90
	8/6/2015				5.67	306.74
	12/23/2015				4.75	307.66
	3/28/2016				5.00	307.41
	8/18/2016				5.56	306.85

NOTES:

ft bgs = feet below ground surface

ft btoc = feet below top of casing

ft amsl = feet above mean sea level

– denotes depth not measured

[1]Elevations based on survey completed 8/14/14 Blum & Associates Land Surveyors, Inc. to Washington State Plane Coordinate System South Zone NAD 83, NAVD 88 elevations.

Table 2
Summary of Groundwater Analytical Results
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Sampled	Analytical Results (micrograms per liter)												
		GRO[1]	DRO[2]	ORO[2]	Benzene[3]	Toluene[3]	Ethyl-benzene[3]	Total Xylenes[3]	Naphthalene[3]	1-Methyl-naphthalene[4]	2-Methyl-naphthalene[4]	Methyl tert-butyl ether[3]	1,2-Dichloro-ethane[3]	1,2 Dibromo-ethane[5]
MW-1	12/23/2005	<50.0	<238	<476	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	8/18/2008	<50.0	**1,480**	**836**	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	3/11/2010	<50.0	**590**	**540**	<1.0	<1.0	<1.0	<6.0	--	--	--	--	--	--
	6/9/2010	<50.0	**720**	<460	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	10/20/2010	<50.0	**670**	<430	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	12/27/2010	<50.0	**520**	<380	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	3/22/2011	<50.0	**630**	<410	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/17/2012	<50.0	470	<380	<1.0	<1.0	3.1	4.2	--	--	--	--	--	--
	8/1/2013	<50.0	490	500	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/14/2014	<50.0	440	410	<5.0	<5.0	<5.0	<10.0	<15.0	<0.094	<0.094	<5.0	<5.0	<0.010
	8/6/2015	--	320	330	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	12/23/2015	--	260	<250	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	3/28/2016	--	380	270	<2.0	--	--	--	--	--	--	--	--	--
	8/18/2016	--	470	370	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
MW-2	12/23/2005	465	<238	<476	**55.2**	2.84	3.46	35.6	--	--	--	--	--	--
	8/18/2008	606	**876**	<500	**30.6**	1.12	2.56	30.9	--	--	--	--	--	--
	3/11/2010	150	**660**	470	**27.7**	<1.0	<1.0	<6.0	--	--	--	--	--	--
	6/9/2010	116	**690**	440	**22.4**	<1.0	<1.0	<3.0	--	--	--	--	--	--
	10/20/2010	95.2	**810**	**590**	**10.6**	<1.0	<1.0	<3.0	--	--	--	--	--	--
	12/27/2010	130	400	<380	**18.6**	<1.0	<1.0	<3.0	--	--	--	--	--	--
	3/22/2011	196	**660**	<430	**47.8**	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/17/2012	158	**500**	<380	**12.6**	<1.0	5.2	9.6	--	--	--	--	--	--
	8/1/2013	260	**700**	**590**	**8.5**	<1.0	<1.0	4.1	--	--	--	--	--	--
	8/14/2014	220	460	300	**7.8**	<5.0	<5.0	<10.0	<15.0	**1.8**	0.81	<5.0	<5.0	<0.010
	8/6/2015	--	460	380	3.4	<3.0	<3.0	<3.0	--	**--**	--	--	--	--
	12/23/2015	--	220	<280	**5.9**	<2.0	<3.0	<3.0	--	**--**	--	--	--	--
	3/28/2016	--	**900**	360	**13**	--	--	--	--	**--**	--	--	--	--
	8/18/2016	--	**610**	310	<20	27	<30	36	--	**--**	--	--	--	--
	8/18/2016	--	**650**	360	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
MW-3	12/23/2005	<50.0	<238	<476	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	8/18/2008	<50.0	**1,660**	**887**	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	3/11/2010	--	--	--	--	--	--	--	--	--	--	--	--	--
	6/9/2010	<50.0	**830**	<400	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	10/20/2010	<50.0	**900**	460	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	12/27/2010	<50.0	**630**	<410	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	3/22/2011	<50.0	**780**	<380	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/29/2012	<50.0	**660**	<400	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--

Table 2
Summary of Groundwater Analytical Results
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Sampled	Analytical Results (micrograms per liter)												
		GRO[1]	DRO[2]	ORO[2]	Benzene[3]	Toluene[3]	Ethyl-benzene[3]	Total Xylenes[3]	Naphthalene[3]	1-Methyl-naphthalene[4]	2-Methyl-naphthalene[4]	Methyl tert-butyl ether[3]	1,2-Dichloro-ethane[3]	1,2 Dibromo-ethane[5]
MW-3 (cont'd)	8/1/2013	<50.0	**550**	**500**	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/14/2014	<50.0	440	330	<5.0	<5.0	<5.0	<10.0	<15.0	<0.094	<0.094	<5.0	<5.0	<0.010
	8/6/2015	--	440	430	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	12/23/2015	--	<120	<270	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	3/28/2016	--	500	340	<2.0	--	--	--	--	--	--	--	--	--
	8/18/2016	--	**580**	400	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
MW-4	12/23/2005	<50.0	<238	<476	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	8/18/2008	<50.0	<243	<485	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	3/11/2010	<50.0	<78	<390	<1.0	<1.0	<1.0	<6.0	--	--	--	--	--	--
	6/9/2010	<50.0	<82	<410	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	10/20/2010	<50.0	<86	<430	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	12/27/2010	<50.0	<83	<420	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	3/22/2011	<50.0	<85	<430	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/29/2012	<50.0	<78	<390	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/1/2013	<50.0	<120	<240	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/14/2014	<50.0	<120	<240	<1.0	<1.0	<1.0	<2.0	<3.0	<0.094	<0.094	<1.0	<1.0	<0.010
	8/6/2015	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-5	8/18/2008	<50.0	433	<481	<0.500	<0.500	<0.500	<1.00	--	--	--	--	--	--
	3/11/2010	<50.0	<82	<410	<1.0	<1.0	<1.0	<6.0	--	--	--	--	--	--
	6/9/2010	<50.0	<84	<420	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	10/20/2010	<50.0	<85	<430	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	12/27/2010	<50.0	<87	<430	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	3/22/2011	<50.0	<75	<380	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/17/2012	<50.0	<76	<380	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/1/2013	<50.0	<120	<240	<1.0	<1.0	<1.0	<3.0	--	--	--	--	--	--
	8/14/2014	<50.0	<120	<240	<1.0	<1.0	<1.0	<2.0	<3.0	<0.094	<0.094	<1.0	<1.0	<0.010
	8/6/2015	--	<100	<240	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	12/23/2015	--	<110	<250	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	3/28/2016	--	<110	<250	<2.0	--	--	--	--	--	--	--	--	--
	8/18/2016	--	150	<260	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
MW-6	8/14/2014	110	**520**	280	<5.0	<5.0	<5.0	<10.0	<15.0	0.13	<0.094	<5.0	<5.0	<0.010
	8/6/2015	--	420	370	<2.0	<2.0	<5.0	<3.0	--	--	--	--	--	--
	12/23/2015	--	290	<260	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	3/28/2016	--	**980**	470	**17**	--	--	--	--	--	--	--	--	--
	8/18/2016	--	**640**	<250	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--

Table 2
Summary of Groundwater Analytical Results
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Sampled	Analytical Results (micrograms per liter)												
		GRO[1]	DRO[2]	ORO[2]	Benzene[3]	Toluene[3]	Ethyl-benzene[3]	Total Xylenes[3]	Naphthalene[3]	1-Methyl-naphthalene[4]	2-Methyl-naphthalene[4]	Methyl tert-butyl ether[3]	1,2-Dichloro-ethane[3]	1,2 Dibromo-ethane[5]
MW-7	8/14/2014	<50.0	260	260	<1.0	<1.0	<1.0	<2.0	<3.0	<0.094	<0.094	<1.0	<1.0	<0.010
	8/6/2015	--	120	<240	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	12/23/2015	--	<110	<250	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
	3/28/2016	--	<110	<250	<2.0	--	--	--	--	--	--	--	--	--
	8/18/2016	--	<110	<250	<2.0	<2.0	<3.0	<3.0	--	--	--	--	--	--
MTCA Method A CLs[6]		**800**	**500**	**500**	**5**	**1,000**	**700**	**1,000**	**160**	**--**	**--**	**20**	**5**	**0.01**
MTCA Method B CLs[7]		**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**1.51**	**32**	**--**	**--**	**--**

NOTES:
Results in **bold** denote concentrations exceeding applicable cleanup levels.
< denotes analyte not detected at or exceeding the reporting limit listed.
-- denotes sample not analyzed.
DRO = total petroleum hydrocarbons (TPH) as diesel-range organics
GRO = TPH as gasoline-range organics
ORO = TPH as oil-range organics

[1] Analyzed by Northwest Method NWTPH-Gx.
[2] Analyzed by Northwest Method NWTPH-Dx.
[3] Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B.
[4] Analyzed by EPA Method 8270C SIM
[5] Analyzed by EPA Method 8011
[6] Washington State Model Toxics Control Act Cleanup Regulation (MTCA) Method A Cleanup Levels for Groundwater, Table 720-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, as revised 2013.
[7] Washington State Model Toxics Control Act Cleanup Regulation Cleanup Levels and Risk Calculations, Standard Method B Values for Groundwater, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

Table 3
Summary of Field Water Quality Parameters
Former Cummings Oil Lease Site
Winlock, Washington

Monitoring Well	Date Measured	Temp (°C)	pH	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxygen Reduction Potential (mV)
MW-1	12/23/2015	8.52	6.31	0.272	17.3	1.39	-21.4
	3/28/2016	13.06	6.17	0.252	44.2	1.11	-8.1
	8/18/2016	20.08	5.75	0.194	5.03	0.79	-0.4
MW-2	12/23/2015	10.34	6.55	0.189	32.6	3.38	-25.3
	3/28/2016	12.27	6.48	0.368	19.7	1.25	-88.5
	8/18/2016	21.45	5.96	0.273	5.21	0.3	-73.7
MW-3	12/23/2015	8.4	6.91	0.304	64.6	1.96	12.1
	3/28/2016	12.04	6.2	0.450	75.8	0.45	-14.7
	8/18/2016	23.04	6.08	0.392	52.2	0.34	-47.2
MW-4	12/23/2015	*Not Sampled*					
	3/28/2016						
	8/18/2016						
MW-5	12/23/2015	11.53	5.75	0.277	7.8	4.1	126.6
	3/28/2016	11.13	5.91	0.27	7.7	1.47	28.4
	8/18/2016	22.78	5.81	0.275	2.60	0.42	98.8
MW-6	12/23/2015	9.8	6.59	0.332	11.60	1.11	-81.1
	3/28/2016	12.66	6.53	0.399	10.20	4.34	-99.1
	8/18/2016	21.17	6.29	0.309	8.84	0.29	-101.7
MW-7	12/23/2015	9.35	7.12	0.254	16.00	1.66	-30.9
	3/28/2016	11.48	6.34	0.201	25.10	2.08	12.5
	8/18/2016	22.37	5.81	0.217	11.8	1.85	63.2

NOTES:

°C = degrees Celcius

mS/cm = millisiemens per centimeter

NTU = nephalometric turbidity units

mg/L = milligrams per liter

mV = millivolts

APPENDIX A

GROUNDWATER SAMPLING GENERAL FIELD PROCEDURES

Title: **Groundwater Sampling**	Procedure Number: **RMD 009**
	Revision Number: **0**
	Effective Date: **August 2014**

Authorization Signatures

Technical Review	Date
Cinnamon Smith	8/26/14
Remediation Practice Quality Coordinator	Date
Elizabeth Denly	8/26/14

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Page No.

ATTACHMENTS

1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) was prepared to provide TRC personnel with general guidance in performing groundwater sampling activities. This SOP details equipment and sampling procedures for low-flow sampling, multi-volume purge sampling and passive diffusion bag sampling from monitoring wells. Various regulatory agencies and project-specific work plans may have specific requirements (e.g., equipment/instrument, flow rate, etc.) that may be applicable and take precedence, depending on the program.

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

1.2 Summary of Method

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling.

For low-flow and multiple well volume removal, there are various types of equipment available to perform groundwater sampling. The most common of these are the submersible pump, peristaltic pump, and bailer. However, the equipment selected and the purge method used, if any, will depend on project goals, data quality objectives (DQOs), hydrogeologic conditions, and regulatory requirements. Care should be taken when choosing the sampling procedures and device(s), as some procedures have the potential to affect the representativeness of the sample more than others. For repeated monitoring events, the sampling methodology and operating equipment employed should be consistent to minimize potential variability due to sampling procedures. The type of sampling method utilized is dependent upon site-specific conditions and it is not within the scope of this document to recommend a specific methodology. Information on applicability of sampling methods can be found on Interstate Technology & Regulatory Council (ITRC) and United States Environmental Protection Agency (EPA) websites.

1.3 Equipment

The following equipment is commonly used to collect groundwater samples from a monitoring well. Site-specific conditions may warrant the use of additional equipment or deletion of items from this list.

- Appropriate level of personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)
- Electronic water level indicator capable of measuring to 0.01 foot accuracy
- Oil/water interface probe
- Extra batteries for water level/interface probe
- Submersible pump with low-flow capabilities (less than 1 liter/min) constructed of inert materials (e.g., stainless steel and Teflon®), such as a bladder pump (with sufficient quantity of bladders, o-rings, grab plates, etc.)
- Peristaltic pump
- Source of power for use with submersible or peristaltic pump (e.g., 12-volt battery, compressor, generator, compressed gas tanks, etc.)
- Flow controller for use with submersible pump (varies depending on type of pump used)
- Bottom-filling bailer constructed of inert materials (i.e., polyethylene, polyvinyl chloride [PVC], stainless steel or Teflon®)
- Bailer cord or wire (recommended Teflon®-coated, stainless steel cable; bailer wire; or contaminant-free rope with a Teflon®-coated stainless steel leader to connect bailer and rope)
- Tubing (Teflon®, Teflon®–lined polyethylene, or high density polyethylene [HDPE], type dependent upon project objectives)
- Silicone tubing (only used for peristaltic pump head and/or flow-through cell connections)
- Water quality meter(s) capable of measuring parameters, such as pH, temperature, specific conductivity, oxidation-reduction potential (ORP), and dissolved oxygen (DO)
- Flow-through cell
- T-connector
- Turbidity meter
- Passive sampling device (and any device-specific accessories)
  - Passive diffusion bags (PDBs)
  - Tether (stainless steel cable or marine-grade polyethylene rope), well cap, and weights, unless already installed
  - Funnel (Fill kit)
  - PVC cable ties
  - Tool to cut cable ties
  - PVC discharge tubes
  - Tether reel
- Well lock keys
- Bolt cutters

- Appropriate tools for equipment and to open well box (e.g., socket wrench, pry bar, etc.)
- Containers with lids for purge water (i.e., 5-gallon buckets, drums, etc.)
- Stopwatch or timer
- Graduated measuring container appropriately sized to measure flow rate
- Sample bottle labels
- Laboratory-grade water (can request from lab – for equipment blanks)
- Chain-of-custody (COC) forms
- Sample cooler(s)
- Photoionization detector (PID) or flame ionization detector (FID) for well head monitoring
- Sample containers (may be supplied by the laboratory depending upon the regulatory program): The proper containers should be determined in conjunction with the analytical laboratory in the planning stages of the project. If not included in sample containers provided by laboratory, sample preservatives will need to be kept with sample containers, and added to sample containers prior to sample collection.
- Field book and/or Groundwater Field Data Record (multiple copies)
- Filtration equipment
- In-line filter (0.45 micron [µm]) or as otherwise required by the project-specific work plan.
- Bubble wrap/Bubble wrap bags
- Lint-free, non-abrasive, disposable towels (e.g., Kimwipes®)
- Indelible marking pens
- Plastic bags (e.g., Ziploc®)
- Ice
- Teflon® tape
- Plastic sheeting or large trash bags which can be cut open
- Umbrella, tent, or equivalent for shading equipment (particularly the flow-through cell) from sunlight or blocking rain
- Equipment decontamination supplies
- Container for bailing water out of water-logged road boxes or well vaults
- Map of well locations and well construction data
- Copy of field notes from previous sampling event for reference
- Project-specific work plan

1.4 Definitions

Bailer — A cylindrical device suspended from a rope or cable, which is used to remove water, non-aqueous phase liquid (NAPL), sediment or other materials from a well or open borehole. Usually equipped with some type of check valve at the base to allow water, NAPL, and/or sediment to enter the bailer and be retained as it is lifted to the surface. A bailer may be made in varying diameters; however a bailer that fits in a two-inch well is the most common. In some instances a < 1-inch diameter bailer (a.k.a. pencil bailer) is used for small diameter wells.

Borehole — A hole drilled into the soil or bedrock using a drill rig or similar equipment.

Dense Non-aqueous Phase Liquid (DNAPL) — Separate-phase product that is denser than water and, therefore, sinks to the bottom of the water column.

Depth To Water (DTW) — The distance to the groundwater surface from an established measuring point.

Drawdown — The response to purging/pumping a well resulting in the lowering of groundwater within the water column in the well or in a water-bearing zone.

FID — An instrument that uses a flame to break down volatile organic compounds (VOCs) into ions that can be measured.

Flow-Through Cell — The container used to immerse the multi-parameter probes in well purge water during pre-sampling well purging. The flow-through cell is usually made of transparent acrylic and is connected to the end of the discharge tubing creating an in-line, sealed container in which purge water circulates around the measurement probes. The discharge from the pump prior to the flow-through cell may be fitted with a check valve or T-connector for collection of water for turbidity measurement.

Flush Mount — The type of well completion where the riser terminates at or below grade. Flush-mounted wells are typically completed with a "curb box" which is an "at-grade" enclosure designed to protect the well riser.

Light Non-aqueous Phase Liquid (LNAPL) — Separate-phase product that is less dense than water and therefore floats on the surface of the water.

Monitoring Well	A well made from a PVC pipe, or other appropriate material, with slotted screen installed across or within a saturated zone. A monitoring well is typically constructed with a PVC or stainless steel pipe in unconsolidated deposits and with steel casing in bedrock.
PID	An instrument that uses an ultraviolet light source to break down VOCs into ions that can be measured.
Piezometer	A well made from PVC or metal with a slotted screen installed across or within a saturated zone. Piezometers are primarily installed to monitor changes in the potentiometric surface elevation.
Potentiometric Surface	A surface representing the hydraulic head of groundwater.
Protective Casing	The pipe installed around the well riser that sticks up from the ground (above-grade completions) or is flush with the ground (at-grade completions, e.g., curb box) in order to protect the well integrity. Protective casings are typically constructed of steel or aluminum and usually closeable with a locking cover/hasp to maintain well integrity between sampling events.
Recharge Rate	The rate at which groundwater returns to the water column in the well.
Separate-Phase Product	A liquid that does not easily dissolve in water. Separate-phase product can be more dense (i.e., DNAPL) or less dense (i.e., LNAPL) than water and, therefore, can be found at different depths in the water column.
Static Water Level	Level at which water resides in a well when the water level is at equilibrium with atmospheric pressure.
Well Cover	The cap or lid constructed at the end of the protective casing (above-grade completions) or flush-mounted curb box (ground surface completions) to secure access to the well. Well covers for stick-up wells are often equipped with a hasp to accommodate a padlock. Well covers for flush-mounted road boxes or vaults are opened and closed using a threaded bolt.
Well Filter Pack	A material composed of clean silica sand or sand and gravel of selected grain size and gradation that is placed in the annulus between the screened interval and the borehole wall in a well for the purpose of retaining and stabilizing the formation material.
Well Plug/Expansion Plug	The plug fashioned into a cap placed into the top of the well riser (e.g., J-Plug). Well plugs are usually designed with an expandable gasket that is activated by turning a locking wing nut or removable key latch, closing a snap cap or engaging a magnetic clutch cap to seal the well riser.

Well Riser	Sections of blank (non-slotted) pipe that extend from the well screen to or above the ground surface.
Well Screen	Pipe (typically PVC or stainless steel) used to retain the formation or filter pack materials outside of the well. The pipe has openings/slots of a uniform width, orientation, and spacing. The openings/slots can vary based on formation and filter pack material specifications.

1.5 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel shall follow the site-specific HASP. TRC personnel will use the appropriate level of PPE as defined in the HASP.

The well head should be pre-screened using a PID/FID to avoid inhalation of contaminants venting from the well. If monitoring results indicate sustained elevated concentrations of organic contaminants, the level of PPE may need to be increased in accordance with the HASP or work could be conducted upwind of the well.

When present, special care should be taken to avoid contact with LNAPL or DNAPL. The use of an air monitoring program, as well as the proper PPE designated by the site-specific HASP, can identify and/or mitigate potential health hazards.

Implementing this SOP may require the use of reagents and/or compressed gases for the calibration and operation of field equipment. These substances may be hazardous and TRC personnel must appropriately handle, store, and dispose of them at all times. Skin contact with liquid from preserved sample bottles must be avoided as they may contain strong acids or bases. When filling bottles pre-preserved with acid (e.g., hydrochloric acid, nitric acid, sulfuric acid), vapors may be released and should not be inhaled. Do not allow bottles with acid to be exposed to elevated atmospheric temperatures or sunlight as this will facilitate fumes from the acids.

1.6 Cautions and Potential Problems

The following sections highlight issues that may be encountered and should be discussed with the Project Manager prior to mobilization into the field.

1.6.1 Pre-Sampling Issues

(a) Selection of equipment for groundwater sampling should consider multiple factors, including: DTW, well specifications (e.g., depth and length of well screen intervals), desired flow rate, possible weather conditions, type and concentration of contaminant(s), and remoteness/accessibility to the site. The benefits and limits of each type of groundwater sampling equipment should be fully reviewed during project planning or prior to mobilization if the project-specific work plan does not identify the required equipment. For example, peristaltic pumps are incapable of withdrawing water in wells in which the depth to water is greater than approximately 20-25 feet below ground surface (bgs).

(b) If the screen or open borehole is greater than 10 feet in length, consult the project-specific work plans for the target sampling interval. Generally, pumps are either placed in the middle of the saturated zone if the water level is below the top of the screen or in the middle of the screen interval if the water level is above the top of the screen.

(c) The need for redevelopment of the monitoring wells should be evaluated periodically in accordance with the project-specific requirements. This is assessed by comparing the measured total depth of the well with the constructed depth. If the measured depth is less than the constructed depth, this may indicate siltation of the well and/or the presence of an obstruction in the well. If it is determined that redevelopment is necessary, it should be performed in accordance with RMD SOP 006, *Well Development.* The time necessary for a well to restabilize after redevelopment will be determined on a project-specific basis and may depend on regulatory requirements.

(d) During the total well depth measurement, there is the potential for sediment, if present at the bottom of the well, to be disturbed, thereby increasing the turbidity of the groundwater. Therefore, the total well depth measurement should be collected the day prior to collecting groundwater samples, if possible.

(e) Use caution if using compressed gas cylinders (e.g., nitrogen, carbon dioxide) for purging/sampling of groundwater. Check for leaks around regulator connections by spraying soapy water on the connections. If a leak is discovered, the connection to the regulator should be disassembled, wrapped with Teflon® tape, and reconnected to the cylinder. If the leak continues, the regulator should be replaced. It should be noted that Department of Transportation (DOT) regulations apply to the transportation and handling of compressed gas cylinders (see 49 Code of Federal Regulations [CFR] 171). Never transport cylinders with the regulator attached. Replace the cylinder valve cover on the compressed gas cylinder before transport.

(f) All field personnel must be made aware of the water level measurement reference point being used for each well at a site (i.e., must be clearly marked) in order to ensure collection of comparable data between events.

(g) Bolt cutters may be necessary to remove rusted locks. Dipping rusted locks in a soapy solution may help with opening difficult locks. Oils and other products containing VOCs (e.g., WD-40) should not be used on locks as these compounds may cause contamination of water samples collected at the well. Replace cut locks and note in the field book.

(h) Prior to accessing the well, physical conditions around the well head should be assessed for situations that might result in cross-contamination or the introduction of foreign material/debris into the well. For example, flush-mounted wells may have water or road sand/salt/debris inside the curb box. Rodents and insects (e.g., bees, wasps) have been known to construct nests within the protective casing of a well. If bees, wasps, or other insects are encountered, insecticides should be used with caution as the chemicals may cause contamination of water samples collected at the well. If water or foreign material is introduced into the well, the Project Manager should be immediately notified.

1.6.2 General Purging and Sampling Issues

(a) Prior to installation of a submersible pump into a well, ensure that the tubing is properly sealed to the pump to avoid losing the pump down the well and to prevent escape of air or water from the pump, which could result in poor pump performance and the aeration of the well water. Do not do this by tugging on tubing. Never lower pumps into the well using only tubing; instead a security line attached to the pump is required to prevent potentially losing the pump down the well.

(b) A submersible pump should not be lowered to the bottom of the well to avoid stirring up any sediment at the bottom of the well and prevent getting the pump stuck (fine sediment accumulation in the bottom of the well can create a strong suction with a flat bottom pump such as a bladder pump, which may require jetting to retrieve the pump).

(c) Start with the lowest pumping rate possible and increase until a sustainable rate is reached. Avoid high pumping rates (> 1 liter/min), as this could lead to damage of the well filter pack, if present. Where practical and/or possible, refer to previous sampling events to establish consistent flow rates.

(d) Some regulatory agencies may have concern about the use of peristaltic pumps when sampling for VOCs due to the potential for loss of VOCs during sampling and alteration of other water quality parameters such as pH and alkalinity. Samplers should review the requirements in the project-specific work plan and/or regulatory guidelines prior to performing the work. Explicit approval to use a peristaltic pump for the collection of VOCs may be required by the governing regulatory agency. An option may be to use the "soda straw" method to collect the VOC sample which does not allow the water to go through the pump head:
    (1) After purging the well with the peristaltic pump, collect all fractions except VOCs from the outlet side of the pump (i.e., VOCs will be collected last instead of first).
    (2) Turn the pump off.
    (3) Change into clean gloves.
    (4) Disconnect the tubing coming out of the well from the inlet side of the pump and immediately put a finger over the end of this tubing to prevent water from draining out of the tubing.
    (5) Retrieve tubing from the well, coiling it in one hand as it is being retrieved (maintain finger over end of tubing).
    (6) Open VOC vials. Briefly remove finger from end of tubing to allow water to flow into vial. Replace finger on end of tubing to stop flow. Do this for remaining VOC vials.

(e) In the event that a well cannot be purged and sampled with a pump, the alternative to pumping may be the use of a bottom-filling bailer. The applicable regulatory agency requirements and the Project Manager should be consulted if in doubt about the appropriateness of using a bailer at a site or during a particular sampling event.

(f) During purging and sampling, the tubing should remain filled with water to minimize possible changes in water chemistry due to contact with the atmosphere. All flow-through cells should be shaded from direct sunlight to minimize the potential for off-gassing and temperature fluctuations.

(g) Ensure monitoring instruments (i.e., multi-parameter water quality instrument, turbidity meter, water level measuring device) are maintained in good condition and properly calibrated to ensure accurate readings. Be sure to have appropriate-sized extra batteries on hand.

(h) Adverse weather conditions may present challenges that need to be dealt with on a case-by-case basis. For example, air temperatures below 32°F may cause ice formation in the tubing, flow-through cell, and on the sampling equipment, or heavy rain could cause standing water issues with flush-mounted wells. Heavy rain can also impact electronic sampling equipment; preventative measures should be taken to keep electronic equipment dry.

(i) Observe and avoid any uncontrolled ambient/surrounding air conditions that could affect analytical results (e.g., truck/vehicle exhaust nearby, industrial building vents). Always ensure that vehicles are turned off during sampling to avoid introducing vehicle exhaust into the sample. If uncontrolled ambient/surrounding air conditions cannot be avoided, contact the Project Manager for further instruction; collection of a field blank sample may be warranted in this situation.

(j) Procedures should be established to minimize potential cross-contamination. For example:

- Wrap monitoring and sampling equipment with protective material (e.g., aluminum foil, polyethylene sheeting, Ziploc® bags) after decontamination and between sampling locations to minimize the potential for cross-contamination between well purging events at different locations.
- Use dedicated or disposable sampling equipment or new tubing at each sampling point when appropriate to minimize the need for decontamination.
- Protect sampling equipment and/or the open well head from blowing soil and dust by covering with plastic sheeting as needed.
- If a bailer and rope are used to purge and/or sample the well, then there is the possibility of contamination from the rope used to lower the bailer. New or dedicated rope should be used when appropriate. Alternatively, a decontaminated, Teflon®-coated stainless steel leader can be attached between the rope and the bailer. The leader acts as an extension to the rope and allows for the top of the bailer to enter the water column without immediately placing the rope into the water. It is important to keep the rope clean and not allow contact with the ground surface during bailing.

(k) Disposal of the groundwater collected during purging must be performed in accordance with all applicable regulations and the project-specific work plan.

(l) Clear tape should not be used to cover labels on containers used for certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.

(m) In cases where it is difficult to obtain sufficient sample volume for multiple analytical fractions as well as required quality control (QC) analyses (*e.g.*, field duplicates, matrix spike/matrix spike duplicate [MS/MSD] analyses), discuss this situation with the Project Manager and laboratory prior to sample collection. Laboratories can often "make do" with less volume, especially for inorganic parameters, or increase the reporting limit proportional to the sample volume obtained.

1.7 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all TRC personnel must be adequately trained. Project- and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project-specific work plan. These requirements may include:

- OSHA 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers
- 8-hour annual HAZWOPER refresher training.

2.0 PROCEDURES

Procedures for collecting groundwater samples from monitoring wells are described below. The project-specific work plan should also be consulted for specific details regarding sampling.

Sampling should always begin at the monitoring well with the least contaminated groundwater and systematically proceed to the well with the most contaminated groundwater, if possible.

2.1 Pre-sampling Activities

(a) It should be determined if there is the requirement to determine static water level measurements on <u>all</u> wells at the site prior to sampling, regardless if the well is being sampled.

(b) Prior to field activities, review historical groundwater sampling logs (if available) to maintain consistency for the current sampling event (e.g., equipment type, pump intake depth setting, flow rate, etc.)

(c) Organize monitoring, purging, and sampling equipment taking care not to allow cross-contamination. This can be accomplished by laying new polyethylene sheeting near the well or using new buckets, etc.

(d) Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan.

(e) Unlock the well cover on the well.

(f) Record the sample location, time, and date in the field book and/or on the Groundwater Field Data Record.

(g) On the Groundwater Field Data Record, note the physical condition of the well, including damage, deterioration, and signs of tampering, if any. Collect photographic documentation of serious damage to present to the Project Manager.

(h) Open the well cap and expansion plug, and stay upwind of and not directly over the well. Note any unusual odors, sounds, or difficulties in opening the well and, if required, measure the organic vapor reading at the rim of the well with a suitable organic vapor screening device (e.g., PID or FID), and record the reading in the field book and/or on the Groundwater Field Data Record. If pressure or vacuum is noted or suspected in the well, allow sufficient time for the water level elevation in the well to equilibrate.

(i) Gently lower a clean, decontaminated water level measuring device into the well to determine the static water level. If appropriate for site conditions, check for the presence of LNAPL or DNAPL using an oil/water interface probe (refer to RMD SOP 004, *Water Level and Product Measurements*). If LNAPL or DNAPL is detected, contact the Project Manager before proceeding with purging and sampling activities. Record the information on depth to groundwater to the nearest 0.01 feet, depth to LNAPL or DNAPL, and/or thickness of NAPL in the field book and/or the Groundwater Field Data Record. Refer to RMD SOP 004, *Water Level and Product Measurements*, for proper procedures in performing these measurements.

(j) If required in the project-specific work plan, measure the depth to the bottom of the well to assist in calculating the well volume of the well. If possible, avoid making total well depth measurements on the same day as sampling due to the tendency to disturb sediment during this measurement. If NAPL is suspected, use a decontaminated oil/water interface probe. If the measured depth is less than the constructed depth, this may indicate that the well needs to be redeveloped (see RMD SOP 006, *Well Development*). Consult the project-specific work plan or Project Manager for further instructions.

2.2 Groundwater Purging Activities

Purging is conducted to ensure that representative groundwater is obtained from the water-bearing unit for analysis. The multiple-volume or low-flow purging approach may be used to remove water from the well and monitor the water in order to determine when a well has been adequately purged (i.e., stabilized); at a minimum, the pH, specific conductance and temperature of the groundwater removed during purging should be monitored and recorded in the field notes. Other parameters may be required in some regulatory jurisdictions (e.g., turbidity). Additionally, the purge volume should be monitored and recorded. In some instances, such as when monitoring at solid waste disposal facilities, simply removing an adequate volume of water (e.g., three well volumes) may be suitable for adequate purging, and sampling can commence. Check with the project-specific work plan and appropriate regulatory guidance to determine any specific purging requirements.

If the well has been previously sampled consistent with this SOP, then the prior purging strategy (e.g., method, pump intake depth and the flow rates) should be followed during subsequent sampling events to maintain consistency and minimize potential variability due to the sampling procedure.

2.2.1 Multiple-Volume Purging Approach

The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization. The field parameters should be recorded at regular volumetric

intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters. If the calculated purge volume is small, the measurements should be taken frequently enough (e.g., every 3 to 5 minutes) to provide a sufficient number of measurements to evaluate stability. If the purge volume is large, measurements taken every 15 minutes may be sufficient.

Purge Volume

Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. To do this, the diameter of the well should be determined and the water level and total depth of the well should be measured and recorded. The specific methodology for obtaining these measurements is included in SOP 004 *Water Level and Product Measurements*.

Once this information is known, the well volume can be calculated using Equation 1:

Well Volume (V) = πr^2 h (cf) **Equation 1**

where:

π = pi (3.14)

r = radius of well in feet (ft)

h = height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]

cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3.

The volume in gallons/linear foot (gal/ft) and liters/linear foot (L/ft) for common-size wells are as follows:

Well Inside Diameter (inches)	Volume (gal/ft)	Volume (L/ft)
1	0.0408	0.1529
2	0.1631	0.6174
3	0.3670	1.3892
4	0.6524	2.4696
6	1.4680	5.5570

If the volumes for the common-size wells above are utilized, Equation 1 is modified as follows:

Well volume = (h)(f) **Equation 2**

where:

h = height of water column (feet)

f = the volume in gal/ft or L/ft

For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed. The field notes should reflect the single-well volume calculations or determinations according to one of the above methods and a reference to the appropriate multiplication of that volume, (i.e., a minimum of 3 well volumes) clearly identified as a purge volume goal.

For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed.

If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. If, after 3 well volumes have been removed, the field parameters have not stabilized (see discussion in Section 2.2.3), additional well volumes (up to a total of 5 well volumes), should be removed. If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging. If, after 5 well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible with respect to turbidity. The conditions of sampling should be noted in the field book.

2.2.2 Low-flow Purging Approach

The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample. The term low-flow refers to the low velocity with which water enters the pump intake during purging and sampling. The objective is to draw representative saturated zone water through the well screen to the pump intake while avoiding disturbance of the stagnant water above the well screen through minimizing drawdown of the water column in the well. To achieve this, the flow rate should be adjusted to less than 1 L/min (usually, this will be a rate less than 500 ml/min and may be as low as 100 ml/min). Once drawdown stabilizes, the sampled water is isolated from the stagnant water in the well casing, thus eliminating the need for its removal. This sampling method is based on the principle that water within the screened zone passes through continuously and does not mix with water above the screen. Water entering the pump can be considered representative of water in the formation after drawdown and indicator parameters have stabilized.

When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval (or center of the water column within the well screen if the water level is below the top of the well screen) to help prevent disturbance of any sediment at the bottom of the well. If known, the pump can be placed adjacent to the areas with the highest hydraulic conductivity or highest level of contaminants. Dedicated pumps can be utilized to minimize disturbance of the water column. Subsequent sampling events should duplicate as closely as possible the pump intake depth and the stabilized flow rate from the previous events.

To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.

The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings. Note any flow rate

adjustments on the Groundwater Field Data Record. Once an appropriate purge rate has been achieved, record this information, continue purging until water quality indicator parameters have stabilized (see Section 2.2.3), and then sample the well.

Attempts should be made to avoid pumping a well dry. If drawdown cannot be maintained at less than 0.3 feet and the falling water level is approaching the top of the screened interval (or the top of the pump for sampling that began with the water level below the top of the screen), perform the following steps:

1. Reduce the flow rate, or turn the pump off and allow for recovery. (The pump must have a check valve to prevent backflow if it is shut off).
2. Begin pumping again at a lower flow rate.
3. If water draws down to the top of the screened interval again (or the top of the pump for sampling that began with the water level below the top of the screen), turn the pump off and allow for recovery.
4. If two tubing volumes (including volume of water in the pump and flow-through cell) have been removed during purging, sampling can proceed the next time the pump is turned on without waiting for indicator field parameters to stabilize. The project-specific work plan or Project Manager should be consulted for guidance.
5. If this procedure is used, this should be recorded in the field book and/or on the Groundwater Field Data Record.

2.2.3 Field Parameter Stabilization During Purging

Stabilization criteria may depend on project objectives or regulatory-specific requirements. Refer to Appendix A for some of the regulatory-specific requirements for field parameter stabilization. Generally, an adequate purge with respect to the ground water chemistry is achieved when, stability for at least three consecutive measurements is as follows:

- pH ± 0.1 standard unit (SU)
- specific conductance within 3%
- turbidity within 10% for values greater than 5 nephelometric turbidity units (NTUs). If three turbidity readings are less than 5 NTUs, the values are considered as stabilized

Other parameters, such as DO, may also be used as a stabilization parameter. Typical stabilization goals for DO are within 0.2 mg/L or 10% saturation, whichever is greater. DO measurements should be conducted using either a flow-through cell or an over-topping cell to minimize or reduce potential oxygenation of the sample.

Because groundwater temperature is generally not very sensitive in distinguishing between stagnant casing water and formation water and is subject to rapid changes during purging, its usefulness is subject to question for the purpose of determining parameter stability. Even if temperature is not used to determine stability during well purging, it is still advisable to record the sample temperature, along with the other groundwater chemistry parameters, during well purging, as it may be needed to interpret other parameter results.

ORP is not always used as a stabilization parameter since it may also be subject to rapid changes during the purging process; however, it may be measured and recorded during well purging.

2.2.4 Special Considerations During Purging

Wells Purged Dry/Purge Adequacy

For wells with slow groundwater recovery, attempts should be made to avoid purging the well dry. This may be accomplished by slowing the purge rate. As water enters a well that has been purged dry, the water may cascade down the sand pack and/or the well screen, potentially stripping VOCs that may be present and/or potentially mobilizing soil fines into the re-accumulating water column.

However, even with slower purge rates, in some situations, a well may be pumped or bailed dry (evacuated) during the purging process. In these situations, evacuation generally constitutes an adequate purge and the well may be sampled following sufficient recovery (enough volume to allow filling of all sample containers). **It is not necessary that the well be evacuated three times before it is sampled.** Purging parameters should be measured and recorded during sample collection to serve as the measurements of record for the sampling event.

It is particularly important that wells be sampled as soon as possible after purging to maintain sample representativeness. If adequate volume is available upon completion of purging, the well should be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered. If possible, sampling of wells that have a slow recovery should be scheduled so that they can be purged and sampled in the same day after adequate volume has recovered. Wells of this type should, unless it is unavoidable, not be purged at the end of one day and sampled the following day.

Temporary Monitoring Wells

Procedures used to purge temporary groundwater monitoring wells may differ from permanent wells, because temporary wells are installed with different DQOs for immediate sample acquisition. Wells of this type may include standard well screens and risers placed in boreholes created by hand augering, power augering, or by drilling. Alternatively, they may consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as a direct push Wellpoint®, a Geoprobe® Screen Point 15/16 sampler, or a Hydropunch® sampler.

Purging to address stagnant water may not necessarily apply to temporary wells, because stagnant water is not typically present. It is important to note, however, that the longer a temporary well is in place and not sampled, the more stagnant the water column may become, and the more appropriate it may be to apply, to the extent possible, standard permanent monitoring well purging criteria.

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well installation procedures disturb the existing saturated conditions, resulting primarily in increased turbidity. Therefore, the goal of purging, if conducted, may be to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure. Low turbidity conditions in these types of wells that are completed within the limit of suction are typically and

routinely achieved by the use of low-flow/low-stress purging techniques using variable-speed peristaltic pumps.

2.2.5 Equipment Considerations for Purging

Monitoring well purging is accomplished by using in-place plumbing and dedicated pumps or by using portable pumps/equipment when dedicated systems are not present. The pump of choice is usually a function of the purging approach (e.g., multiple-volume vs. low-flow), well diameter, the DTW, the total depth of the well, the amount of water that is to be removed during purging, the specific analytical testing program for the well, and the equipment previously used during purging and sampling of the well. A peristaltic pump is appropriate for purging whenever the head difference between the sampling location and the water level is less than the limit of suction (approximately 25' to 30') and the volume to be removed is reasonably small. For wells where the water level is below the limit of suction, and/or where there is a large volume of water to be purged, the variable-speed electric submersible pump or adjustable-rate bladder pumps would be appropriate. Bailers may also be used for purging in appropriate situations (e.g., shallow wells with small purge volumes); bailers are not suitable for low-flow purging.

The following subsections describe well evacuation devices that are most commonly used. Other devices are available but are not discussed in this SOP due to their limited use. Site-specific operating procedures should be developed in the case that an uncommon purge device is used.

2.2.5.1 Purging with a Suction Pump

There are many different types of suction pumps. They commonly include: centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that incorporates a roller to squeeze flexible tubing, thereby creating suction. This tubing can be dedicated to a well for re-use or discarded. It is recommended that 1/4 inch or 3/8 inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

(a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2 (applicable to peristaltic pumps only).
(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.
(c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer's specifications.
(d) Ensure that the pump tubing is set at the pre-determined pump intake depth.
(e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.

(f) Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, adjust the rate accordingly or, if consistent with the purging and sampling objectives, lower the tubing further into the well and continue pumping.

(g) Using the water quality meter, take an initial reading of the required indicator parameters. All measurements, except turbidity, must be obtained using a transparent flow-through cell unless an unforeseen situation makes this impractical or inadvisable. Initially, turbidity may be elevated. Once turbidity has decreased to a measurable range, begin monitoring indicator parameters at approximately every 3-5 minutes, or as appropriate. Please note that flow-through cell size should be taken into account in conjunction with the flow rate to determine the length of time between water quality parameter readings. At least one flow-through cell volume should be turned over between readings. For example, if the flow through cell size is 500 mL and the flow rate is 100 mL/min, then it would be appropriate to measure water quality parameters every 5 minutes.

(h) Record the readings on the Groundwater Field Data Record. The monitoring probes must be submerged in water at all times. Record the indicator parameters, along with the water level, as described in Step (g) above. If removing a specified volume of water (e.g., 3-5 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. Stabilization criteria are discussed in Section 2.2.3.

Particulate build-up in the flow-through cell may impact indicator parameters. If the cell must be cleaned during pumping operations, continue pumping and disconnect the cell for cleaning, then reconnect and continue monitoring. Record the start and stop times, and describe the cleaning steps in the field book.

If indicator parameter stabilization is required and parameters have not stabilized after 2-hours of purging (or other pre-determined length of time), one of three options may be taken after consultation with the Project Manager:

1) continue purging until stabilization is achieved;
2) discontinue purging, do not collect any samples, and record in the field book and/or on the Groundwater Field Data Record the stabilization conditions and steps taken to attempt to achieve stabilization; or,
3) discontinue purging, collect samples and document attempts to achieve stabilization.

NOTE: If parameters do not stabilize, or turbidity remains greater than 5 NTU within the project-determined time range (EPA recommends up to 2 hours), contact the Project Manager to develop a modified sampling approach.

(i) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.

(j) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.2.5.2 Purging with a Submersible Pump

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110-

or 220-volt AC power supply. Those units powered by compressed gas (e.g., bladder pump) normally use a small electric controller that also needs a 12-volt DC battery or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells and the height of the potentiometric surface/water table (e.g., pressure head). It is recommended that 1/4-inch or 3/8-inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

(a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2.

(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.

(c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer's specifications. If the pump itself is being lowered into the well, ensure a safety line is attached.

(d) Non-dedicated purge/sampling vs. dedicated purge/sampling systems.

Dedicated systems: Pump has already been installed. Refer to historical monitoring well information, and record the depth of the pump intake in the field book and/or on the Groundwater Field Data Record.

Non-dedicated systems: Determine the target depth of the pump intake. Note that this may be a historical intake depth; see well construction data or the project-specific work plan. If there is not an established intake depth, the center of the screened interval should be targeted. If the measured water level is lower than the top of the well screen, position the pump intake at the midpoint of the water column. The intake should be generally 1 to 2 feet above the bottom of the well to minimize potential mobilization of any settled sediment, the risk of the pumping suction being broken, or the entrainment of air in the pump tubing and resulting sample. Slowly lower the pump, safety line, and tubing into the well to the pre-determined pump intake depth. The tubing should be cut to the desired length to assist in installing the pump. Measure the depth of the pump intake while lowering the tubing/pump into location. Record the pump intake depth in the field book and/or on the Groundwater Field Data Record. For deeper wells and large diameter wells, two staff members may be necessary to accomplish this task.

(e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.

(f) Measure the flow rate of the pump with a graduated container and stop watch. The pump pressure may need to be increased for discharge to occur. Record the volume of water collected for a period of 1 minute and calculate the flow rate as follows.

$$Flowrate\,(mL/min) = \frac{volume\,collected\ \ (mL)}{1\,minute}$$

(g) Measure the water level and record the flow rate and the water level. This should be performed every 3 to 5 minutes during purging. For low-flow purging, the flow rate should be adjusted to result in a rate between 100 to 500 mL/min; however, if drawdown of the well is observed, a slower flow rate may be necessary. If using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL volatile organic analysis (VOA) vial, if possible.

(h) Prior to recording the water quality indicator parameters, a minimum of one tubing volume should be purged. Note that this includes the volume of the flow-through cell.

(i) Proceed to steps (g) through (j) in Section 2.2.5.1.

2.2.5.3 Purging with a Bailer

(a) Determine the volume of water to be purged as described in Section 2.2.1.

(b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of tubing or other purging/sampling equipment with foreign materials.

(c) Use a well-dedicated bailer (i.e., used exclusively for that well only), a decontaminated bailer or an unused, disposable bailer.

(d) Attach an appropriate length of (a) bailing line, (b) Teflon®-coated bailing wire or (c) rope with Teflon®-coated stainless steel leader to reach the bottom of the well. Secure a knot or series of knots to the top of the bailer. Be sure to have additional length of line to facilitate handling of the bailer at the surface (typically 10 ft).

(e) Lower the bailer gently into the well until it reaches the water column and fills with water from the bottom. Note: It is recommended that the bailer be lowered into the water to a depth that prevents the water from entering the top of the bailer. This is done to prevent excess turbulence caused by filling from the bottom and the top simultaneously. Controlling the line attached to the bailer as it is lowered into the well is also important to prevent degassing of the water as the bailer impacts the water. In shallow wells, controlling the line is not too difficult; however, for wells of greater depths it is common to utilize a hand-over-hand (windmill) approach using both hands to control longer lengths of line and prevent the loops in the line from tangling with one another. This procedure is simple to learn and saves a good deal of time by preventing tangles. Do not allow the bailing line or rope to become contaminated by surface soil.

(f) Once the bailer is full of water, gently withdraw the bailer from the well until it comes out of the top of the well. Be sure to control excess line in your hands to prevent the rope and bailer from touching the ground, and then grasp the bailer as it appears at the top of the well.

(g) Immediately pour the water into a vessel for water quality measurements, and record the measurements in the field book or on the Groundwater Field Data Record (at the project-required frequency). Otherwise, pour water into a 5-gallon bucket or other vessel to track the volume purged. As a general rule, standard 2-inch bailers are able to hold about 1 liter of water when full. This process will have to be repeated several times to complete adequate purging of the well (e.g., three to five well volumes).

(h) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.

(i) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.3 Post-purging Groundwater Sample Collection

(a) New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.

(b) If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell or sample from the T-connector, if used. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.

(c) If using bottom-filling bailers,

- Slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling).
- Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.

2.3.1 Sample Collection Order

Fractions of the groundwater sample should be collected in the following order (i.e., decreasing volatility) unless otherwise specified in the project-specific work plan:

1. VOCs;
2. Semivolatile organic compounds (SVOCs);
3. Other organic parameters;
4. Unfiltered inorganic constituents (e.g., total metals);
5. Filtered inorganic constituents (e.g., dissolved metals); and
6. Other constituents.

During sample collection, allow the water to flow directly down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid in order to minimize aeration and turbulence and maintain sample integrity. The tubing should remain filled with water.

2.3.2 VOC Sample Collection

Collection of VOCs/Volatile Petroleum Hydrocarbons (VPH): Samples for VOCs will be collected first unless they are being collected by the "straw" method described in Section 1.6.2 (d), and the sample vial must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken to not flush any preservative out of the vial when topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected. Note: Extra VOC vials should be obtained prior to the sampling event in case this situation occurs.

Note: When using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 ml VOA vial, if possible.

When acid preservation is used for the collection of VOCs, the acid must be added to the vials before sample collection. However, in most cases 40-ml VOA vials come pre-preserved. If a pre-preserved vial effervesces upon the addition of sample, the acid preservative can be rinsed out of the vial with sample water and then used to collect the sample. The laboratory should be made aware that the affected sample will not be acid-preserved as this may affect the sample holding time. Note effervescence in the field book for future reference.

2.3.3 Non-VOC Sample Collection

Completely fill the remaining sample containers for all non-VOC analyses.

Preserve the non-VOC samples in accordance with method and project-specific requirements following sample collection if the sample containers are not pre-preserved. (**NOTE:** Pre-preserved vials may be supplied by the laboratory, depending on the program).

2.3.4 Field Filtering

Depending upon project requirements, field filtering may be performed for non-VOC analyses. An in-line filter should be fitted at the end of the discharge tubing and the sample should be collected after the filter. Pre-rinse the in-line filter by allowing a minimum of 0.5 to 1 liter of groundwater from the well to pass through the filter prior to sampling. Ensure the filter is free of air bubbles prior to collecting samples. Preserve the filtered water sample immediately or directly fill pre-preserved containers (if provided). Clearly note "filtered" or "dissolved" on sample label and COC document.

2.4 Groundwater Sample Collection Without Purging (Passive Sampling)

Passive sampling can be defined as the free flow of contaminants from the media being sampled to a receiving phase in a sampling device. Depending upon the sampler, the receiving phase can be a solvent (e.g., water), chemical reagent, or porous adsorbent (e.g., activated carbon). While there are many different types of passive samplers, most have a barrier between the medium being sampled and the receiving phase. The barrier determines the sampling rate that contaminants are collected at a given concentration and can be used to selectively permit or restrict various classes of chemicals from entering the receiving phase.

There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers.

Passive samplers are deployed down a well to the desired depth within the screened interval or open borehole to obtain a discrete sample without using pumping or a purging technique. Most samplers are able to be stacked to obtain samples at multiple depths. Some samplers can also be used to measure contaminants in groundwater as it enters a surface water body.

Diffusion, or equilibrium, samplers are devices that rely on diffusion of the analytes to reach equilibrium between the sampler fluid and the well water. Samples are time-weighted toward

conditions at the sampling point during the latter portion of the deployment period. The degree of weighting depends on analyte and device-specific diffusion rates. Typically, conditions during only the last few days of sampler deployment are represented. Depending upon the contaminant of concern, equilibration times range from a few days to several weeks. Diffusion samplers are less versatile than grab samplers as they are not generally effective for all chemical classes.

Both the diffusion and integrating samplers depend upon permeation or diffusion through barriers that hold the receiving phase. This diffusion process is chemical and barrier specific. Diffusion samplers are commonly known as PDBs or rigid porous polyethylene (RPP) samplers. PDBs may be used to sample for VOCs, and RPPs may be used to sample for various organic and inorganic constituents. PDBs must be allowed to remain in the well for a sufficient period of time to allow the deionized water in the sampler to come into equilibrium with the constituents in the ambient groundwater.

Some regulatory agencies allow groundwater samples to be collected without purging the well. This may be accomplished by suspending a passive sampler in the well for a period of time appropriate for the type of passive sampler being used. It is important to confirm that the chosen sampler is compatible with the contaminants of concern including all VOCs of interest at the site.

Diffusion passive samplers are used most commonly and the procedure for their use is as follows:

(a) Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.

(b) New passive samplers are attached via PVC cable ties to a tether (a pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well. There should be sufficient well screen saturation within the well to completely cover the passive sampler. For VOCs, it is recommended that there should be several feet of groundwater above the top of the PDB.

(c) The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers). Longer equilibration times may be necessary in lower permeability formations. Once sufficient time for equilibration has passed, the PDB samplers can be retrieved when convenient.

(d) Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.

(e) Detach the passive sampler from the tether.

(f) Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.

(g) Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. Tilting the passive

sampler will control the flow rate. The VOA vials must be filled within the first several minutes of passive sampler retrieval. (Note that sample vials should be prepared and opened on a stable surface or holding device such as a foam pack. Decanting sample from passive samplers into containers requires techniques that may require some practice and patience.) Refer to Section 2.3.2 for special circumstances regarding the filling of VOA vials.

(h) A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.

(i) Dispose of the passive sampler after use.

2.5 Post-sampling Activities

(a) Cease pumping and, if system is non-dedicated, disassemble and decontaminate the purging and sampling equipment. Verify the end of the tubing is not submerged in the purge bucket prior to turning off the pump.

(b) Dispose of the bailer (if disposable) and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the bailer in a plastic bag for transport to the site decontamination area.

(c) Dispose of the empty passive sampler and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the empty passive sampler in a plastic bag for transport to the site decontamination area

(d) Replace the well cap and well cover on the well and lock the outer casing (if present).

(e) Label each sample. If the labels are covered with clear tape, ensure this is not performed for VOA vials.

(f) Place all samples in a cooler with ice.

(g) Ensure samples are delivered to the laboratory well before the required holding time expires.

(h) Consult the project-specific work plan to determine if a calibration check is required at the end of the day for the water quality parameters.

3.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager.

Each project must consider investigation-derived waste disposal methods and have a plan in place prior to performing the field work. Provisions must be in place as to what will be done with investigation-derived waste. If investigation-derived waste cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The collection of QC samples is dependent upon the DQOs. Project-specific work plans should be consulted to determine the required frequency of QC sample collection.

4.1 Field Duplicates

The following procedures should be used for collecting field duplicates of groundwater samples:

(a) For QC purposes, each duplicate sample will be typically submitted to the laboratory as a "blind" duplicate sample, in that a unique sample identification not tied to the primary sample identification will be assigned to the duplicate (e.g., DUP-01). Standard labeling procedures used for groundwater sampling will be employed. However, a sample collection time will not be included on the sample label or the COC form. The actual source of the duplicate sample will be recorded in the field book and/or on the Groundwater Field Data Record.

(b) Each duplicate sample will be collected simultaneously with the actual sample by alternately filling sample and duplicate bottles. Following the order of collection specified for each set of containers (VOCs, SVOCs, other organic parameters, unfiltered inorganic constituents, and filtered inorganic constituents), the duplicate sample containers will be alternately filled with groundwater for each parameter.

(c) All collection and preservation procedures outlined for groundwater sampling will be followed for each duplicate sample.

4.2 Equipment Blanks

Equipment blanks include reagent water that is run through the bailer (if not disposable), rope, leader line, decontaminated pump, a representative section of the pump's tubing, or any other piece of sampling equipment that may have come in contact with the sample. The equipment blanks are collected and preserved in the same sample containers as field samples. If dedicated or disposable systems are used, equipment blanks are not required, although an initial blank could be performed to demonstrate that the dedicated equipment is clean prior to use. If only dedicated tubing is used, the equipment blank will include only the pump in subsequent sampling events. A passive sampler is considered a dedicated device and no equipment blank is required.

Ideally, the reagent water should come from the laboratory and be certified clean. If not certified and/or if not from the laboratory performing the analyses, a separate water blank that has not run through the sampling equipment should be sent to the laboratory for analysis.

4.3 Trip Blanks

Trip blanks will be used to check for potential contamination of VOCs via migration during storage and shipping. Trip blanks typically consist of two to three 40 mL VOA vials filled with analyte-free water and preserved with hydrochloric acid (HCl) to pH <2 SU. Trip blank containers are usually supplied pre-filled by the laboratory. Trip blanks are typically submitted to the laboratory at a frequency of one per cooler for coolers that contain samples for VOC and/or VPH analysis. Trip blanks are analyzed by the laboratory for VOCs and/or VPH, depending on field sample analyses.

4.4 MS/MSDs and MS/Duplicates

MSs are an additional analysis of a sample spiked by the laboratory with a subset or all of the target analytes and are used to demonstrate the accuracy of analytical methods for a given matrix. MSDs are an additional analysis of a sample spiked with a subset or all of the target analytes and are also used to demonstrate the accuracy of analytical methods for a given matrix. MS/MSDs also provide a measure of analytical precision for a given matrix. Duplicates are an additional analysis of a sample and are used to demonstrate the precision of analytical methods for a given matrix.

Triplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform the MS/MSD analyses for organic parameters. Duplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform MS/Duplicate analyses for inorganic parameters. The sample designated for MS/MSD or MS/Duplicate analyses should be noted in the Comments column of the COC document.

4.5 Temperature Blanks

Temperature blanks consist of a sample container filled with non-preserved water (potable or distilled) and typically are included in all coolers that contain samples that require temperature preservation. These may be added to the coolers by the field team if not provided by the laboratory. Temperature blanks must remain inside the coolers on ice during the sampling process.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

Record the sample location, sample identification, and date and time of collection in the field book and/or the Groundwater Field Data Record. The Groundwater Field Data Record (Attachment B) should be used to record the following information:

- Volume of each sample
- Sample identification number
- Sample location (sketch of the sample point)
- Time and date sample was collected
- Personnel performing the task
- Volume of water removed
- Purging time
- Flow rate during purging and sampling
- Weather conditions during sampling
- Field parameters such as water level, pH, temperature, conductivity, turbidity, ORP, and DO
- Sample collection equipment and method used
- Decontamination procedures
- Analytical parameters
- Preservation method and amount of preservative

All sample numbers must be documented on the COC form that accompanies the samples during shipment. Any deviations from the records management procedures specified in the project-specific work plan must be approved by the Project Manager and documented in the field book.

6.0 REFERENCES

Interstate Technology Regulatory Council (ITRC). March 2006. *Technology Overview of Passive Sampler Technologies.*

USEPA. November 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530-R-93-001. USEPA Office of Solid Waste.

USEPA. April 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA Ground Water Issue. EPA/540-S-95-504. USEPA Office of Solid Waste and Emergency Response.

USEPA. May 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*. EPA/542-S-02-001. USEPA Office of Solid Waste and Emergency Response.

USEPA. September 2004. Field Sampling Guidance Document #1220: Groundwater Well Sampling. USEPA Region 9 Laboratory Richmond, California.

USEPA, January 19, 2010. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. USEPA Region 1, Rev. 3.

USEPA. March 6, 2013. *Groundwater Sampling.* SESDPROC-301-R3. USEPA Region 4, Science and Ecosystem Support Division. Athens, Georgia.

USEPA. April 22, 2014. Passive (No Purge) Samples. http://www.clu-in.org/characterization/technologies/default.focus/sec/Passive_%28no%20purge%29_Samplers/cat/Overview/

7.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
0	AUGUST 2014	NOT APPLICABLE

Attachment A:

Groundwater Field Parameter Stabilization Criteria for Selected Jurisdictions

Jurisdiction	Information Source	Applicable Stabilization Criteria
USEPA Region 1	Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells; U.S. Environmental Protection Agency Region 1, January 19, 2010. http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf (for low flow PDF) http://www.epa.gov/region1/lab/qa/qualsys.html (for EPA's Quality System Documents)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: ±3% Turbidity: ±10% if >5 NTUs; if three Turbidity values are <5 NTU, consider the values as stabilized Dissolved Oxygen: ±10% if >0.5 mg/L, if three Dissolved Oxygen values are <0.5 mg/L, consider the values as stabilized Oxidation/Reduction Potential: ±10 millivolts
USEPA Region 2	Groundwater Sampling Procedure: Low Stress (Low Flow) Purging and Sampling, SOP # SST-7, Revision No. 1, November 2010.	Same as above
USEPA Region 4	USEPA Region 4 SOPs: http://www.epa.gov/region4/sesd/fbqstp/index.html See Chemical Parameter Stabilization Criteria (section 3.2.1.1.2 of Groundwater Sampling SOP, revision 3/6/2013: http://www.epa.gov/region4/sesd/fbqstp/Groundwater-Sampling.pdf	pH: ±0.1 unit Specific Conductance: ±5% Temperature: Not used Turbidity: "Stabilized" (no criteria specified) if >10 NTUs ; if three Turbidity values are <10 NTUs, consider the values as stabilized Dissolved Oxygen (optional parameter): ±0.2 mg/L or ±10% of saturation, whichever is greater Oxidation/Reduction Potential: Not used
USEPA Region 5	Ground Water Forum Issue Paper (May 2002, Yeskis and Zavala) http://www.epa.gov/superfund/remedytech/tsp/download/gw_sampling_guide.pdf A minimum set of parameters would include pH, conductivity, and turbidity or DO. Puls and Barcelona, 1996 (pH, specific conductance, ORP, turbidity) Wilde et al., 1998 (pH, turbidity, DO)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: Not used Turbidity: ±10% if >10 NTUs Dissolved Oxygen: ±0.3 mg/L Oxidation/Reduction Potential: ±10 millivolts
USEPA Region 9	See USEPA Region 1 (above)	
USEPA Region 10	See USEPA Region 5 (above)	
Alabama	Alabama Environmental Investigation and Remediation Guidance (section C.3.1) http://www.adem.state.al.us/MoreInfo/pubs/AEIRGInvestigation.pdf	pH: ±0.1 unit Specific Conductance: ±10% Temperature: "Constant" (no criteria specified) Turbidity: Stabilized (no criteria specified), or <10 NTUs Dissolved Oxygen: No criteria specified Oxidation/Reduction Potential: No criteria specified

Jurisdiction	Information Source	Applicable Stabilization Criteria
Indiana	Indiana Department of Environmental Management The Micro-Purge Sampling Option http://www.in.gov/idem/files/remediation_tech_guidance_micro-purge.pdf The parameters normally measured for stability (listed in increasing order of sensitivity) are pH, temperature, specific conductivity, oxidation-reduction potential, DO and turbidity. At least one of the last three listed must be used.	pH: ±0.1 unit Specific Conductance: ±3% Temperature: ±3% Turbidity: ±10% Dissolved Oxygen: ±10% Oxidation/Reduction Potential: ±10 millivolts (document says microvolts, but that may be an error)
Michigan	MDEQ Part 201 Op Memo 2, Attachment 5 http://www.michigan.gov/documents/deq/deq-rrd-OpMemo_2_Attachment5_249853_7.pdf	No specific values to determine stabilization are listed, but the Op Memo lists several other groundwater sampling guidance documents. If a valid reference exists, then it can be used to justify a sampling approach and stabilization parameters.
New Jersey	New Jersey Department of Environmental Protection http://www.state.nj.us/dep/srp/guidance/fspm/	pH: ± 0.1 unit Specific Conductance: ± 3% Temperature: ± 3% Dissolved Oxygen: ± 10% Turbidity: ± 10% for values greater than 1 NTU ORP/Eh: ± 10 millivolts
Ohio	Ohio EPA SOPs: http://www.epa.state.oh.us/portals/30/rules/FSOPs.pdf See Purging Stabilization Criteria (SOP 2.2.4, dated January 2, 2007, review in progress)	pH: ±0.1 unit Specific Conductance: ±3% Temperature: No criteria specified Turbidity: Below 10 NTUs ideal; ±10% if greater than 10 NTUs Dissolved Oxygen: ±0.3 mg/L Oxidation/Reduction Potential: ±10 millivolts
This table was last updated in July 2014.		

Attachment B:

Example Groundwater Field Data Records

TRC

Groundwater
Field Data Record

Project: Project No.: Date/Time: Sheet ___ of ___

TRC Personnel: Well ID:

WELL INTEGRITY

	YES	NO
Protect. Casing Secure	☐	☐
Concrete Collar Intact	☐	☐
PVC Stick-up Intact	☐	☐
Well Cap Present	☐	☐
Security Lock Present	☐	☐

Sampling Equipment: _____

Flow-thru Cell Volume: _____

PID SCREENING MEAS.

Background	
Well Mouth	

Protective Casing Stick-up _____ ft. (from ground)

Riser Stick-up (from ground) _____ ft.

WELL DIAMETER ☐ 2 inch ☐ 4 inch ☐ 6 inch

Other: _____

WELL MATERIAL

☐ PVC ☐ SS

Other: _____

Well Depth _____ ft. ☐ top of riser ☐ top of casing ☐ _____ ☐ measured ☐ historical

Water Depth _____ ft. LNAPL/DNAPL Depth = _____

Well Volume _____ NAPL Thickness = _____

Depth of pump intake: _____

Static water level after pump put into well: _____

Initial purge Rate/ Water Level (100-400 ml/min):

Adjusted purge Rates/time/WL(record changes)

Flow rate at time of sampling:

Total volume of water purged:

FIELD WATER QUALITY MEASUREMENTS (record at appropriate intervals)

Time									
Temp. (°C)									
Conduct. (µmhos/cm)									
DO (mg/L)									
pH (su)									
ORP (millivolts)									
Turbidity (NTU)									
Flow (ml/min)									
Depth To Water (ft)									
Cumulative Purge Vol. (gal or L)									

Time						
Temp. (°C)						
Conduct. (µmhos/cm)						
DO (mg/L)						
pH (Std. Units)						
Eh/ORP (millivolts)						
Turbidity (NTU)						
Flow (ml/min)						
Depth To Water (ft)						
Cumulative Purge Vol. (gal or L)						

Stabilization Criteria*
(3 consecutive readings)
- Temperature: ± 3 %
- Conduct. (µmhos/cm): ± 3 %
- DO (mg/L): ± 10 % (for values >0.5 mg/L)
- pH (Std. Units): ± 0.1 SU
- ORP (millivolts): ± 10 mV
- Turbidity (NTU): +/- 10 % (for values >5.0 NTUs)
- Drawdown: < 0.3 ft (can be greater as long as water level stabilizes above well screen)

	Purge	Sample
Peristaltic Pump	☐	☐
Submersible Pump	☐	☐
Bladder Pump	☐	☐
Bailer	☐	☐
Other: _____	☐	☐

Comments: _____

Analytical Parameter	Filtered (Y/N)	Preservation	# Bottles	Size/Type Bottles	Time Collected	QC	Sample #

* Consult the applicable regulatory guidance for the specific criteria.

Signed: _____ Rev: April 2014

WATER SAMPLE LOG

PROJECT NAME:		PREPARED			CHECKED		
PROJECT NUMBER:		BY:		DATE:	BY:		DATE:

SAMPLE ID: WELL DIAMETER: ☐ 2" ☐ 4" ☐ 6" ☐ OTHER _____

WELL MATERIAL: ☐ PVC ☐ SS ☐ IRON ☐ GALVANIZED STEEL ☐ OTHER _____

SAMPLE TYPE: ☑ GW ☐ WW ☐ SW ☐ DI ☐ LEACHATE ☐ OTHER _____

PURGING	TIME:	DATE:	SAMPLE	TIME:	DATE:

PURGE METHOD: ☐ PUMP _____ ☐ BAILER _____

DEPTH TO WATER: _____ T/ PVC

DEPTH TO BOTTOM: _____ T/ PVC

PUMP INTAKE DEPTH: _____ T/ PVC

FLOW-THRU CELL VOLUME _____ LITERS

WELL VOLUME: _____ ☐ LITERS ☐ GALLONS

VOLUME REMOVED: _____ ☐ LITERS ☐ GALLONS

COLOR: _____ ODOR: _____

TURBIDITY

☐ NONE ☐ SLIGHT ☐ MODERATE ☐ VERY

DISPOSAL METHOD: ☐ GROUND ☐ DRUM ☐ OTHER

PH: _____ SU CONDUCTIVITY: _____ umhos/cm

ORP: _____ mV DO: _____ mg/L

TURBIDITY: _____ NTU

☐ NONE ☐ SLIGHT ☐ MODERATE ☐ VERY

TEMPERATURE: _____ °C OTHER: _____

COLOR: _____ ODOR: _____

FILTRATE (0.45 um) ☐ YES ☐ NO

FILTRATE COLOR: _____ FILTRATE ODOR: _____

QC SAMPLE: ☐ MS/MSD ☐ DUP- _____

COMMENTS:

TIME	PURGE RATE (ML/MIN)	PH (SU)	CONDUCTIVITY (umhos/cm)	ORP (mV)	D.O. (mg/L)	TURBIDITY (NTU)	TEMPERATURE (°C)	WATER LEVEL (FEET)	CUMULATIVE PURGE VOLUME (GAL OR L)
									INITIAL

NOTE: STABILIZATION TEST IS COMPLETE WHEN 3 SUCCESSIVE READINGS ARE WITHIN THE FOLLOWING LIMITS:

pH: +/- **10 %** COND.: +/- **10 %** ORP: +/- **10 %** D.O.: +/- **10 %** TURB: +/- **10 %** or </= **5** TEMP.: +/- **0.5°C**

BOTTLES FILLED PRESERVATIVE CODES A - NONE B - HNO3 C - H2SO4 D - NaOH E - HCL F - _____

NUMBER	SIZE	TYPE	PRESERVATIVE	FILTERED	NUMBER	SIZE	TYPE	PRESERVATIVE	FILTERED
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N
				☐ Y ☐ N					☐ Y ☐ N

SHIPPING METHOD: _____ DATE SHIPPED: _____ AIRBILL NUMBER: _____

COC NUMBER: _____ SIGNATURE: _____ DATE SIGNED: _____

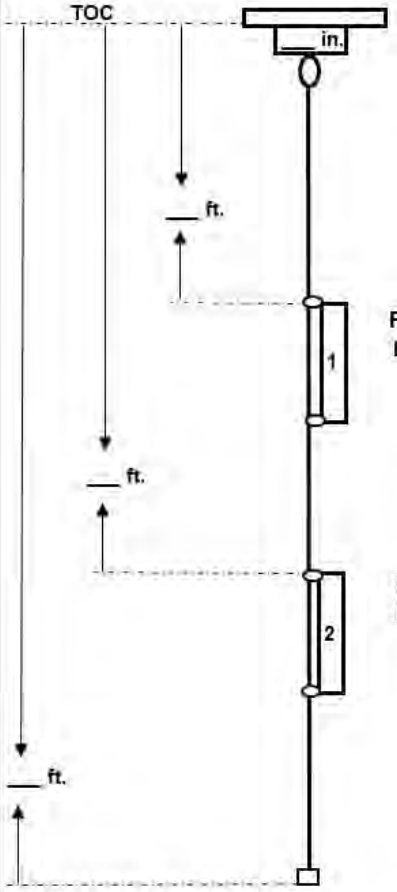
TRC

Groundwater Sampling Record for Organics (For Wells with Passive Diffusion Bags)

Project Name/No:

Well ID:

Installation of PDBs:	Sampling of PDBs:
TRC Personnel: _____	TRC Personnel: _____
Date: _____	Date: _____
Time: _____	DTW (ft): _____
DTW (ft): _____	



PDB #1
Length: ___ in.

Sample ID: _____
Sample Time: _____
Evidence of algae, iron or other coatings?: _____

PDB #2
Length: ___ in.

Sample ID: _____
Sample Time: _____
Evidence of algae, iron or other coatings?: _____

Measured well depth during tether installation: ___ ft.

Field Notes:

Rev. April 2014

Attachment C: SOP Fact Sheet

GROUNDWATER SAMPLING

PURPOSE AND OBJECTIVE

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling. All three approaches are summarized in this document.

WHAT TO BRING

- Site-specific HASP and field book
- Project-specific work plan
- Figure or site map showing well locations and table showing well construction details
- Field data sheets from previous sampling event
- Well wrenches, ratchet set, and turkey baster to remove standing water from flushmount manholes
- Bolt cutters, padlocks and keys
- Water level meter of sufficient length
- Decontaminated pump, control box, power source (i.e., battery, generator, etc.)
- Tubing (Teflon®, Teflon®–lined polyethylene, or HDPE, type dependent upon project objectives)
- Multi-parameter instrument and flow-through cell (typically should include: pH, temperature, conductivity, ORP, and DO)
- Turbidity meter
- Equipment decontamination supplies (refer to RMD SOP 010, *Equipment Decontamination*)
- Appropriate PPE
- Field book
- Sample bottleware, labeled cooler, ice, temperature blank and blank COC forms; may also need field blank bottles and reagent-grade water
- Zip-loc® plastic bags
- Groundwater field data records
- Graduated cylinder and stop-watch
- Rope for tying off pump at desired intake
- Indelible marking pens
- Bubble wrap
- 5-gallon bucket(s)

As Needed:

- Calibrated PID or FID for well mouth readings
- Oil/water interface probe of sufficient length
- Drums for purge water, grease pen and adhesive drum labels; appropriate crescent or socket wrench
- Filtration equipment, if required (0.45 micron filters, or as otherwise required for the project)
- Other non-routine PPE such as Tyvek coveralls or respirators
- Traffic cones
- Field calibration sheets and calibration solutions

OFFICE

- Prepare/update the site-specific HASP; make sure the field team is familiar with the most recent version.
- Review the project-specific work plan with the Project Manager and/or the field team leader. Discuss the following:
  - Communication procedures;
  - Sampling order and designation;
  - Collection and sample method;
  - Analytical parameters, holding times and turn-around times;
  - Laboratory (contact/shipping info, COC, billing references);
  - Purge water management (Drums? Discharge to ground?);
  - QC sample collection; and
  - Decontamination procedures.
- Verify that monitoring wells will be accessible and/or coordinate to have a site contact available to assist.
- Make sure that monitoring well sample designations and QC sample designations/frequency are understood.
- Confirm that all necessary equipment is available in-house or has been ordered. Rental equipment is typically delivered the day before fieldwork is scheduled. Prior to departure or mobilization to site, test equipment and make sure it is in proper working order. Have rental equipment supplier contact information available for use in field.
- Review sample bottle order for accuracy and completeness and damaged bottles.
- Discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager.

ON-SITE

GROUNDWATER SAMPLING

- Review the HASP with all field personnel, sign acknowledgement form and conduct Health & Safety tailgate meeting. Check in security, site contact, or designated person per project-specific work plan or Project Manager.
- Make sure appropriate PPE is worn by all personnel and work area is safe (i.e., utilize traffic cones; minimize interference with on-site activities and pedestrian traffic, etc.)
- Calibrate equipment (if applicable) and record all rental equipment serial numbers in the field book.
- Open wells to allow equilibration and collect full round of water level gauging before sampling is started (unless otherwise noted in project-specific work plan). Record the following:
  - Well mouth PID/FID reading (if necessary);
  - Depth to product and water;
  - Total well depth (not required if free product is measured unless otherwise noted in project-specific work plan); and
  - Condition of wells (i.e., lid broken, pad cracked, rusted lock) and collect photographs if site allows camera use.

SAMPLING PROCEDURES: PRE-PURGE

- Decontaminate pump.
- Take water level measurements prior to pump installation.
- Connect sampling tubing to pump outlet and lower to sample depth; **ALWAYS USE ROPE TO SECURE PUMP TO SURFACE.**
- The pump intake depth(s) for each well should be specified in the project-specific work plan (either specific depth or mid-point of saturated well screen).
- For wells with screened or open borehole intervals greater than 10 feet in length, sampling of multiple intervals may be required.
- If samples are to be collected from multiple depths from an individual well, always collect a sample from the shallowest depth first and leave enough extra tubing coiled at the surface so the pump can be lowered to the next interval; always try to cover excess tubing present at the surface to prevent the air temperature from influencing the measurements and exposure to contaminants on the ground;
- Be careful not to let the pump hit the bottom of the well.
- If using Teflon®-lined tubing, be sure that the lining does not bunch up around the connection. This will restrict water flow and make the pump work harder than it has to.
- Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan.

SAMPLING PROCEDURES: MULTIPLE-VOLUME PURGING

- The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization.
- The field parameters should be recorded at regular volumetric intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters.
- Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. Once this information is known, the well volume can be calculated using the following equation:

  Well Volume (V) = $\pi r^2 h$

- For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed.
- For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed.
- If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume.
- In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection.
- If, after 3 well volumes have been removed, the field parameters have not stabilized, additional well volumes (up to a total of 5 well volumes), should be removed.
- If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging.

SAMPLING PROCEDURES: LOW-FLOW PURGING

- The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample.
- When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval to help prevent disturbance of any sediment at the bottom of the well.

GROUNDWATER SAMPLING

- To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.
- The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings.
- Attempts should be made to avoid pumping a well dry.

Field Parameter Stabilization During Purging

- Generally, an adequate purge with respect to the groundwater chemistry is achieved when stability for at least three consecutive measurements is achieved. See stability requirements in Appendix A of this SOP.

POST-PURGE GROUNDWATER SAMPLE COLLECTION

- New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.
- If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.
- If using bottom-filling bailers, slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling). Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.
- Collect groundwater samples in the following order:
  - VOCs;
  - SVOCs;
  - Other organic parameters;
  - Unfiltered inorganic constituents; and
  - Filtered inorganic constituents.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Preserve the non-VOC samples in pre-preserved vials supplied by the laboratory or if the sample containers are not pre-preserved, preserve the non-VOC samples in accordance with method and project-specific requirements.
- Depending upon project requirements, filtering may be performed. See procedures listed in Section 2.3.4 of this SOP. Clearly note "filtered" on the sample label and the COC.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.
- Decontaminate non-disposable sampling equipment between uses.

PASSIVE SAMPLING

- There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers. Be aware of sample holding times, and arrange for samples to be in the laboratory's possession accordingly.
- Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.
- New passive samplers are attached via PVC cable ties to a tether (pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well.
- The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers).
- Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.
- Detach the passive sampler from the tether.
- Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.

GROUNDWATER SAMPLING

- Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. The VOA vials must be filled within the first several minutes of passive sampler retrieval.
- A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.
- Dispose of the passive sampler after use.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.

DOs AND DO NOTs OF GROUNDWATER PURGING AND SAMPLING

DOs:

- DO have the following items when going into the field: site-specific work plan; site-Specific HASP; appropriate PPE (steel-toed boots, safety glasses, etc.) as required by the Site-Specific HASP; field book and a water-proof ball-point pen; business cards; nitrile gloves; well keys; copies of well installation forms and field data forms from previous sampling event.
- DO make sure that the equipment is set up properly and the bottleware is nearby and ready to be filled. There is little time between taking parameters.
- DO look at the water quality parameters from the previous round of sampling. If there is a large deviation from the previous round's measurements, make sure the meters are properly calibrated and the parameter units are the same. Otherwise, consult the Project Manager or field team leader.
- DO fill sample bottles slowly to make sure that they are not overfilled and that preservative does not become diluted. If collecting filtered samples, fill all non-filtered first, then fill filtered samples - if water is very silty, more than one filter might be required to fill sample bottles.
- DO record the time that purging begins and ends. "Purge Stop" and sample start time are the same.
- DO call your Project Manager or field team leader if unexpected conditions are encountered or at least daily to update them. It is also recommended to call when sampling is winding down for the day to make sure that the project-specific work plan has been fully implemented and there are no additional tasks to complete. Provide shipping tracking numbers to the Project Manager and laboratory contact.
- DO have the numbers for laboratory, vehicle rental and equipment rental providers readily available while in the field.
- DO record sample locations and parameters in the field book and the Groundwater Field Data Records as you purge.
- DO check on the purging setup frequently to make sure proper equipment function is maintained.
- DO bring ice to the site in the morning so that samples are kept cool throughout the entire event. Storing samples in a warm cooler can invalidate sample results and may result in re-sampling on your own time.

DO NOTs:

- DO NOT sign anything in the field. This includes disposal documentation, statements, etc.; call the Project Manager if this is an issue.
- DO NOT allow the pump or sampling equipment to hit the bottom of the well - If the pump hits the bottom of the well, it can stir up mud. Remember, the goal of low-flow sampling is to collect non-turbid samples.
- DO NOT use non-indelible ink to label samples or record field notes – if the field book gets wet, notes become illegible.
- DO NOT leave air bubbles in VOA vials.
- DO NOT pour any extracted water back down into the well.
- DO NOT lean over wells with pens, keys, cell phones, tools, etc. in your pocket.
- DO NOT use clear tape to cover labels on certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.

APPENDIX B

GROUNDWATER MONITORING FIELD DATA SHEETS

FARALLON CONSULTING

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Sacramento

FIELD REPORT

Date: 12/23/2015 **Project #:** 283-005 **Task #:** 008

Project: Fmr. Cummings Oil Lease Site **Site Address:** 908 NW Kerron Ave

Client: TRC **Contractor:** NA

Weather: Intermittent Rain **Temp:** 40° F

Equipment Used: Field Truck, Level D PPE, Peristaltic Pump, Water Level, YSI, Decon Kit

Hours: NA (Contractor) 13.4 (Staff) **Mileage:** 220 **Project Manager:** Stacy Patterson

Prepared By: Jared Kerr **Reviewed By:**

Comments:

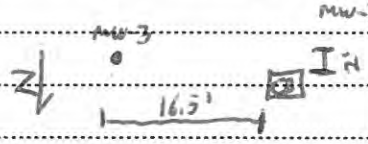
0545 Depart from Issaquah, WA
0752 Arrive on site, conduct H&S meeting
0800 Begin opening all wells
0810 All wells located except MW-3. It is beneath a layer of gravel of unknown thickness. Attempts at locating MW-3 will be made throughout the day. MW-3 located at 0935.
0855 Begin taking water level measurements
0916 MOB to MW-1, begin purging @ 0934.
1003 Sample MW-1, ID: 283-005-MW-1-122315
1012 MOB to MW-5, begin purging @ 1036
1110 Sample MW-5, ID: 283-005-MW-5-122315
1118 MOB to MW-6, begin purging @ 1147. Flex tubing had to be changed. Previous flex tubing was worn, preventing the Peristaltic Pump from operating properly due to a low friction coefficient of the flex tubing.
1222 Sample MW-6, ID: 283-005-MW-6-122315
1235 Depart site for lunch
1312 Return to site, MOB to MW-7.
1330 Trouble drawing water with Peristaltic pump, Flex tubing changed

FIELD REPORT (continued)

Project: Fmr. Cummings Oil Lease Site **Date:** 12/23/15 **Project #:** 283-005 **Task #:** 008

1424 Sample MW-7, ID: 283-005-MW-7-122315

1435 MOB to MW-3, begin purging at 1504



1532 Sample MW-3, ID: 283-005-MW-3-122315

1544 MOB to MW-2, begin purging at 1607.

1635 Sample MW-2, ID: 283-005-MW-2-122315

1650 Label Purge water drum. Purge water drum is located at NE corner of the site

1654 Depart site

1907 Return to Issaquah, WA.

O.K.

FARALLON CONSULTING

NAPL and Groundwater Level Measurement Summary Form

Date: 12/23/2015 Project Name: Former Cummings Oil Lease Site

Project Number: 283-005 Task: 008 Project Location: Winlock, WA

Equipment Used: Water Level, Decon Kit Project Manager: Stacy Patterson

Well Number	Time	Depth to NAPL (feet)	Depth to Water (feet)	NAPL Thickness (feet)	Total Well Depth (feet)	Comments
MW-1	0856		2.15		11.27	
MW-2	0858		2.31		10.95	Petroleum Hydrocarbon odor
MW-3	1030		2.24		9.63	16.5' E & 2' S from SW nearest corner of CB dve W.
MW-4	0903		0.33		11.03	
MW-5	0909		3.63		10.30	
MW-6	0900		2.92		10.15	Petroleum Hydrocarbon odor
MW-7	0904		4.75		9.05	

Prepared By: Jared Kerr

LOW FLOW WELL PURGING AND SAMPLING DATA

WELL NO: MW- 1

DATE: 12/23/15 | PROJECT NAME: Fmr. Cummings Oil Lease Site | PROJECT NO: 283-005

WEATHER CONDITIONS: Rain

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	11,27 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	2,15 FT.
LENGTH OF WATER	FT.	CALCULATED ONE WELL VOLUME[1]:	GAL.
DEPTH OF SAMPLE POINT	~~5 ft bgs~~ 6.5' below TOC FT.	ESTIMATED VOLUME PURGED	1,5 GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" Polyethylene

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
0934	INITIAL	3,52	--	--	--	--	--	--	
0937	150	3,64	8,64	0,273	6,30	1,69	25,2	-10,3	Clear, no odor
0940	150	3,70	8,61	0,273	6,31	1,51	23,3	-12,8	
0943	150	3,71	8,51	0,272	6,30	1,48	23,8	-14,1	
0946	150	3,77	8,52	0,271	6,30	1,47	21,6	-15,9	
0949	150	3,82	8,49	0,272	6,31	1,45	20,4	-17,1	
0952	150	3,90	8,50	0,272	6,31	1,43	18,3	-18,7	
0955	150	3,94	8,51	0,272	6,31	1,40	17,0	-20,0	
0958	150	3,95	8,52	0,272	6,31	1,39	17,3	-21,4	

J.K.

DEPTH TO WATER AFTER PURGING (TOC) FT. | SAMPLE FILTERED ☐ YES ☐ NO SIZE ____

NOTES: Sample point ≈ 6.5' JK ~~bgs~~ below TOC

SAMPLE TIME: 1003 ID# 283-005-MW-1-122315

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

WELL NO: MW-2

DATE: 12/23/15	PROJECT NAME: Fmr. Cummings Oil Lease Site	PROJECT NO: 283-005

WEATHER CONDITIONS: Rain

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ☐ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	10.95 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	2.31 FT.
LENGTH OF WATER	— FT.	CALCULATED ONE WELL VOLUME[1]:	— GAL.
DEPTH OF SAMPLE POINT	2-3' below WL FT.	ESTIMATED VOLUME PURGED	1.5 GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" Polyethylene

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1607	INITIAL	3.51	--	--	--	--	--	--	Slightly Turbid
1610	200	3.81	10.27	0.186	6.53	6.62	101.0	103.7	Hydrocarbon odor
1613	200	3.91	10.19	0.188	6.53	6.39	97.0	8.04	
1616	200	3.97	10.22	0.189	6.54	5.48	78.7	2.21	
1619	200	4.06	10.41	0.191	6.54	3.97	65.1	-5.37	
1622	200	4.12	10.43	0.191	6.54	3.68	52.5	-14.1	
1625	200	4.17	10.36	0.190	6.54	3.52	40.8	-17.9	
1628	200	4.25	10.30	0.189	6.55	3.42	37.1	-21.4	
1631	200	4.33	10.34	0.189	6.55	3.38	32.6	-25.3	

J.K.

DEPTH TO WATER AFTER PURGING (TOC) FT. | SAMPLE FILTERED ☐ YES ☐ NO SIZE ____

NOTES: Sample point ≈ 6.5 below TOC

SAMPLE TIME: 1635 · ID# 283-005-MW-2-122315

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

WELL NO: MW-3

DATE: 12/23/15	PROJECT NAME: Fmr. Cummings Oil Lease Site	PROJECT NO: 283-005

WEATHER CONDITIONS: Rain

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ☐ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	9.63 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	2.24 FT.
LENGTH OF WATER	— FT.	CALCULATED ONE WELL VOLUME[1]:	— GAL.
DEPTH OF SAMPLE POINT	FT.	ESTIMATED VOLUME PURGED	1.5 GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" Polyethylene

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1504	INITIAL	3.52	--	--	--	--	--	--	Slightly Turbid,
1507	200	3.63	8.13	0.301	6.92	3.55	181.1	85.3	no odor
1510	200	3.78	8.10	0.301	6.91	2.97	164.5	56.9	
1513	200	3.94	8.24	0.302	6.90	2.20	120.6	40.0	
1516	200	4.04	8.43	0.303	6.91	2.14	104.3	33.6	
1519	200	4.08	8.37	0.303	6.91	2.05	95.8	26.7	
1522	200	4.11	8.39	0.303	6.91	2.02	80.1	20.7	
1525	200	4.17	8.41	0.303	6.91	1.98	66.8	17.2	
1528	200	4.19	8.40	0.304	6.91	1.96	64.6	12.1	

JK.

DEPTH TO WATER AFTER PURGING (TOC) 4.19 FT. SAMPLE FILTERED ☐ YES ☐ NO SIZE ____

NOTES: Sample Point ≈ 6.5' below TOC

SAMPLE TIME: 1532 · ID# 283-005-MW-3-122315

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

WELL NO: MW- 5

DATE: 12/23/15	PROJECT NAME: Fmr. Cummings Oil Lease Site	PROJECT NO: 283-005

WEATHER CONDITIONS: Partly Cloudy (40's)

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	10.27 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	3.74 FT.
LENGTH OF WATER	— FT.	CALCULATED ONE WELL VOLUME[1]:	— GAL.
DEPTH OF SAMPLE POINT	2-3' below WL FT.	ESTIMATED VOLUME PURGED	2.0 GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" Polyethylene

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1036	INITIAL	4.14	--	--	--	--	--	--	
1039	150	4.32	11.44	0.265	6.02	3.91	33.0	47.9	Clear, no odor
1042	150	4.36	11.54	0.267	5.93	3.93	23.1	62.5	
1045	150	4.41	11.54	0.269	5.89	3.95	20.2	71.9	
1048	150	4.53	11.55	0.274	5.84	4.22	13.4	86.3	
1051	150	4.59	11.61	0.277	5.80	4.40	13.5	97.3	
1054	150	4.69	11.73	0.277	5.78	4.39	11.8	108.8	
1057	150	4.72	11.69	0.278	5.77	4.31	9.9	111.0	
1100	150	4.75	11.61	0.278	5.76	4.30	7.7	~~117.8~~ 117.8	
1103	150	4.77	11.54	0.278	5.75	4.23	8.7	123.0	
1106	150	4.80	11.53	0.277	5.75	4.10	7.8	126.6	

DEPTH TO WATER AFTER PURGING (TOC) 4.80 FT. SAMPLE FILTERED ☐ YES ☐ NO SIZE ____

NOTES: Sample Point = 7 below TOC

SAMPLE TIME: 1110 ID# 283-005-MW-5-122315

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

WELL NO: MW- 6

DATE: 12/23/15	PROJECT NAME: Fmr. Cummings Oil Lease Site	PROJECT NO: 283-005

WEATHER CONDITIONS: Rain

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	10.15 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	2.93 FT.
LENGTH OF WATER	~~7.22~~ FT.	CALCULATED ONE WELL VOLUME[1]:	~~1.17~~ GAL.
DEPTH OF SAMPLE POINT	2-3' below WL FT.	ESTIMATED VOLUME PURGED	~~2 gal~~ JK 1.5 GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" Polyethylene

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1147	INITIAL	4.05	--	--	--	--	--	--	
1150	150	4.21	9.69	0.277	6.50	1.36	12.1	-16.5	Clear, petroleum
1153	150	4.38	9.60	0.285	6.51	1.32	12.4	-20.7	hydrocarbon odor
1156	150	4.44	9.55	0.291	6.51	1.26	8.9	-30.2	
1159	150	4.47	9.48	0.295	6.52	1.22	9.7	-40.6	
1202	150	4.53	9.52	0.302	6.53	1.18	10.2	-57.1	
1205	150	4.57	9.60	0.301	6.54	1.16	11.4	-59.9	
1208	150	4.59	9.61	0.315	6.56	1.14	10.8	-66.2	
1211	150	4.62	9.75	0.322	6.57	1.12	10.9	-72.1	
1214	150	4.64	9.74	0.325	6.57	1.11	10.5	-76.3	
1217	150	4.66	9.80	0.332	6.59	1.11	11.6	-81.1	

O.K.

DEPTH TO WATER AFTER PURGING (TOC) 4.66 FT. SAMPLE FILTERED ☐ YES ☐ NO SIZE _____

NOTES:

SAMPLE TIME: 1222 ID# 283-005-MW-6-122315

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

			WELL NO: MW-7
DATE: 12/23/15	PROJECT NAME: Fmr. Cummings Oil Lease Site		PROJECT NO: 283-005
WEATHER CONDITIONS: Rain			
WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER			
SAMPLE TYPE: ☐ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER			
WELL DEPTH (TOC) 9.05 FT.		DEPTH TO WATER BEFORE PURGING (TOC) 4.75 FT.	
LENGTH OF WATER — FT.		CALCULATED ONE WELL VOLUME[1]: — GAL.	
DEPTH OF SAMPLE POINT 2-3' below WL FT.		ESTIMATED VOLUME PURGED 2.5 GAL.	
EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER			
CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED			
WATER ANALYZER: YSI	PUMP TYPE: Peristaltic	TUBING: 1/4" Polyethylene	

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1346	INITIAL	4.96	--	--	--	--	--	--	Slightly Turbid,
1349	200	5.03	9.57	0.256	7.16	3.58	51.4	32.9	No odor
1352	200	5.11	9.51	0.256	7.14	2.40	55.7	14.9	
1355	200	5.18	9.40	0.255	7.14	1.95	43.8	3.65	
1358	200	5.22	9.32	0.255	7.14	1.88	36.4	-4.74	
1401	200	5.26	9.18	0.253	7.13	1.84	27.1	-9.19	
1404	200	5.29	9.27	0.254	7.13	1.84	22.8	-11.5	
1407	200	5.33	9.34	0.255	7.13	1.80	19.2	-17.8	
1410	200	5.35	9.49	0.255	7.12	1.77	19.5	-22.6	
1413	200	5.38	9.44	0.255	7.12	1.74	18.1	-25.3	
1416	200	5.41	9.37	0.254	7.12	1.71	17.4	-28.5	
1419	200	5.44	9.35	0.254	7.12	1.66	16.0	-30.9	
			O.K.						

DEPTH TO WATER AFTER PURGING (TOC) 5.44 FT.	SAMPLE FILTERED ☐ YES ☐ NO SIZE ____
NOTES: Sample Point ≅ 7.5' below TOC	SAMPLE TIME: 1424 · ID# 283-005-MW-7-122315
	DUPLICATE ☐ TIME: ID#:
	EQUIP. BLANK: ☐ TIME: ID#:
	PREPARED BY: Jared Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

BNSF RAILWAY

CHAIN OF CUSTODY

LABORATORY INFORMATION

Laboratory: Test America Seattle
Address: 5755 8th St E
City/State/ZIP: Tacoma WA 98424
Project Manager: Kristine Allen
Phone: (253) 922-2310
Fax: (253) 922-5047

LAB WORK ORDER:

SHIPMENT INFORMATION

Shipment Method:
Tracking Number:

BNSF PROJECT INFORMATION

BNSF Project Number: WAWIN-05-0001
BNSF Project Name: Fmr. Cummings Oil Lease Site
BNSF Contact: Scott MacDonald
Project State of Origin: Washington
Project City: Winlock
BNSF Work Order No.: TBD

CONSULTANT INFORMATION

Company: Farallon Consulting
Address: 975 5th Ave NW
City/State/ZIP: Issaquah WA 98027
Project Number: 283-005
Project Manager: Stacy Patterson
Email: spatterson@farallonconsulting.com
Phone: (425) 295-0800
Fax: N/A

TURNAROUND TIME

- [ ] 1-day Rush
- [ ] 2-day Rush
- [ ] 3-day Rush
- [ ] 5- to 8-day Rush
- [x] Standard 10-Day
- [ ] Other

DELIVERABLES

- [ ] BNSF Standard (Level II)
- [ ] Level III
- [ ] Level IV
- [ ] Other Deliverables?
- [ ] EDD Req, Format?

SAMPLE INFORMATION

	Sample Identification	Containers	Sample Collection Date	Sample Collection Time	Sample Collection Sampler	Filtered Y/N	Type (Comp/Grab)	Matrix	METHODS FOR ANALYSIS: BTEX (8260B)	METHODS FOR ANALYSIS: NWTPH-Dx	COMMENTS	LAB USE
1	283-005-MW-1-122315	5	12/23/15	1003	JK	N	G	Water	X	X		
2	283-005-MW-2-122315	5	12/23/15	1635	"	"	"	"	X	X		
3	283-005-MW-3-122315	5	12/23/15	1522	"	"	"	"	X	X		
4	283-005-MW-5-122315	5	12/23/15	1110	"	"	"	"	X	X		
5	283-005-MW-6-122315	5	12/23/15	1222	"	"	"	"	X	X		
6	283-005-MW-7-122315	5	12/23/15	1424	"	"	"	"	X	X		
7												
8												
9												
10												
11												
12												
13												
14												
15												

Relinquished By:	Date/Time: 12/24/15 1037	Received By:	Date/Time: 12/24/15 1037	Comments and Special Analytical Requirements:
Relinquished By:	Date/Time:	Received By:	Date/Time:	
Relinquished By:	Date/Time:	Received By:	Date/Time:	
Received by Laboratory:	Date/Time:	Lab Remarks:	Lab: Custody Intact? ☐ Yes ☐ No	Custody Seal No. / BNSF COC No

ORIGINAL - RETURN TO LABORATORY WITH SAMPLES

DUPLICATE - CONSULTANT

TAL-1001 (0912)

WASTE INVENTORY TRACKING SHEET

Project Number: 283-005
Project Name: Former Cummings Oil Lease Site
Project Address: 908 NW Kerron Ave
Field Work: Groundwater monitoring
Project Manager: Stacy Patterson

Page of
Date: 23-Dec-15
Prepared By: Jared Kerr
Date Removed:
Transporter:
Disposal Location:

Container ID	Fullness	**Contents** (soil-gw-decon water) / Origin (boring or well number)	Date(s) Accumulated	Labled (Y/N)	Sampled (Y/N)	Comments
1	30	Purge/Decon water	12/23/2015	Y	Y	30-gallon drum located in NW corner of site.

NOTES: Contents should be specified and include identification of well/boring, media, souce, depth of soil (if applicable), and any other applicable information.

Location of Drums (sketch or describe):

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Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Sacramento | Irvine

DAILY HEALTH AND SAFETY BRIEFING LOG

PROJECT INFORMATION	
Farallon PN: 283-005	Project Name: Former Cummings 0.1 Lease Site
Site Address: 908 NW Kerron Ave	City/State: Winlock, WA
MEETING INFORMATION	
Conducted By: Jared Kerr	Weather: Overcast / Rain
Major Job Task: GW sampling	Date: 12/23/15

DAILY EQUIPMENT CHECKLIST

☐ Site Check In	☐ First Aid Kit Location(s)	☐ Ear Plugs (if required)
☒ Proper ID/Safety Credentials	☐ Fire Extinguisher Location(s)	☐ Hand Protection (if required)
☒ Hard Hat	☐ Eye Wash Station	☐ Face Shield (if required)
☒ Safety Glasses	☐ Traffic Control (if needed)	☐ Respirator (if required)
☒ Orange Reflective Vest (H or X back BNSF)		☐ _____
☒ Safety Toe Boots (lace up and leather BNSF)		☐ _____

HEALTH AND SAFETY BRIEFING

☒ Head Count (No. of employees: 1)	☐ Excavation Safety (if applicable)
☒ Emergency Response Truck	☐ Health Hazards
☒ Who will...?(provide names below) Call 911: Jared Alternate to call 911: ~ Provide First Aid/CPR: Jared	☐ Environmental Hazards ☐ Physical Hazards ☐ Slips, Trips and Falls ☐ Utility Locates
☐ Emergency Exits/ Rally Points/Hospital Route	☐ Near Miss Reporting (reminder to look)
☐ Site Security and Exclusion Zone	☐ Incident Reporting (Procedures and forms)
☐ Vehicle/Equipment-Specific Safety Practices	☐ Traffic Control
☐ Stop Work Authority	☐ HASP Reviewed and Signed

SITE-SPECIFIC HEALTH AND SAFETY ISSUES DISCUSSED

1) Vehicle Traffic
2)
3)
4)
5)

DAILY HEALTH AND SAFETY BRIEFING ATTENDEES

NAME	COMPANY	SIGNATURE
Jared Kerr	Farallon	

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Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Sacramento

FIELD REPORT

Date: 3/28/2016 **Project #:** 283-005 **Task #:**008

Project: Fmr. Cummings Oil lease site **Site Address:** 908 NW Kerron Ave

Client: TRC **Contractor:** NA

Weather: Sunny **Temp:** 40's-50's °F

Equipment Used: Field truck, level D PPE, peristaltic pump, YSI, water level meter, Decon kit

Hours: _____ _____ **Mileage:** 220 **Project Manager:** Beth Padgett

Contractor *Staff*

Prepared By: J. Kerr **Reviewed By:** _____

Comments:

0630 Depart from Issaquah, WA

0825 Arrive on site, don PPE, conduct H & S meeting

0830 Begin opening all monitoring wells.

0859 All monitoring wells open.

0920 Begin obtaining water level measurements

0943 MOB to MW-5 to begin purging.

1015 YSI interface is not connecting to the probe after hitting the "Sonde Run" button. The batteries on the interface have been changed. Connection was attempted both while the probes were submerged and non-submerged in water. Connection cable was inspected and several attempts were made at securing a correct connection.

1022 Receive call from Jason (Equipco) "Power Sonde" button was unchecked in settings.

1023 Begin purging MW-5 with YSI readings.

1041 Collect sample MW5-032816.

1107 Begin purging MW-7.

1153 Collect sample MW-7-032816.

1215 Depart site for lunch.

1230 Return from lunch. MOB to MW-3.

1334 Collect sample MW-3-032816.

FIELD REPORT (continued)

Project: Fmr. Cummings Oil lease site **Date:** 3/28/2016 **Project #:** 283-005 **Task #:** 8

1400 MOB to MW-1.
1507 Collect sample MW-1-032816.
1612 Collect sample MW-6-032816.
1630 MOB to MW-2.
1710 Collect sample MW-2-032816
1734 Begin to decon YSI & demobilize site.
1757 Depart site.
1953 Return to office.
2011 Complete packing up.

J.K.

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NAPL and Groundwater Level Measurement Summary Form

Date:	3/28/16			**Project Nam**	Fmr. Cummings Oil lease site	
Project Number:	283-005	**Task:**		**8 Project Loc**	Winlock, WA	
Equipment Used:	Water level, decon kit			**Project Man**	Beth Padgett	

Well Number	Time	Depth to NAPL (feet)	Depth to Water (feet)	NAPL Thickness (feet)	Total Well Depth (feet)	Comments
MW-1	0927	—	2.11	—	11.28	No odor
MW-2	0939	—	2.27	—	10.94	Petroleum-like odor
MW-3	0933	—	2.15	—	9.67	No odor
MW-4	0930	—	1.07	—	11.05	No odor
MW-5	0924	—	4.65	—	10.32	No odor
MW-6	0939	—	2.93	—	10.15	Petroleum-like odor
MW-7	0936	—	5.00	—	9.06	No odor

Prepared By: J. Kerr

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW-1
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005
WEATHER CONDITIONS: Mostly Sunny		
WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER		
SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER		
WELL DEPTH (TOC) 11.28 FT.	DEPTH TO WATER BEFORE PURGING (TOC) 2.16 FT.	
LENGTH OF WATER — FT.	CALCULATED ONE WELL VOLUME[1]: — GAL.	
DEPTH OF SAMPLE POINT 2-3' below WL FT.	ESTIMATED VOLUME PURGED 1.5 GAL.	
EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER		
CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED		
WATER ANALYZER: YSI	PUMP TYPE: Peristaltic	TUBING: 1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1429	INITIAL	3.39	--	--	--	--	--	--	
1432	150	3.89	12.36	0.241	6.11	1.34	97.1	10.3	Turbid, no odor
1435	150	4.06	12.62	0.238	6.07	1.52	133.7	9.3	
1438	150	4.20	12.80	0.236	6.10	1.61	120.7	8.5	
1441	150	4.31	12.83	0.235	6.10	1.69	125.3	8.1	
1444	150	4.43	12.80	0.232	6.13	1.88	132.2	9.5	
1447	150	4.51	12.81	0.232	6.18	1.97	114.4	9.0	
1450	150	4.65	12.70	0.245	6.13	1.63	70.9	7.3	
1453	150	4.66	12.84	0.247	6.12	1.35	73.2	0.6	
1456	150	4.66	12.97	0.248	6.14	1.20	61.9	-4.1	
1459	150	4.65	13.07	0.249	6.13	1.15	66.7	-3.8	
1502	150	4.65	13.15	0.249	6.16	1.13	74.4	-5.9	
1505	150	4.65	13.06	0.252	6.17	1.11	44.2	-8.1	
				JK.					

DEPTH TO WATER AFTER PURGING (TOC) 4.65 FT. | SAMPLE FILTERED ☐ YES ■ NO SIZE ____

NOTES:

11.28
- 2.16
9.12 x 0.17 = 1.55 gallons

SAMPLE TIME: 1507 ID# MW-1-032816

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: J. Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW-2
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005
WEATHER CONDITIONS: Mostly Sunny		
WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER		
SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER		
WELL DEPTH (TOC) 10.94 FT.	DEPTH TO WATER BEFORE PURGING (TOC) 2.76 FT.	
LENGTH OF WATER 8.18 FT.	CALCULATED ONE WELL VOLUME[1]: — GAL.	
DEPTH OF SAMPLE POINT 2-3' below WL FT.	ESTIMATED VOLUME PURGED GAL.	
EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER		
CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED		
WATER ANALYZER: YSI	PUMP TYPE: Peristaltic	TUBING: 1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1639	INITIAL	2.76	--	--	--	--	--	--	
1645	250	4.01	11.60	0.367	6.44	2.98	37.9	-81.4	Clear, no odor
1648	150	DR 4.17	11.86	0.366	6.39	2.71	41.2	-81.9	
1651	150	4.33	12.13	0.367	6.41	2.08	32.8	-80.2	
1654	150	4.49	12.24	0.367	6.44	2.01	35.8	-79.3	
1657	150	4.52	12.17	0.368	6.46	1.97	36.3	-81.9	
1700	150	4.62	12.25	0.367	6.47	1.62	28.7	-84.7	
1703	150	4.72	12.25	0.368	6.46	1.22	25.4	-86.5	
1706	150	4.79	12.27	0.368	6.48	1.25	19.7	-88.5	Clear, petroleum-like odor

J.K.

DEPTH TO WATER AFTER PURGING (TOC) 4.79 FT.	SAMPLE FILTERED ☐ YES ■ NO SIZE ____
NOTES:	SAMPLE TIME: 1710 ID# MW-2-032816
	DUPLICATE ☐ TIME: ID#:
	EQUIP. BLANK: ☐ TIME: ID#:
	PREPARED BY: J. Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW-3
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005

WEATHER CONDITIONS: Partly Cloudy

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	9.67 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	1.99 FT.
LENGTH OF WATER	— FT.	CALCULATED ONE WELL VOLUME[1]:	— GAL.
DEPTH OF SAMPLE POINT	2-3' below WL FT.	ESTIMATED VOLUME PURGED	GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1243	INITIAL	1.99	--	--	--	--	--	--	
1248	150	3.09	12.29	0.396	6.37	1.64	223.5	24.4	Turbid, no odor
1251	150	3.14	11.95	0.394	6.18	1.46	244.5	18.0	
1254	150	3.30	11.90	0.392	6.15	1.36	233.7	17.2	
1257	150	3.32	11.82	0.392	6.15	1.31	234.1	14.8	
1300	150	3.35	11.72	0.393	6.14	1.21	227.0	13.4	
1303	150	3.40	11.71	0.399	6.14	1.12	200.7	10.4	
1306	150	3.43	12.05	0.423	6.16	0.74	157.7	11.6	
1309	150	3.48	12.34	0.431	6.19	0.51	139.9	-8.9	
1312	150	3.53	12.42	0.435	6.18	0.46	140.3	-8.5	
1315	150	3.55	12.41	0.436	6.19	0.45	138.7	-9.1	
1318	150	3.58	12.38	0.438	6.19	0.45	102.4	-8.2	
1321	150	3.59	12.23	0.443	6.19	0.44	97.1	-10.9	
1324	150	3.62	12.08	0.444	6.19	0.44	95.9	-12.2	
1327	150	3.63	12.02	0.447	6.19	0.44	80.3	-13.1	
1330	150	3.65	12.04	0.450	6.20	0.45	76.8	-14.7	
				JK.					

DEPTH TO WATER AFTER PURGING (TOC) 3.65 FT. SAMPLE FILTERED ☐ YES ■ NO SIZE ____

NOTES: Minimum purge volume = 1.36 gallons
Depth to sample point = 6' bgs

SAMPLE TIME: 1334 ID# MW-3-032816

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: J. Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW - 5
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005
WEATHER CONDITIONS: Partly Cloudy		
WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER		
SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER		
WELL DEPTH (TOC) 10.32 FT.	DEPTH TO WATER BEFORE PURGING (TOC) 4.66 FT.	
LENGTH OF WATER — FT.	CALCULATED ONE WELL VOLUME[1]: — GAL.	
DEPTH OF SAMPLE POINT ~~9~~ 10 bgs FT.	ESTIMATED VOLUME PURGED 1.75 GAL.	
EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER		
CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED		
WATER ANALYZER: YSI	PUMP TYPE: Peristaltic	TUBING: 1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
0954	INITIAL	4.66	--	--	--	--	--	--	
1024	250	5.44	11.03	0.283	5.90	2.17	1.8	28.6	Clear, no odor
1027	200	5.53	11.08	0.277	5.91	2.05	1.7	28.5	
1030	200	5.55	11.10	0.276	5.90	2.00	1.8	29.5	
1033	200	5.58	11.09	0.274	5.88	1.98	2.7	30.1	
1036	175	5.64	11.04	0.279	5.92	1.63	6.9	26.6	
1039	175	5.75	11.13	0.270	5.91	1.47	7.7	28.4	

J.K.

DEPTH TO WATER AFTER PURGING (TOC) 5.75 FT.	SAMPLE FILTERED ☐ YES ■ NO SIZE ____	
NOTES:	SAMPLE TIME: 1041 ID# MW-5-032816	
	DUPLICATE ☐ TIME:	ID#:
	EQUIP. BLANK: ☐ TIME:	ID#:
	PREPARED BY: J. Kerr	

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW-6
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005
WEATHER CONDITIONS: Mostly Sunny		
WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER		
SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER		
WELL DEPTH (TOC) 10.15 FT.	DEPTH TO WATER BEFORE PURGING (TOC) 2.94 FT.	
LENGTH OF WATER - FT.	CALCULATED ONE WELL VOLUME[1]: - GAL.	
DEPTH OF SAMPLE POINT 2-3' below WL FT.	ESTIMATED VOLUME PURGED GAL.	
EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER		
CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED		
WATER ANALYZER: YSI	PUMP TYPE: Peristaltic	TUBING: 1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1533	INITIAL	2.94	--	--	--	--	--	--	
1543	250	4.40	12.63	0.372	6.45	6.21	29.1	-88.7	Clear, petroleum
1546	150	4.44	12.64	0.367	6.40	6.50	32.1	-86.3	odor.
1549	150	4.52	12.71	0.386	6.42	6.30	22.6	-86.6	
1552	150	4.60	12.51	0.391	6.44	5.78	23.8	-93.0	
1555	150	4.65	12.27	0.397	6.46	5.91	20.3	-95.3	
1558	150	4.69	12.28	0.397	6.47	5.66	19.4	-95.5	
1601	150	4.74	12.36	0.397	6.49	5.28	19.8	-96.9	
1604	150	4.80	12.59	0.397	6.52	4.92	14.8	-99.8	
1607	150	4.81	12.59	0.397	6.53	4.88	17.3	-99.5	
1610	150	4.72	12.66	0.399	6.53	4.34	10.2	-99.1	Clear, petroleum odor.

J.K.

DEPTH TO WATER AFTER PURGING (TOC) 4.72 FT.	SAMPLE FILTERED ☐ YES ■ NO SIZE ____
NOTES: Depth to sample point = 7.5' bgs	SAMPLE TIME: 1612 ID# MW-6-032816
	DUPLICATE ☐ TIME: ID#:
	EQUIP. BLANK: ☐ TIME: ID#:
	PREPARED BY: J. Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

LOW FLOW WELL PURGING AND SAMPLING DATA

		WELL NO: MW-7
DATE: 3/28/16	PROJECT NAME: Fmr. Cummings Oil lease site	PROJECT NO: 283-005

WEATHER CONDITIONS: Mostly Sunny

WELL DIAMETER (IN.) ☐ 1 ■ 2 ☐ 4 ☐ 6 ☐ OTHER

SAMPLE TYPE: ■ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC)	9.06 FT.	DEPTH TO WATER BEFORE PURGING (TOC)	5.01 FT.
LENGTH OF WATER	FT.	CALCULATED ONE WELL VOLUME[1]:	GAL.
DEPTH OF SAMPLE POINT	FT.	ESTIMATED VOLUME PURGED	GAL.

EQUIP. DECON. ■ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ■ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER:	PUMP TYPE:	TUBING:
YSI	Peristaltic	1/4" poly

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ■ °C (+/- 0.1°)	SPECIFIC CONDUCT. (+/- 3%)	pH (+/- 0.1)	DISS. OXYGEN (mg/l) (+/- 10%)	TURBIDITY (NTU) (NA)	ORP (mV) (+/- 10 mV)	REMARKS (EVIDENT ODOR, COLOR, PID)
1109	INITIAL	5.01	--	--	--	--	--	--	
1118	175	5.37	11.02	0.158	6.47	3.39	30.4	16.6	
1121	175	5.48	10.99	0.154	6.40	3.24	25.4	18.1	
1124	150	5.53	11.06	0.155	6.38	3.21	25.0	19.0	
1127	150	5.55	11.11	0.155	6.38	3.19	26.2	19.5	
1130	150	5.60	11.20	0.158	6.37	3.08	26.8	21.9	
1133	150	5.63	11.29	0.163	6.36	3.00	27.1	23.9	
1136	150	5.69	11.27	0.174	6.36	2.83	29.6	22.9	
1139	150	5.76	11.37	0.183	6.34	2.69	32.7	20.7	
1142	150	5.76	11.40	0.190	6.35	2.59	44.4	16.5	
1145	150	5.79	11.46	0.197	6.34	2.46	33.0	17.9	
1148	150	5.80	11.49	0.203	6.35	2.43	33.4	17.8	
1151	150	5.86	11.48	0.201	6.34	2.08	25.1	12.5	

OK.

DEPTH TO WATER AFTER PURGING (TOC) 5.86 FT. SAMPLE FILTERED ☐ YES ■ NO SIZE ____

NOTES:

SAMPLE TIME: 1153 ID# MW-7-032816

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY: J. Kerr

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

FARALLON CONSULTING

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Sacramento | Irvine

DAILY HEALTH AND SAFETY BRIEFING LOG

PROJECT INFORMATION	
Farallon PN: 283-005	Project Name: Fmr. Cummings Oil lease site
Site Address: 908 NW Kerron Ave	City/State: Winlock, WA
MEETING INFORMATION	
Conducted By: J. Kerr	Weather: Overcast (40's °F)
Major Job Task: GW monitoring	Date: 3/28/16

DAILY EQUIPMENT CHECKLIST

☐ Site Check In	☒ First Aid Kit Location(s)	☐ Ear Plugs (if required)
☒ Proper ID/Safety Credentials	☒ Fire Extinguisher Location(s)	☐ Hand Protection (if required)
☒ Hard Hat	☐ Eye Wash Station	☐ Face Shield (if required)
☒ Safety Glasses	☐ Traffic Control (if needed)	☐ Respirator (if required)
☒ Orange Reflective Vest (H or X back BNSF)		☐ _____
☒ Safety Toe Boots (lace up and leather BNSF)		☐ _____

HEALTH AND SAFETY BRIEFING

☐ Head Count (No. of employees: 1)	☐ Excavation Safety (if applicable)
☐ Emergency Response Lot across street	☐ Health Hazards
☐ Who will...?(provide names below)	☐ Environmental Hazards
Call 911: Jared	☐ Physical Hazards
Alternate to call 911: \	☐ Slips, Trips and Falls
Provide First Aid/CPR: Jared	☐ Utility Locates
☐ Emergency Exits/ Rally Points/Hospital Route	☐ Near Miss Reporting (reminder to look)
☐ Site Security and Exclusion Zone	☐ Incident Reporting (Procedures and forms)
☐ Vehicle/Equipment-Specific Safety Practices	☐ Traffic Control
☐ Stop Work Authority	☐ HASP Reviewed and Signed

SITE-SPECIFIC HEALTH AND SAFETY ISSUES DISCUSSED

1) Vehicle traffic
2) Monitoring wells near roadway
3)
4)
5)

DAILY HEALTH AND SAFETY BRIEFING ATTENDEES

NAME	COMPANY	SIGNATURE
Jared Kerr	Farallon	

WASTE INVENTORY TRACKING SHEET

Project Number: 283-005
Project Name: Fmr. Cummings Oil lease site
Project Address: 908 Kerron Ave
Field Work Description: Groundwater monitoring
Project Manager: Beth Padgett

Page: of
Generation Date: 3/28/2016
Prepared By: J. Kerr
Date Waste Removed:
Waste Transporter:
Waste Disposal Location:

Unique Container ID	Container Size	% Capacity Used	Contents (Soil/GW/Decon Water)/ Origin (Boring or Well ID)	Date(s) Accumulated	Labeling (Contents Under Test/ Haz/Non-Haz/Other-Specify)	Sampled (Y/N)	Comments
1	36 gallon	70	GW & Decon water	12/23/15 3/28/16	Non-Haz	Y	

NOTES: Contents should be specified and include identification of well/boring, media, source, depth of soil (if applicable), and any other helpful information.
Container ID should be unique when compared against other nearby containers. Special waste labels may include flammable, corrosive, dangerous when wet, and/or oxidizer.
Location of Drums (sketch or describe): NE corner of the site

FARALLON CONSULTING

FIELD REPORT FORM

Project No.: 240581 Date: 8/18/16

Project Name: Winlock Personnel: AHM

Weather: Sunny, ~ 85°F Page: 1 of 1

0850 - Arrive onsite. Search for and locate wells MW-1, MW-2, MW-3, MW-5, MW-6, and MW-7. Open wells and remove caps. Allow to equilibrate before measuring depth to water (DTW). Cannot locate MW-4, call to Keith Woodburne to ask for instructions on finding well MW-4.

Measure DTW and depth to bottom in monitoring wells (see Depth to Water Field Form dated 8/18/16). Purge and sample wells ~~after~~ (see Groundwater Sampling Records dated 8/18/16).

1400 - Spoke from Forallon calls to explain location of MW-4. Describes location as being near the gravel area ~~before the~~ west of the sloped area. Could not locate MW-4 as area is overgrown.

Finish groundwater sampling. Clean up site and check that all wells are covered and all monuments are secured.

1515 - Offsite.

DEPTH TO WATER FIELD FORM

Project No.: 240581

Site Name: Winlock

TRC Personnel: AHM

Date: 8/18/16

Well Number	Screen Interval	Depth to Water	Depth to Product	Free Product Thickness (ft)	Free Product Recovery	Total Depth	Comments
MW-1	5-12	3.08				11.23	
MW-2	5-11	3.20				10.89	
MW-3	5-10	2.85				9.66	
MW-4	5-12	—					Could not locate
MW-5	5-10	5.31				10.27	
MW-6	5-10	3.81				10.17	
MW-7	5-9	5.56				9.01	

GROUNDWATER SAMPLING RECORD

Project No.: 240581
Project Name: Winlock
Weather: Sunny, ~ 65°F

Date: 8/18/16
Personnel: AHM
Page: 1 of 1

Well Name:	MW-1
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-12
Depth to bottom (ft btoc):	12

(a) Initial Water Level (ft)	3.08
(b) Measured Total Depth (ft)	11.23
(c) Height of Water Column (ft) = b – a	8.15
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	no
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate L/min
1116	7	3.08									150
1119		4.60	450	19.48	5.70	0.209	0.90	3.9	none	8.04	150
1122		4.63	810	19.71	5.22	0.192	0.86	22.5	none	9.30	120
1125		4.69	1170	19.86	5.30	0.190	0.94	19.0	none	8.66	
1128		4.70	1530	19.94	5.56	0.191	0.86	8.3	none	8.91	
1131		4.73	1890	20.02	5.70	0.192	0.89	1.3	none	7.03	
1134		4.77	2250	20.04	5.73	0.194	0.84	0.2	none	5.26	
1137		4.82	2610	20.08	5.75	0.194	0.79	-0.4	none	5.03	

Sample Time:	MW1 – ~~08/18/16~~ 08/16 @ 1137
Comments:	

GROUNDWATER SAMPLING RECORD

Project No.: 240581 Date: 9/19/16

Project Name: Winlock Personnel: AHM

Weather: sunny, 86°F Page: 1 of 1

Well Name:	MW-2
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-11
Depth to bottom (ft btoc):	11

(a) Initial Water Level (ft)	3.20
(b) Measured Total Depth (ft)	10.89
(c) Height of Water Column (ft) = b – a	7.69
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	yes
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate mL/min
1200	7	3.20	—	—	—	—	—	—	—	—	—
1203	↓	~~3.78~~	360	20.26	6.24	0.273	0.51	-97.3	none	7.68	120
1206		4.20	660	20.78	5.99	0.273	0.37	-76.8	~~none~~	3.93	100
1209		4.25	960	21.11	5.64	0.272	0.36	-67.5	~~none~~	4.60	↓
1212	↓	4.40	1260	21.45	5.96	0.273	0.30	-73.7	~~none~~	5.21	↓

Sample Time:	MW2-0916 @ 1212
Comments:	Duplicate MW2D-0916 @ 1112

TRC Results you can rely on

GROUNDWATER SAMPLING RECORD

Project No.: 240581 Date: 9/19/16

Project Name: Winlock Personnel: AHM

Weather: Sunny, breezy, 90°F Page: 1 of 1

Well Name:	MW-3
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-10
Depth to bottom (ft btoc):	10

(a) Initial Water Level (ft)	2.85
(b) Measured Total Depth (ft)	9.66
(c) Height of Water Column (ft) = b – a	6.81
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	no
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate
1312	7	2.85	—								
1315	↑	3.21	300	22.69	6.13	0.391	0.89	-47.4	lt. brown	83.1	100
1318	↑	3.46	600	22.98	6.09	0.390	0.52	-45.6	lt. brown	55.4	↓
1321	↑	3.61	900	22.83	6.06	0.391	0.42	-47.0	lt. brown	55.5	↓
1324	↓	3.68	1200	23.01	6.08	0.392	0.34	-47.2	lt. brown	52.2	↓

Sample Time:	MW3-0916 @ 1324
Comments:	

GROUNDWATER SAMPLING RECORD

Project No.: 240581 Date: 9/18/16

Project Name: Winlock Personnel: AHM

Weather: sunny, breezy, 90°F Page: 1 of 1

Well Name:	MW-5
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-10
Depth to bottom (ft btoc):	10

(a) Initial Water Level (ft)	5.31
(b) Measured Total Depth (ft)	10.27
(c) Height of Water Column (ft) = b – a	4.96
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	no
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate
1433	7	5.31	—	—	—	—	—	—	—	—	100
1436	↓	5.61	300	23.11	5.87	0.276	0.84	90.3	none	3.86	100
1439		5.69	600	23.31	5.86	0.279	0.53	91.2	none	2.65	↓
1442		5.80	900	22.80	5.84	0.277	0.40	95.3	none	2.71	
1445	↓	5.84	1200	22.78	5.81	0.275	0.42	98.8	none	2.60	↓

Sample Time:	MW5-0816 @ 1445
Comments:	

GROUNDWATER SAMPLING RECORD

Project No.: 240581 Date: 8/19/16

Project Name: Winlock Personnel: AHM

Weather: Sunny, 90°F Page: 1 of 1

Well Name:	MW-6
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-10
Depth to bottom (ft btoc):	10

(a) Initial Water Level (ft)	3.81
(b) Measured Total Depth (ft)	10.17
(c) Height of Water Column (ft) = b – a	6.36
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	no
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate
1237	7	3.81	—	—	—	—	—	—	—	—	—
1240	↓	4.61	360	21.22	6.33	0.313	0.52	-104.7	none	11.09	120
1243		4.66	660	21.30	6.30	0.312	0.42	-105.6	none	9.03	100
1246		4.75	960	21.29	6.28	0.310	0.32	-105.9	none	8.96	↓
1249	↓	4.84	1260	21.17	6.29	0.309	0.29	-101.7	none	8.84	

Sample Time:	MW6-0816 @1249
Comments:	

GROUNDWATER SAMPLING RECORD

Project No.: 240581
Project Name: Winlock
Weather: Sunny, breezy, 90°F

Date: 8/18/16
Personnel: AHM
Page: 1 of 1

Well Name:	MW-7
Chain-of-Custody No.:	—
Measuring Point:	TOC
Screened Interval (ft):	5-9
Depth to bottom (ft btoc):	9

(a) Initial Water Level (ft)	5.54
(b) Measured Total Depth (ft)	9.01
(c) Height of Water Column (ft) = b – a	3.45
(d) Casing Diameter (in)	2
(e) Casing Volume (gal) = con × c Conversion (con) (ft to gal)	

WELLHEAD CONDITIONS	
Casing:	good
Lock:	no
Standing Water:	no
Comments/Required Maintenance:	no

Time	Intake Depth (ft btoc)	Depth to Water (ft btoc)	Cum. Vol. Purged (ml)	Temp. (°C)	pH	Specific Cond. (µS/cm)	DO (mg/L)	Redox (mV)	Color	Turbidity	Flow Rate mL/min
1342	7	5.56	—								100
1345	↓	5.77	300	22.51	5.93	0.213	2.32	53.9	none	12.4	↓
1348		5.79	600	23.03	5.84	0.217	1.95	61.4	none	12.04	
1351		5.83	900	22.62	5.83	0.215	1.79	62.1	none	11.0	
1354		5.84	1200	22.37	5.81	0.217	1.85	63.2	none	11.8	

Sample Time:	MW7-0816 @ 1354
Comments:	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

☐ Rush

☐ Short Hold

Chain of Custody Record

Client	Client Contact	Date	Chain of Custody Number
TRC	Keith Woodburne	8/19/16	29238
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
19874 141st PL NE	425-489-1938		
City / State / Zip Code	**Sampler**	**Lab Contact**	
Woodinville / WA / 98072	A. Meugniot		
Project Name and Location (State)	**Billing Contact**		
Winlock, WA	Scott MacDonald @ BNSF		
Contract/Purchase Order/Quote No.			
BNSF TH (will contact w #)			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: DRO to C28 NWTPH-Dx	BTEX by 8260C	Special Instructions/ Conditions of Receipt
MW1-0816	8/18/16	1137		X						X			X	X	
MW2-0816		1212		X						X			X	X	
MW2D-0816		1112		X						X			X	X	
MW3-0816		1324		X						X			X	X	
MW5-0816		1445		X						X			X	X	
MW6-0816		1249		X						X			X	X	
MW7-0816		1354		X						X			X	X	
TRIP BLANK				X										X	

Cooler	Possible Hazard Identification	Sample Disposal	(A fee may be assessed if samples are retained longer than 1 month)
☒ Yes ☐ No Cooler Temp: _____	☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown	☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months	

Turn Around Time Required (business days)

☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other _____

QC Requirements (Specify)

	Sign/Print	Date	Time
1. Relinquished By	Amanda Meugniot	8/19/16	1246
2. Relinquished By			
3. Relinquished By			
1. Received By	Francisco Lunas Jr	8/19/16	1246
2. Received By			
3. Received By			

Comments

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-8274-580 (0210)

APPENDIX C

LABORATORY ANALYTICAL REPORTS
AND
CHAIN-OF-CUSTODY DOCUMENTATION

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-56156-1
Client Project/Site: 283-005 Cummings Oil Site

For:
Farallon Consulting LLC
975 5th Avenue NW
Suite 100
Issaquah, Washington 98027

Attn: Stacy Patterson

Kristine D. Allen

Authorized for release by:
1/8/2016 4:30:14 PM

Kristine Allen, Manager of Project Management
(253)248-4970
kristine.allen@testamericainc.com

Table of Contents

Case Narrative

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Job ID: 580-56156-1

Laboratory: TestAmerica Seattle

Narrative

Job Narrative
580-56156-1

Comments
No additional comments.

Receipt
The samples were received on 12/24/2015 10:37 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 4.0º C.

GC/MS VOA
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

GC Semi VOA
Method(s) NWTPH-Dx: The following sample contained a hydrocarbon pattern in the diesel range; however, the elution pattern was later than the typical diesel fuel pattern used by the laboratory for quantitative purposes: 283-005-MW-1-122315 (580-56156-1).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client Sample ID: 283-005-MW-1-122315
Date Collected: 12/23/15 10:03
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-1
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 16:21	1
Toluene	ND		2.0		ug/L			12/31/15 16:21	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 16:21	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 16:21	1
o-Xylene	ND		2.0		ug/L			12/31/15 16:21	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*102*		*85 - 120*		*12/31/15 16:21*	*1*
Trifluorotoluene (Surr)	*105*		*70 - 136*		*12/31/15 16:21*	*1*
4-Bromofluorobenzene (Surr)	*103*		*75 - 120*		*12/31/15 16:21*	*1*
Dibromofluoromethane (Surr)	*93*		*85 - 115*		*12/31/15 16:21*	*1*
1,2-Dichloroethane-d4 (Surr)	*96*		*70 - 120*		*12/31/15 16:21*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.26**		0.11		mg/L		01/04/16 12:46	01/07/16 11:47	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		01/04/16 12:46	01/07/16 11:47	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*76*		*50 - 150*	*01/04/16 12:46*	*01/07/16 11:47*	*1*

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-2-122315
Date Collected: 12/23/15 16:35
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-2
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	**5.9**		2.0		ug/L			12/31/15 16:49	1
Toluene	ND		2.0		ug/L			12/31/15 16:49	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 16:49	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 16:49	1
o-Xylene	ND		2.0		ug/L			12/31/15 16:49	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*101*		*85 - 120*		*12/31/15 16:49*	*1*
Trifluorotoluene (Surr)	*103*		*70 - 136*		*12/31/15 16:49*	*1*
4-Bromofluorobenzene (Surr)	*104*		*75 - 120*		*12/31/15 16:49*	*1*
Dibromofluoromethane (Surr)	*89*		*85 - 115*		*12/31/15 16:49*	*1*
1,2-Dichloroethane-d4 (Surr)	*95*		*70 - 120*		*12/31/15 16:49*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.22**		0.12		mg/L		01/04/16 12:46	01/07/16 12:07	1
Motor Oil (>C24-C36)	ND		0.28		mg/L		01/04/16 12:46	01/07/16 12:07	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*72*		*50 - 150*	*01/04/16 12:46*	*01/07/16 12:07*	*1*

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-3-122315
Date Collected: 12/23/15 15:32
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-3
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 17:16	1
Toluene	ND		2.0		ug/L			12/31/15 17:16	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 17:16	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 17:16	1
o-Xylene	ND		2.0		ug/L			12/31/15 17:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*102*		*85 - 120*		*12/31/15 17:16*	*1*
Trifluorotoluene (Surr)	*104*		*70 - 136*		*12/31/15 17:16*	*1*
4-Bromofluorobenzene (Surr)	*104*		*75 - 120*		*12/31/15 17:16*	*1*
Dibromofluoromethane (Surr)	*89*		*85 - 115*		*12/31/15 17:16*	*1*
1,2-Dichloroethane-d4 (Surr)	*94*		*70 - 120*		*12/31/15 17:16*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.12		mg/L		01/04/16 12:46	01/07/16 12:27	1
Motor Oil (>C24-C36)	ND		0.27		mg/L		01/04/16 12:46	01/07/16 12:27	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*80*		*50 - 150*	*01/04/16 12:46*	*01/07/16 12:27*	*1*

Client Sample ID: 283-005-MW-5-122315
Date Collected: 12/23/15 11:10
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-4
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 17:44	1
Toluene	ND		2.0		ug/L			12/31/15 17:44	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 17:44	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 17:44	1
o-Xylene	ND		2.0		ug/L			12/31/15 17:44	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*98*		*85 - 120*		*12/31/15 17:44*	*1*
Trifluorotoluene (Surr)	*103*		*70 - 136*		*12/31/15 17:44*	*1*
4-Bromofluorobenzene (Surr)	*104*		*75 - 120*		*12/31/15 17:44*	*1*
Dibromofluoromethane (Surr)	*90*		*85 - 115*		*12/31/15 17:44*	*1*
1,2-Dichloroethane-d4 (Surr)	*97*		*70 - 120*		*12/31/15 17:44*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		01/04/16 12:46	01/07/16 12:47	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		01/04/16 12:46	01/07/16 12:47	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*87*		*50 - 150*	*01/04/16 12:46*	*01/07/16 12:47*	*1*

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-6-122315
Date Collected: 12/23/15 12:22
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-5
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 18:12	1
Toluene	ND		2.0		ug/L			12/31/15 18:12	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 18:12	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 18:12	1
o-Xylene	ND		2.0		ug/L			12/31/15 18:12	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*102*		*85 - 120*		*12/31/15 18:12*	*1*
Trifluorotoluene (Surr)	*105*		*70 - 136*		*12/31/15 18:12*	*1*
4-Bromofluorobenzene (Surr)	*105*		*75 - 120*		*12/31/15 18:12*	*1*
Dibromofluoromethane (Surr)	*97*		*85 - 115*		*12/31/15 18:12*	*1*
1,2-Dichloroethane-d4 (Surr)	*98*		*70 - 120*		*12/31/15 18:12*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.29**		0.11		mg/L		01/04/16 12:46	01/07/16 13:08	1
Motor Oil (>C24-C36)	ND		0.26		mg/L		01/04/16 12:46	01/07/16 13:08	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*65*		*50 - 150*	*01/04/16 12:46*	*01/07/16 13:08*	*1*

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-7-122315
Date Collected: 12/23/15 14:24
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-6
Matrix: Water

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 18:39	1
Toluene	ND		2.0		ug/L			12/31/15 18:39	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 18:39	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 18:39	1
o-Xylene	ND		2.0		ug/L			12/31/15 18:39	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*101*		*85 - 120*		*12/31/15 18:39*	*1*
Trifluorotoluene (Surr)	*104*		*70 - 136*		*12/31/15 18:39*	*1*
4-Bromofluorobenzene (Surr)	*105*		*75 - 120*		*12/31/15 18:39*	*1*
Dibromofluoromethane (Surr)	*92*		*85 - 115*		*12/31/15 18:39*	*1*
1,2-Dichloroethane-d4 (Surr)	*100*		*70 - 120*		*12/31/15 18:39*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		01/04/16 12:46	01/07/16 13:28	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		01/04/16 12:46	01/07/16 13:28	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*83*		*50 - 150*	*01/04/16 12:46*	*01/07/16 13:28*	*1*

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 580-208914/4
Matrix: Water
Analysis Batch: 208914

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			12/31/15 12:37	1
Toluene	ND		2.0		ug/L			12/31/15 12:37	1
Ethylbenzene	ND		3.0		ug/L			12/31/15 12:37	1
m-Xylene & p-Xylene	ND		3.0		ug/L			12/31/15 12:37	1
o-Xylene	ND		2.0		ug/L			12/31/15 12:37	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*101*		*85 - 120*		*12/31/15 12:37*	*1*
Trifluorotoluene (Surr)	*102*		*70 - 136*		*12/31/15 12:37*	*1*
4-Bromofluorobenzene (Surr)	*104*		*75 - 120*		*12/31/15 12:37*	*1*
Dibromofluoromethane (Surr)	*93*		*85 - 115*		*12/31/15 12:37*	*1*
1,2-Dichloroethane-d4 (Surr)	*96*		*70 - 120*		*12/31/15 12:37*	*1*

Lab Sample ID: LCS 580-208914/5
Matrix: Water
Analysis Batch: 208914

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Benzene			20.1	20.2		ug/L		101	80 - 120		
Toluene			20.0	20.7		ug/L		104	75 - 120		
Ethylbenzene			20.1	20.5		ug/L		102	75 - 125		
m-Xylene & p-Xylene			20.0	20.4		ug/L		102	75 - 130		
o-Xylene			20.0	20.2		ug/L		101	80 - 120		

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
Toluene-d8 (Surr)	*100*		*85 - 120*
Trifluorotoluene (Surr)	*109*		*70 - 136*
4-Bromofluorobenzene (Surr)	*103*		*75 - 120*
Dibromofluoromethane (Surr)	*99*		*85 - 115*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 120*

Lab Sample ID: LCSD 580-208914/6
Matrix: Water
Analysis Batch: 208914

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene			20.1	19.9		ug/L		99	80 - 120	2	30
Toluene			20.0	20.0		ug/L		100	75 - 120	3	30
Ethylbenzene			20.1	20.0		ug/L		100	75 - 125	2	30
m-Xylene & p-Xylene			20.0	20.0		ug/L		100	75 - 130	2	30
o-Xylene			20.0	20.1		ug/L		100	80 - 120	1	30

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
Toluene-d8 (Surr)	*100*		*85 - 120*
Trifluorotoluene (Surr)	*107*		*70 - 136*
4-Bromofluorobenzene (Surr)	*103*		*75 - 120*
Dibromofluoromethane (Surr)	*98*		*85 - 115*

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCSD 580-208914/6
Matrix: Water
Analysis Batch: 208914

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	101		70 - 120

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Lab Sample ID: MB 580-208994/1-A
Matrix: Water
Analysis Batch: 209138

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 208994

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		01/04/16 12:46	01/07/16 10:26	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		01/04/16 12:46	01/07/16 10:26	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	84		50 - 150	01/04/16 12:46	01/07/16 10:26	1

Lab Sample ID: LCS 580-208994/2-A
Matrix: Water
Analysis Batch: 209138

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 208994

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
#2 Diesel (C10-C24)	2.00	1.91		mg/L		95	59 - 120
Motor Oil (>C24-C36)	2.01	1.72		mg/L		86	71 - 140

Surrogate	LCS %Recovery	LCS Qualifier	Limits
o-Terphenyl	87		50 - 150

Lab Sample ID: LCSD 580-208994/3-A
Matrix: Water
Analysis Batch: 209138

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 208994

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
#2 Diesel (C10-C24)	2.00	1.95		mg/L		97	59 - 120	2	27
Motor Oil (>C24-C36)	2.01	1.79		mg/L		89	71 - 140	4	27

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
o-Terphenyl	88		50 - 150

Lab Chronicle

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-1-122315
Lab Sample ID: 580-56156-1
Date Collected: 12/23/15 10:03
Matrix: Water
Date Received: 12/24/15 10:37

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 16:21	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 11:47	KZ1	TAL SEA

Client Sample ID: 283-005-MW-2-122315
Lab Sample ID: 580-56156-2
Date Collected: 12/23/15 16:35
Matrix: Water
Date Received: 12/24/15 10:37

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 16:49	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 12:07	KZ1	TAL SEA

Client Sample ID: 283-005-MW-3-122315
Lab Sample ID: 580-56156-3
Date Collected: 12/23/15 15:32
Matrix: Water
Date Received: 12/24/15 10:37

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 17:16	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 12:27	KZ1	TAL SEA

Client Sample ID: 283-005-MW-5-122315
Lab Sample ID: 580-56156-4
Date Collected: 12/23/15 11:10
Matrix: Water
Date Received: 12/24/15 10:37

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 17:44	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 12:47	KZ1	TAL SEA

Client Sample ID: 283-005-MW-6-122315
Lab Sample ID: 580-56156-5
Date Collected: 12/23/15 12:22
Matrix: Water
Date Received: 12/24/15 10:37

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 18:12	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 13:08	KZ1	TAL SEA

Lab Chronicle

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Client Sample ID: 283-005-MW-7-122315
Date Collected: 12/23/15 14:24
Date Received: 12/24/15 10:37

Lab Sample ID: 580-56156-6
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	208914	12/31/15 18:39	CJ	TAL SEA
Total/NA	Prep	3510C			208994	01/04/16 12:46	RBL	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	209138	01/07/16 13:28	KZ1	TAL SEA

Laboratory References:

TAL SEA = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Certification Summary

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Laboratory: TestAmerica Seattle

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska (UST)	State Program	10	UST-022	03-02-16
California	State Program	9	2901	01-31-16
L-A-B	DoD ELAP		L2236	01-19-16
L-A-B	ISO/IEC 17025		L2236	01-19-16
Montana (UST)	State Program	8	N/A	04-30-20
Oregon	NELAP	10	WA100007	11-06-16
US Fish & Wildlife	Federal		LE058448-0	02-28-16
USDA	Federal		P330-14-00126	04-08-17
Washington	State Program	10	C553	02-17-16

Sample Summary

Client: Farallon Consulting LLC
Project/Site: 283-005 Cummings Oil Site

TestAmerica Job ID: 580-56156-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
580-56156-1	283-005-MW-1-122315	Water	12/23/15 10:03	12/24/15 10:37
580-56156-2	283-005-MW-2-122315	Water	12/23/15 16:35	12/24/15 10:37
580-56156-3	283-005-MW-3-122315	Water	12/23/15 15:32	12/24/15 10:37
580-56156-4	283-005-MW-5-122315	Water	12/23/15 11:10	12/24/15 10:37
580-56156-5	283-005-MW-6-122315	Water	12/23/15 12:22	12/24/15 10:37
580-56156-6	283-005-MW-7-122315	Water	12/23/15 14:24	12/24/15 10:37

BNSF RAILWAY — CHAIN OF CUSTODY

LABORATORY INFORMATION

Laboratory: Test America Seattle
Address: 5755 8th St E
City/State/ZIP: Tacoma WA 98424
Project Manager: Kristine Allen
Phone: (253) 922-2310
Fax: (253) 922-5047

LAB WORK ORDER:

SHIPMENT INFORMATION

Shipment Method:
Tracking Number:

BNSF PROJECT INFORMATION

BNSF Project Number: WAWIN-05-0001
BNSF Project Name: Fmr. Cummings Oil Lease Site
BNSF Contact: Scott MacDonald
Project State of Origin: Washington
Project City: Winlock
BNSF Work Order No.: TBD

CONSULTANT INFORMATION

Company: Farallon Consulting
Address: 975 5th Ave NW
City/State/ZIP: Issaquah WA 98027
Project Number: 283-005
Project Manager: Stacy Patterson
Email: spatterson@farallonconsulting.com
Phone: (425) 295-0800 Fax: NA

TURNAROUND TIME

- [ ] 1-day Rush
- [ ] 2-day Rush
- [ ] 3-day Rush
- [ ] 5- to 8-day Rush
- [x] Standard 10-Day
- [ ] Other

DELIVERABLES

- [ ] BNSF Standard (Level II)
- [ ] Level III
- [ ] Level IV
- [ ] Other Deliverables?
- [ ] EDD Req, Format?

SAMPLE INFORMATION

	Sample Identification	Containers	Sample Collection Date	Sample Collection Time	Sampler	Filtered Y/N	Type (Comp/Grab)	Matrix	METHODS FOR ANALYSIS: BTEX (8260B)	METHODS FOR ANALYSIS: NWTPH-Dx	COMMENTS	LAB USE
1	283-005-MW-1-122315	5	12/23/15	1003	JK	N	G	water	X	X		
2	283-005-MW-2-122315	5	12/23/15	1635	"	"	"	"	X	X		
3	283-005-MW-3-122315	5	12/23/15	1532	"	"	"	"	X	X		
4	283-005-MW-5-122315	5	12/23/15	1110	"	"	"	"	X	X		
5	283-005-MW-6-122315	5	12/23/15	1222	"	"	"	"	X	X		
6	283-005-MW-7-122315	5	12/23/15	1424	"	"	"	"	X	X		
7												
8												
9												
10												
11												
12												
13												
14												
15												

IB A2 Cooler Cor 4.0 w/o Unc 3.8
Cooler Dsc LgGre/blu @Lab
Wet Packs Packing bub
cli dra

	Date/Time		Date/Time
Relinquished By:	12/24/15 1037	Received By: Tom Stanton	12/24/15 1037
Relinquished By:		Received By:	
Relinquished By:		Received By:	
Received by Laboratory:		Lab Remarks:	Lab: Custody Intact? ☐ Yes ☐ No

Comments and Special Analytical Requirements:

Custody Seal No.
BNSF COC No

ORIGINAL - RETURN TO LABORATORY WITH SAMPLES
DUPLICATE - CONSULTANT
TAL-1001 (0912)

Login Sample Receipt Checklist

Client: Farallon Consulting LLC

Job Number: 580-56156-1

Login Number: 56156
List Number: 1
Creator: Simpson, Jennell 1

List Source: TestAmerica Seattle

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-58398-1
Client Project/Site: Fmr. Cummings Oil Lease Site

For:
Farallon Consulting LLC
975 5th Avenue NW
Suite 100
Issaquah, Washington 98027

Attn: Stacy Patterson

Authorized for release by:
4/7/2016 4:52:04 PM
Christabel Escarez, Project Manager I
(253)922-2310
christabel.escarez@testamericainc.com

Designee for

Kristine Allen, Manager of Project Management
(253)248-4970
kristine.allen@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Case Narrative

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Job ID: 580-58398-1

Laboratory: TestAmerica Seattle

Narrative

Receipt
The samples were received on 3/30/2016 11:52 AM; the samples arrived in good condition, properly preserved, and on ice. The temperature of the cooler at receipt was 4.1º C.

GC/MS VOA
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

GC Semi VOA
Method(s) NWTPH-Dx: The following samples contained a hydrocarbon pattern in the diesel range; however, the elution pattern was later than the typical diesel fuel pattern used by the laboratory for quantitative purposes: 283-005-MW-1-032816 (580-58398-1) and 283-005-MW-3-032816 (580-58398-3).

Method(s) NWTPH-Dx: The following samples contained a hydrocarbon pattern in the diesel range; however, the elution pattern was earlier than the typical diesel fuel pattern used by the laboratory for quantitative purposes: 283-005-MW-2-032816 (580-58398-2) and 283-005-MW-6-032816 (580-58398-5).

Method(s) NWTPH-Dx: The %RPD of the laboratory control sample (LCS) and laboratory control standard duplicate (LCSD) for 2 Diesel (C10-C24) for preparation batch 580-214265 recovered outside acceptance limits.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Definitions/Glossary

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Qualifiers

GC Semi VOA

Qualifier	Qualifier Description
*	RPD of the LCS and LCSD exceeds the control limits

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-1-032816
Date Collected: 03/28/16 15:07
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-1
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			04/05/16 17:54	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*100*		*85 - 120*		*04/05/16 17:54*	*1*
4-Bromofluorobenzene (Surr)	*93*		*75 - 120*		*04/05/16 17:54*	*1*
Dibromofluoromethane (Surr)	*100*		*85 - 115*		*04/05/16 17:54*	*1*
Trifluorotoluene (Surr)	*105*		*70 - 136*		*04/05/16 17:54*	*1*
1,2-Dichloroethane-d4 (Surr)	*113*		*70 - 120*		*04/05/16 17:54*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.38**	*	0.11		mg/L		04/04/16 10:17	04/05/16 08:59	1
Motor Oil (>C24-C36)	**0.27**		0.25		mg/L		04/04/16 10:17	04/05/16 08:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*76*		*50 - 150*	*04/04/16 10:17*	*04/05/16 08:59*	*1*

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-2-032816
Date Collected: 03/28/16 17:10
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-2
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	**13**		2.0		ug/L			04/05/16 18:23	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*102*		*85 - 120*		*04/05/16 18:23*	*1*
4-Bromofluorobenzene (Surr)	*97*		*75 - 120*		*04/05/16 18:23*	*1*
Dibromofluoromethane (Surr)	*96*		*85 - 115*		*04/05/16 18:23*	*1*
Trifluorotoluene (Surr)	*104*		*70 - 136*		*04/05/16 18:23*	*1*
1,2-Dichloroethane-d4 (Surr)	*104*		*70 - 120*		*04/05/16 18:23*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.90**	*	0.11		mg/L		04/04/16 10:17	04/05/16 09:19	1
Motor Oil (>C24-C36)	**0.36**		0.25		mg/L		04/04/16 10:17	04/05/16 09:19	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*80*		*50 - 150*	*04/04/16 10:17*	*04/05/16 09:19*	*1*

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-3-032816
Date Collected: 03/28/16 13:34
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-3
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			04/05/16 18:52	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*103*		*85 - 120*		*04/05/16 18:52*	*1*
4-Bromofluorobenzene (Surr)	*88*		*75 - 120*		*04/05/16 18:52*	*1*
Dibromofluoromethane (Surr)	*99*		*85 - 115*		*04/05/16 18:52*	*1*
Trifluorotoluene (Surr)	*104*		*70 - 136*		*04/05/16 18:52*	*1*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 120*		*04/05/16 18:52*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.50**	*	0.11		mg/L		04/04/16 10:17	04/05/16 09:58	1
Motor Oil (>C24-C36)	**0.34**		0.25		mg/L		04/04/16 10:17	04/05/16 09:58	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*77*		*50 - 150*	*04/04/16 10:17*	*04/05/16 09:58*	*1*

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-5-032816
Date Collected: 03/28/16 10:41
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-4
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			04/05/16 19:20	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*108*		*85 - 120*		*04/05/16 19:20*	*1*
4-Bromofluorobenzene (Surr)	*90*		*75 - 120*		*04/05/16 19:20*	*1*
Dibromofluoromethane (Surr)	*95*		*85 - 115*		*04/05/16 19:20*	*1*
Trifluorotoluene (Surr)	*107*		*70 - 136*		*04/05/16 19:20*	*1*
1,2-Dichloroethane-d4 (Surr)	*103*		*70 - 120*		*04/05/16 19:20*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND	*	0.11		mg/L		04/04/16 10:17	04/05/16 10:17	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		04/04/16 10:17	04/05/16 10:17	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*79*		*50 - 150*	*04/04/16 10:17*	*04/05/16 10:17*	*1*

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-6-032816
Date Collected: 03/28/16 16:12
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-5
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	**17**		2.0		ug/L			04/05/16 19:49	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*101*		*85 - 120*		*04/05/16 19:49*	*1*
4-Bromofluorobenzene (Surr)	*96*		*75 - 120*		*04/05/16 19:49*	*1*
Dibromofluoromethane (Surr)	*97*		*85 - 115*		*04/05/16 19:49*	*1*
Trifluorotoluene (Surr)	*97*		*70 - 136*		*04/05/16 19:49*	*1*
1,2-Dichloroethane-d4 (Surr)	*103*		*70 - 120*		*04/05/16 19:49*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.98**	*	0.11		mg/L		04/04/16 10:17	04/05/16 10:37	1
Motor Oil (>C24-C36)	**0.47**		0.25		mg/L		04/04/16 10:17	04/05/16 10:37	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*79*		*50 - 150*	*04/04/16 10:17*	*04/05/16 10:37*	*1*

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-7-032816
Date Collected: 03/28/16 11:53
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-6
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			04/05/16 20:18	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*107*		*85 - 120*		*04/05/16 20:18*	*1*
4-Bromofluorobenzene (Surr)	*90*		*75 - 120*		*04/05/16 20:18*	*1*
Dibromofluoromethane (Surr)	*94*		*85 - 115*		*04/05/16 20:18*	*1*
Trifluorotoluene (Surr)	*106*		*70 - 136*		*04/05/16 20:18*	*1*
1,2-Dichloroethane-d4 (Surr)	*101*		*70 - 120*		*04/05/16 20:18*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND	*	0.11		mg/L		04/04/16 10:17	04/05/16 10:56	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		04/04/16 10:17	04/05/16 10:56	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*76*		*50 - 150*	*04/04/16 10:17*	*04/05/16 10:56*	*1*

Method: 8260C - Volatile Organic Compounds by GC/MS

Lab Sample ID: MB 580-214347/4
Matrix: Water
Analysis Batch: 214347

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			04/05/16 10:19	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*103*		*85 - 120*		*04/05/16 10:19*	*1*
4-Bromofluorobenzene (Surr)	*91*		*75 - 120*		*04/05/16 10:19*	*1*
Dibromofluoromethane (Surr)	*101*		*85 - 115*		*04/05/16 10:19*	*1*
Trifluorotoluene (Surr)	*109*		*70 - 136*		*04/05/16 10:19*	*1*
1,2-Dichloroethane-d4 (Surr)	*107*		*70 - 120*		*04/05/16 10:19*	*1*

Lab Sample ID: LCS 580-214347/5
Matrix: Water
Analysis Batch: 214347

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Benzene			10.0	9.76		ug/L		97	80 - 120		

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
Toluene-d8 (Surr)	*102*		*85 - 120*
4-Bromofluorobenzene (Surr)	*97*		*75 - 120*
Dibromofluoromethane (Surr)	*98*		*85 - 115*
Trifluorotoluene (Surr)	*108*		*70 - 136*
1,2-Dichloroethane-d4 (Surr)	*102*		*70 - 120*

Lab Sample ID: LCSD 580-214347/6
Matrix: Water
Analysis Batch: 214347

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene			10.0	9.32		ug/L		93	80 - 120	5	30

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
Toluene-d8 (Surr)	*96*		*85 - 120*
4-Bromofluorobenzene (Surr)	*98*		*75 - 120*
Dibromofluoromethane (Surr)	*100*		*85 - 115*
Trifluorotoluene (Surr)	*101*		*70 - 136*
1,2-Dichloroethane-d4 (Surr)	*106*		*70 - 120*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Lab Sample ID: MB 580-214265/1-A
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 214265

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		04/04/16 10:17	04/05/16 06:00	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		04/04/16 10:17	04/05/16 06:00	1

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC) (Continued)

Lab Sample ID: MB 580-214265/1-A
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 214265

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	77		50 - 150	04/04/16 10:17	04/05/16 06:00	1

Lab Sample ID: MB 580-214265/1-B
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 214265

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		04/04/16 10:17	04/05/16 11:36	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		04/04/16 10:17	04/05/16 11:36	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	79		50 - 150	04/04/16 10:17	04/05/16 11:36	1

Lab Sample ID: LCS 580-214265/2-A
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 214265

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
#2 Diesel (C10-C24)	2.00	1.47		mg/L		74	59 - 120
Motor Oil (>C24-C36)	2.01	1.56		mg/L		78	71 - 140

Surrogate	LCS %Recovery	LCS Qualifier	Limits
o-Terphenyl	71		50 - 150

Lab Sample ID: LCS 580-214265/2-B
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 214265

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
#2 Diesel (C10-C24)	2.00	1.52		mg/L		76	59 - 120
Motor Oil (>C24-C36)	2.01	1.57		mg/L		78	71 - 140

Surrogate	LCS %Recovery	LCS Qualifier	Limits
o-Terphenyl	74		50 - 150

Lab Sample ID: LCSD 580-214265/3-A
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 214265

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
#2 Diesel (C10-C24)	2.00	1.96	*	mg/L		98	59 - 120	28	27
Motor Oil (>C24-C36)	2.01	1.96		mg/L		98	71 - 140	23	27

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
o-Terphenyl	86		50 - 150

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC) (Continued)

Lab Sample ID: LCSD 580-214265/3-B
Matrix: Water
Analysis Batch: 214317

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 214265

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
#2 Diesel (C10-C24)			2.00	1.96		mg/L		98	59 - 120	25	27
Motor Oil (>C24-C36)			2.01	1.84		mg/L		92	71 - 140	16	27

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
o-Terphenyl	*87*		*50 - 150*

Lab Chronicle

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-1-032816
Lab Sample ID: 580-58398-1
Date Collected: 03/28/16 15:07
Matrix: Water
Date Received: 03/30/16 11:52

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 17:54	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 08:59	KZ1	TAL SEA

Client Sample ID: 283-005-MW-2-032816
Lab Sample ID: 580-58398-2
Date Collected: 03/28/16 17:10
Matrix: Water
Date Received: 03/30/16 11:52

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 18:23	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 09:19	KZ1	TAL SEA

Client Sample ID: 283-005-MW-3-032816
Lab Sample ID: 580-58398-3
Date Collected: 03/28/16 13:34
Matrix: Water
Date Received: 03/30/16 11:52

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 18:52	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 09:58	KZ1	TAL SEA

Client Sample ID: 283-005-MW-5-032816
Lab Sample ID: 580-58398-4
Date Collected: 03/28/16 10:41
Matrix: Water
Date Received: 03/30/16 11:52

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 19:20	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 10:17	KZ1	TAL SEA

Client Sample ID: 283-005-MW-6-032816
Lab Sample ID: 580-58398-5
Date Collected: 03/28/16 16:12
Matrix: Water
Date Received: 03/30/16 11:52

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 19:49	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 10:37	KZ1	TAL SEA

Lab Chronicle

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Client Sample ID: 283-005-MW-7-032816
Date Collected: 03/28/16 11:53
Date Received: 03/30/16 11:52

Lab Sample ID: 580-58398-6
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	214347	04/05/16 20:18	TL1	TAL SEA
Total/NA	Prep	3510C			214265	04/04/16 10:17	MDD	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	214317	04/05/16 10:56	KZ1	TAL SEA

Laboratory References:

TAL SEA = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Certification Summary

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Laboratory: TestAmerica Seattle

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska (UST)	State Program	10	UST-022	03-02-17
California	State Program	9	2901	01-31-18
L-A-B	DoD ELAP		L2236	01-19-19
L-A-B	ISO/IEC 17025		L2236	01-19-19
Montana (UST)	State Program	8	N/A	04-30-20
Oregon	NELAP	10	WA100007	11-06-16
US Fish & Wildlife	Federal		LE058448-0	10-31-16
USDA	Federal		P330-14-00126	04-08-17
Washington	State Program	10	C553	02-17-17

Sample Summary

Client: Farallon Consulting LLC
Project/Site: Fmr. Cummings Oil Lease Site

TestAmerica Job ID: 580-58398-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
580-58398-1	283-005-MW-1-032816	Water	03/28/16 15:07	03/30/16 11:52
580-58398-2	283-005-MW-2-032816	Water	03/28/16 17:10	03/30/16 11:52
580-58398-3	283-005-MW-3-032816	Water	03/28/16 13:34	03/30/16 11:52
580-58398-4	283-005-MW-5-032816	Water	03/28/16 10:41	03/30/16 11:52
580-58398-5	283-005-MW-6-032816	Water	03/28/16 16:12	03/30/16 11:52
580-58398-6	283-005-MW-7-032816	Water	03/28/16 11:53	03/30/16 11:52

58398

BNSF RAILWAY

CHAIN OF CUSTODY

LAB WORK ORDER:

LABORATORY INFORMATION

Laboratory: Test America Seattle
Address: 5755 8th St E
City/State/ZIP: Tacoma, WA 98424
Project Manager: Kristine Allen
Phone: (253) 922-2310
Fax: (253) 922-5047

SHIPMENT INFORMATION

Shipment Method:
Tracking Number:

BNSF PROJECT INFORMATION

BNSF Project Number: WAWIN-05-0001
BNSF Project Name: Fmr. Cummings Oil Lease site
BNSF Contact: Scott MacDonald
Project State of Origin: Washington
Project City: Winlock
BNSF Work Order No.:

CONSULTANT INFORMATION

Company: Farallon Consulting
Address: 975 5th Ave NW
City/State/ZIP: Issaquah, WA 98027
Project Number: 283-005
Project Manager: Beth Padgett
Email: bpadgett@farallonconsulting.com
Phone: (425) 295-0800 Fax: NA

TURNAROUND TIME

- [ ] 1-day Rush
- [ ] 2-day Rush
- [ ] 3-day Rush
- [ ] 5- to 8-day Rush
- [x] Standard 10-Day
- [ ] Other

DELIVERABLES

- [ ] BNSF Standard (Level II)
- [ ] Level III
- [ ] Level IV
- [ ] Other Deliverables?
- [ ] EDD Req, Format?

SAMPLE INFORMATION

	Sample Identification	Containers	Sample Collection Date	Time	Sampler	Filtered Y/N	Type (Comp/ Grab)	Matrix	8260 Benzene	NWTPH-Dx	COMMENTS	LAB USE
1	283-005-MW-1-032816	5	3/23/16	1507	SK	N	G	water	X	X		
2	283-005-MW-2-032816			1710					X	X		
3	283-005-MW-3-032816			1334					X	X		
4	283-005-MW-5-032816			1041					X	X		
5	283-005-MW-6-032816			1612					X	X		
6	283-005-MW-7-032816			1153					X	X		
7												
8												
9												
10												
11												
12												
13												
14												
15												

580-58398 Chain of Custody

TB ___ Cooler IR2 Cor 4.1°C Unc 4.2°C
Cooler Dsc Lg Blue/Wht @ Lab 1405
Wet/Packs Packing Bubble
w/o

Relinquished By:	Date/Time: 3/29/16 1700	Received By:	Date/Time: 3/30/16 1152
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Received by Laboratory:	Date/Time:	Lab Remarks:	Lab: Custody Intact? ☐ Yes ☐ No

Comments and Special Analytical Requirements:
Labels will not include (283-005) within the sample ID. Please include this, (283-005) to the samples' ID.

Custody Seal No.
BNSF COC No

ORIGINAL - RETURN TO LABORATORY WITH SAMPLES
DUPLICATE - CONSULTANT
TAL-1001 (0912)

4/7/2016

Login Sample Receipt Checklist

Client: Farallon Consulting LLC

Job Number: 580-58398-1

Login Number: 58398
List Number: 1
Creator: Gall, Brandon A

List Source: TestAmerica Seattle

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-61941-1
Client Project/Site: BNSF Winlock, WA
Revision: 1

For:
TRC Solutions, Inc.
19874 141st Place NE
Woodinville, Washington 98072

Attn: Mr. Keith Woodburne

Kristine D. Allen

Authorized for release by:
10/13/2016 5:28:46 PM
Kristine Allen, Manager of Project Management
(253)248-4970
kristine.allen@testamericainc.com

Designee for

Robert Greer, Project Manager II
(253)922-2310
robert.greer@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Job ID: 580-61941-1

Laboratory: TestAmerica Seattle

Narrative

Report was revised 10-13-16. There was a sequencing error on the autosampler for the NWTPH-Dx analysis. The original result reported for sample MW 3-0816 (580-61941-4) was a different client sample. This was confirmed by re-analysis and comparing the chromatograms. The report was revised to report the correct sample for sample MW 3-0816 (580-61941-4).

Job Narrative
580-61941-1

Comments
No additional comments.

Receipt
The samples were received on 8/19/2016 12:46 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 0.5º C.

GC/MS VOA
Method(s) 8260C: The following sample was diluted to bring the concentration of target analytes within the calibration range: MW 2-0816 (580-61941-2). Elevated reporting limits (RLs) are provided.

Method(s) 8260C: The following sample was received preserved in hydrochloric acid and presented a pH between 5-8. Analysis was performed within 7 days per EPA recommendation: MW 2-0816 (580-61941-2) .

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

GC Semi VOA
Method(s) NWTPH-Dx: The matrix spike (MS) recoveries for 2 Diesel (C10-C24) and Motor Oil (>C24-C36) for preparation batch 580-226297 and analytical batch 580-226474 were outside control limits. Non-homogeneity is suspected because the associated laboratory control sample (LCS) recovery was within acceptance limits.

Method(s) NWTPH-Dx: The following samples contained a hydrocarbon pattern in the diesel range; however, the elution pattern was later than the typical diesel fuel pattern used by the laboratory for quantitative purposes: MW 5-0816 (580-61941-5), MW 6-0816 (580-61941-6) and MW 7-0816 (580-61941-7).

Method(s) NWTPH-Dx: The following samples contained a hydrocarbon pattern in the diesel range; however, the elution pattern was later than the typical diesel fuel pattern used by the laboratory for quantitative purposes: MW 1-0816 (580-61941-1), MW 2-0816 (580-61941-2), MW 2D-0816 (580-61941-3), MW 3-0816 (580-61941-4) and (580-61840-C-6-A).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Organic Prep
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 1-0816
Date Collected: 08/18/16 11:37
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-1
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 05:14	1
Toluene	ND		2.0		ug/L			08/29/16 05:14	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 05:14	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 05:14	1
o-Xylene	ND		2.0		ug/L			08/29/16 05:14	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*89*		*82 - 122*		*08/29/16 05:14*	*1*
Trifluorotoluene (Surr)	*112*		*80 - 141*		*08/29/16 05:14*	*1*
4-Bromofluorobenzene (Surr)	*105*		*75 - 125*		*08/29/16 05:14*	*1*
Dibromofluoromethane (Surr)	*112*		*77 - 118*		*08/29/16 05:14*	*1*
1,2-Dichloroethane-d4 (Surr)	*113*		*65 - 143*		*08/29/16 05:14*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.47**		0.11		mg/L		08/30/16 16:33	09/02/16 00:35	1
Motor Oil (>C24-C36)	**0.37**		0.26		mg/L		08/30/16 16:33	09/02/16 00:35	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*86*		*50 - 150*	*08/30/16 16:33*	*09/02/16 00:35*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 2-0816
Date Collected: 08/18/16 12:12
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-2
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		20		ug/L			08/29/16 09:02	10
Toluene	**27**		20		ug/L			08/29/16 09:02	10
Ethylbenzene	ND		30		ug/L			08/29/16 09:02	10
m-Xylene & p-Xylene	**36**		30		ug/L			08/29/16 09:02	10
o-Xylene	ND		20		ug/L			08/29/16 09:02	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*87*		*82 - 122*		*08/29/16 09:02*	*10*
Trifluorotoluene (Surr)	*109*		*80 - 141*		*08/29/16 09:02*	*10*
4-Bromofluorobenzene (Surr)	*112*		*75 - 125*		*08/29/16 09:02*	*10*
Dibromofluoromethane (Surr)	*106*		*77 - 118*		*08/29/16 09:02*	*10*
1,2-Dichloroethane-d4 (Surr)	*105*		*65 - 143*		*08/29/16 09:02*	*10*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.61**		0.11		mg/L		08/30/16 16:33	09/02/16 00:57	1
Motor Oil (>C24-C36)	**0.31**		0.26		mg/L		08/30/16 16:33	09/02/16 00:57	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*89*		*50 - 150*	*08/30/16 16:33*	*09/02/16 00:57*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 2D-0816
Date Collected: 08/18/16 11:12
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-3
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 05:42	1
Toluene	ND		2.0		ug/L			08/29/16 05:42	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 05:42	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 05:42	1
o-Xylene	ND		2.0		ug/L			08/29/16 05:42	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*89*		*82 - 122*		*08/29/16 05:42*	*1*
Trifluorotoluene (Surr)	*110*		*80 - 141*		*08/29/16 05:42*	*1*
4-Bromofluorobenzene (Surr)	*109*		*75 - 125*		*08/29/16 05:42*	*1*
Dibromofluoromethane (Surr)	*114*		*77 - 118*		*08/29/16 05:42*	*1*
1,2-Dichloroethane-d4 (Surr)	*112*		*65 - 143*		*08/29/16 05:42*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.65**		0.11		mg/L		08/30/16 16:33	09/02/16 01:19	1
Motor Oil (>C24-C36)	**0.36**		0.25		mg/L		08/30/16 16:33	09/02/16 01:19	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*96*		*50 - 150*	*08/30/16 16:33*	*09/02/16 01:19*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 3-0816
Date Collected: 08/18/16 13:24
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-4
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 07:36	1
Toluene	ND		2.0		ug/L			08/29/16 07:36	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 07:36	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 07:36	1
o-Xylene	ND		2.0		ug/L			08/29/16 07:36	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*89*		*82 - 122*		*08/29/16 07:36*	*1*
Trifluorotoluene (Surr)	*112*		*80 - 141*		*08/29/16 07:36*	*1*
4-Bromofluorobenzene (Surr)	*107*		*75 - 125*		*08/29/16 07:36*	*1*
Dibromofluoromethane (Surr)	*113*		*77 - 118*		*08/29/16 07:36*	*1*
1,2-Dichloroethane-d4 (Surr)	*113*		*65 - 143*		*08/29/16 07:36*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.58**		0.11		mg/L		08/30/16 16:33	09/02/16 04:17	1
Motor Oil (>C24-C36)	**0.40**		0.25		mg/L		08/30/16 16:33	09/02/16 04:17	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*96*		*50 - 150*	*08/30/16 16:33*	*09/02/16 04:17*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 5-0816
Date Collected: 08/18/16 14:45
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-5
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 06:11	1
Toluene	ND		2.0		ug/L			08/29/16 06:11	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 06:11	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 06:11	1
o-Xylene	ND		2.0		ug/L			08/29/16 06:11	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*89*		*82 - 122*		*08/29/16 06:11*	*1*
Trifluorotoluene (Surr)	*111*		*80 - 141*		*08/29/16 06:11*	*1*
4-Bromofluorobenzene (Surr)	*107*		*75 - 125*		*08/29/16 06:11*	*1*
Dibromofluoromethane (Surr)	*114*		*77 - 118*		*08/29/16 06:11*	*1*
1,2-Dichloroethane-d4 (Surr)	*114*		*65 - 143*		*08/29/16 06:11*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.15**		0.11		mg/L		08/31/16 14:30	09/01/16 22:22	1
Motor Oil (>C24-C36)	ND		0.26		mg/L		08/31/16 14:30	09/01/16 22:22	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*85*		*50 - 150*	*08/31/16 14:30*	*09/01/16 22:22*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 6-0816
Date Collected: 08/18/16 12:49
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-6
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 06:39	1
Toluene	ND		2.0		ug/L			08/29/16 06:39	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 06:39	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 06:39	1
o-Xylene	ND		2.0		ug/L			08/29/16 06:39	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*91*		*82 - 122*		*08/29/16 06:39*	*1*
Trifluorotoluene (Surr)	*110*		*80 - 141*		*08/29/16 06:39*	*1*
4-Bromofluorobenzene (Surr)	*107*		*75 - 125*		*08/29/16 06:39*	*1*
Dibromofluoromethane (Surr)	*109*		*77 - 118*		*08/29/16 06:39*	*1*
1,2-Dichloroethane-d4 (Surr)	*112*		*65 - 143*		*08/29/16 06:39*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.64**		0.11		mg/L		08/31/16 14:30	09/01/16 22:44	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		08/31/16 14:30	09/01/16 22:44	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*91*		*50 - 150*	*08/31/16 14:30*	*09/01/16 22:44*	*1*

Client Sample ID: MW 7-0816
Date Collected: 08/18/16 13:54
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-7
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 07:08	1
Toluene	ND		2.0		ug/L			08/29/16 07:08	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 07:08	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 07:08	1
o-Xylene	ND		2.0		ug/L			08/29/16 07:08	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*87*		*82 - 122*		*08/29/16 07:08*	*1*
Trifluorotoluene (Surr)	*112*		*80 - 141*		*08/29/16 07:08*	*1*
4-Bromofluorobenzene (Surr)	*105*		*75 - 125*		*08/29/16 07:08*	*1*
Dibromofluoromethane (Surr)	*115*		*77 - 118*		*08/29/16 07:08*	*1*
1,2-Dichloroethane-d4 (Surr)	*114*		*65 - 143*		*08/29/16 07:08*	*1*

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	**0.11**		0.11		mg/L		08/31/16 14:30	09/01/16 23:06	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		08/31/16 14:30	09/01/16 23:06	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*82*		*50 - 150*	*08/31/16 14:30*	*09/01/16 23:06*	*1*

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: Trip Blank
Date Collected: 08/18/16 00:01
Date Received: 08/19/16 12:46

Lab Sample ID: 580-61941-8
Matrix: Water

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 04:17	1
Toluene	ND		2.0		ug/L			08/29/16 04:17	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 04:17	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 04:17	1
o-Xylene	ND		2.0		ug/L			08/29/16 04:17	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*88*		*82 - 122*		*08/29/16 04:17*	*1*
Trifluorotoluene (Surr)	*111*		*80 - 141*		*08/29/16 04:17*	*1*
4-Bromofluorobenzene (Surr)	*106*		*75 - 125*		*08/29/16 04:17*	*1*
Dibromofluoromethane (Surr)	*114*		*77 - 118*		*08/29/16 04:17*	*1*
1,2-Dichloroethane-d4 (Surr)	*111*		*65 - 143*		*08/29/16 04:17*	*1*

Method: 8260C - Volatile Organic Compounds by GC/MS

Lab Sample ID: MB 580-226104/4
Matrix: Water
Analysis Batch: 226104

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		2.0		ug/L			08/29/16 02:23	1
Toluene	ND		2.0		ug/L			08/29/16 02:23	1
Ethylbenzene	ND		3.0		ug/L			08/29/16 02:23	1
m-Xylene & p-Xylene	ND		3.0		ug/L			08/29/16 02:23	1
o-Xylene	ND		2.0		ug/L			08/29/16 02:23	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Toluene-d8 (Surr)	*88*		*82 - 122*		*08/29/16 02:23*	*1*
Trifluorotoluene (Surr)	*113*		*80 - 141*		*08/29/16 02:23*	*1*
4-Bromofluorobenzene (Surr)	*108*		*75 - 125*		*08/29/16 02:23*	*1*
Dibromofluoromethane (Surr)	*116*		*77 - 118*		*08/29/16 02:23*	*1*
1,2-Dichloroethane-d4 (Surr)	*117*		*65 - 143*		*08/29/16 02:23*	*1*

Lab Sample ID: LCS 580-226104/5
Matrix: Water
Analysis Batch: 226104

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Benzene			10.0	10.9		ug/L		109	80 - 120		
Toluene			10.0	8.79		ug/L		88	75 - 120		
Ethylbenzene			10.0	9.40		ug/L		94	75 - 119		
m-Xylene & p-Xylene			10.0	9.48		ug/L		95	75 - 119		
o-Xylene			10.0	9.84		ug/L		98	74 - 120		

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
Toluene-d8 (Surr)	*86*		*82 - 122*
Trifluorotoluene (Surr)	*107*		*80 - 141*
4-Bromofluorobenzene (Surr)	*111*		*75 - 125*
Dibromofluoromethane (Surr)	*114*		*77 - 118*
1,2-Dichloroethane-d4 (Surr)	*109*		*65 - 143*

Lab Sample ID: LCSD 580-226104/6
Matrix: Water
Analysis Batch: 226104

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene			10.0	10.7		ug/L		107	80 - 120	2	14
Toluene			10.0	8.57		ug/L		86	75 - 120	2	19
Ethylbenzene			10.0	9.11		ug/L		91	75 - 119	3	14
m-Xylene & p-Xylene			10.0	9.10		ug/L		91	75 - 119	4	14
o-Xylene			10.0	9.55		ug/L		95	74 - 120	3	16

Surrogate	*LCSD %Recovery*	*LCSD Qualifier*	*Limits*
Toluene-d8 (Surr)	*85*		*82 - 122*
Trifluorotoluene (Surr)	*109*		*80 - 141*
4-Bromofluorobenzene (Surr)	*109*		*75 - 125*
Dibromofluoromethane (Surr)	*113*		*77 - 118*

Method: 8260C - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCSD 580-226104/6
Matrix: Water
Analysis Batch: 226104

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	108		65 - 143

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Lab Sample ID: MB 580-226297/1-A
Matrix: Water
Analysis Batch: 226474

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 226297

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		08/30/16 16:33	09/01/16 20:08	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		08/30/16 16:33	09/01/16 20:08	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	122		50 - 150	08/30/16 16:33	09/01/16 20:08	1

Lab Sample ID: LCS 580-226297/2-A
Matrix: Water
Analysis Batch: 226474

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 226297

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
#2 Diesel (C10-C24)	2.01	1.84		mg/L		92	59 - 120
Motor Oil (>C24-C36)	2.01	2.05		mg/L		102	53 - 129

Surrogate	LCS %Recovery	LCS Qualifier	Limits
o-Terphenyl	106		50 - 150

Lab Sample ID: LCSD 580-226297/3-A
Matrix: Water
Analysis Batch: 226474

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 226297

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
#2 Diesel (C10-C24)	2.01	1.93		mg/L		96	59 - 120	5	27
Motor Oil (>C24-C36)	2.01	2.15		mg/L		107	53 - 129	5	19

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
o-Terphenyl	101		50 - 150

Lab Sample ID: MB 580-226383/1-A
Matrix: Water
Analysis Batch: 226527

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 226383

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
#2 Diesel (C10-C24)	ND		0.11		mg/L		08/31/16 14:30	09/01/16 21:15	1
Motor Oil (>C24-C36)	ND		0.25		mg/L		08/31/16 14:30	09/01/16 21:15	1

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC) (Continued)

Lab Sample ID: MB 580-226383/1-A
Matrix: Water
Analysis Batch: 226527

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 226383

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	91		50 - 150	08/31/16 14:30	09/01/16 21:15	1

Lab Sample ID: LCS 580-226383/2-A
Matrix: Water
Analysis Batch: 226527

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 226383

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
#2 Diesel (C10-C24)			2.01	1.88		mg/L		94	59 - 120		
Motor Oil (>C24-C36)			2.01	2.05		mg/L		102	53 - 129		

Surrogate	LCS %Recovery	LCS Qualifier	Limits
o-Terphenyl	91		50 - 150

Lab Chronicle

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 1-0816

Lab Sample ID: 580-61941-1

Date Collected: 08/18/16 11:37

Matrix: Water

Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 05:14	STA	TAL SEA
Total/NA	Prep	3510C			226297	08/30/16 16:33	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226474	09/02/16 00:35	KZ1	TAL SEA

Client Sample ID: MW 2-0816

Lab Sample ID: 580-61941-2

Date Collected: 08/18/16 12:12

Matrix: Water

Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		10	226104	08/29/16 09:02	STA	TAL SEA
Total/NA	Prep	3510C			226297	08/30/16 16:33	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226474	09/02/16 00:57	KZ1	TAL SEA

Client Sample ID: MW 2D-0816

Lab Sample ID: 580-61941-3

Date Collected: 08/18/16 11:12

Matrix: Water

Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 05:42	STA	TAL SEA
Total/NA	Prep	3510C			226297	08/30/16 16:33	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226474	09/02/16 01:19	KZ1	TAL SEA

Client Sample ID: MW 3-0816

Lab Sample ID: 580-61941-4

Date Collected: 08/18/16 13:24

Matrix: Water

Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 07:36	STA	TAL SEA
Total/NA	Prep	3510C			226297	08/30/16 16:33	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226474	09/02/16 04:17	KZ1	TAL SEA

Client Sample ID: MW 5-0816

Lab Sample ID: 580-61941-5

Date Collected: 08/18/16 14:45

Matrix: Water

Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 06:11	STA	TAL SEA
Total/NA	Prep	3510C			226383	08/31/16 14:30	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226527	09/01/16 22:22	KZ1	TAL SEA

Lab Chronicle

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Client Sample ID: MW 6-0816

Lab Sample ID: 580-61941-6

Date Collected: 08/18/16 12:49
Matrix: Water
Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 06:39	STA	TAL SEA
Total/NA	Prep	3510C			226383	08/31/16 14:30	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226527	09/01/16 22:44	KZ1	TAL SEA

Client Sample ID: MW 7-0816

Lab Sample ID: 580-61941-7

Date Collected: 08/18/16 13:54
Matrix: Water
Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 07:08	STA	TAL SEA
Total/NA	Prep	3510C			226383	08/31/16 14:30	JCV	TAL SEA
Total/NA	Analysis	NWTPH-Dx		1	226527	09/01/16 23:06	KZ1	TAL SEA

Client Sample ID: Trip Blank

Lab Sample ID: 580-61941-8

Date Collected: 08/18/16 00:01
Matrix: Water
Date Received: 08/19/16 12:46

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260C		1	226104	08/29/16 04:17	STA	TAL SEA

Laboratory References:

TAL SEA = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Certification Summary

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Laboratory: TestAmerica Seattle

Unless otherwise noted, all analytes for this laboratory were covered under each certification below.

Authority	Program	EPA Region	Certification ID	Expiration Date
Washington	State Program	10	C553	02-17-17

Analysis Method	Prep Method	Matrix	Analyte

Sample Summary

Client: TRC Solutions, Inc.
Project/Site: BNSF Winlock, WA

TestAmerica Job ID: 580-61941-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
580-61941-1	MW 1-0816	Water	08/18/16 11:37	08/19/16 12:46
580-61941-2	MW 2-0816	Water	08/18/16 12:12	08/19/16 12:46
580-61941-3	MW 2D-0816	Water	08/18/16 11:12	08/19/16 12:46
580-61941-4	MW 3-0816	Water	08/18/16 13:24	08/19/16 12:46
580-61941-5	MW 5-0816	Water	08/18/16 14:45	08/19/16 12:46
580-61941-6	MW 6-0816	Water	08/18/16 12:49	08/19/16 12:46
580-61941-7	MW 7-0816	Water	08/18/16 13:54	08/19/16 12:46
580-61941-8	Trip Blank	Water	08/18/16 00:01	08/19/16 12:46

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

☐ Rush
☐ Short Hold

Chain of Custody Record

Client	Client Contact	Date	Chain of Custody Number
TRC	Keith Woodburne	8/19/16	29238
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** 1 of 1
19874 141st PL NE	425-489-1939	61941	
City / **State** / **Zip Code**	**Sampler**	**Lab Contact**	
Woodinville / WA / 98072	A. Meugniot		
Project Name and Location (State)	**Billing Contact**		
Winlock, WA	Scott MacDonald @ BNSF		
Contract/Purchase Order/Quote No.			
BNSF TT# (will contact w #)			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: DAC to 8 NWTPH-Dx	Analysis: BTEX by 8260C
-1 MW1-0816	8/18/16	1137		X						X			X	X
MW2-0816		1212		X						X			X	X
-3 MW2D-0816		1112		X						X			X	X
MW3-0816		1324		X						X			X	X
-5 MW5-0816		1445		X						X			X	X
MW6-0816		1249		X						X			X	X
-7 MW7-0816		1354		X						X			X	X
TRIP BLANK				X										X

Special Instructions/ Conditions of Receipt

580-61941 Chain of Custody

TB #2 Cooler Cor 0.5° Unc 0.7°
Cooler Dsc Ly Bucket @ Lab 1625
Wet/Packs Packing Bubble
w/o

Cooler	Possible Hazard Identification	Sample Disposal	(A fee may be assessed if samples are retained longer than 1 month)
☒ Yes ☐ No Cooler Temp: ____	☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown	☐ Return To Client ☒ Disposal By Lab ☐ Archive For ____ Months	

Turn Around Time Required (business days)
☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other ____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By Sign/Print: Amanda Meugniot	8/19/16	1246	1. Received By Sign/Print: Francisco Luna, Jr.	8/19/16	1246
2. Relinquished By Sign/Print:			2. Received By Sign/Print:		
3. Relinquished By Sign/Print:			3. Received By Sign/Print:		

Comments

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-8274-580 (0210)

Login Sample Receipt Checklist

Client: TRC Solutions, Inc.

Job Number: 580-61941-1

Login Number: 61941

List Source: TestAmerica Seattle

List Number: 1

Creator: Blankinship, Tom X

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

APPENDIX D

MANN-KENDALL STATISTICAL TREND ANALYSIS OF SELECT WELLS

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Former Cummings Oil Lease Site*
Site Address:	*Winlock, WA*
Additional Description:	

Well (Sampling) Location?	**MW-1**
Level of Confidence (Decision Criteria)?	**95%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

		Hazardous Substances (unit is ug/L)					
Sampling Event	Date Sampled	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
#1	12/23/2005	25	119	238			
#2	8/18/2008	25	**1,480**	836			
#3	3/11/2010	25	**590**	540			
#4	6/9/2010	25	**720**	230			
#5	10/20/2010	25	**670**	230			
#6	12/27/2010	25	**520**	190			
#7	3/22/2011	25	**630**	205			
#8	8/17/2012	25	470	190			
#9	8/1/2013	25	490	500			
#10	8/14/2014	25	440	410			
#11	8/6/2015		320	330			
#12	12/23/2015		260	125			
#13	3/28/2016		380	270			
#14	8/18/2016		470	370			
#15							
#16							

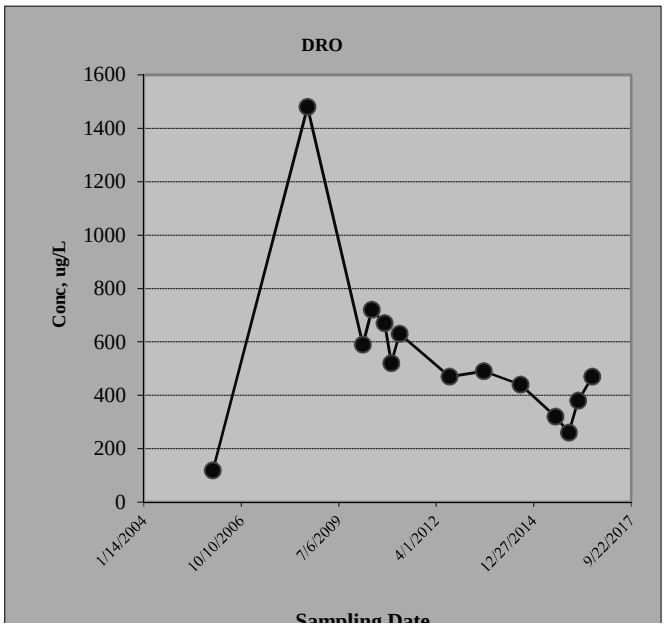
2. Mann-Kendall Non-parametric Statistical Test Results

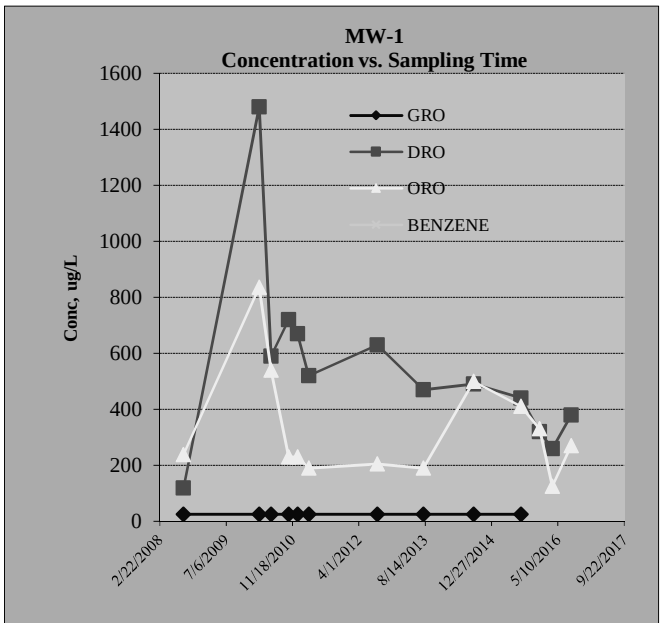
Hazardous Substance?	**GRO**	**DRO**	**ORO**	**BENZENE**	**TOLUENE**	**ETHYLBENZENE**
Confidence Level Calculated?	-900.00%	98.70%	77.50%	NA	NA	NA
Plume Stability?	Stable	Shrinking	Stable	NA	NA	NA
Coefficient of Variation?	CV <= 1		CV <= 1	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	0	-42	-15	0	0	0
Number of Sampling Rounds?	10	14	14	0	0	0
Average Concentration?	25.00	539.93	333.14	NA	NA	NA
Standard Deviation?	0.00	315.72	189.29	NA	NA	NA
Coefficient of Variation?	0.00	0.58	0.57	NA	NA	NA
Blank if No Errors found				n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance? **DRO**

Plume Stability? **Shrinking**





Sampling Date

Sampling Date

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Former Cummings Oil Lease Site*
Site Address:	*Winlock, WA*
Additional Description:	

Well (Sampling) Location?	**MW-2**
Level of Confidence (Decision Criteria)?	**95%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

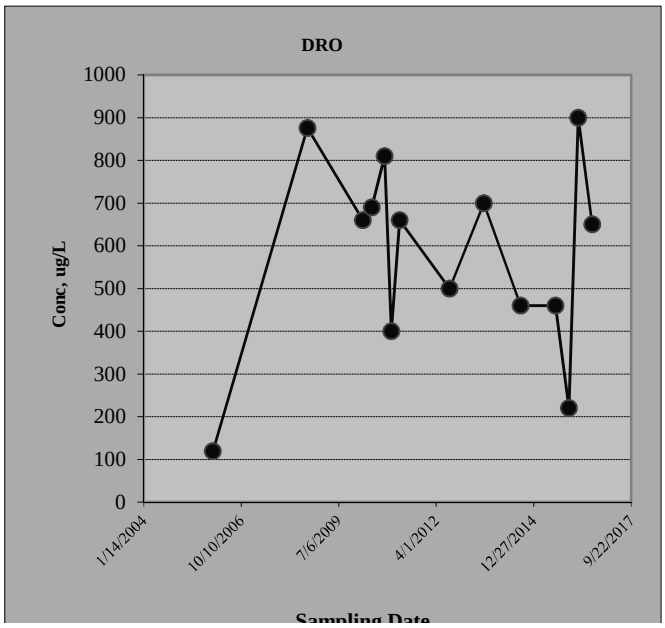
		Hazardous Substances (unit is ug/L)					
Sampling Event	Date Sampled	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
#1	12/23/2005	465	**119**	238	**55.2**		
#2	8/18/2008	606	**876**	250	**30.6**		
#3	3/11/2010	150	**660**	470	**27.7**		
#4	6/9/2010	116	**690**	440	**22.4**		
#5	10/20/2010	95.2	**810**	**590**	**10.6**		
#6	12/27/2010	130	400	190	**18.6**		
#7	3/22/2011	196	**660**	215	**47.8**		
#8	8/17/2012	158	**500**	190	**12.6**		
#9	8/1/2013	260	**700**	**590**	**8.5**		
#10	8/14/2014	220	460	300	**7.8**		
#11	8/6/2015		460	380	3.4		
#12	12/23/2015		220	140	**5.9**		
#13	3/28/2016		**900**	360	**13**		
#14	8/18/2016		**650**	360	1		
#15							
#16							

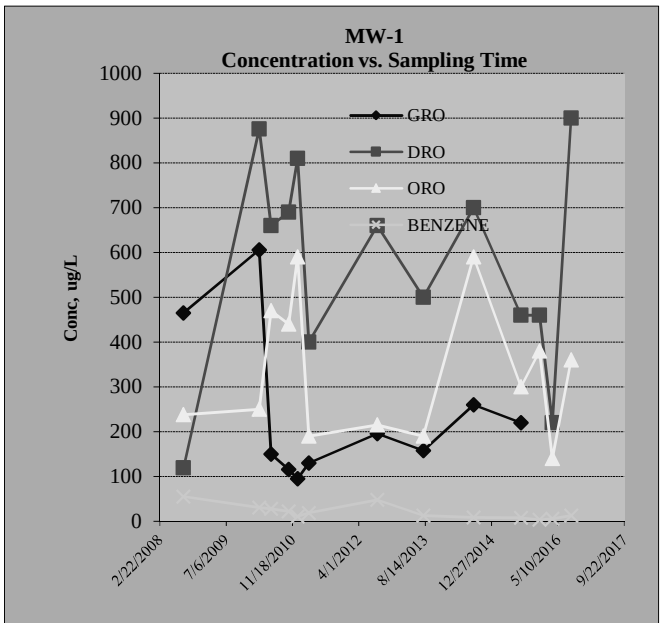
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
Confidence Level Calculated?	50.00%	62.60%	54.30%	100.00%	NA	NA
Plume Stability?	Stable	Stable	Stable	Shrinking	NA	NA
Coefficient of Variation?	CV <= 1	CV <= 1	CV <= 1		n<4	n<4
Mann-Kendall Statistic "S" value?	1	-7	-4	-63	0	0
Number of Sampling Rounds?	10	14	14	14	0	0
Average Concentration?	239.62	578.93	336.64	18.94	NA	NA
Standard Deviation?	166.86	231.52	145.41	16.37	NA	NA
Coefficient of Variation?	0.70	0.40	0.43	0.86	NA	NA
Blank if No Errors found					n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance?	**DRO**
Plume Stability?	**Stable**





Sampling Date

Sampling Date

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Former Cummings Oil Lease Site*
Site Address:	*Winlock, WA*
Additional Description:	

Well (Sampling) Location?	**MW-3**
Level of Confidence (Decision Criteria)?	**95%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

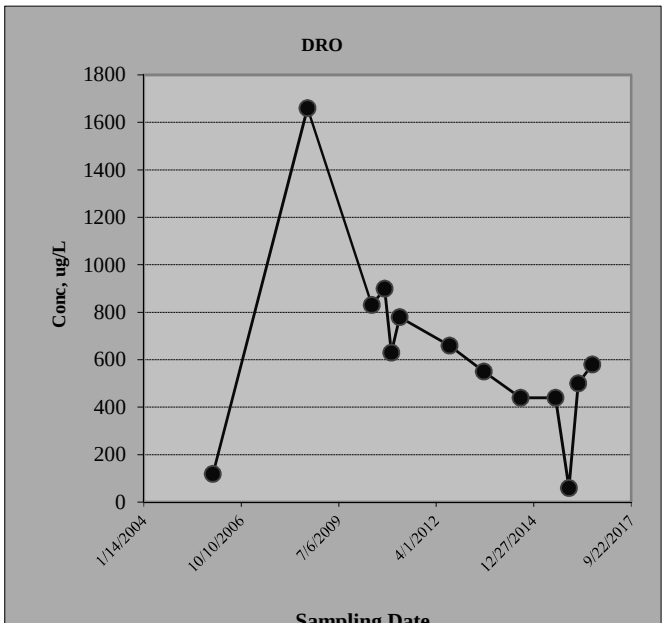
		Hazardous Substances (unit is ug/L)					
Sampling Event	Date Sampled	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
#1	12/23/2005		119	238			
#2	8/18/2008		**1,660**	**887**			
#3	6/9/2010		**830**	200			
#4	10/20/2010		**900**	460			
#5	12/27/2010		**630**	205			
#6	3/22/2011		**780**	190			
#7	8/17/2012		**660**	200			
#8	8/1/2013		**550**	**500**			
#9	8/14/2014		440	330			
#10	8/6/2015		440	430			
#11	12/23/2015		60	135			
#12	3/28/2016		500	340			
#13	8/18/2016		**580**	400			
#14							
#15							
#16							

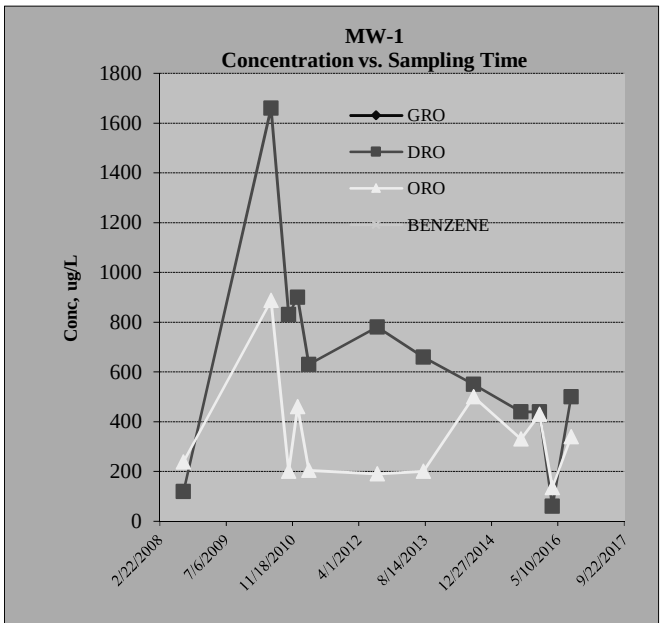
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
Confidence Level Calculated?	NA	97.10%	52.40%	NA	NA	NA
Plume Stability?	NA	Shrinking	Stable	NA	NA	NA
Coefficient of Variation?	n<4		CV <= 1	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	0	-33	-3	0	0	0
Number of Sampling Rounds?	0	13	13	0	0	0
Average Concentration?	NA	626.85	347.31	NA	NA	NA
Standard Deviation?	NA	395.93	200.56	NA	NA	NA
Coefficient of Variation?	NA	0.63	0.58	NA	NA	NA
Blank if No Errors found	n<4			n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance?	**DRO**
Plume Stability?	**Shrinking**





Sampling Date

Sampling Date

Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

Site Name:	*Former Cummings Oil Lease Site*
Site Address:	*Winlock, WA*
Additional Description:	

Well (Sampling) Location?	**MW-6**
Level of Confidence (Decision Criteria)?	**95%**

1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

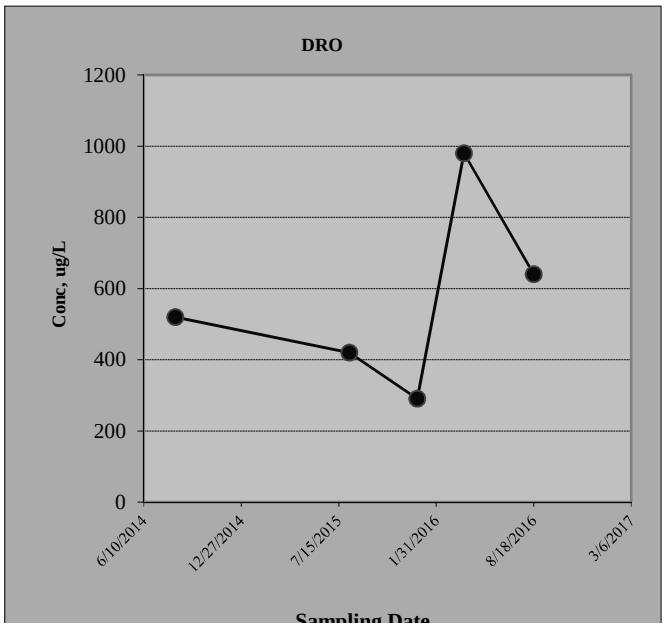
		Hazardous Substances (unit is ug/L)					
Sampling Event	Date Sampled	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
#1	8/14/2014		**520**	280			
#2	8/6/2015		420	370			
#3	12/23/2015		290	130			
#4	3/28/2016		**980**	470			
#5	8/18/2016		**640**	125			
#6							
#7							
#8							
#9							
#10							
#11							
#12							
#13							
#14							
#15							
#16							

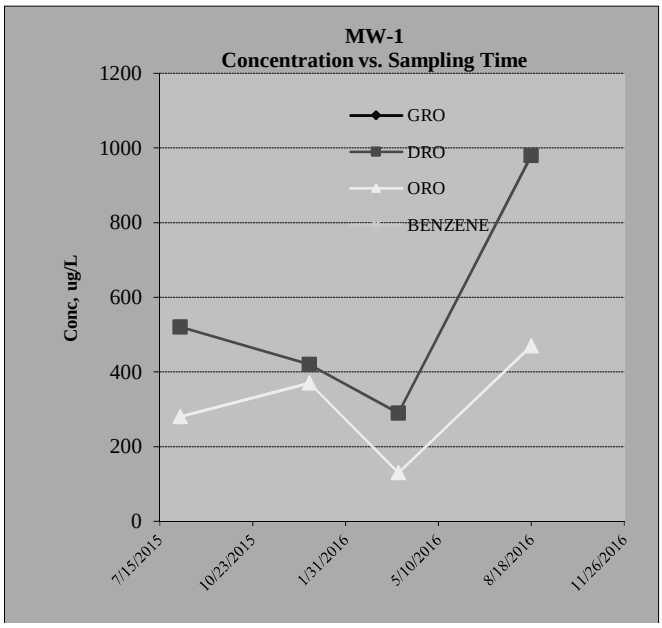
2. Mann-Kendall Non-parametric Statistical Test Results

Hazardous Substance?	GRO	DRO	ORO	BENZENE	TOLUENE	ETHYLBENZENE
Confidence Level Calculated?	NA	59.20%	59.20%	NA	NA	NA
Plume Stability?	NA	Stable	Stable	NA	NA	NA
Coefficient of Variation?	n<4	CV <= 1	CV <= 1	n<4	n<4	n<4
Mann-Kendall Statistic "S" value?	0	2	-2	0	0	0
Number of Sampling Rounds?	0	5	5	0	0	0
Average Concentration?	NA	570.00	275.00	NA	NA	NA
Standard Deviation?	NA	262.87	150.50	NA	NA	NA
Coefficient of Variation?	NA	0.46	0.55	NA	NA	NA
Blank if No Errors found	n<4			n<4	n<4	n<4

3. Temporal Trend: Plot of Concentration vs. Sampling Time

Hazardous substance?	**DRO**
Plume Stability?	**Stable**





Sampling Date

Sampling Date