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January 20, 2016

Mr. John Mefford
Washington State Department of Ecology
CRO Toxics Cleanup Program
1250 West Alder Street
Union Gap, WA 98903-0009

Re: Submittal of Monitoring Well Installation Work Plan
BNSF – Glacier Park East Site
NE Corner of U. S. Highway 2 and Chumstick Highway
Leavenworth, Washington
Facility/Site No.: 349
Cleanup Site ID No.: 4234
Agreed Order No.: DE 01 TCPCR-3168

Dear Mr. Mefford:
On behalf of the BNSF Railway Company, TRC is please to submit the attached *Monitoring Well Installation Work Plan* for the Glacier Park East Site located in Leavenworth, Washington. This work plan has been prepared and the off-site monitoring well installations planned to address Ecology comments outlined in a November 18, 2015 email communication and subsequent phone conversation with regards to the need for additional groundwater characterization and plume definition.

If you have any questions regarding the attached work plan, please contact me at (425) 489-1938, extension 18177.

Sincerely,

Keith Woodburne, L.G.
Senior Project Manager

cc: Scott MacDonald, BNSF

Attachment: *Monitoring Well Installation Work Plan*, dated January 20, 2016

TRC

Results you can rely on

MONITORING WELL INSTALLATION WORK PLAN

BNSF Glacier Park East Site

Leavenworth, Washington

Prepared for:

BNSF Railway Company

2454 Occidental Avenue South, Suite 1A

Seattle, Washington 98134

Prepared by:

TRC

January 2016

TRC

Results you can rely on

MONITORING WELL INSTALLATION WORK PLAN

January 20, 2016

BNSF Glacier Park East
Leavenworth, Washington

TRC Project No. 249542

Prepared For:

BNSF Railway Company
2454 Occidental Avenue South, Suite 1A
Seattle, Washington 98134

By:

Amanda Meugniot
Senior Staff Geologist

Keith Woodburne L.G.
Senior Project Manager

State of Washington
2955
Licensed Geologist
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TRC
19874 141st Place NE
Woodinville, Washington
(425) 489-1938

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1.0 INTRODUCTION

1.1 Work Plan Objective

On behalf of BNSF Railway Company (BNSF), this *Monitoring Well Installation Work Plan* is presented in accordance with the terms of the Washington State Department of Ecology (Ecology) issued Agreed Order Number DE 01TCPCR-3168 and communications with Ecology for the BNSF owned Glacier Park East site located on the northeast corner of the intersection of Highway 2 and Chumstick Highway in Leavenworth, Washington (the Site, Figures 1 and 2).

In response to Ecology's concerns that impacted groundwater may be migrating offsite towards the Wenatchee River this work plan has been prepared for the installation of two (2) new groundwater monitoring wells in the presumed downgradient direction from the current monitoring well network.

1.2 Summary of Work Plan Activities

This scope of work encompasses the following activities, which are detailed in subsequent sections of this report:

- Installation two (2) groundwater monitoring wells at presumed downgradient locations from the current monitoring well network (Figure 3); and
- Collection of groundwater samples from the newly installed monitoring wells.

All work will be completed to achieve the work plan objectives and performed in general conformance with the National Contingency Plan (NCP), codified as 40 Code of Federal Regulations (CFR) Part 300 and Washington Administrative Code (WAC) Title 173 Chapter 160.

2.0 MONITORING WELL INSTALLATION

2.1 Pre-field Activities

Prior to beginning field work, Notice of Intent forms and applicable fees will be submitted to Ecology. In addition, all necessary access agreements and encroachment permits will be obtained for the proposed drilling locations. Monitoring well locations will be marked with white paint or staked according to Washington Northwest Utility Notification Center (NUNC) requirements. At least two days prior to commencing work at the site, NUNC will be notified. The NUNC ticket will be maintained as long as work continues at the site, and will be updated as necessary for any monitoring well location adjustments that are made based upon the field data. In addition, a private utility locator will be contracted to confirm the absence of buried utilities at each proposed well location. Prior to drilling each boring, a pilot hole will be advanced using a hand auger or air-knife to approximately 5 feet below grade (fbg) to safely verify the absence of buried utilities.

A site and job specific health and safety plan that promotes personnel safety and preparedness during the planned activities will be developed prior to conducting the proposed work at the site. On the morning of the day that the field activities are to commence, a "tailgate" meeting will be conducted with all exclusion zone workers to discuss the health and safety issues and concerns related to the specific work.

2.2 Well Installation

TRC proposes to install two (2) intermediate zone monitoring wells at presumed downgradient locations from the current monitoring well network as depicted on Figure 3. Proposed monitoring well MW-6 will be located approximately 50 feet southeast of existing well MW-3 in the adjacent City of Leavenworth right-of-way to the southeast of the Site. Proposed monitoring well MW-7 will be located approximately 125 feet southeast of existing well MW-2 on a privately owned parcel located to the southeast of the adjacent City of Leavenworth right-of-way.

The groundwater monitoring wells will be installed using an air rotary or sonic drill rig. At each well location, a complete lithological log will be developed during advancement of the pilot boring. Soil samples (cores) will be collected starting at ground surface to total depth using a split-spoon sampler or similar device. Each core sample will be logged in accordance with the Unified Soil Classification System (USCS; ASTM D-2487) and will include:

- Soil description (color, texture, structure, moisture/wetness, odor);
- Depth to groundwater;
- Total depth; and
- Drill rig type and drilling method.

Odors and/or elevated volatile compound readings (using a PID, or equivalent) will be documented at least every 5 feet, targeting areas displaying visual evidence of contamination.

As detailed in Table 1, monitoring wells will be installed with screen intervals and depths designed to intercept the groundwater table beneath the Site. Monitoring wells MW-6 and MW-7 will be installed to an estimated total depth of approximately 75 fbg.

The proposed monitoring wells will be installed in accordance with ASTM D5092 *Standard Practice for Design and Installation of Groundwater Monitoring Wells* and WAC Title 173 Chapter 160. It is anticipated that construction specifications of the new wells will be consistent with the existing Site monitoring wells, which include 2-inch diameter polyvinyl chloride (PVC) blank (riser) casing, 20 feet of slotted PVC well screen with a 0.020 slot size, and are completed with a #2/12 sand and sealed with hydrated bentonite chips and cement grout. The estimated total depth and screen interval will be finalized in the field based on lithology. The wellhead will be sealed with a watertight, lockable well cap. A flush-mounted, watertight, traffic-rated well box or monument well box, depending on site conditions, will be installed over the wellhead.

Well construction details, such as screen interval and total depth, will be finalized in the field based on lithology.

2.3 Well Development

The proposed monitoring wells will be developed by surging and purging of up to ten well casing volumes of water to remove fine-grained material from the wells. Purge water will be monitored for field parameters including pH, electrical conductivity (EC), temperature, and turbidity. Well development will continue until field parameters stabilize (i.e., turbidity readings reach between five [5] and fifty [50] Nephelometric Turbidity Units [NTU]) or a minimum of ten well volumes have been purged from well.

2.4 Well Survey

A Washington-licensed land surveyor will survey the northings and eastings and elevation of the top of the casing for all newly installed wells. The northings and eastings will be based on

Washington Coordinate System of 1983, north zone. The elevations will be measured to within a vertical accuracy of 0.01 feet from the top of casing based on the United States Coastal Geodetic Survey 1929 Mean Sea Level Datum (NGVD29).

3.0 GROUNDWATER MONITORING

3.1 Background

Quarterly groundwater monitoring was initiated at the site in October 2001 and five (5) monitoring wells (designated MW-1 through MW-5) were sampled for Site Contaminants of Concern (COCs) including Total Petroleum Hydrocarbons (TPH) as Diesel-Range Organics (DRO), Oil-Range Organics (ORO), and Gasoline-Range Organics (GRO); and benzene, toluene, ethylbenzene, and total xylenes (BTEX). In 2007, groundwater monitoring frequency was reduced from quarterly to semi-annually and wells MW-1 and MW-5 were eliminated from the sampling program.

Recent groundwater trends observed in Site monitoring wells are discussed in the *Second Semi-Annual 2015 Groundwater and Cap Inspection Report* prepared by TRC and summarized below:

- GRO concentrations in groundwater during the November 2015 monitoring event ranged from non-detect to 471 micrograms per liter (µg/L), well below the MTCA Method A cleanup level of 800 µg/L. GRO concentrations in wells MW-2 and MW-3 have fluctuated over the period of record (October 2001 through November 2015). GRO concentrations in well MW-2 have shown a clear decreasing trend since March 2012 and have remained below the laboratory reporting limit of 100 µg/L since December 2012. GRO concentrations in well MW-3 have generally declined since December 2012 with only one reported concentration in December 2013 above the MTCA Method A cleanup level of 800 µg/L and an increase in concentration during this event to 471 µg/L. GRO concentrations in well MW-4 exhibited generally decreasing trends between 2003 and 2010, and with the exception of a spike of 140 micrograms per liter (µg/L) in October 2011, concentrations have remained below laboratory reporting limits and well below the MTCA Method A cleanup level of 800 µg/L for GRO.

- DRO concentrations in groundwater during the November 2015 monitoring event ranged from 436 µg/L to 3,080 µg/L. The DRO concentrations in monitoring wells MW-3 and MW-4 exceeded the MTCA Method A cleanup level of 500 µg/L. DRO concentrations decreased significantly in wells MW-2, MW-3, and MW-4 after the cap was installed in 2003. However, DRO concentrations began to fluctuate starting in approximately 2009 (wells MW-2 and MW-3) and 2010 (well MW-4). An increasing concentration trend has been observed in well MW-2 since September 2012.

- ORO concentrations in groundwater during the November 2015 monitoring event ranged from 537 µg/L to 1,820 µg/L. The ORO concentrations in MW-2, MW-3, and MW-4 exceeded the MTCA Method A cleanup level of 500 µg/L. ORO concentrations, which had been generally consistent in each well during the period of record, began to fluctuate in approximately 2010 (wells MW-2 and MW-3) and 2012 (well MW-4) and exhibit a similar trend to DRO in wells MW-3 and MW-4.

- During the November 2015 monitoring event, benzene was only detected in well MW-3 at a concentration of 4.65 µg/L, below the MTCA Method A cleanup level of 5 µg/L. Concentrations of benzene have been well below the MTCA Method A cleanup level in well MW-2 since 2008 and MW-4 during the period of record. Concentrations of benzene have historically fluctuated in well MW-3, however, they have been below the MTCA Method A cleanup level since March 2014.

Groundwater analytical results for Site monitoring wells are provided on Table 3.

3.2 Groundwater Sampling of Newly Installed Wells

Sampling of newly installed monitoring wells MW-6 and MW-7 will be incorporated into the current site-wide groundwater monitoring program and initially sampled on a semi-annual basis beginning in the second quarter of 2016. The newly installed wells will be sampled no less than 48-hours post-development to evaluate COC concentrations in off-site groundwater. Development and sampling of newly installed wells MW-6 and MW-7 will coincide with first half 2016 semi-annual monitoring event.

During the monitoring event, the wells will be gauged and sampled according to the general field procedures described in Appendix A. The samples will be analyzed for DRO and ORO by Ecology method NWTPH-Dx, GRO by Ecology method NWTPH-Gx, and BTEX by Environmental Protection Agency (EPA) method 8260C.

4.0 REPORT PREPARATION

In an effort to provide Ecology with near-real time progress updates, TRC intends to share the following items as they become available:

- Analytical results for groundwater samples collected from wells MW-2, MW-3, MW-4, MW-6, and MW-7;
- Lithological data monitoring well MW-6 and MW-7 locations; and
- Well construction logs, surveyed well locations, and well construction details for newly installed monitoring wells.

In addition, the deliverables listed above will be formally presented in the forthcoming *First Semi-Annual 2016 Groundwater Monitoring Report, Cap Inspection and Well Installation Report*.

5.0 IMPLEMENTATION SCHEDULE

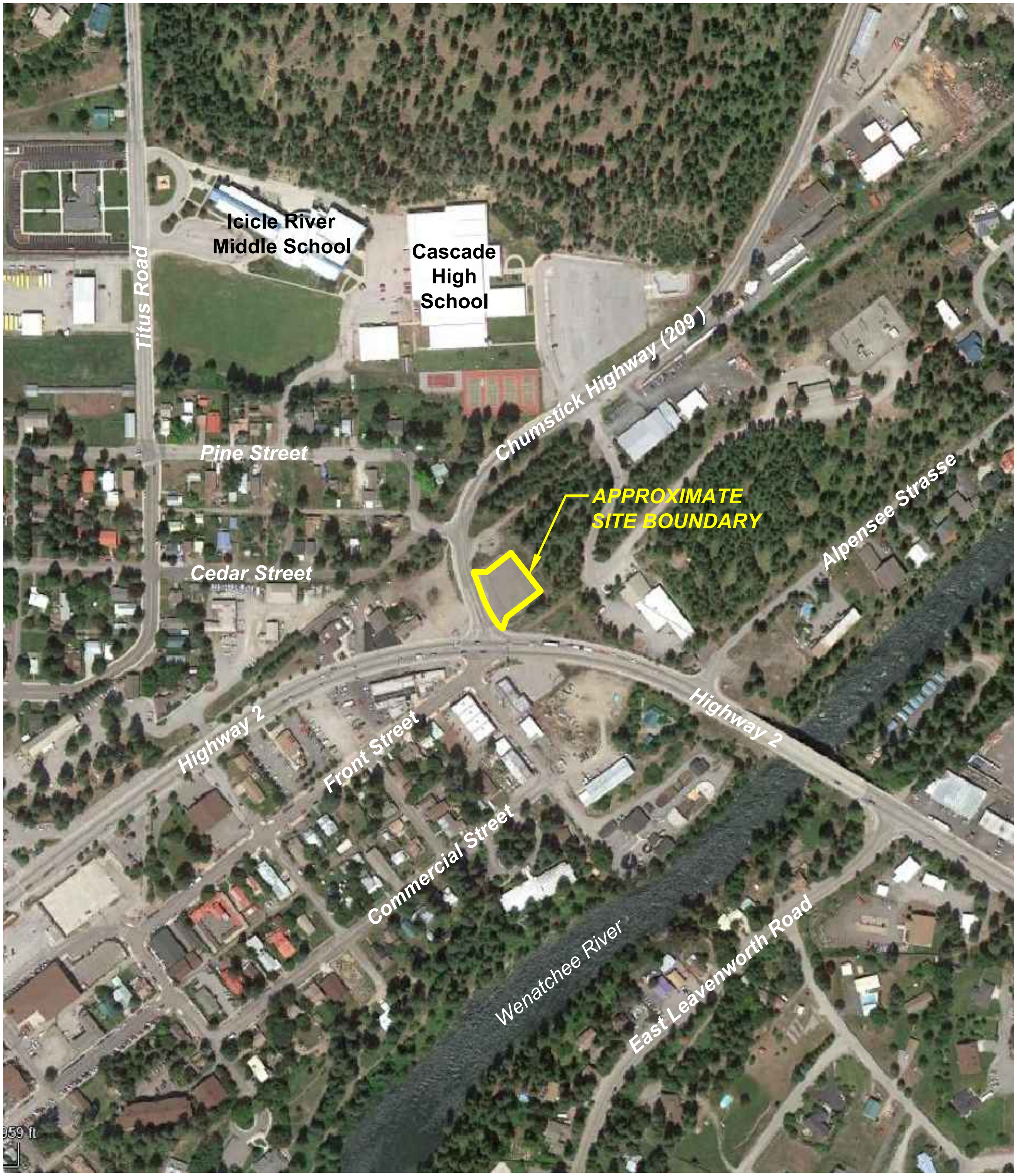
Contingent on approval of this work plan, TRC is prepared to implement the proposed scope of work. Work plan activities will be performed according to the estimated completion schedule listed below:

- Agency approval of this *Monitoring Well Installation Work Plan* is anticipated within one (1) month of submittal.
- TRC will coordinate access agreements and schedule and complete the proposed well installations and development in late-March or early-April when Site access is not impeded by snow and ice.
- Following installation of the monitoring wells, TRC will conduct the first semi-annual sampling event, which will include all wells in the site-wide groundwater monitoring program.

6.0 REFERENCES

TRC, December 2015. *Second Semi-Annual 2015 Groundwater Monitoring and Cap Inspection Report, BNSF Glacier Park East, Leavenworth, Washington*.

FIGURES

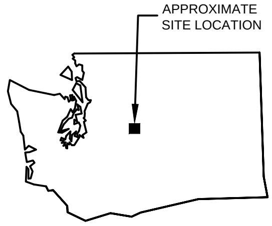


SOURCE AERIAL PHOTO: Google Earth, July 2013.

N

APPROXIMATE SCALE (FEET)

0 400 800

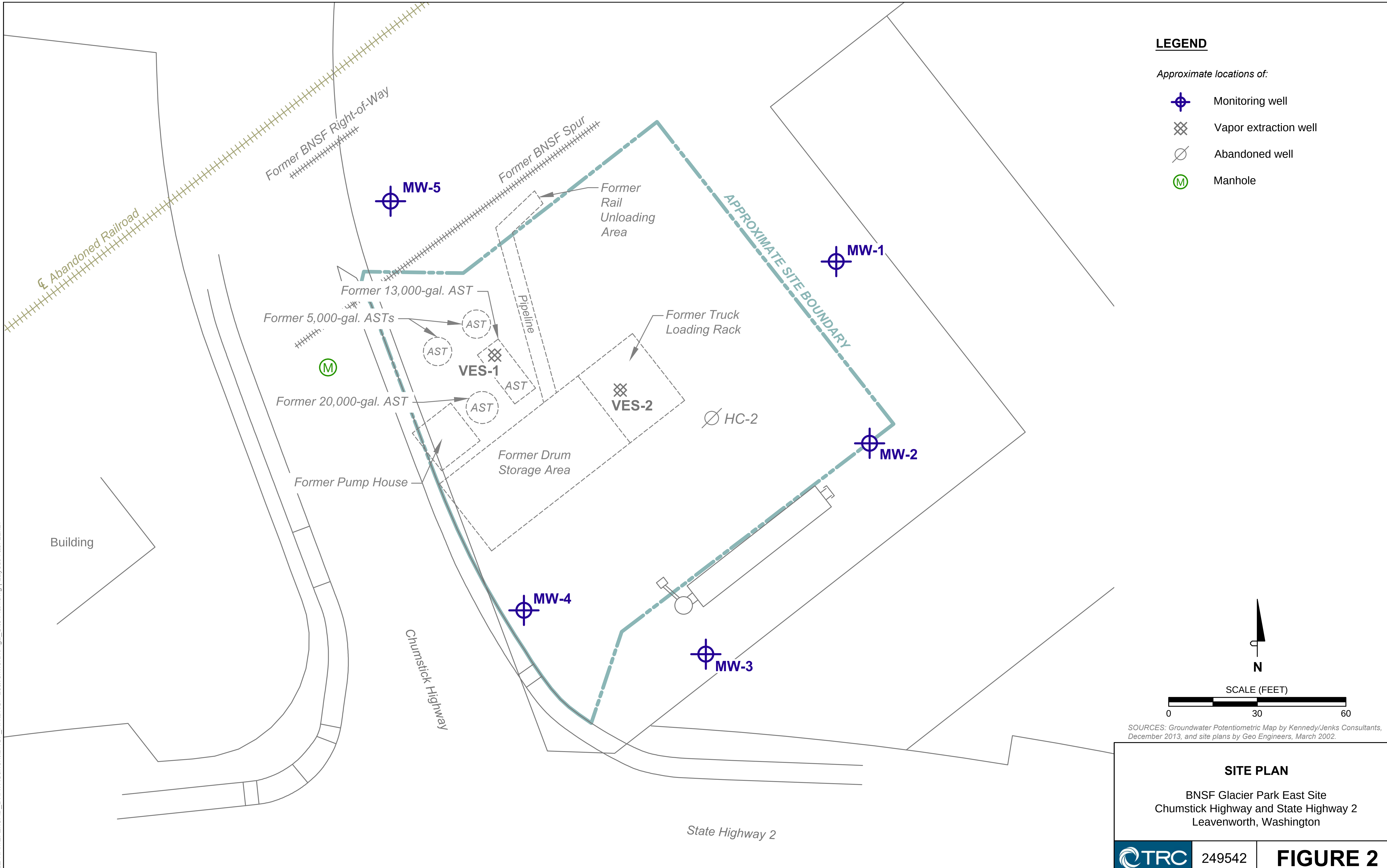


VICINITY MAP

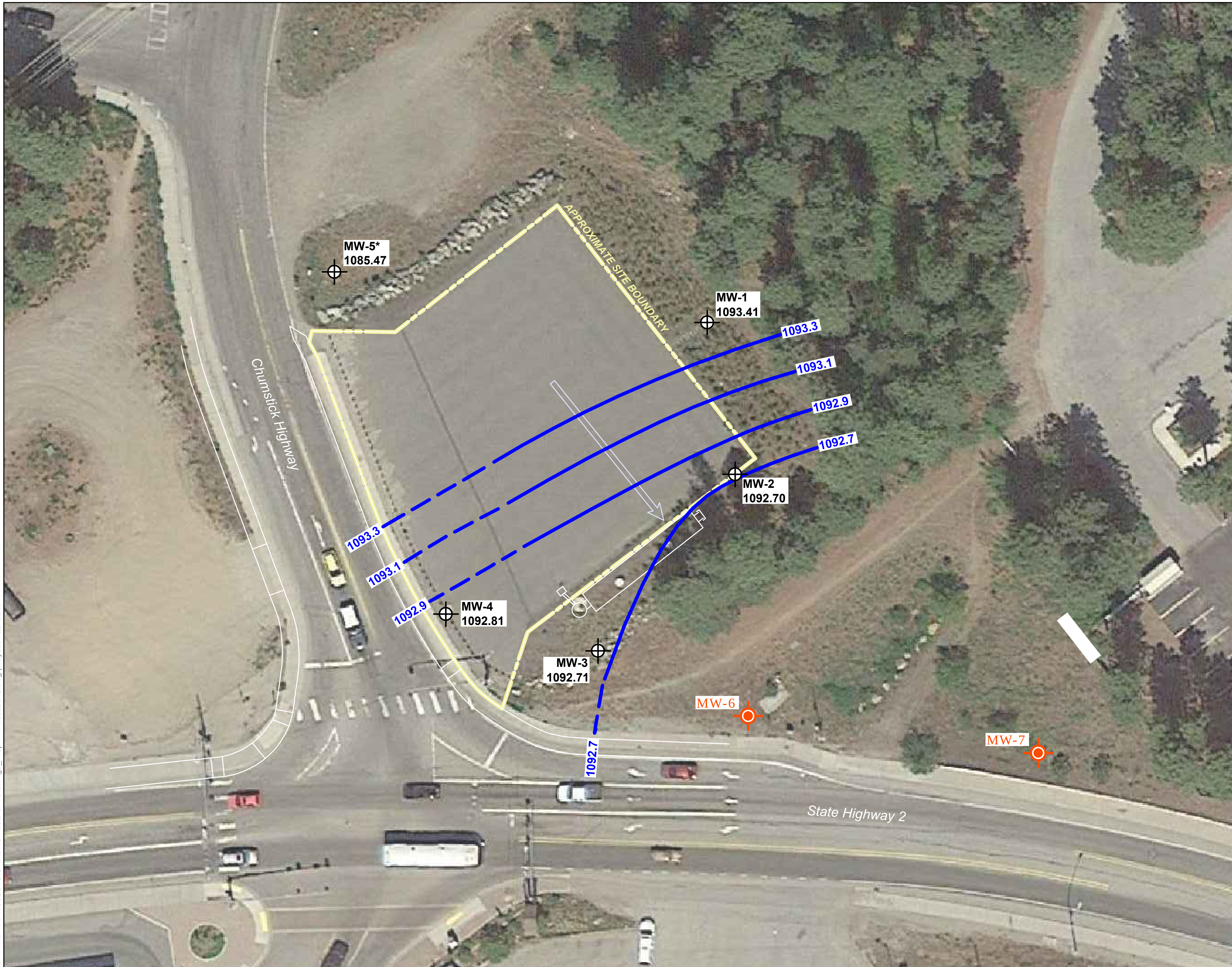
BNSF Glacier Park East Site
Chumstick Highway and State Highway 2
Leavenworth, Washington

TRC | 249542 | **FIGURE 1**

FILE NAME: Z:\CAD_DRAW\Current\BNSF_RR\BNSF Leavenworth\Fig1_Vicinity Map_Aerial.dwg | Layout Tab: 8x11



LEGEND
Approximate locations of:
Monitoring well
Vapor extraction well
Abandoned well
Manhole
Former BNSF Right-of-Way
Former BNSF Spur
Abandoned Railroad
MW-5
MW-1
MW-2
MW-3
MW-4
Former Rail Unloading Area
APPROXIMATE SITE BOUNDARY
Former 13,000-gal. AST
Former 5,000-gal. ASTs
AST
Pipeline
VES-1
VES-2
Former Truck Loading Rack
HC-2
Former 20,000-gal. AST
Former Drum Storage Area
Former Pump House
Building
Chumstick Highway
State Highway 2
N
SCALE (FEET)
0
30
60
SOURCES: Groundwater Potentiometric Map by Kennedy/Jenks Consultants, December 2013, and site plans by Geo Engineers, March 2002.
SITE PLAN
BNSF Glacier Park East Site
Chumstick Highway and State Highway 2
Leavenworth, Washington
TRC
249542
FIGURE 2
FILE NAME: Z:\CAD_DRAW\Current\BNSF_RR\BNSF Leavenworth\Fig2_Site Plan.dwg | Layout Tab: 11x17



SOURCES: Groundwater Potentiometric Map by Kennedy/Jenks Consultants, December 2013, and site plans by Geo Engineers, March 2002. Aerial photo by Google Earth, May 2015.

PROPOSED MONITORING WELL LOCATIONS

BNSF Glacier Park East Site
Chumstick Highway and State Highway 2
Leavenworth, Washington

TRC | 249542 | **FIGURE 3**

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TABLES

Table 1

Well Construction Details for Proposed Groundwater Monitoring Wells

BNSF Glacier Park East Site

Leavenworth, Washington

Well ID	Well Type	Aquifer	Approximate Screen Interval [a] (fbg)	Well Diameter (in)	Screen Slot Size (in)	Sand Pack
MW-6	Proposed Monitoring Well	Intermediate Zone	55-75	2	0.020	#2/12
MW-7	Proposed Monitoring Well	Intermediate Zone	55-75	2	0.020	#2/12

Notes:

fbg = feet below grade

[a] Screen intervals to be finalized in field based on lithology.

Table 2
Well Construction Details for Existing Groundwater Monitoring Wells
BNSF Glacier Park East Site
Leavenworth, Washington

Well ID	Date Installed	TOC Elevation (ft AMSL)	Well Diameter (in)	Total Depth (fbg)	Screen Interval (fbg)
Intermediate Zone Wells					
MW-1[a]	11/8/1995	1,153.21	2	77	62-77
MW-2[a]	NA	1,161.12	2	83	63-83
MW-3[a]	9/18/2001	1,156.29	2	78	58-78
MW-4[a]	9/19/2001	1,156.90	2	74	54-74
MW-5	9/20/2001	1,158.09	2	80.5	60.5-80.5

Notes:
TOC = top of casing
ft AMSL = feet above mean sea level
fbg = feet below grade
NA = Not available
[a] TOC elevation, total depth, and screen interval following well extension on 10/02/2002 prior to the placement of clean fill and installation of the asphalt cap.

Table 3
Summary of Groundwater Analytical Results
BNSF Railway Company
Glacier Park East
Leavenworth, Washington

Analytical results in micrograms per liter (µg/L)

Monitoring Well	Date Sample	Total Petroleum Hydrocarbons			Volatile Organic Compounds			
		Gasoline Range	Diesel Range	Heavy Oil Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
MTCA Method A Cleanup Levels [1]		800	500	500	5	1,000	700	1,000
MW-1	10/4/2001	<50	<281 I	<562	<0.5	**1.79**	<0.5	<1.0
	12/20/2001	<50	<250 J	<500	<0.5	<0.5	<0.5	<1.0
	3/21/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/26/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/24/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/18/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/14/2003	<50	**543**	<500	<0.5	<0.5	<0.5	**1.24**
	5/30/2003	<50	**710**	<500	<0.5	<0.5	<0.5	<1.0
	3/26/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/27/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/1/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/9/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2005	<50	**1,710**	**1,130**	<0.5	<0.5	<0.5	<1.0
	6/29/2005 - Dup	<50	**1,040**	**722**	<0.5	<0.5	<0.5	<1.0
	9/23/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/30/2005	<50	<282	<562	<0.5	<0.5	<0.5	<1.0
	3/28/2006	<50	<253	<505	<0.5	<0.5	<0.5	<1.0
	6/29/2006	<50	<253	<505	<0.5	<0.5	<0.5	<1.0
	9/5/2006	<80	<248	<495	<0.5	<0.5	<0.5	<1.0
	12/11/2006	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/30/2007	<50	<248	<495	<0.5	<0.5	<0.5	<1.0
MW-2	10/4/2001	<50	--	--	<0.5	<0.5	<0.5	<1.0
	12/20/2001	**102**	<250 J	<500	**0.52**	<0.5	<0.5	<1.0
	3/21/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/26/2002	**82**	<250	<500	<0.5	<0.5	<0.5	**1.73**
	9/24/2002	**125**	<250	<500	<0.5	<0.5	**0.815**	**1.06**
	12/18/2002	--	--	--	--	--	--	--
	3/14/2003	--	--	--	--	--	--	--
	5/30/2003	**165**	**499**	<500	**1.18**	<0.5	<0.5	<1.0
	3/26/2004	**99.1**	<250	<500	<0.5	<0.6	<0.5	**1.30**
	6/29/2004	**71.2**	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/27/2004	**96.9**	**264**	<500	<0.5	<0.5	<0.5	<1.0
	12/1/2004	**67.8**	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/9/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2005	**55.6**	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/23/2005	**54.6**	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/30/2005	**84.6**	<248	<495	<0.5	<0.5	**0.763**	**2.74**
	3/28/2006	**180**	<253	<505	**0.558**	<0.5	**0.993**	**1.38**
	6/29/2006	**154**	<250	<500	**0.801**	<0.5	<0.5	<1.0
	9/5/2006	**98.2**	<278	<556	**0.932**	<0.5	**0.79**	<1.0
	12/11/2006	**71**	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/30/2007	**258**	<245	<490	**2.66**	<0.5	**1.11**	**2.12**
	9/6/2007	**341**	<253	<505	**5.28**	<0.5	**3.67**	**3.23**
	4/29/2008	**318**	<250	<500	**3.22**	<0.5	**0.968**	**1.28**
	10/1/2008	**563**	<250	<500	**2.97**	**0.608**	**3.93**	**2.88**
	4/30/2009	**154**	<245	<490	**0.604**	<0.5	<0.5	**1.10**
	10/12/2009	**300**	**180**	<470	**1.0 H**	<1.0	<1.0	<1.0
	4/29/2010	**160**	<120	**300**	<0.5	<0.5	<0.5	**1.8**
	10/12/2010	**190**	**220**	<250	**0.76**	<0.5	<0.5	<1.0
	4/28/2011	**97**	<120	<240	<1.0	<1.0	<1.0	<1.0
	10/13/2011	**590**	**140**	<260	**4.6**	<1.0	**6.4**	**2.7**
	3/9/2012	**580**	**75.2**	<450	<1.0	<1.0	<1.0	<3.0
	6/20/2012	**118**	<76	<380	**1.1**	<1.0	<1.0	<3.0
	9/20/2012	**74.7**	<76	<380	<1.0	<1.0	<1.0	<3.0
	12/11/2012	<100	**200**	**290**	<1.0	<1.0	<1.0	<3.0
	3/18/2013	<100	**240**	<250	<0.5	<5.0	<0.5	<1.5
	12/4/2013	<100	**240**	<250	<0.5	<5.0	<0.5	<1.5

Table 3
Summary of Groundwater Analytical Results
BNSF Railway Company
Glacier Park East
Leavenworth, Washington

Analytical results in micrograms per liter (µg/L)

Monitoring Well	Date Sample	Total Petroleum Hydrocarbons			Volatile Organic Compounds			
		Gasoline Range	Diesel Range	Heavy Oil Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
MTCA Method A Cleanup Levels [1]		800	500	500	5	1,000	700	1,000
MW-3	3/18/2014	<100	**240**	<250	<0.5	<5.0	<0.5	<1.5
	6/19/2014	<100	**260**	<250	<0.5	<5.0	<0.5	<1.5
	11/20/2014	<100	**700**	**610**	<0.5	<5.0	<0.5	<1.5
	4/15/2015	<100	**350**	<250	<0.5	<5.0	<0.5	<1.5
	11/3/2015	<100	**436**	**537**	<0.5	<5.0	<0.5	<1.5
	10/5/2001	**1,280 I**	**1,730**	<500	**28.1 I**	**11.2 I**	**51.6 I**	**4.52 I**
	12/20/2001	**977 I**	<250 J	<500 J	**19.2 I**	**2.40 I**	**7.62 I**	**3.55 I**
	12/20/2001 - Dup	**950 I**	<250 J	<500 J	**19.3 I**	**2.42 I**	**7.60 I**	**3.55 I**
	3/21/2002	**993 I**	**255**	<500	**14.9 I**	**2.95 I**	**4.58 I**	**7.35 I**
	3/21/2002 - Dup	**963 I**	**428**	<500	**16.7 I**	**1.23 I**	**2.66 I**	**1.84 I**
	6/26/2002	**823**	<250	<500	**16.6**	**1.02 I**	**2.46 I**	**3.6**
	6/26/2002 - Dup	**762**	<250	<500	**15.4**	**1.03 I**	**2.48 I**	**3.56 I**
	9/24/2002	**1,020 I**	<250 J	<500 J	**16.2 I**	**4.77 I**	**29.4 I**	**8.74 I**
	9/24/2002 - Dup	**1,030 I**	<250 J	<500 J	**16.3 I**	**4.73 I**	**29.6 I**	**8.69 I**
	12/18/2002	**1,300**	<250	<500	**20.7**	**7.42**	**78.9**	**10.4**
	12/18/2002 - Dup	**1,250**	<250	<500	**21.1**	**7.43**	**79.4**	**10.2**
	3/14/2003	**919 I**	**2,330**	<500	**12 I**	**2.58 I**	**27.7 I**	**2.5 I**
	3/14/2003 - Dup	**849 I**	**2,200**	<500	**11.4 I**	**2.21 I**	**25.5 I**	**2.32 I**
	5/30/2003	**959**	**2,820**	<500	**22.7**	**6.01**	**42.8**	**7.12**
	5/30/2003 - Dup	**845**	**3,610**	**580**	**14.4**	**3.88**	**27**	**3.46**
	3/26/2004	**1,060**	**443**	<500	**19.7**	**7.44**	**24**	**4.32**
	3/26/2004 - Dup	**1,090**	**528**	<500	**19.1**	**7.14**	**23**	**3.62**
	6/29/2004	**1,260**	**305**	<500	**25.6**	**8.11**	**20.7**	**2.99**
	6/29/2004 - Dup	**1,050**	<250	<500	**21.7**	**6.82**	**17.4**	**2.61**
	9/27/2004	**1,340**	**535**	<500	**19.4**	**9.41**	**31.8**	**7.29**
	12/1/2004	**1,450**	**259**	<500	**20.9**	**8.06**	**27**	**4.82**
	3/9/2005	**698**	**602**	<500	**11.7**	**2.52**	**4.84**	**1.28**
	3/9/2005 - Dup	**639**	**334**	<500	**9.33**	**1.98**	**3.84**	<1.0
	6/29/2005	**909**	**324**	<500	**11**	**1.67**	**4.72**	**2.27**
	6/29/2005 - Dup	--	--	<501	--	--	--	--
	9/23/2005	**718**	<250	<500	**7.38**	**0.994**	**1.96**	**2.25**
	12/30/2005	**377**	<248	<495	**5.01**	**0.799**	**0.89**	**1.04**
	3/28/2006	**603**	<250	<500	**4.28**	<0.5	**0.918**	**1.99**
	6/29/2006	**998**	<278	<500	**12.7**	**1.61**	**10.5**	**3.03**
	9/5/2006	**655**	**366**	<556	**20.1**	**8.83**	**74.5**	**33.5**
	12/11/2006	**959**	**369**	<490	**4.66**	<0.5	<0.5	**2.06**
	3/30/2007	**2,510**	**341**	<485	**32.3**	**17.7**	**89.9**	**56.8**
	9/6/2007	**2,080**	<250	<500	**30.7**	**38.8**	**137**	**106**
	4/29/2008	**1,550 J**	**419 I**	<476	**12.8**	**16.2**	**48.4**	**29.9**
	4/29/2008 - Dup	**2,000 J**	<250	<500	**16.7**	**19.9**	**54.6**	**31.7**
	10/1/2008	**2,250 J**	<248	<495	**17.4**	**24.2**	**117**	**84.2**
	10/1/2008 - Dup	**2,390 J**	<240	<481	**18.3**	**25.4**	**118**	**88.9**
	4/30/2009	**1,050**	<248	**532**	**9.39**	**7.33**	**26.5**	**25**
	4/30/2009 - Dup	**1,040**	<238	<476	**9.36**	**7.3**	**26.2**	**24.6**
	10/12/2009	**4,600**	**980**	**720**	**27**	**41**	**180**	**40**
	10/12/2009 - Dup	**4,700**	**910**	**570**	**27**	**43**	**190**	**42**
	4/29/2010	**1,100**	**690**	<250	**9.9**	**7.5**	**16**	**13**
	4/29/2010 - Dup	**890**	**480**	<250	**9**	**6.4**	**14**	**12**
	10/12/2010	**1,300**	**1,600**	<240	**11**	**18**	**69**	**68**
	10/12/2010 - Dup	**1,300**	**2,700**	**370**	**10**	**18**	**70**	**69**
	4/28/2011	**65**	**120**	<250	**1**	<1.0	<1.0	<1.0
	4/28/2011 - Dup	**74**	**150**	<250	**1**	<1.0	<1.0	<1.0
	10/13/2011	<50	<130	<260	<1.0	<1.0	<1.0	<1.0
	10/13/2011 - Dup	**57**	<120	<250	<1.0	<1.0	<1.0	<1.0
	3/9/2012	**1,080**	**3,800**	**1,400**	**10**	**9.6**	**9.7**	**18.6**
	3/9/2012 - Dup	**985**	**4,100**	**1,500**	**9.1**	**8.7**	**8.9**	**17**
	6/20/2012	**50.6**	**120**	<380	**1.4**	<1.0	<1.0	<3.0
	6/20/2012 - Dup	**62.1**	<82	<410	**1.6**	<1.0	<1.0	<3.0
	9/20/2012	<50	**93**	<420	<1.0	<1.0	<1.0	<3.0
	9/20/2012 - Dup	<50	<79	<400	<1.0	<1.0	<1.0	<3.0
	12/11/2012	**1,460**	**1,800**	**1,300**	**7.3**	**39.9**	**14.9**	**71.5**

Table 3
Summary of Groundwater Analytical Results
BNSF Railway Company
Glacier Park East
Leavenworth, Washington

Analytical results in micrograms per liter (µg/L)

Monitoring Well	Date Sample	Total Petroleum Hydrocarbons			Volatile Organic Compounds			
		Gasoline Range	Diesel Range	Heavy Oil Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
MTCA Method A Cleanup Levels [1]		800	500	500	5	1,000	700	1,000
MW-3 Continued	12/11/2012 - Dup	**708**	**1,600**	**1,300**	**3.7**	**22.9**	**7.2**	**35.1**
	3/18/2013	**600**	**1,800**	**1,300**	**5.2**	**7.8**	**2.7**	**24**
	3/18/2013 - Dup	**610**	**1,100**	**250**	**5.4**	**8.1**	**2.8**	**25**
	12/4/2013	**1,000**	**2,300**	**630**	**14**	**21**	**19**	**110**
	12/4/2013 - Dup	**1,000**	**2,900**	**1,000**	**14**	**20**	**19**	**110**
	3/18/2014	<100	**1,900**	**860**	**1.7**	<5.0	<0.5	**1.6**
	3/18/2014 - Dup	<100	**1,900**	**870**	**1.6**	<5.0	<0.5	**1.6**
	6/19/2014	<100	**800**	**250**	**0.95**	<5.0	<0.5	<1.5
	6/19/2014 - Dup	<100	**1,000**	**380**	<0.5	<5.0	<0.5	<1.5
	11/20/2014	**150**	**2,700**	**1,400**	**1.7**	<5.0	**0.74**	<1.5
	11/20/2014 - Dup	**120**	**2,800**	**1,500**	**1.8**	<5.0	**0.64**	<1.5
	4/15/2015	<100	**1,400**	**510**	**0.77**	<5.0	<0.5	<1.5
	11/3/2015	**471**	**3,080**	**1,820**	**4.65**	<5.0	**1.95**	**5.68**
MW-4	10/5/2001	**149**	**1,940**	<561	<0.5	**2.17**	<0.5	<1.0
	10/5/2001 - Dup	**140**	**2,180**	<561	<0.5	**2.08**	<0.5	<1.0
	12/20/2001	**50.7**	<250 J	<500 J	<0.5	<0.5	<0.5	<1.0
	3/21/2002	**63.4**	**393**	<500	<0.5	<0.5	<0.5	<1.0
	6/26/2002	**244**	<250	<500	**2.73**	<0.5	<0.5	**1.06**
	9/24/2002	**253**	<250	<500	**3.31**	<0.5	<0.5	**1.01**
	12/18/2002	**236**	<250	<500	**1.73**	<0.5	<0.5	<1.0
	3/14/2003	**254**	**2,830**	<500	**0.847**	<0.5	<0.5	<1.0
	5/30/2003	**199**	**2,980**	<500	**0.602**	<0.5	<0.5	<1.0
	3/26/2004	**204**	**314**	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2004	**204**	**469**	<500	<0.5	<0.5	<0.5	<1.0
	9/27/2004	**192**	**408**	<500	<0.5	<0.5	<0.5	<1.0
	12/1/2004	**196**	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/9/2005	**153**	**378**	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2005	**183**	**477**	<500	<0.5	<0.5	<0.5	<1.0
	9/23/2005	**180**	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/30/2005	**137**	<248	<495	<0.5	<0.5	<0.5	<1.0
	3/28/2006	**170**	<243	<485	<0.5	<0.5	<0.5	<1.0
	6/29/2006	**132**	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/5/2006	<80	<263	<526	<0.5	<0.5	<0.5	<1.0
	12/11/2006	<50	<245	<490	<0.5	<0.5	<0.5	<1.0
	3/30/2007	<50	<253	<505	<0.5	<0.5	<0.5	<1.0
	9/6/2007	**267**	<250	<500	0.65	<0.5	<0.5	<3.0
	4/29/2008	**98.7**	<248	<495	<0.5	<0.5	<0.5	<1.0
	10/1/2008	**52.2**	<248	<495	<0.5	<0.5	<0.5	<1.0
	4/30/2009	**76.4**	<245	<490	--	<0.5	<0.5	<1.0
	10/12/2009	**68**	<120	<250	<1.0	<1.0	<1.0	<1.0
	4/29/2010	**75**	<120	<240	<0.5	<0.5	<0.5	<1.0
	10/12/2010	**65**	**580**	<240	<0.5	<0.5	<0.5	<1.0
	4/28/2011	<50	<120	<240	<1.0	<1.0	<1.0	<1.0
	10/13/2011	**140**	**350**	<250	<1.0	<1.0	<1.0	<1.0
	3/9/2012	<50	**2,800**	**1,400**	<1.0	<1.0	<1.0	<3.0
	6/20/2012	<50	<79	<400	<1.0	<1.0	<1.0	<3.0
	9/20/2012	<50	<79	<400	<1.0	<1.0	<1.0	<3.0
	12/11/2012	<100	**2,100**	**1,800**	<1.0	<1.0	<1.0	<3.0
	3/18/2013	<100	**1,400**	**400**	<0.5	<5.0	<0.5	<1.5
	12/4/2013	<100	**1,300**	**440**	<0.5	<5.0	<0.5	<1.5
	3/18/2014	<100	**2,200**	**1,100**	<0.5	<5.0	<0.5	<1.5
	6/19/2014	<100	**1,600**	**710**	<0.5	<5.0	<0.5	<1.5
	11/20/2014	<100	**2,900**	**1,900**	<0.5	<5.0	<0.5	<1.5
	4/15/2015	<100	**1,900**	**940**	**0.56**	<5.0	<0.5	<1.5
	4/15/2015 - Dup	<100	**1,800**	**790**	<0.5	<5.0	<0.5	<1.5
	11/3/2015	<100	**1,980**	**1,310**	<0.5	<5.0	<0.5	<1.5

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Monitoring Well	Date Sample	Total Petroleum Hydrocarbons			Volatile Organic Compounds			
		Gasoline Range	Diesel Range	Heavy Oil Range	Benzene	Toluene	Ethylbenzene	Total Xylenes
MTCA Method A Cleanup Levels [1]		800	500	500	5	1,000	700	1,000
MW-5	10/5/2001	<50	--	--	<0.5	<0.5	<0.5	<1.0
	12/20/2001	<50	<250 J	<500	<0.5	<0.5	<0.5	<1.0
	3/21/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/26/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/24/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/18/2002	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/14/2003	<50	<250	<500	<0.5	<0.5	<0.5	**1.24**
	5/30/2003	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/26/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/27/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/27/2004 - Dup	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/1/2004	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/1/2004 - Dup	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	3/9/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/23/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	9/23/2005 - Dup	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/30/2005	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/30/2005 - Dup	<50	<248	<495	<0.5	<0.5	<0.5	<1.0
	3/28/2006	<50	<243	<485	<0.5	<0.5	<0.5	<1.0
	3/28/2006 - Dup	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2006	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	6/29/2006 - Dup	<50	<263	<526	<0.5	<0.5	<0.5	<1.0
	9/5/2006	<80	<278	<556	<0.5	<0.5	<0.5	<1.0
	9/5/2006 - Dup	<80	<253	<505	<0.5	<0.5	<0.5	<1.0
	12/11/2006	<50	<250	<500	<0.5	<0.5	<0.5	<1.0
	12/11/2006 - Dup	<50	<248	<495	<0.5	<0.5	<0.5	<1.0
	3/30/2007	<50	<245	<490	<0.5	<0.5	<0.5	<1.0
	3/30/2007 - Dup	<50	<245	<490	<0.5	<0.5	<0.5	<1.0

Notes:
Bold indicates detections and shading indicates concentration greater than or equal to MTCA Method A Cleanup Levels.

-- = not analyzed
< = not detected above laboratory reporting limit
Dup = duplicate sample
MTCA = Model Toxics Control Act

I = the analyte concentration may be artifically elevated because of co-eluting compounds or components.
J = the surrogate recovery for this sample cannot be accurately quantified because of interference from co-eluting compounds and/or the surrogate recovery for the sample was outside established control limits because of a sample matrix effect.
H = the samples were analyzed outside of the analytical holding time due to an analyst oversight.

[1] Washington State Department of Ecology, Model Toxics Control Act Regulation and Statute, MTCA Cleanup Regulation Chapter 173-340 WAC, Model Toxics Control Act Chapter 70.105D RCW, Uniform Environmental Covenants Act Chapter 64.70 RCW. Publication No. 94-06. Revised 2013.

APPENDIX A

GENERAL FIELD PROCEDURES

GENERAL FIELD PROCEDURES

A description of the general field procedures used during monitoring activities is presented below. For an overview of protocol, refer to the appropriate section(s).

FLUID LEVEL MONITORING

Fluid levels are monitored in the wells using an electronic interface probe with conductance sensors. The presence of liquid-phase hydrocarbons is verified using a hydrocarbon-reactive paste. The depth to liquid-phase hydrocarbons and water is measured relative to the top of casing. Well boxes or casing elevations are surveyed to within 0.01 foot relative to a county or city bench mark.

LOW-FLOW PURGING AND SAMPLING

This procedure is designed to assist the user in taking representative groundwater samples from *groundwater monitoring wells. Samples will be collected using low-flow (minimal drawdown) purging and sampling methods* as discussed in <u>U.S. EPA, Ground Water Issue, Publication Number EPA/540/S-95/504</u>, April 1996 by Puls, R.W. and M.J. Barcelona - "Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures."

The field sampler's objective is to purge and sample the well so that the water that is discharged from the pump, and subsequently collected, is representative of the formation water from the aquifer's identified zone of interest.

The wells to be sampled are equipped with QED Well Wizard™ bladder (squeeze-type) pumps or Peristaltic Pumps Each bladder pump or the suction inlet tubing of the peristaltic pump is positioned with its inlet located within the desired portion of the screened interval of the well. The down well equipment includes a bladder pump and/or Teflon-lined PE (polyethylene) tubing.

<u>Initial Pump Flow Test Procedures</u>

If possible, the optimum flow rate for each well will be established during well development or redevelopment, or in advance of the actual sampling event. The monitoring well must be gauged for Static Water Level (SWL) prior to the installation of the pump and before pumping of any water from the well. The measurement will be documented on a Low Flow Ground Water Sample Collection Record, or field data sheet.

After pump/tubing installation, and confirmation that the SWL has returned to its original level (as determined prior to pump installation), the bladder pump or peristaltic pump should be started at a discharge rate between 100 ml to 300 ml per minute without any in-line flow cell connected. The water level in the well casing must be monitored continuously for any change from the original measurement. If significant drawdown is observed, the pump's flow rate should be incrementally reduced until the SWL drawdown ceases and stabilizes. Total drawdown from the initial (static) water level should not exceed 25% of the distance between pump inlet location and the top of the well screen. (For example, if a well has a 10-foot screen zone and the pump inlet is located mid-screen; the maximum drawdown should be 1.25 feet.) In any case, the water level in the well should not be lowered below the top of the screen/intake zone of the well.

Once the specific well's optimum discharge rate, without an in-line flow cell connected, has been determined and documented, the in-line flow cell system to be used is connected to the well discharge and the control settings required to achieve the well's optimum discharge rate are determined with the in-line flow cell connected. (Due to the system's back-pressure, the discharge rate will be decreased by 10-20%). All control settings are to be documented on the gauging and sampling sheet as specific to that particular well's ID and will be utilized for its subsequent purging and sampling events.

Purge and Sampling Events

Prior to the initiation of purging a well, the SWL will be measured and documented. The pump will be started utilizing its documented control settings and its discharge rate will be confirmed by volumetric discharge measurement with the in-line flow cell connected. If necessary, any minor modifications to the control settings to achieve the well's optimum discharge rate will be documented on the gauging sheet. When the optimum pump flow rate has been established, the SWL draw down has stabilized within the required range and at least one pump system volume (bladder volume + discharge tubing volume) has been purged, begin taking field measurements for pH, temperature (T), conductivity (Ec), oxygen reduction potential (ORP) and dissolved oxygen (DO) using a "QED" Model MP-20 in-line flow cell, or other multi-parameter meter. All water chemistry field measurements will be documented on the field data sheet. Measurements should be taken every three to five minutes until stabilization has been achieved. Stabilization is achieved after all parameters have stabilized for three consecutive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity and dissolved oxygen. Three consecutive measurements indicating stability should be within:

Temperature	± 10%
pH	± 0.1 units
Conductance	± 03

When water quality parameters have stabilized, and there has been no change in the stabilized SWL (i.e., no continuous draw down), sample collection may begin.

Equipment List

The following equipment is needed to conduct low flow purging and sampling:

- Bladder pump installed within the well's screened interval
- Pump controller and air source set to operate at the specific well's documented optimum discharge rate
- In-line flow cell and meter(s) with connection fittings and tubing to measure water quality
- Water level probe or installed dedicated water level measurement system
- Sample containers appropriate for the analytical requirements
- Low Flow Ground Water Sample Collection Record, or field data sheets
- 300-500 milliliter graduated cylinder or measuring cup
- 5 gallon bucket(s) for collecting purge water
- Wristwatch with second hand or stopwatch
- Sufficient cleaning and decontamination supplies if portable water level probe is utilized
- Peristaltic pump & tubing, in place of bladder pump, if applicable
- Multi-parameter meter, in place of in-line flow cell, if applicable

Procedure QED Bladder Pumps

1. Calibrate all field instruments at the start of each day's deployment per the instrument manufacturer's instructions. Record calibration data on the "Field Instruments Calibration Documentation Form."
2. Drive to the first well scheduled to be sampled (typically the least contaminated). Make notes in the field logbook, describing the well condition and activity in the vicinity of the well. Decontaminate the portable water gauging probe by washing with phosphate-free detergent, rinsing with potable water.
3. Measure the depth to water from the surveyed reference mark on the wellhead and record the measurement on the gauging and sampling sheet. Lock the water level meter in place so that the level can be monitored during purging and sampling. When placing the probe in the well, take precautions to not disturb or agitate the water.
4. Connect the compressed air source's airline to the pump controller's "AIR IN" connection (If utilizing a gas-engine operated compressor, locate the compressor at least 25 feet, down wind from the wellhead).
5. Connect the pump controller "AIR OUT" air-line to the bladder pump's air supply fitting at the wellhead.
6. Connect the pump discharge line to the in-line flow cell's "IN" fitting.
7. Connect the flow cell's "OUT" line and secure to drain the purge water into the purge water collection container.
8. Start the air supply to the pump. Set the pump controller settings to the documented settings for the specific well. Confirm the flow rate is equal to the well's established optimum flow rate. Modify as necessary (documenting any required modifications).
9. Monitor the water level and confirm that the SWL draw down has stabilized within the well's allowable limits.
10. After a single pump-system's volume (bladder volume + discharge tubing volume) has been adequately purged, read and record water quality field measurements every three to five minutes until all parameters have stabilized within their allowable ranges for at least three consecutive measurements. When stabilization has been achieved, sample collection may begin.
11. Disconnect the flow cell, and it's tubing, from the pump discharge line before collecting samples. Decrease the pump rate to 100 milliliters per minute or less by lowering the controller's air pressure setting prior to collecting samples for volatiles. Utilize the QED Model 400 Controller's 'MANUAL SAMPLE' button to ensure minimized sample exposure to the ambient air. Refer to the task instructions for the correct order and procedures for filling sample containers. Place the samples in a cooler with enough ice to keep them at 4 degrees Centigrade.
12. Once samples for volatiles have been collected, re-establish pump flow rate to the original purge flow rate by inputting the documented controller settings for the well without the in-line flow cell connected and collect remaining samples.
13. When all sample containers have been filled, make a final measurement of the well's SWL and record the measurement on the gauging and sampling sheet. If the well has a "QED" dedicated bottom sounder, measure the well's total depth and record the measurement, as well.

14. Measure and record total purge volume collected. Consolidate generated purge water.
15. Remove and decontaminate the portable water level probe with phosphate-free detergent, rinsing with potable water.
16. Disconnect the controller air supply to the pump.
17. Secure the pump's discharge line/discharge adapter in the wellhead.
18. Secure the wellhead cover and secure with its lock. Move equipment to next well to be sampled.
19. At the end of each day, post calibrate all field instruments and record the measurements on the "Field Calibration Documentation Form".
20. Clean and decontaminate the in-line flow cell with phosphate-free detergent, rinsing with potable water.

Procedure Peristaltic Pump

1. Record all depth to water readings on field data sheets
2. Calibrate all field instruments according to manufacturer's directions.
3. Setup pump and install silicone tubing in the roller head.
4. Place suction tubing at desired intake level in well, (mid screen) and attach to pump silicone tubing.
5. Attach tubing at discharge side of pump head and place in collection container.
6. Start pump and adjust flow rate to achieve flow without depressing water level more than necessary (approx. 0.30').
7. Record parameter readings after parameters have stabilized (3 consecutive readings that fall within the acceptance criteria).
8. Decrease the flow rate of the pump to achieve approximately 100 ml/min. when collecting samples.
9. Change all tubing between wells and repeat procedure.

CHAIN OF CUSTODY PROTOCOL

Chain of custody protocol is followed for all groundwater samples selected for laboratory analysis. The chain of custody form(s) accompanies the samples from the sampling locality to the laboratory, providing a continuous record of possession prior to analysis.

DECONTAMINATION

Groundwater Sampling

Purging and sampling equipment that could contact well fluids is either dedicated to a particular well or cleaned prior to each use in a soap solution followed by two tap water rinses.