Phase 2 Interim Action Completion Report

Former Fueling and Maintenance Facility
Skykomish, Washington

Prepared by:

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RETEC Project Number: BN050-16423-910

Prepared for:

The Burlington Northern and Santa Fe Railway Company
2454 Occidental Street, Suite 1A
Seattle, Washington 98134-1451

April 10, 2003

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April 10, 2003

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1 Introduction

The Burlington Northern and Santa Fe Railway Company (BNSF) is implementing an interim cleanup action at the former fueling and maintenance facility in Skykomish, Washington pursuant to an Agreed Order (DE 01TCPNR-2800) with the Washington State Department of Ecology (Ecology). The interim action entails construction of a subsurface barrier wall and light non-aqueous phase liquids (LNAPL) product recovery system intended to reduce and eventually eliminate seeps to the South Fork of the Skykomish River. A detailed discussion of the design basis for this work is presented in the Interim Action Basis of Design for LNAPL Barrier System, Aug. 10, 2001. The Basis of Design describes the interim action as consisting of two phases of work:

- **Phase 1:** Construction of a subsurface barrier wall, monitoring wells and recovery wells.

- **Phase 2:** Installation of LNAPL recovery equipment in recovery wells, restoration of road and sidewalk surfaces on West River Drive, and preparation of an LNAPL recovery system Operations, Maintenance and Monitoring Plan.

BNSF completed Phase 1 in the summer of 2001 as documented in the report "Subsurface LNAPL Barrier System Phase 1 Interim Action Completion Report" (RETEC, 2002a). The design for Phase 2 is provided in "Design for Phase 2 of the Interim Action" (RETEC, 2002b) and two subsequent design addenda (RETEC, 2002c and 2002d).

Road and sidewalk restoration along West River Road has been deferred by BNSF and Ecology, after consultation with the Town of Skykomish, pending a determination of a final cleanup plan for the site (RETEC 2002c). The Operations, Maintenance and Monitoring Plan for the LNAPL recovery system is contained in Attachment A to the original Phase 2 design document (RETEC, 2002b).

This report documents completion of the Phase 2 fieldwork, including reconfiguring LNAPL recovery operations at wells R-1, R-2, and R-4, initiating recovery operations at well R-8, and installing new wells (5-W-5, RW-6 and RW-9). Figure 1 shows the location of the barrier wall and the nearby monitoring and recovery wells.

2 Summary of Work to Reconfigure

2.1 LNAPL Recovery Operations

The LNAPL recovery systems and vaults (R-1, R-2, R-4 and R-8) were upgraded between November 4, 2002 and December 5, 2002, in accordance with the scope of work presented in the design documents (RETEC, 2002b, 2002c, 2002d). This work required that recovery operations be suspended during that time, as previously reported to Ecology in monthly progress reports and meetings. LNAPL recovery operations at wells R-1, R-2, and R-4 were discontinued on November 4, 2002 and resumed on December 6, 2002. Minor field modifications were made to the work described in the design documents, including:

1) Each rectangular steel recovery tank was mounted on a field-constructed wooden frame composed of 4 x 6 CCA treated lumber (Figure 2). This mounting approach was used to elevate the skimmer/tank assemblies approximately 6 inches off the bottoms of the vaults while preserving ample clearance between the skimmer equipment and the vault lid hardware.

2) The electrical service box that previously serviced recovery well R-4 was moved to a position directly opposite recovery well R-8 on the north side of West River Road (Figure 1). The design plans originally called for moving this box to the RETEC power supply pole at the intersection of 6th Street and West River Road. The field modification was made to avoid complete re-wiring between the pole and recovery wells R-4 and R-8.

3) Well-screens that protruded above the inside bottom of some recovery well vaults (R-2, R-4 and R-8) were sealed off as shown in Figure 2. Sections of 10-inch PVC pipe were cut to fit over the well-screen and extend above the top of the well-screen by approximately 2 inches. The annular region between PVC pipe and well-screen was then packed with lightly-hydrated cement-based grout to form a seal. Care was taken to ensure that the grout did not enter the well.

When product recovery recommenced, LNAPL accumulations were observed in R-1 and R-8 (approximately one gallon per well). There was no recoverable LNAPL in R-4 at startup. Recovery operations from well R-2 were ready to commence on January 3, 2003; however there was no recoverable product in this well at that time.

3 Construction of New Wells

3.1 Scope of Work

Three wells (Figure 1) were installed as part of Phase 2 of the interim action. These wells included one monitoring well (5-W-5) and two recovery wells (RW-6 and RW-9). The monitoring well (5-W-5) was installed, at Ecology's request, at the eastern edge of the barrier wall as close to the edge of the wall as possible. This was the most suitable location to check for the presence of free product and to confirm whether the barrier wall at the eastern end of the wall is containing free product. The recovery wells (RW-6 and RW-9) were installed, following consultations with Ecology, in response to fluid gauging measurements made on November 1, 2002, during which free LNAPL was measured in a well (MW-45) west of R-1 for the first time since installation of the barrier wall. These new recovery wells were constructed to allow for the collection of free LNAPL downgradient from the existing recovery wells, in the event that product pools behind the wall and migrates west along the barrier wall, consistent with the barrier wall design. The wells were installed at the intersection of the east-west trending barrier wall with the wing walls, and as close to the wall as possible. The wing walls were constructed to promote the accumulation of free LNAPL and therefore were the most suitable locations for LNAPL recovery wells.

3.2 Well Installation

The three wells were drilled by Boart Longyear using the rotosonic drilling method between December 11 and 14, 2002. The rotosonic drilling method, which is also known as vibratory or sonic drilling, uses an oscillating drill bit and core barrel to quickly advance through the subsurface. The boreholes were initially advanced to the prescribed depth, and then the wells were constructed inside the drill casing. The three wells were drilled along West River Road in Skykomish. Electrical transmission lines are present along the side of the road and were close to the drill sites. Because the overhead power lines were close to the drilling sites, at two of the well locations (5-W-5 and RW-9), Potelco, Inc., grounded and/or shielded the lines during drilling and well construction operations.

3.3 Observations of Geology and Contaminant Profiles

A field geologist logged each of the boreholes, and the borehole data were recorded with depth (Attachment 1). The borehole logs included lithologic and textural descriptions, visual evidence of contamination and a description of any contamination encountered. Continuous soil sampling was conducted to enable accurate logging of the well location geology and ensure that the

well screens were set at appropriate depths. No chemical analysis of the soil samples was performed, consistent with the Phase 2 design documents.

Geologic logging indicated that the monitoring well, 5-W-5, was located close to the slurry wall, because the top two feet of the borehole were through the slurry wall. The remainder of the borehole, including the screened interval, was in native ground. The well only penetrated the barrier wall through the top two feet because the eastern edge of the barrier wall slopes towards the west away from the vertical at an approximate angle of 35 degrees. There was no evidence of free LNAPL in the borehole, although there was hydrocarbon odor below 14 feet. This suggests that LNAPL is not migrating around the east edge of the barrier wall.

Geologic logging of RW-6 and RW-9 indicates evidence of petroleum staining of the native sand and gravel, and visible contamination below 8 feet below ground surface (bgs) in RW-6 and 7 feet bgs in RW-9. LNAPL has not been measured in subsequent fluid level gauging of these wells; this indicates that the staining is residual contaminant and is not indicative of free LNAPL.

3.4 Well Construction Details

Well construction details are provided in Table 1. The construction of 5-W-5 and RW-6 differed slightly from the original design details due to formation heaving during the well installation. Monitoring well 5-W-5 was constructed of 4-inch diameter PVC, with a 20-slot screen, a 1-foot PVC sump, and a 10-20 sand pack. There was considerable formation heaving in the drill casing during installation and as a result, the well is set at 19 feet bgs instead of 21 feet. The two recovery wells RW-6 and RW-9 were constructed of 8-inch diameter stainless steel, 40-slot, wire wrap screen, with a 2-foot sump, and pea gravel sand pack. Formation heaving was also encountered during the installation of RW-6 resulting in a completion depth of 20.5 feet bgs instead of 21 feet. The bottom of RW-9 is set at 21 feet bgs. The three wells were completed with flush mount protective lids cemented into the asphalt road.

3.5 Well Development

Upon completion, the wells were developed using a combination of surging and pumping to restore the natural permeability of the formation adjacent to the borehole and to remove formation damage that may have resulted from the well drilling and installation. A surge block was first used on the well to disturb and break up any fine-grained accumulations resulting from drilling. The wells were then pumped using a downhole electric submersible pump to remove the fine-grained material and develop the sand pack. Minimum quantities of water (approximately 50 to 100 gallons per well) were removed to reduce possible smearing effects on the aquifer formation in the well vicinity.

3.6 Decontamination

Prior to drilling, a decontamination pad was constructed in the drill staging area located in the center of the railroad property. All downhole drilling equipment was steam-cleaned between each use. The decontamination water was collected and contained in 55-gallon drums. All cuttings from well and borehole drilling were also contained in 55-gallon drums. These drums were labeled to describe their contents and were initially stored in the drum storage area until offsite disposal.

3.7 Surveying

Upon completion of the wells, a licensed land surveyor surveyed the wells locations and elevations to an accuracy of 0.01 feet using a nearby US Geological Survey benchmark. The survey data are presented on the well logs in Attachment 1.

Table 1 Well Construction Details

Item	5-W-5	RW-6	RW-9
Completion	Flush Mount	Flush Mount	Flush Mount
Well Monument	Heavy duty, steel	Heavy duty, steel	Heavy duty, steel
Cap	Lockable	Lockable	Lockable
Casing	4-inch, sch. 40, PVC	8-inch, stainless steel	8-inch, stainless steel
Screen	4-inch, sch. 40, 20-slot, PVC, 3-18 feet	8-inch, 40 slot, stainless steel, v-wrap wire, 3.5-18.5 feet	8-inch, 40 slot, stainless steel, v-wrap wire, 4-19 feet
Sump	4-inch, sch. 40, PVC, 18-19 feet	8-inch, stainless steel, 18-20.5 feet	8-inch, stainless steel, 19-21 feet
Filter	10-20 grade silica sand, 2.5-19 feet	3/8-inch pea gravel, 3-21 feet	3/8-inch pea gravel, 3-21 feet
Seal	3/8-inch bentonite pellets, 2-2.5 feet	3/8-inch bentonite pellets, 2-3 feet	3/8-inch bentonite pellets, 2-3 feet
Surface Grout	Cement w/ 10% bentonite, to ground surface	Cement w/ 10% bentonite, to ground surface	Cement w/ 10% bentonite, to ground surface

4 References

RETEC, 2002a. *Subsurface LNAPL Barrier System Phase 1 Interim Action Completion Report – Former Maintenance and Fueling Facility, Skykomish, Washington.* Prepared for the Burlington Northern Railroad by The RETEC Group, Seattle, Washington. February 15, 2002.

RETEC, 2002b. *Design for Phase 2 of the Interim Action – Former Maintenance and Fueling Facility, Skykomish, Washington.* Prepared for the Burlington Northern Railroad by The RETEC Group, Seattle, Washington. September 6, 2002.

RETEC, 2002c. *Addendum to Design for Phase 2 of the Interim Action – Former Maintenance and Fueling Facility, Skykomish, Washington.* Prepared for the Burlington Northern Railroad by The RETEC Group, Seattle, Washington. October 16, 2002.

RETEC, 2002d. *Addendum No. 2 to Design for Phase 2 of the Interim Action – Former Maintenance and Fueling Facility, Skykomish, Washington.* Prepared for the Burlington Northern Railroad by The RETEC Group, Seattle, Washington. November 14, 2002.

Figures

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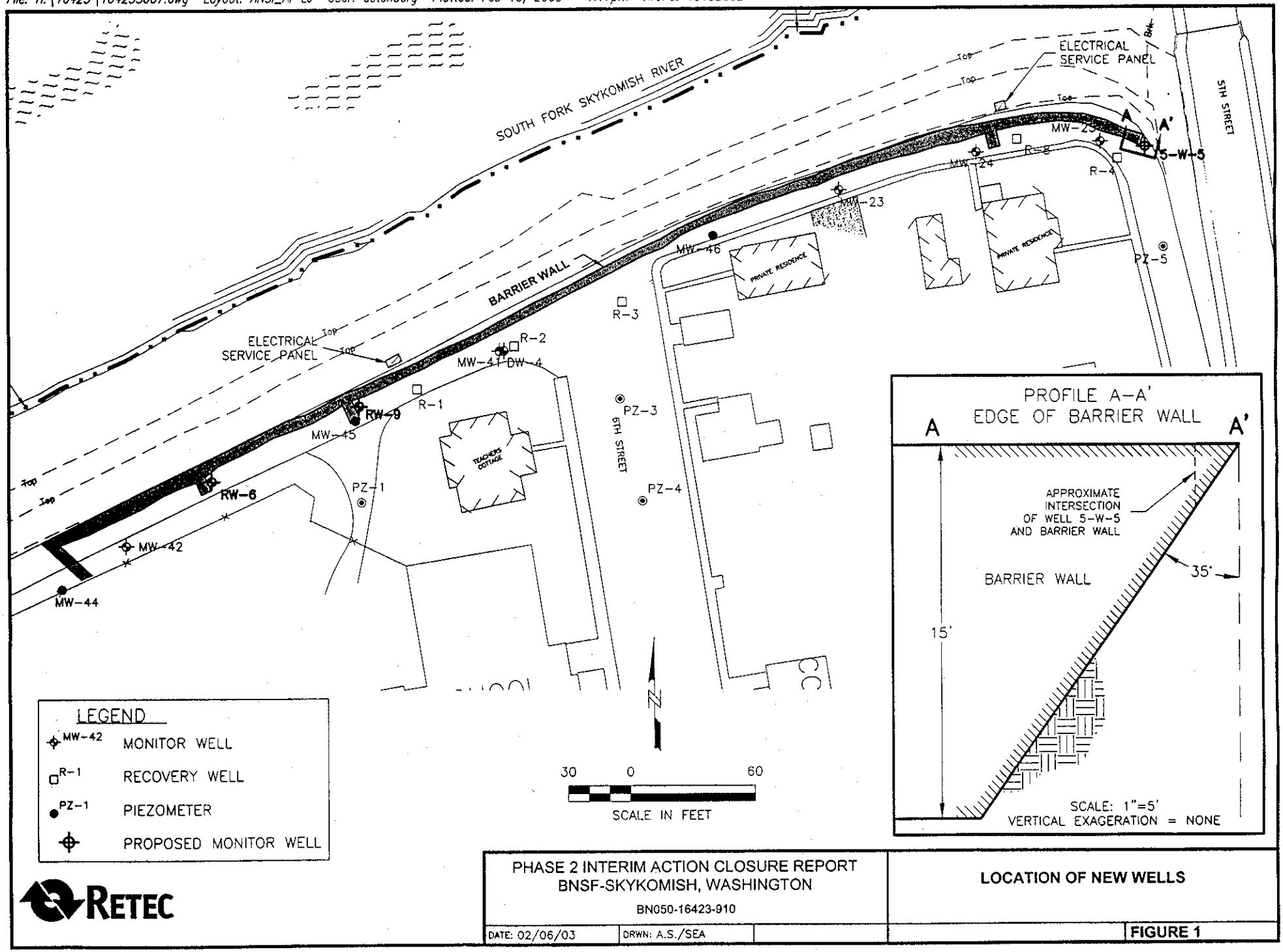

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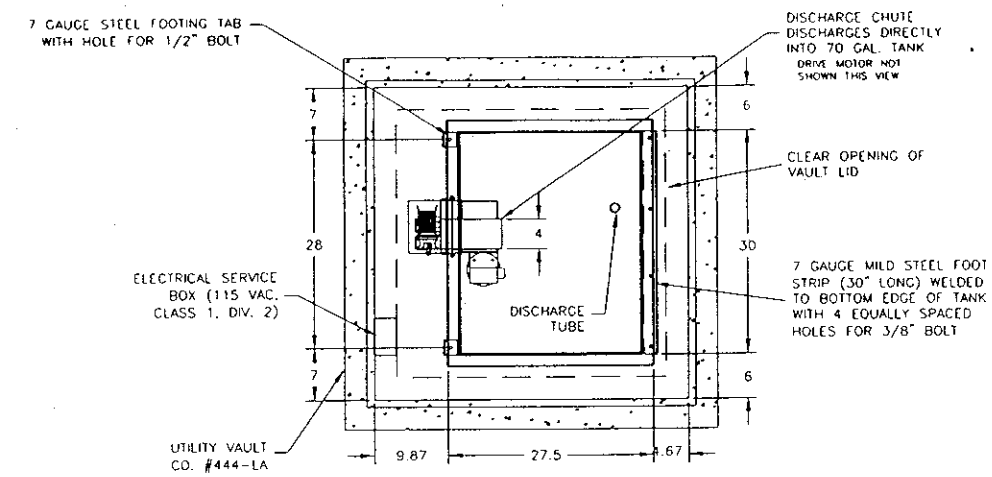
PHASE 2 INTERIM ACTION CLOSURE REPORT
BNSF-SKYKOMISH, WASHINGTON
BN050-16423-910

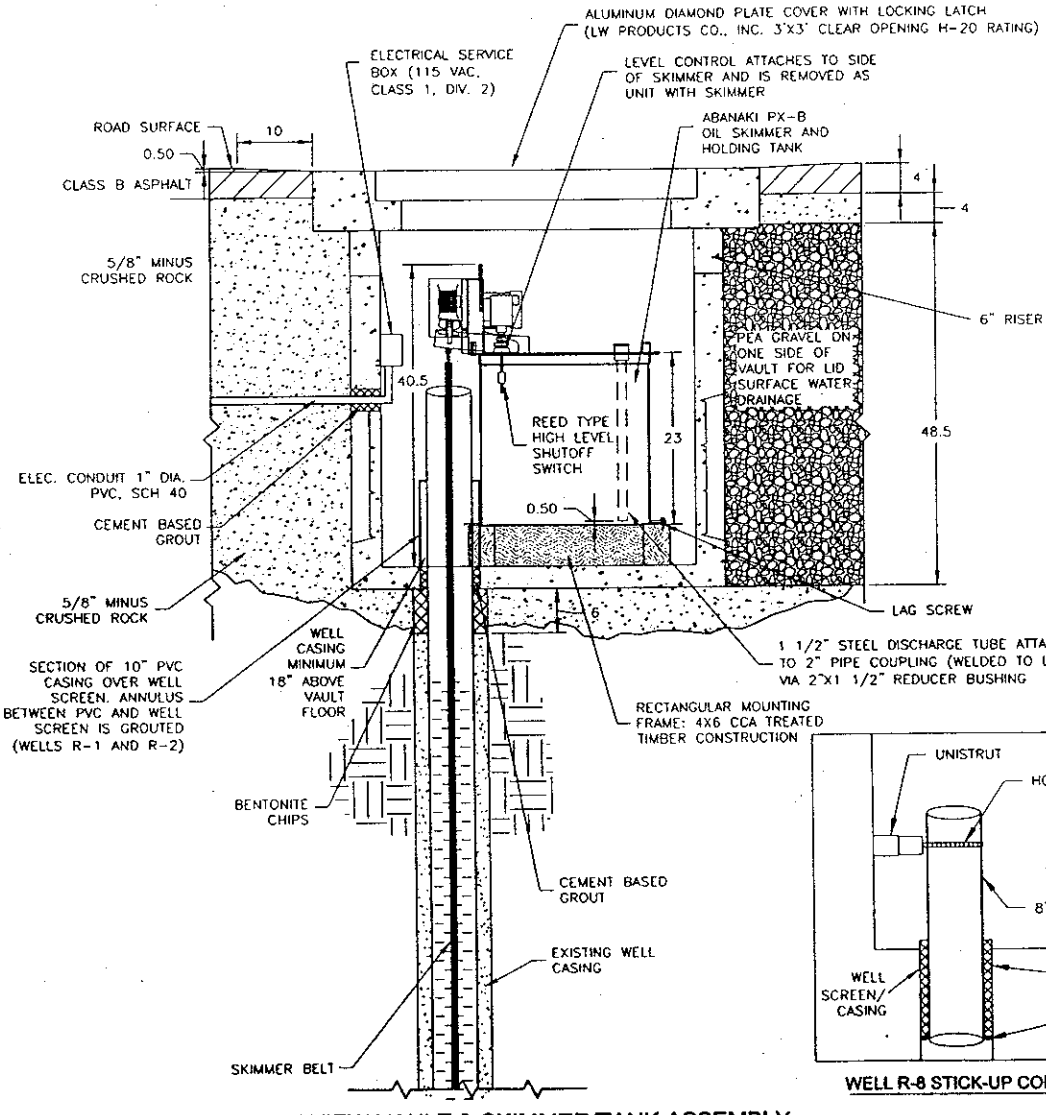
LOCATION OF NEW WELLS

DATE: 02/06/03 | DRWN: A.S./SEA | FIGURE 1



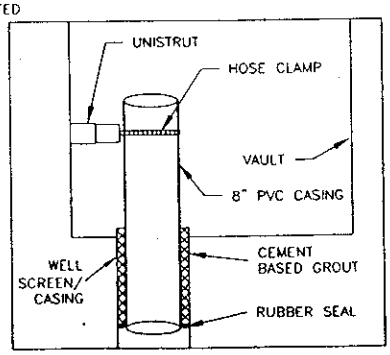
TOP VIEW VAULT & SKIMMER/TANK ASSEMBLY

SCALE: 3/4"=1'



SIDE VIEW VAULT & SKIMMER/TANK ASSEMBLY

SCALE: 3/4"=1'



WELL R-8 STICK-UP CONFIGURATION

NOT TO SCALE

NOTE:
ALL DIMENSIONS ARE IN INCHES

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BNSF SKYKOMISH, WASHINGTON BN050-16423-010	GENERAL RECOVERY SYSTEM LAYOUT (REVISED OCT. 15, 2002)
DATE: 02/11/03 DRWN: A.S./SEA	FIGURE 2

Attachment 1

Well Logs

Rev 1 – April 10, 2003

Boring/Well Log

Well #: RW-6
Sheet 1 of 1

Project: **Skykomish**	Monument: **Heavy Duty Flushmount**	Stick Up: **Flushmount**
Project #: **BN050-04018-437**	Northing: **259335.4** Easting: **1510040.9**	Ground Elevation: **924.72**
Location: **River Dr. towards E. end**	Drill Rig Type: **Rotosonic**	MP Elevation: **924.42**
Client: **BNSF**	Method: **Rotosonic coring**	Total Depth: **21.00**
Start Date & Time: **12/14/2002 9:00:00 AM**	Casing ID: **8"**	Filter Pack: **3-21' (3/8" pea gravel)**
Finish Date & Time: **12/14/2002 2:15:00 PM**	Boring ID: **12"**	Seal: **2-3' (3/8" bentonite chips)**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth**	Grout: **0-2' (Cement w/ 10% bentonite)**
Operator: **Nathan Jackson**	Logged By: **Kit Nielsen**	Screen: **3.5-18.5' (0.040 slot 8" stainl. steel)**

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
RW6 (0-5)	0-5	80					0	(0-0.3): ASPHALT - road surface	0	
								(0.3-3): SLURRY WALL; bentonite, grey	1	
									2	
								(3-6): SAND, very gravelly, slightly silty, with cobbles up to 8-in in diameter, SP; moist, brown, loose, no odor or visible contamination (OVC).	3	
									4	
RW6 (5-10)	5-10	100					5		5	
								(6-8): GRAVEL, sandy, with cobbles up to 4-in diameter, slightly silty, GP; brown, loose, no OVC.	6	
									7	
								(8-13): Same as above; wet, HC odor, visible contamination, black staining, blebs of product.	8 ▽	Water depth on 12/12/2002 @ 0930.
									9	
RW6 (10-15)	10-15	90					10		10	
									11	
									12	
									13	
								(13-14): Same as above; visual contamination decreasing.	14	
RW6 (15-20)	15-20	60					15	(14-16): SILT, very sandy, fine grained, ML; dense, stiff, wet, no OVC.	15	
								(16-21): GRAVEL, sandy, with cobbles up to 6-in diameter, GP; wet, brown, loose, no OVC.	16	
									17	
									18	
									19	
							20		20	
									21	

Remarks and Datum Used: Well bottom is at 20.5 ft instead of 21 ft because of heaving sand during installation.

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
12/14/2002	10:00	8

Boring/Well Log

Well #: RW-9
Sheet 1 of 1

Project: **Skykomish**	Monument: **Heavy Duty Flushmount**	Stick Up: **Flushmount**
Project #: **BN050-04018-437**	Northing: **259373.7** Easting: **1510117.0**	Ground Elevation: **924.89**
Location: **River Dr.**	Drill Rig Type: **Rotosonic**	MP Elevation: **924.26**
Client: **BNSF**	Method: **Rotosonic coring**	Total Depth: **21.00**
Start Date & Time: **12/12/2002 9:00:00 AM**	Casing ID: **8"**	Filter Pack: **3-21' (3/8" pea gravel)**
Finish Date & Time: **12/13/2002 12:30:00 PM**	Boring ID: **12"**	Seal: **2-3' (3/8" bentonite chips)**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth**	Grout: **0-2' (Cement w/ 10% bentonite)**
Operator: **Nathan Jackson**	Logged By: **Kit Nielsen**	Screen: **4-19' (0.040 slot 8" stainl. steel)**

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
RW9 (0-5)	0-5	100					0	(0-0.3): ASPHALT - road surface.	0	
								(0.3-4): SAND, gravelly, silty, SP; grey to brown, moist, loose, no odor or visible contamination (OVC).	1	
									2	
									3	
									4	
RW9 (5-10)	5-10	50					5	(4-5): SAND, fine to medium grained, slightly silty, SW; brown, white grains, loose, moist, no OVC.	5	
								(5-7): SILT, sandy, with cobbles, ML; grey, stiff, moist, slight odor, no visible contamination.	6	
									7	
								(7-9): SAND, gravelly, with cobbles up to 6-in diameter, silty, SP; brown, HC odor and visible contamination starting at 9 ft.	8	
									9 ▽	Water depth on 12/12/2002 @ 0930.
RW9 (10-15)	10-15	0					10	(9-15): GRAVEL, sandy, with cobbles up to 4-in diameter, GP; wet, brown, loose, HC odor and visible contamination.	10	
									11	
									12	
									13	
									14	
RW9 (15-21)	15-21	100					15	(15-19): Same as above; visible contamination becomes slight.	15	
									16	
									17	
									18	
									19	
								(19-21): SAND, slightly gravelly, slightly silty, with cobbles up to 3-in diameter, SW; black and white, loose, HC odor, slight visible contamination.	20	
							20		21	

Remarks and Datum Used:

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
12/12/2002	9:30	9

Boring/Well Log

Well #: 5-W-5
Sheet 1 of 1

Project: **Skykomish**	Monument: **Heavy Duty Flushmount**	Stick Up: **Flushmount**
Project #: **BN050-04018-437**	Northing: **259497.0** Easting: **1510497.0**	Ground Elevation: **926.90**
Location: **River Dr. at E. end of Wall**	Drill Rig Type: **Rotosonic**	MP Elevation: **926.22**
Client: **BNSF**	Method: **Rotosonic Coring**	Total Depth: **21.00**
Start Date & Time: **12/11/2002 10:40:00 AM**	Casing ID: **4"**	Filter Pack: **2.5-19' (10-2- silica sand)**
Finish Date & Time: **12/11/2002 2:30:00 PM**	Boring ID: **8"**	Seal: **2-2.5' (3/8" bentonite chips)**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth**	Grout: **0-2' (Cement w/ 10% bentonite)**
Operator: **Nathan Jackson**	Logged By: **Kit Nielsen**	Screen: **3-18' (0.020 slot 4" Sch. 40 PVC)**

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
MW5-W-5 (0-5)	0-5	90					0	(0-0.3): ASPHALT - road surface	0	
								(0.3-2): SLURRY WALL - gray bentonite	1	
									2	
								(2-5): SAND, gravelly, silty, brown, some cobbles, SP; moist, no odor or visible contamination (OVC).	3	
									4	
MW5-W-5 (5-10)	5-10	50					5	(5-14.5): GRAVEL, sandy, cobbles up to 6-inches diameter, GP; brown, moist, no OVC.	5	
									6	
									7 ▽	Water depth on 12/17/2002 @ 1030.
									8	
									9	
MW5-W-5 (10-15)	10-15	60					10		10	
									11	
									12	
									13	
									14	
MW5-W-5 (15-20)	15-20	40					15	(14.5-15): Same as above; wet, hydrocarbon (HC) odor.	15 ▽	Water depth on 12/11/2002 @ 1230.
								(15-18): SILT with fine sand, slightly clayey, ML; grey brown, wet, stiff, HC odor, possible slight HC sheen	16	
									17	
									18	
								(18-21): SAND, coarse grained, SW; black and white, well sorted, wet, slight HC odor, no visible contamination.	19	
							20		20	
									21	

Remarks and Datum Used:

Sand bridging occurred while removing casing.

Original screen bottom was at 20 ft, but came up to 18 ft.

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Sample Type

N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
12/11/2002	1230	15
12/17/2002	1030	7