Technical Report

Monitor Well Installation Recommendations Heglar Kronquist Landfill, Mead, Washington

Prepared for

Kaiser Aluminum
Baton Rouge, Louisiana

Exponent

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Acronyms and Abbreviations

Ecology	Washington State Department of Ecology
μg/L	micrograms per liter
mg/L	milligrams per liter
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
SAP	sampling and analysis plan
the Site	Heglar Kronquist Landfill, Mead, Washington
USCS	unified soil classification system
USGS	U.S. Geological Survey

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Heglar Kronquist Landfill, Mead, Washington

Introduction

The first phase of the remedial investigation for the Heglar Kronquist Landfill in Mead, Washington (the Site; Figure 1) was conducted in May 2010. This technical report presents preliminary results of the groundwater, spring, and surface water studies, and provides recommendations for installing monitor wells in the second phase. The primary purpose of the first phase was to develop a basic understanding of the Site area hydrogeology and shallow groundwater/surface water interactions.

As described in the final remedial investigation/feasibility study (RI/FS) work plan (ARCADIS 2009a), several soil borings were drilled in the vicinity of the Site to provide data to characterize the local geology. Where groundwater was encountered, grab water samples were collected to evaluate water quality at these locations. Groundwater samples were also collected from a few residential wells in the Site area. Water samples were collected from streams and springs in the area to aid in understanding groundwater/surface water interactions.

Regional Geology

The Site lies within a relatively complex geologic region with Cretaceous plutonic rocks exposed to the east and just north of the landfill, overlain by fluvoacustrine fine-grained sediments of the Miocene Age, Columbia River Basalt, and glacial and windblown deposits. The surficial deposits and morphology are, in part, the result of outburst floods which occurred up to13,000 to 15,000 years ago.

The plutonic rocks in the area north and east of the Site (Figure 2) are granitic in nature (Stoffel et al. 1991). The granites are dense, with weathered tops and some fractures capable of producing small volumes of water. Above the granite is the Latah Formation, consisting of lacustrine and fluvial silts, sands, and clays. Columbia River Basalts flowed across the Latah sometimes interfingering with this formation. East of the site, the basalt is capped by fine-grained windblown deposits of the Palouse Formation. The valleys are filled with glacial-age clays, silts, sands, gravels, and boulders, including flood outburst deposits. Younger alluvium materials are deposited along the current drainages.

Site Area Geology

The study area is on a block described by various geologists (e.g., Stoffel et al. 1991; Griggs 1966; Cline 1969) as landslide material. Immediately to the east of the landfill is a steep slope that reflects the landslide plane. These landslides, common to the region, may have been caused by undercutting of the soft, underlying Latah sediments during multiple flood outburst events, with subsequent collapse of the basalt (Bjornstad 2006). The original pit into which dross was placed was created by mining this broken basalt in the landslide block.

The mesa immediately to the east of the Site is capped with up to 70 ft of loess of the Palouse Formation (Figure 2). This formation is described as mostly clay in nearby well logs. The Palouse overlies the Columbia River Basalt which is about 85 ft thick. Some groundwater is produced from the weathered and fractured basalt.

The Columbia River Basalt is underlain by up to 500 ft of sands, clays, and silts of the Latah Formation. Most of the upper portion of the Latah is finer grained and likely produces little groundwater. Between about 300 to 400 ft below the surface, depending on topography, is a loose sand described in driller's logs as "quick sand" that produces groundwater.

In the northern portion of the study area, the glacial, younger fluvial, and flood outburst deposits lap up onto the granitic rocks which are exposed just east of Heglar Road (Figure 2).

Results of Field Investigation

Lithologic Borings

Given the complex geological nature of this Site, lithologic borings were constructed during the first phase of the remedial investigation to develop a better understanding of the geology prior to installing monitor wells during the second phase. Prior to borehole abandonment, grab water samples were collected from the boreholes for field testing and laboratory analyses. Field testing included measurement of specific conductance and chloride, which are two parameters used as indicators of potential groundwater impact from the landfill. These field measurements were used with the geologic information being developed in the field to guide final placements and depths of some of the subsequent borings.

Originally, 12 borings were planned. Fifteen were completed. One additional boring (BH-13) was requested by a landowner. At one location (BH-8a), a second, offset boring (BH-8b), was drilled to confirm the nature of the basalt encountered in the first location. One additional boring (BH-15) was installed based on field conditions to aid in the understanding of geology south of the Site.

Two boreholes were moved from the locations shown in the RI/FS work plan (ARCADIS 2009a). Based on information derived from BH-8 and a nearby residential well, the original locations for BH-1 and BH-2 were relocated south of the Site to improve the geologic understanding in this area. Modifications to the final RI/FS work plan, including these borehole locations, were approved by the Washington State Department of Ecology (Ecology).

Boring logs for BH-1 through BH-13 and BH-15 are provided in Appendix A. BH-14 was used as the sample identification for the field duplicate collected at Boring BH-10.

Results of the Investigation

Geology

Four cross sections have been constructed using information developed in the soil boring program (Figures 3 through 7), including the May 2010 survey data provided in Appendix B. Most of the borings in the vicinity of the Site encountered basalt gravels and basalt rubble. As shown on cross section C-C′ (Figure 7), there is a narrow band of broken basalt and basalt gravel that trends from the granite outcrop on the north to BH-11 to the south. This trend continues to the south into Section 10, where driller’s logs (10bba-1 and 10bcb-1; Figure 8) show that a few feet of broken basalt were encountered on a landslide block in the western half of this section. The gravels and broken basalts represent the eroded top of the basalts in the landslide block, having been eroded, perhaps by the later flood outbursts, which also removed the overlying Palouse sediments.

As seen on the cross sections (Figures 4 through 7), there is a narrow, linear fine-grained sediment zone which trends northeasterly from the vicinity of 3cba through BH-1 to 3bcd-2. This linear feature could be fluvial, although it does not appear to continue northeast to BH-3 or southwest to BH-11 or BH-12. It is possible this is a flood outburst scour feature filled with slackwater fine-grained sediments. The driller’s log of 3cba shows clay from ground surface to 400 ft indicating there is no basalt below this fine-grained feature. This feature may be definable on the aerial photography, as shown on Figure 2.

The private wells encountered the Latah on the west side of the study area (residential Wells 3b and 3cbb-1, Figure 4). The Latah was also encountered just east of the slide plane at BH-5 (Figures 4 and 5). BH-9 encountered younger alluvium along a shallow drainage way.

Based on their relative elevations, it is apparent that Springs SW-1, SW-2, and SW-3 are likely at the interface between basalt gravels/rubble and the Latah. Spring SW-4 likely issues from the base of the Columbia River Basalt on the eastern side of the slide plane.

Water Quality

Water collected from wells, boreholes, springs, and streams was analyzed in the field for chloride, specific conductance, temperature, turbidity, and pH. These water samples were also submitted to an analytical laboratory for analyses of alkalinity, total dissolved solids, metals, ammonia, chloride, fluoride, phosphate, sulfate, nitrate, and nitrite. Water samples collected from Springs SW-2 and SW-3 were also analyzed for additional metals and volatile organic compounds. Concentrations of all constituents detected in groundwater collected from lithologic borings and wells are summarized in Appendix C (Table C-1). A summary of select constituents detected in groundwater is summarized in Table 1. Concentrations of all constituents detected in water collected from springs and streams are summarized in Appendix C (Table C-2). A summary of select constituents detected in springs and streams are summarized in Table 2.

Groundwater samples were collected from all of the lithologic borings except BH-8a and BH-8b where groundwater was not encountered. Groundwater samples were also collected from select residential wells, including an additional well and a cistern at the request of two property owners. The locations of these samples and water samples collected from an onsite monitor well and streams and springs are shown on Figure 8. A summary of sample locations shown on Figure 8 is provided in Table 3. Chloride was measured in the field and by the analytical laboratory. As shown in Tables 1 and 2, these measurements are similar except where the upper chloride range of the field kit of 400 milligrams per liter (mg/L) was exceeded. Chloride, as measured by the analytical laboratory, is depicted on Figure 8. Chloride concentrations for the private well sampling conducted in 2008 by Hart Crowser (Hart Crowser 2009) and for the May 2010 remedial investigation are shown on Figure 8. Older data (e.g., water data from the 1980 Sweet Edwards investigations) are not shown.

As expected, the chloride concentration is a good indicator of landfill impacts to ground and surface waters. It is a known constituent of the black dross and it is a good tracer because it does not readily adsorb in a groundwater system. Other indicators of black dross, including sodium, potassium, and total dissolved solids, correlate well with chloride as shown on Figure 9. This good correlation confirms that the use of chloride as the principal indicator is appropriate for this Site. Upon reviewing the chloride data, two general breakpoints where chosen for convenience in order to visually represent the distribution of chloride: 50 milligrams per liter (mg/L) and 100 mg/L. Sample results are color coded on Figure 8 based on these breakpoints.

Groundwater with chloride concentrations ranging from just under 100 mg/L to more than 800 mg/L is present in a narrow band from BH-3 southward to BH-11. Water from springs SW-2 and SW-3 (designated 3cbd-2 and 3 cbd-1, respectively, in previous studies) contain quite different chloride concentrations even though they are close together. Water from SW-2 contains 22 mg/L chloride and SW-3 produces water with a chloride concentration of 301 mg/L. This pattern has been seen in the past although not consistently, suggesting that the source for the two springs is, at times, different. Groundwater in the basalt gravels/rubble north (BH-4) and south (BH-11) of springs SW-2 and SW-3 contains chloride ranging from 90 mg/L (BH-11) to 810 mg/L (BH-4).

The residential wells completed into or near the top of the granite have low chloride concentrations (2 mg/L or less [3b, 3cbb-1, and 3bbc]). Domestic Well 16 (HC-16; Hart Crowser 2009) also has low chloride (19 mg/L) as does Lucy Spring (SW-1 [20 mg/L]) to the south and Spring SW-4 to the north (10 mg/L). Groundwater coming into the slide block from the upland area contains low chloride (13 mg/L in BH-5).

The fine-grained unit that extends from 3bcd-2 to 3cba contains groundwater with relatively low chloride. Chloride concentrations in this geologic unit range from 30 mg/L at BH-15 to 57 mg/L in water from BH-1. These chloride levels may be natural and the result of restricted groundwater movement within these fine-grained sediments. In any event, this fine-grained feature is not a conduit for the higher chloride water in the adjacent basalt gravel/rubble, streams, and springs to the west and south.

The water produced from alluvial boring BH-9 has a chloride concentration of 368 mg/L. Surface water samples collected at SW-5 and SW-8 contain chloride concentrations of 252 mg/L and 239 mg/L, respectively. The chloride in BH-9 and the surface water in the unnamed drainage downstream of this boring (SW-5 and SW-8 locations) are likely the result of higher chloride water discharging into the unnamed drainage from Spring SW-3, and at times from Spring SW-2. Water with elevated chloride also likely discharges into the subsurface below the unnamed drainage from the basalt gravel/rubble to the east. This discharge ultimately contributes to the base flow in Deadman Creek and likely to the chloride in the Deadman Creek alluvium at Wells 4bcd and 5add.

As expected, the concentrations of other parameters, such as total dissolved solids, specific conductance, and sodium, correlate well with chloride concentrations. This strong correlation is not observed for all of the metals concentrations. For example, the chloride concentration at BH-15 was just over 30 mg/L but the dissolved arsenic was over 35 micrograms per liter (μg/L). Also, at BH-7 the chloride concentration was slightly lower than 7 mg/L, but the dissolved aluminum concentration was 529 μg/L. In comparison, the chloride concentration at BH-10 was 388 mg/L, but the dissolved aluminum and arsenic concentrations were 132 μg/L and less than 1 μg/L, respectively. The apparent reason for this lack of correlation is suspended sediment. Although the samples were filtered (and sometimes filtered twice if there was obvious turbidity), residual suspended sediment was likely present contributing to elevated metals in some water samples. Evidence of turbid samples was observed in the field at most borehole locations (see turbidity measurements in Table C-1) and is the result of sampling open boreholes that could not be cleaned up due to low flow rates. Because of the high turbidity, most samples were gravity settled before field filtering.

Groundwater Flow

Water levels were measured in all the boreholes that encountered groundwater. However, these measurements do not represent equilibrated water levels because the borings were plugged soon after sampling. Therefore, hydraulic gradients cannot be inferred from these measurements, but can only be inferred from the general relationship commonly found between topography and hydraulic gradient.

Based on the hydrogeologic interpretation developed during this investigation, the current conceptual model of groundwater flow is as follows:

- Subsurface discharge from the uplands block westward into the landslide blocks and springs at the base of the basalt in the upland block.

- Movement through basalt gravels and broken basalt is northwest toward BH-3 and westerly around the fine-grained feature toward BH-4.

- The pathway from the landfill to Spring SW-3, and at times to Spring SW-2, or BH-11 is not clear. The low chloride in the fine-grained feature described above indicates that this feature is not a conduit for groundwater moving from the landfill to the south toward springs SW-2, SW-3, and BH-11.

- There is an apparent lineament on the aerial photograph which runs from the area of SW-3 to the east/northeast (Figure 2). It is unknown at this time if this lineament is an expression of a geologic feature that may affect flow toward Spring SW-3.

Proposed Monitor Well Installation

Based on data gathered during the first phase of this study, six monitor wells are proposed at the locations shown on Figure 10. Proposed locations 1 through 4 are designed to be near or beyond the margins of groundwater with elevated chlorides. Their primary purpose is to monitor the stability of this margin. Proposed monitor wells 2, 3, and 4 are located on private properties not owned by Kaiser. Therefore, installation of these wells is contingent on execution of access agreements with the property owners.

Locations 5 and 6 will be used to test the water quality in the landslide block east and west of the linear, fine-grained feature described above. Location 6, if possible, will be located in the apparent lineament described above. Prior to completing monitor wells 5 and 6, Kaiser proposes to drill a test hole in the fine-grained feature in which BH-1, BH-15, and 3bcd-2 are completed. The purpose of this test hole is to determine if there is basalt gravel/rubble beneath the fine-grained sediment (as shown in Cross Section C-C’ as a possibility) that could provide a pathway from the landfill to the area of SW-2/SW-3. This test hole will be drilled to a sea level elevation just below springs SW-2 and SW-3. If this test hole shows that basalt gravel/rubble is present, and it contains water with chloride concentrations indicative of landfill impact, Well 5 will be moved to the location of the test hole.

At this time it is not considered necessary to install an alluvial well downgradient of BH-9. As discussed above, groundwater moves from the slide block into the alluvial envelope beneath the unnamed drainage west of the site and then into the base flow of Deadman Creek. Therefore, the best location for future monitoring will be surface water sample collection, and perhaps, sampling from private wells near Deadman Creek.

The proposed monitor well locations discussed above, the purpose of each well, estimated well depths, and estimated screened intervals are summarized in Table 4. Four of the planned wells will be completed with 2-in. polyvinyl chloride (PVC), and two wells will be completed with 4-in. PVC to allow possible future hydraulic testing. A monitor well construction diagram for a flush to grade completion is provided on Figure 11.

Detailed monitor well installation procedures are provided in Section 5.3 of the final sampling and analysis plan and quality assurance project plan (SAP/QAPP) (ARCADIS 2009b) and are summarized below. A few construction details have been modified based on results of the lithologic drilling program completed during phase one of the remedial investigation, including screen length and size.

Monitor Well Installation Procedures

Boreholes will be drilled with an air rotary or sonic drilling rig. Returns will be examined as they come off the cyclone (for air rotary) or in cores (for sonic). The returns will be logged using the Unified Soil Classification System (USCS). Monitor wells will be completed with 2-in. or 4-in. ID Schedule 40 PVC casing with 15 ft of 0.020-in. slotted screen on a PVC blank. The screens will be packed with silica sand and the sand pack will be extended approximately 2 ft above the top of the screen, and approximately 3 ft of fine sand will be placed on top of the sand pack. The annular space of the well will be sealed with hydrated bentonite chips or a cement slurry with 4 to 6 percent bentonite to approximately 2 ft below ground surface.

Monitor wells will be completed flush to grade or with aboveground monuments, as appropriate. Aboveground well completions will include a 4-ft, steel protective casing set in a concrete slab (24 in. × 24 in. × 6 in.) and three metal protective posts in a triangular array around the casing. A locking PVC cap will be installed on top of the riser and an Ecology Unique Well Identification tag will be attached. Monitor wells will be developed by air-jetting or surging and bailing until temperature, pH, and conductivity stabilize.

A log will be completed for each well. Each log will include the date started and completed, ground surface elevation, site identification, facility name, geologist/hydrogeologist/engineer name, consulting firm name, drilling contractor name, materials encountered, total depth of well, borehole and well diameter, water levels measured during drilling, well completion details, screened interval, static water level elevation, and sampling intervals. The classification system used to describe the materials will be specified on the log.

Each newly installed monitor well will be surveyed following completion by a surveyor licensed in Washington State. Surveyed top of casing elevations will be reported ±0.01 ft relative to a permanent Site benchmark. The survey will be completed using a U.S. Geological Survey coordinate system.

Proposed Monitoring Program

As specified in the SAP/QAPP (ARCADIS 2009b), monitor wells will be allowed to equilibrate up to 3 weeks after completion, prior to purging and sampling. Sampling will be conducted on a quarterly basis during the remedial investigation. Post-remedial investigation sampling will be conducted, if necessary, in accordance with a schedule determined in consultation with Ecology.

The monitoring program is described in the SAP/QAPP. Recommended field and analytical laboratory parameters are summarized as follows:

- Field parameters
  - pH

  - Specific conductance
  - Temperature
  - Turbidity
- Analytical laboratory parameters
  - Dissolved calcium, magnesium, potassium, and sodium
  - Dissolved fluoride, chloride, and sulfate
  - Dissolved ammonia as nitrogen
  - Dissolved nitrate as nitrogen
  - Dissolved nitrite as nitrogen
  - Alkalinity
  - Total dissolved solids.

Sampling procedures, and sample collection, handling, and preservation are described in the SAP/QAPP, including analytical methods and reporting limits.

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ARCADIS. 2009a. Final remedial investigation and feasibility study work plan, Heglar Kronquist Landfill, Mead, Washington. Prepared for Kaiser Aluminum, Baton Rouge, LA. ARCADIS. September 18, 2009.

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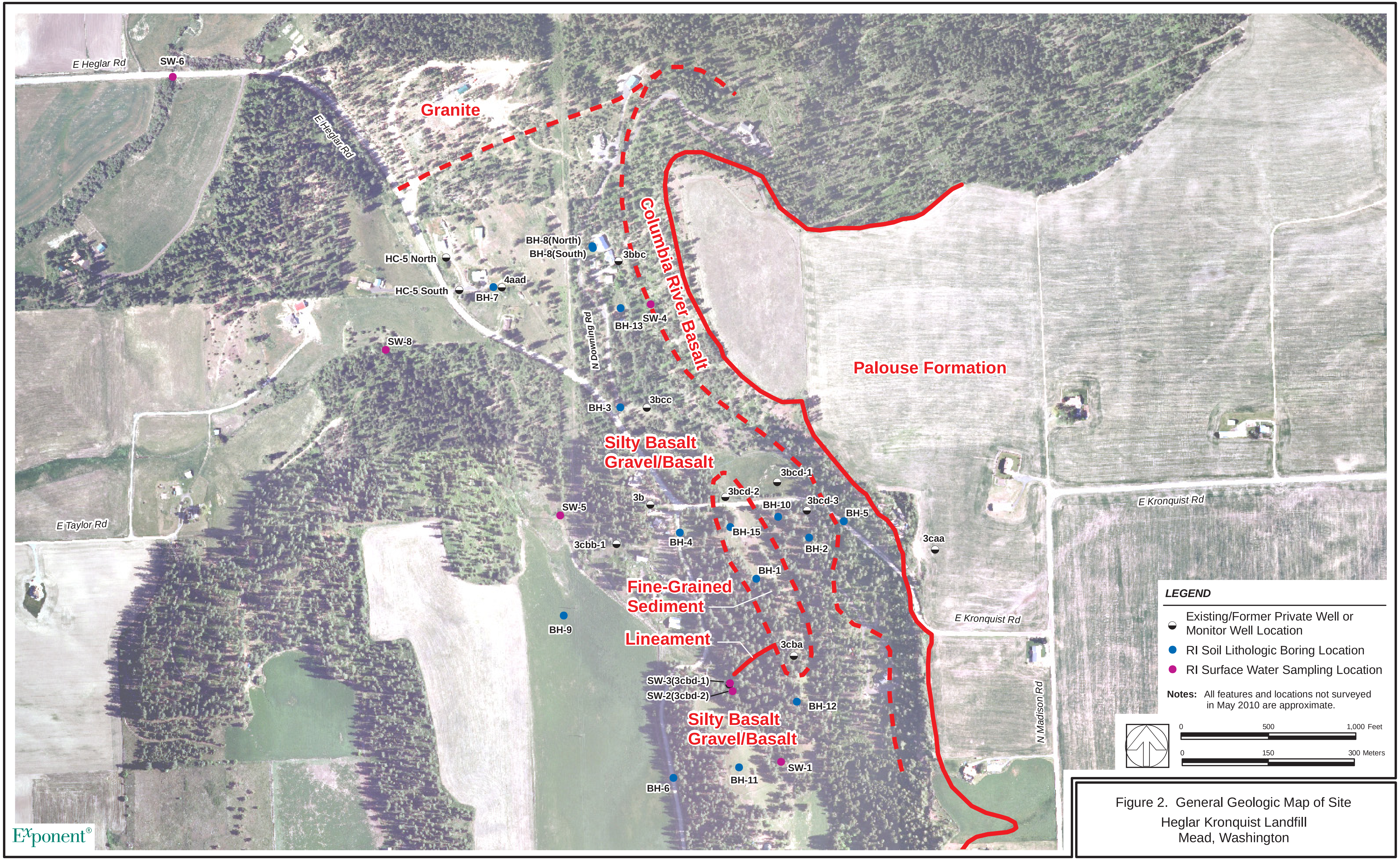
Figure 1. Site Location Map
Heglar Kronquist Landfill
Mead, Washington



Notes: All features and locations not surveyed in May 2010 are approximate.

Figure 2. General Geologic Map of Site
Heglar Kronquist Landfill
Mead, Washington

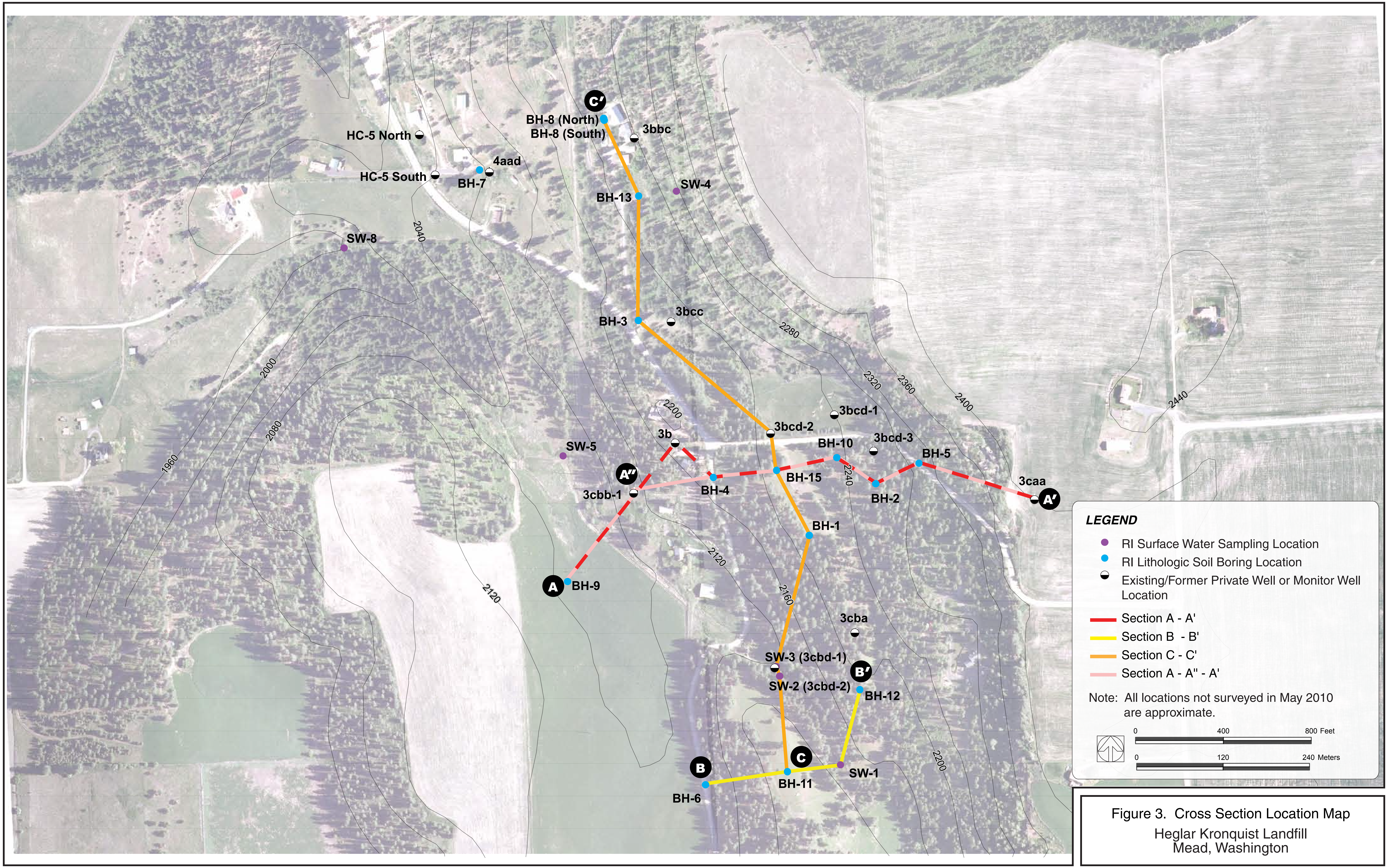


Figure 3. Cross Section Location Map
Heglar Kronquist Landfill
Mead, Washington

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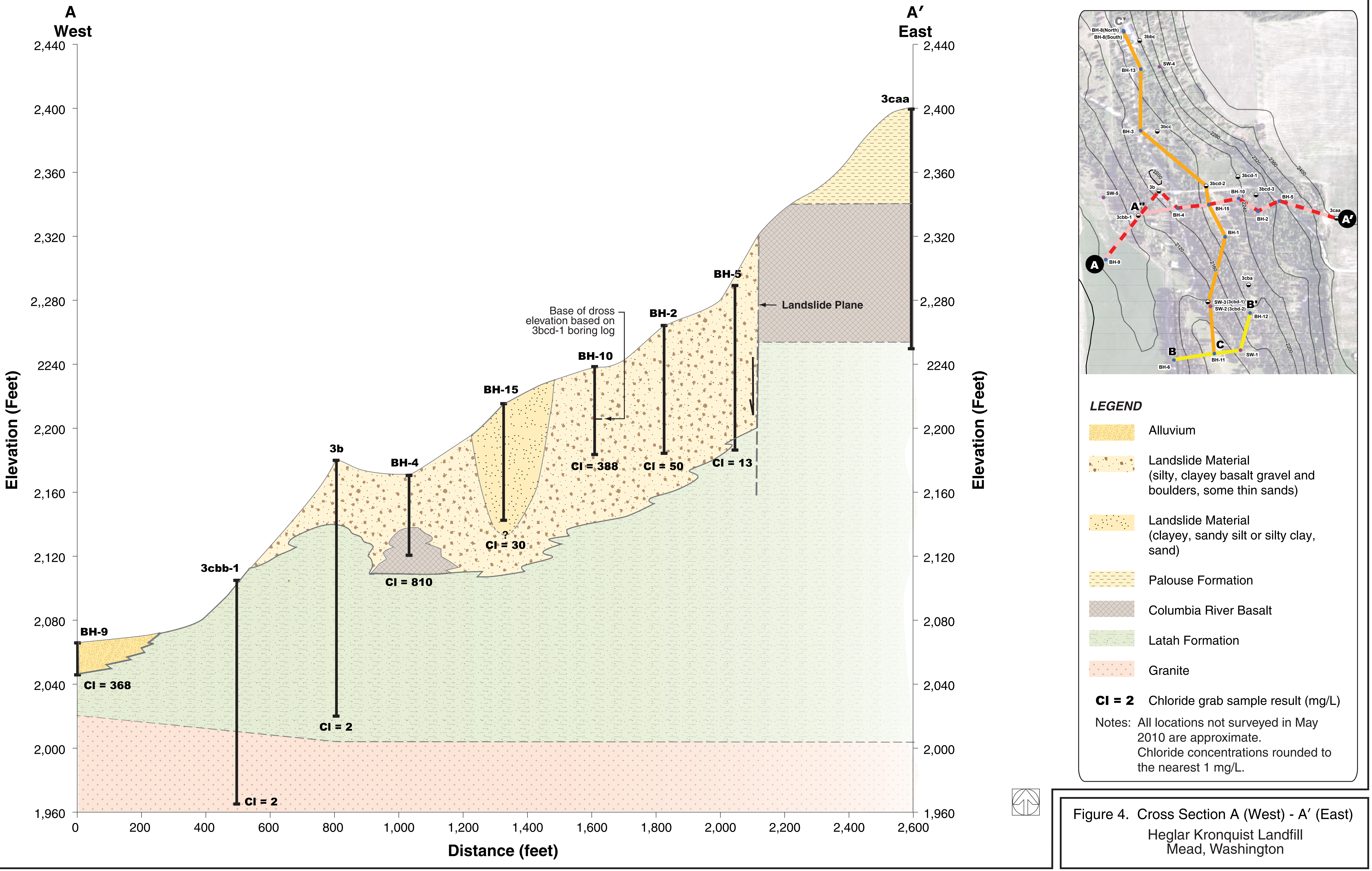

Notes: All locations not surveyed in May 2010 are approximate.
Chloride concentrations rounded to the nearest 1 mg/L.

Figure 4. Cross Section A (West) - A′ (East)

Heglar Kronquist Landfill
Mead, Washington

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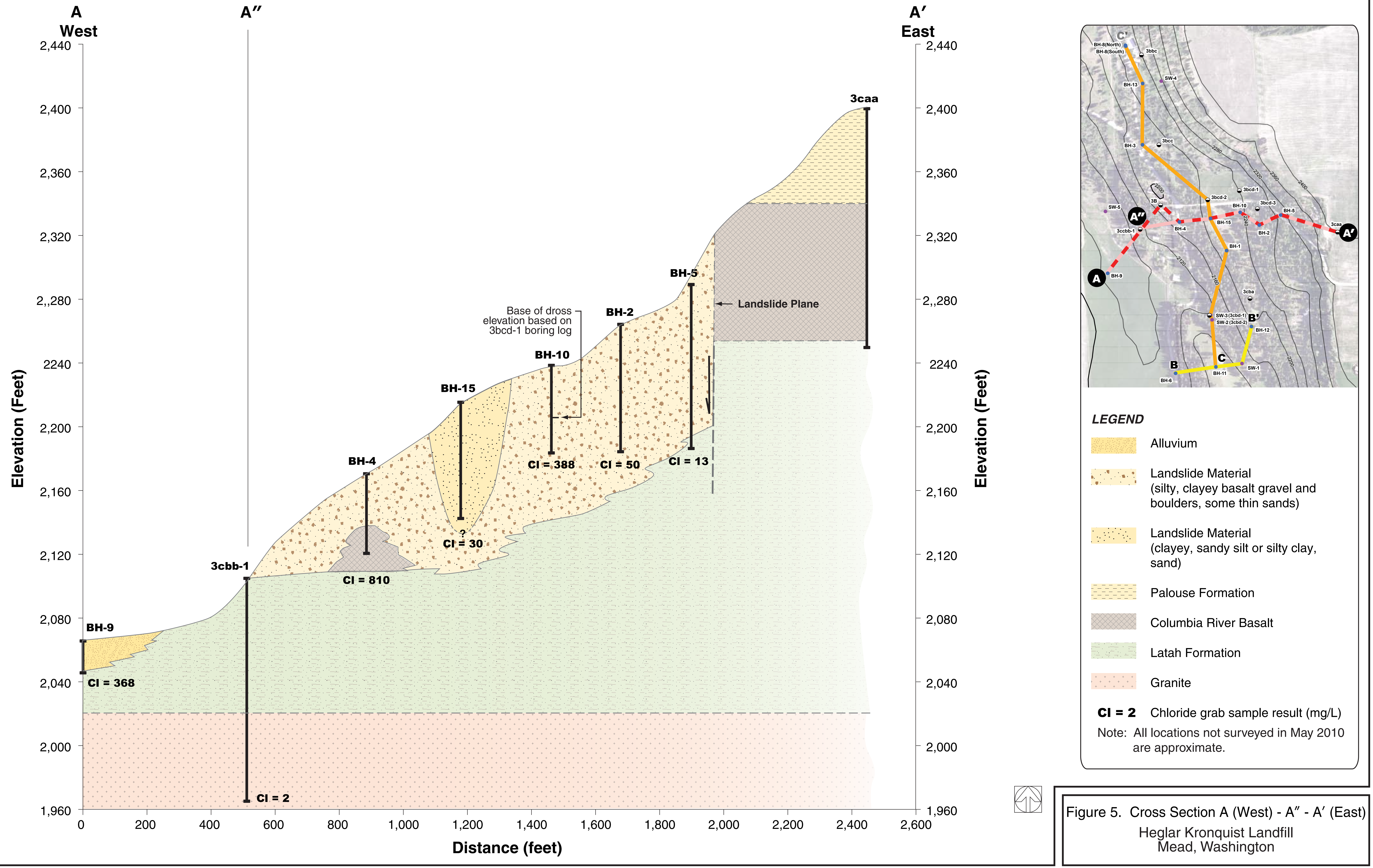

Figure 5. Cross Section A (West) - A″ - A′ (East)
Heglar Kronquist Landfill
Mead, Washington

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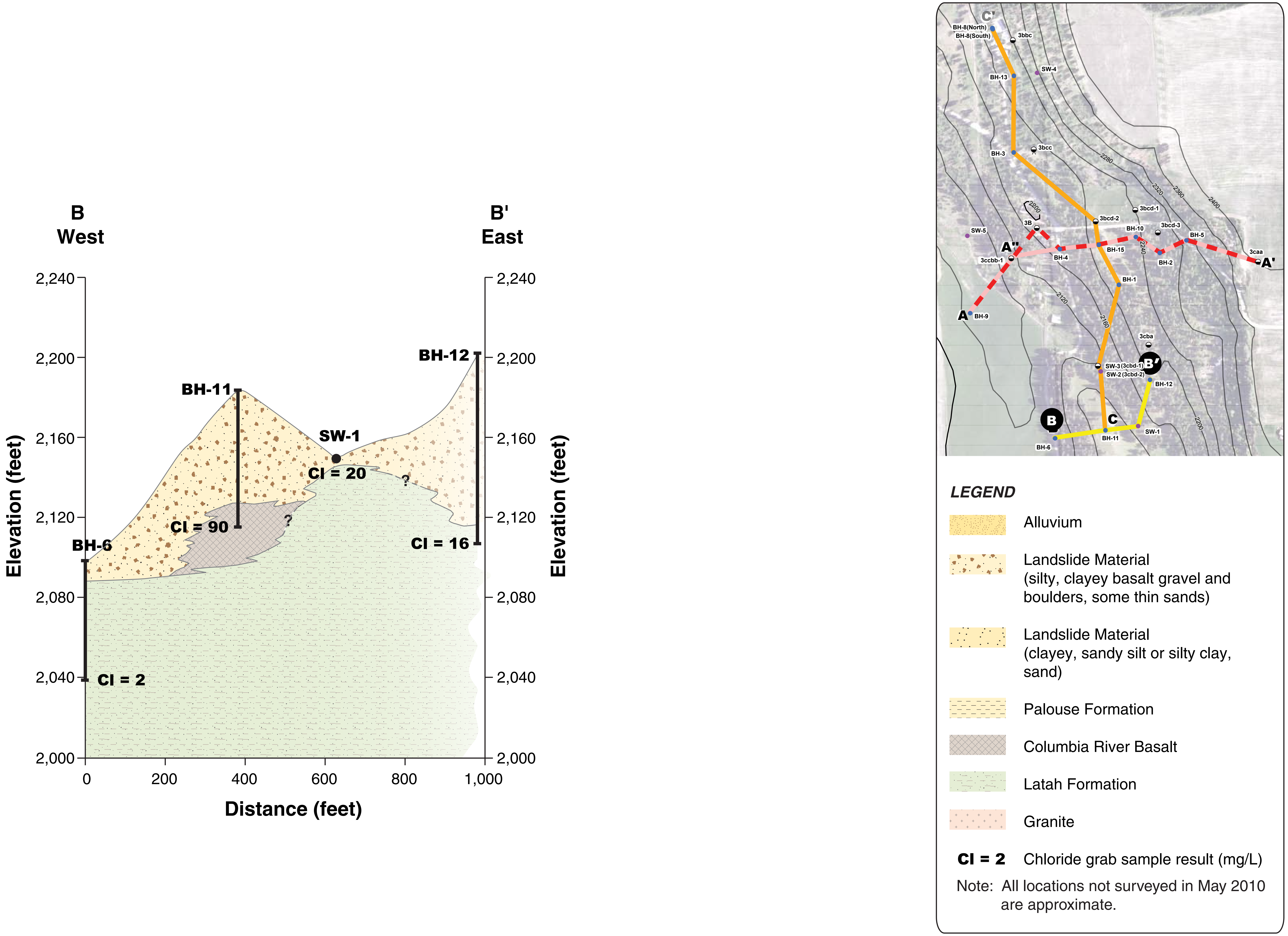
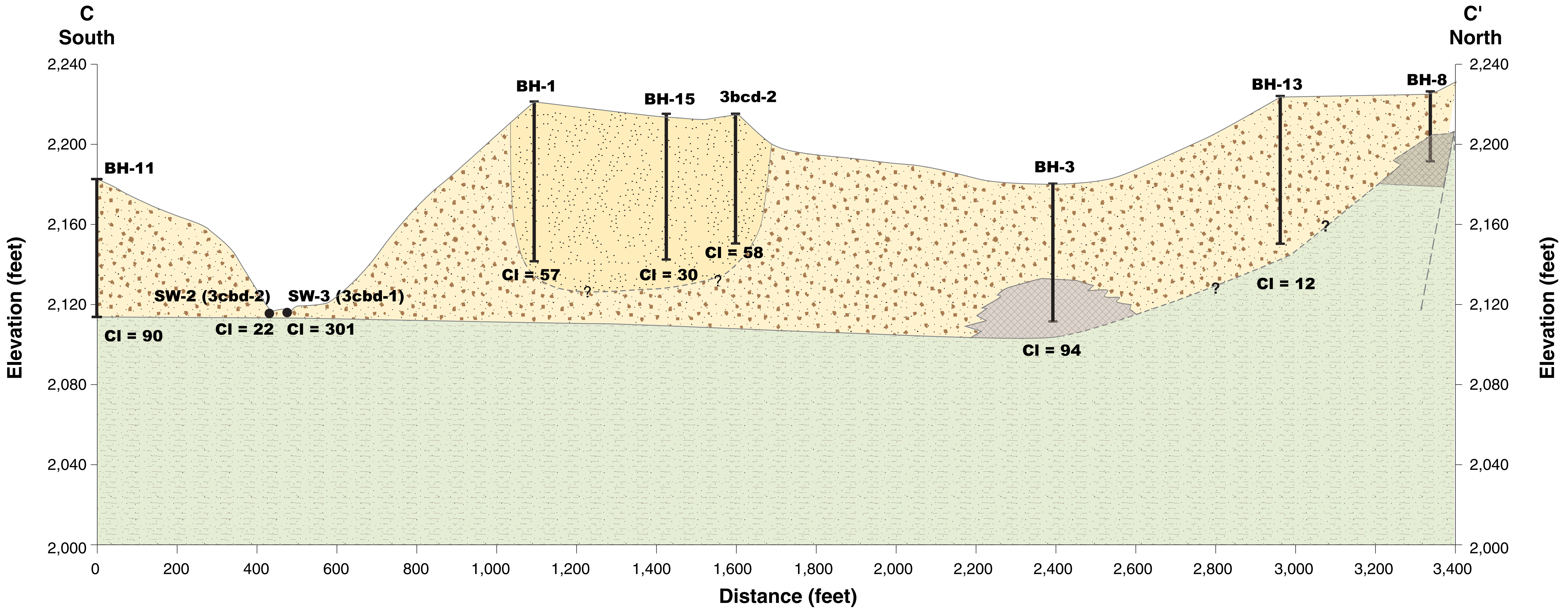
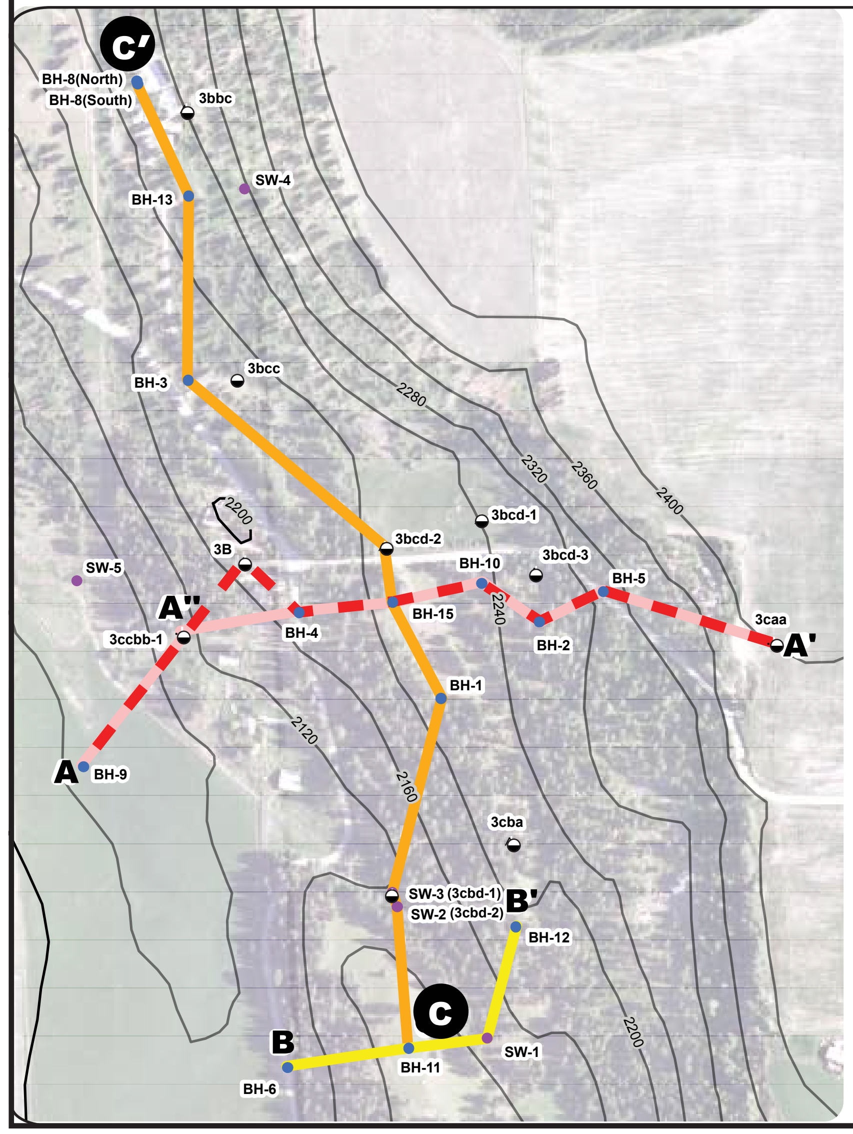


Figure 6. Cross Section B (West) - B' (East)

Heglar Kronquist Landfill
Mead, Washington





LEGEND

▨	Alluvium
▨	Landslide Material (silty, clayey basalt gravel and boulders, some thin sands)
▨	Landslide Material (clayey, sandy silt or silty clay, sand)
▨	Palouse Formation
▨	Columbia River Basalt
▨	Latah Formation
▨	Granite
Cl = 2	Chloride grab sample result (mg/L)

Note: All locations not surveyed in May 2010 are approximate.

Figure 7. Cross Section C (South) - C' (North)

Heglar Kronquist Landfill
Mead, Washington

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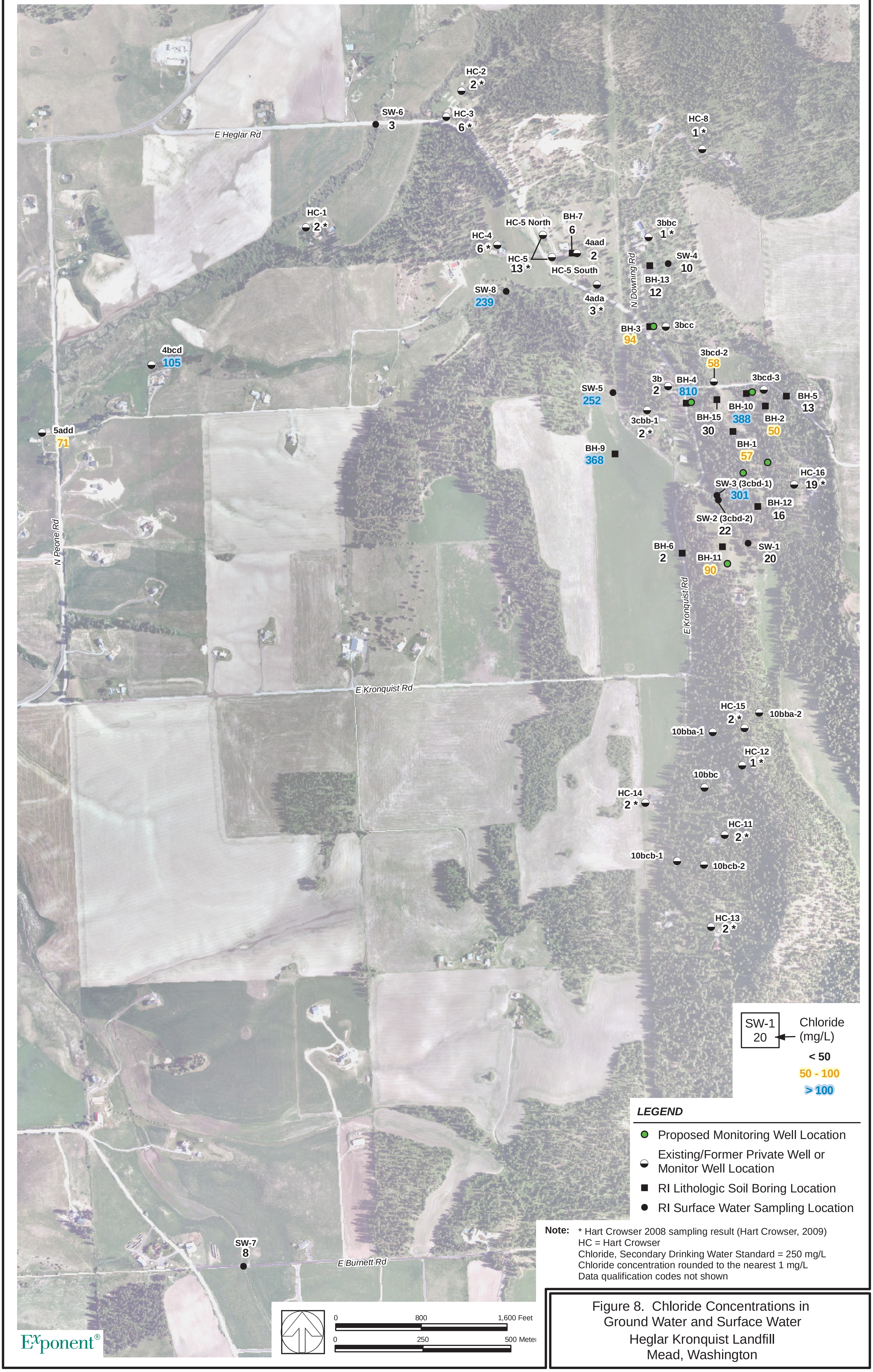

LEGEND

- ● Proposed Monitoring Well Location
- ◒ Existing/Former Private Well or Monitor Well Location
- ■ RI Lithologic Soil Boring Location
- ● RI Surface Water Sampling Location

Note: * Hart Crowser 2008 sampling result (Hart Crowser, 2009)
HC = Hart Crowser
Chloride, Secondary Drinking Water Standard = 250 mg/L
Chloride concentration rounded to the nearest 1 mg/L
Data qualification codes not shown

Figure 8. Chloride Concentrations in Ground Water and Surface Water
Heglar Kronquist Landfill
Mead, Washington

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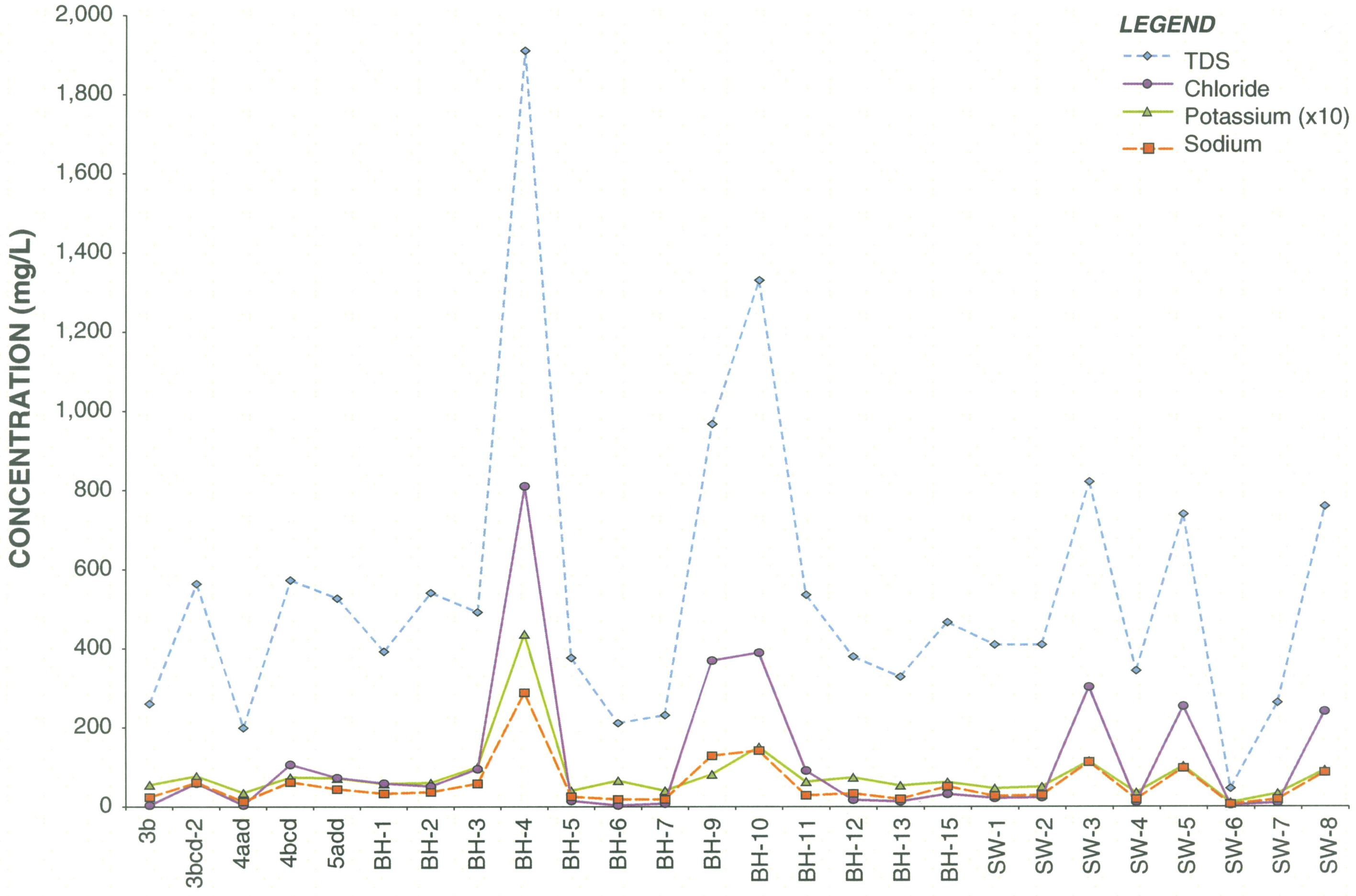

Figure 9. Water Quality Graph—TDS, Cl, K (x10), Na

Heglar Kronquist Landfill
Mead, Washington

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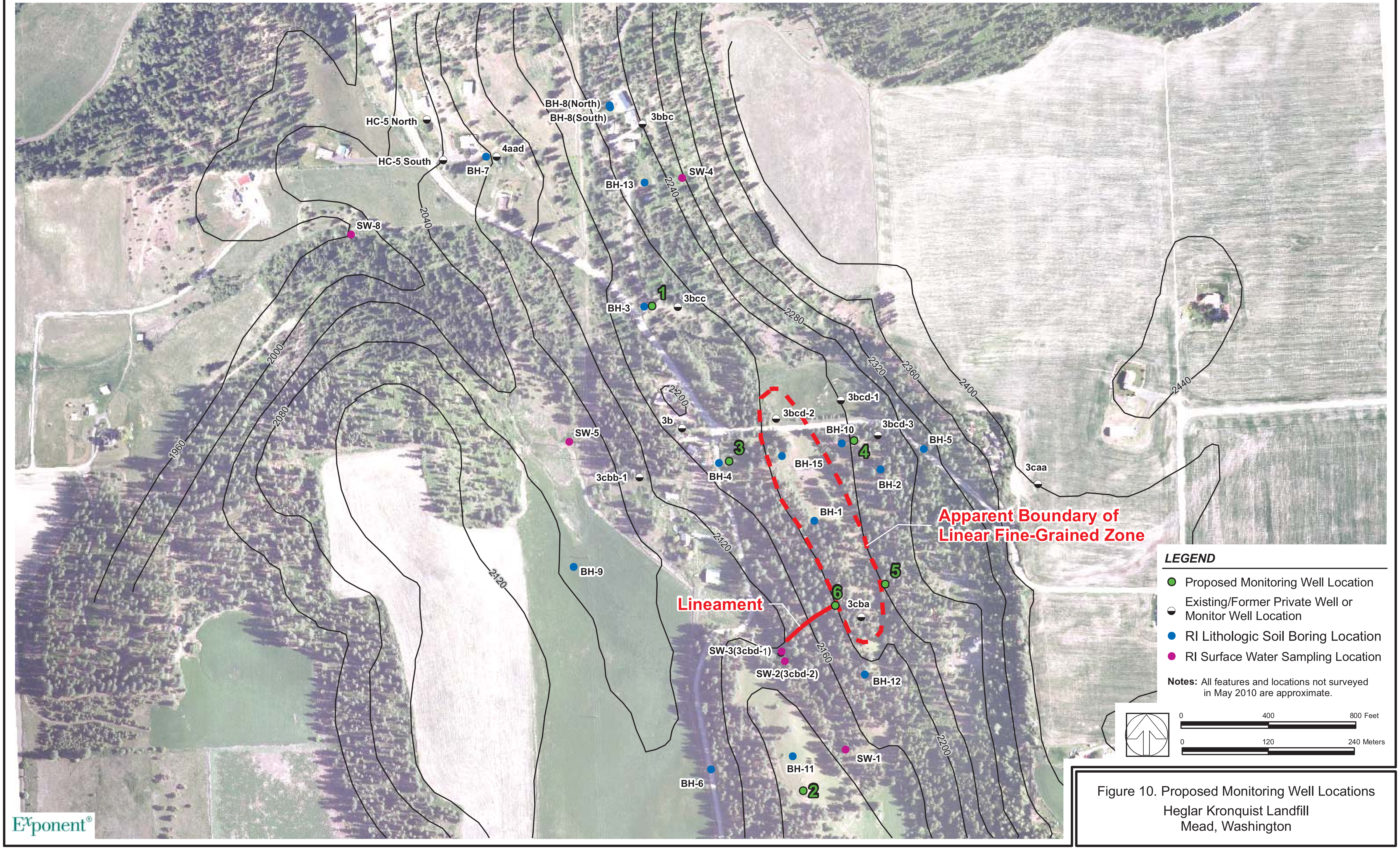

Figure 10. Proposed Monitoring Well Locations
Heglar Kronquist Landfill
Mead, Washington

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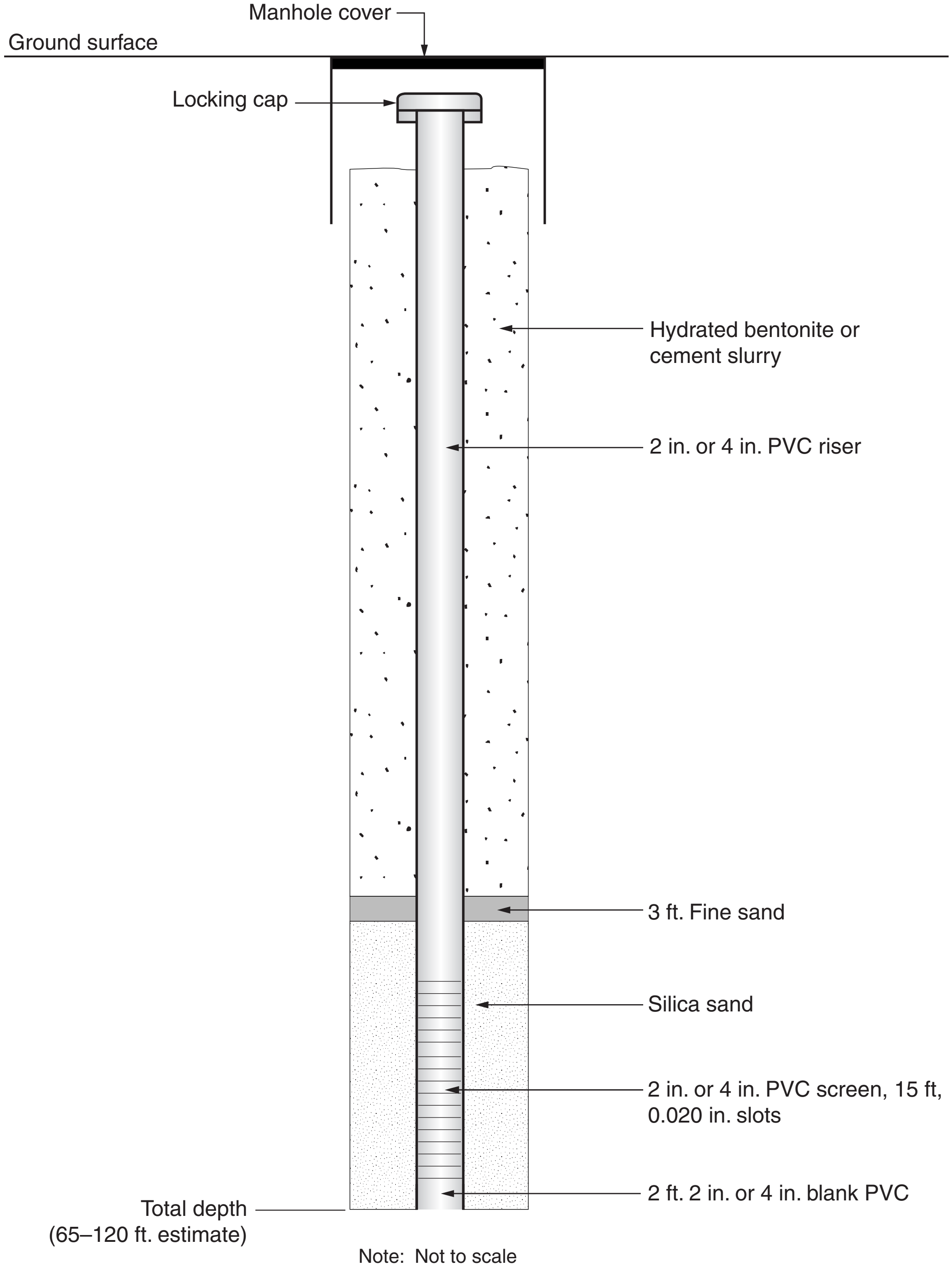

Figure 11. Monitor Well Construction Diagram
Heglar Kronquist Landfill
Mead, Washington

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Table 1. Water quality results for groundwater, select analyses

Chemical	Method	Units	Private Well 3b 5/12/2010	Monitor Well 3bcd-2 5/17/2010	Cistern 4aad 5/13/2010	Private Well 4bcd 5/12/2010	Private Well 5add 5/12/2010	Soil Boring BH-1 5/12/2010	Soil Boring BH-2 5/12/2010	Soil Boring BH-3 5/11/2010	Soil Boring BH-4 5/11/2010	Soil Boring BH-5 5/10/2010	Soil Boring BH-6 5/12/2010	Soil Boring BH-7 5/13/2010	Soil Boring BH-9 5/7/2010	Soil Boring BH-10 5/6/2010	Soil Boring BH-11 5/7/2010	Soil Boring BH-12 5/6/2010	Soil Boring BH-13 5/4/2010	Soil Boring BH-15 5/13/2010
Field Data																				
Specific Conductance	-	µmhos/cm	447	948	247	1,099	1,009	725	932	889	3,251	622	222	311	1,804	1,914	969	554	567	804
Chloride	-	mg/L	10	80	7.5	160	95	70	< 60	< 115	> 400	25	7.5	15	> 400	> 400	105	< 25	< 20	40
Analytical Laboratory Data																				
Fluoride	300.0	mg/L	0.40	0.27	0.43	0.25	0.22	0.36	0.35	0.18 *J*	0.14 *J*	0.43	0.38	0.3	0.3	0.23	0.27	0.34	0.3	0.54
Alkalinity, Total as CaCO$_3$	2320B	mg/L	245	311	118	400	352	234	138	215	171	281	223	214	310	220	276	263	173	360
Solids, Total Dissolved	2540C	mg/L	259	563	198	572	526	391	540	491	1,910	375	210	230	967	1,330	535	378	327	465
Ammonia as Nitrogen	350.1	mg/L	0.020 *U*	0.070 *U*	0.02 *U*	0.020 *U*	0.025 *U*	0.046 *U*	0.116	0.020 *U*	0.020 *U*	0.020 *U*	0.064 *U*	0.069 *U*	0.021 *J*	0.442	0.020 *U*	0.02 *U*	0.02 *U*	0.031 *U*
Nitrite as Nitrogen	353.2	mg/L	0.012 *U*	0.049 *U*	0.005 *J*	0.012 *U*	0.010 *U*	0.058 *U*	0.183	0.035 *U*	0.041 *U*	0.020 *U*	0.006 *J*	0.024 *J*	0.030 *U*	0.074	0.017 *U*	0.005 *U*	0.005 *U*	0.007 *J*
Nitrate as Nitrogen	353.2	mg/L	0.045 *J*	15.9 *J*	0.036 *U*	2.88 *J*	6.04 *J*	1.82 *J*	26.0 *J*	15.8 *J*	34.9 *J*	8.8 *J*	0.052 *U*	3.22 *J*	6.59 *J*	52.2	9.93 *J*	0.009 *U*	9.02	0.061 *U*
Sulfate	300.0	mg/L	2.62	34.7	2.19	22.8	22.9	18.3	41.4	21.3	32.2	18.4	3.4	9.51	33.3	47.0	30.0	30.8	36.2	31.7
Bicarbonate alkalinity as CaCO$_3$	2320B	mg/L	245	311	118	400	352	234	138	215	171	281	223	214	310	220	276	263	173	360
Chloride	300.0	mg/L	2.11	57.9	2.35	105	71.4	57.4	50.1	93.9	810	13.4	1.77	6.42	368	388	89.7	15.8	11.5	30.3
Calcium (dissolved)	200.7	µg/L	--	80,600	--	--	--	68,600	99,400	70,500	186,000	64,900	29,300	29,600	131,000	152,000	105,000	58,000	54,600	73,800
Calcium	200.7	µg/L	44,100	--	22,100	91,200	93,400	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium (dissolved)	200.7	µg/L	--	35,600	--	--	--	27,200	37,400	19,000 *J*	60,100 *J*	24,700 *J*	12,700	9,440	47,200 *J*	53,000 *J*	33,300 *J*	22,800 *J*	17,900	29,100
Magnesium	200.7	µg/L	16,900	--	9,210	47,200	42,100	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium (dissolved)	200.7	µg/L	--	7,590	--	--	--	5,650	5,880	9,920	43,500	3,850	6,410	3,880	7,990	14,900	6,140	7,220	5,170	6,040
Potassium	200.7	µg/L	5,360	--	3,320	7,260	7,040	--	--	--	--	--	--	--	--	--	--	--	--	--
Sodium (dissolved)	200.7	µg/L	--	59,400	--	--	--	31,400	35,400	56,800	287,000	23,700	17,100	17,000	127,000	140,000	26,900	31,900	17,800	49,600
Sodium	200.7	µg/L	22,700	--	11,300	60,600	42,800	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes: *J* - estimated value
U - not detected by laboratory or qualified as not detected (data validation)
-- - not analzyed
Higher concentration of sample and field duplicate shown.

Table 2. Water quality results for springs and streams, select analyses

			Spring	Spring	Spring	Spring	Drainage	Creek	Creek	Drainage
Chemical	Method	Units	SW-1 5/14/2010	SW-2 5/14/2010	SW-3 5/14/2010	SW-4 5/14/2010	SW-5 5/14/2010	SW-6 5/14/2010	SW-7 5/17/2010	SW-8 5/13/2010
Field Data										
Specific Conductance	-	µmhos/cm	669	694	1,577	571	1,403	66	419	1,327
Chloride	-	mg/L	35	35	340	20	320	10	15	320
Analytical Laboratory Data										
Fluoride	300.0	mg/L	0.27	0.31	0.24	0.25	0.25	0.060 *J*	0.22	0.26
Alkalinity, Total as CaCO3	2320B	mg/L	254	237	228	174	216	21.6	162	230
Solids, Total Dissolved	2540C	mg/L	408	408	821	342	739	44.0	261	759
Nitrite as Nitrogen	353.2	mg/L	0.0060 *U*	0.007 *U*	0.006 *U*	0.013 *U*	0.039 *U*	0.010 *U*	0.043 *U*	0.01 *J*
Nitrate as Nitrogen	353.2	mg/L	9.26 *J*	9.93 *J*	18.0 *J*	12.0 *J*	14.8 *J*	0.113 *U*	1.63 *J*	10.8 *J*
Sulfate	300.0	mg/L	42.3	40.4	36.3	40.7	36.7	2.20	18.4	32.4
Bicarbonate alkalinity as CaCO3	2320B	mg/L	254	237	228	174	216	21.6	162	230
Chloride	300.0	mg/L	20.0	21.7	301	9.77	252	2.69	8.30	239
Calcium	200.7	µg/L	70,600	74,000	118,000	65,000	104,000	4,840	48,400	108,000
Magnesium	200.7	µg/L	25,200	26,500	39,600	18,500	36,300	1,060	13,500	36,600
Potassium	200.7	µg/L	4,460	4,880	11,300	3,350	10,100	851	3,140	9,060
Sodium	200.7	µg/L	25,200	27,500	111,000	17,200	96,100	4,510	17,000	84,900

Notes: *J* - estimated value

U - not detected by laboratory or qualified as not detected (data validation)

-- - not analzyed

Higher concentration of sample and field duplicate shown.

Table 3. Summary of sample locations shown on Figure 8

Sample Location	Sample Location Description	Date of Chloride Concentrations Shown on Figure 8	Investigator
3b	Private well	May 2010	Exponent
3bcd-2	Monitor well	May 2010	Exponent
4aad	Cistern	May 2010	Exponent
4bcd	Private well	May 2010	Exponent
5add	Private well	May 2010	Exponent
BH-1	Borehole	May 2010	Exponent
BH-2	Borehole	May 2010	Exponent
BH-3	Borehole	May 2010	Exponent
BH-4	Borehole	May 2010	Exponent
BH-5	Borehole	May 2010	Exponent
BH-6	Borehole	May 2010	Exponent
BH-7	Borehole	May 2010	Exponent
BH-9	Borehole	May 2010	Exponent
BH-10	Borehole	May 2010	Exponent
BH-11	Borehole	May 2010	Exponent
BH-12	Borehole	May 2010	Exponent
BH-13	Borehole	May 2010	Exponent
BH-15	Borehole	May 2010	Exponent
SW-1 (3cca)	Spring	May 2010	Exponent
SW-2 (3cbd-2)	Spring	May 2010	Exponent
SW-3 (3cbd-1)	Spring	May 2010	Exponent
SW-4 (3bcb)	Spring	May 2010	Exponent
SW-5	Drainage	May 2010	Exponent
SW-6	Creek	May 2010	Exponent
SW-7	Creek	May 2010	Exponent
SW-8	Drainage	May 2010	Exponent
HC-1	Private well	December 2008	Hart Crowser
HC-2	Private well	December 2008	Hart Crowser
HC-3	Private well	December 2008	Hart Crowser
HC-4	Private well	December 2008	Hart Crowser
HC-5 North	Private well	December 2008	Hart Crowser
HC-5 South	Private well	December 2008	Hart Crowser
HC-8	Private well	December 2008	Hart Crowser
HC-11	Private well	December 2008	Hart Crowser
HC-12	Private well	December 2008	Hart Crowser
HC-13	Private well	December 2008	Hart Crowser
HC-14	Private well	December 2008	Hart Crowser
HC-15	Private well	December 2008	Hart Crowser
HC-16	Private well	December 2008	Hart Crowser
3bbc	Private well	December 2008	Hart Crowser
3cbb-1	Private well	December 2008	Hart Crowser
4ada	Private well	December 2008	Hart Crowser
3bcc	Monitor well	--	--
3bcd-3	Monitor well	--	--
10bba-1	Private well	--	--
10bba-2	Private well	--	--
10bbc	Private well	--	--
10bcb-1	Private well	--	--
10bcb-2	Private well	--	--

Table 4. Proposed monitor wells: Purpose and estimated completion

Proposed Well #	Target Zone	Purpose	Estimated Total Depth (ft)	Estimated Screen Interval (ft)
1	Base basalt gravel, basalt rubble	Monitor stability of north end of elevated chlorides	85	65−80
2	Base basalt gravel, basalt rubble	Monitor stability of south end of elevated chlorides	75	55−70
3	Base basalt gravel, basalt rubble	Monitor stability of west side of elevated chlorides	65	45−60
4	Base basalt gravel, basalt rubble	Monitor stability of east edge of elevated chlorides	95	75−90
5	Base basalt gravel, basalt rubble	Water quality east of fine-grained feature	120	100−115
6	Base basalt gravel, basalt rubble, possible pathway	Water quality west of the fine-grained feature and along apparent lineament northeast of Spring SW-3 (3cbd-1)	115	95−110

Appendix A

Boring Logs

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-1

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington

DRILLING CONTRACTOR Environmental West Exploration

PROJECT NUMBER 0907194.000

DRILLING METHOD Air Rotary

LOCATION Northing:304888.19 Easting:2524577.95

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

OVA EQUIPMENT

GROUND ELEVATION 2221.75 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 80.0 ft

▽ **FIRST ENCOUNTERED WATER** 72.0 ft / Elev 2149.8 ft

▼ **STABILIZED WATER** 68.7 ft / Elev 2153.1 ft

LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/12/10

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
		ML	▨	3.0	Cream and brown, clayey SILT, moist. Trace clay clasts.	2218.8	
5 10		ML	▥	10.0	Light brown, soft SILT. Dry.	2211.8	5 10
15		ML	▨	15.0	Light brown SILT with trace to some clay.	2206.8	15
		SM	░	16.0	Reddish brown, fine SAND with silt.	2205.8	
20		ML	▥		Brown to reddish brown, soft SILT with trace clay. Silt is mica rich, and dry to slightly moist.		20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-1

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		ML			Brown to reddish brown, soft SILT with trace clay. Silt is mica rich, and dry to slightly moist. *(continued)*		
25				25.0		2196.8	25
		ML			Light brown, clayey SILT. Slightly moist.		
				28.5		2193.3	
		ML			Reddish brown, soft SILT. Dry.		
30							30
				34.0		2187.8	
		ML			Light brown, soft SILT with trace fine sand. Dry.		
35							35
				39.0		2182.8	
		ML			Light brown, clayey SILT. Slightly moist.		
40							40
45				45.0		2176.8	45
		CL			Light brown, silty CLAY. Moist.		
50							50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-1

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		CL	▨	52.0	Light brown, silty CLAY. Moist. *(continued)*	2169.8	
		ML	▨	53.0	Light brown, clayey SILT. Moist.	2168.8	
55 60		CL	▨	61.0	Light brown to grayish light brown, silty, mica rich CLAY. Moist.	2160.8	55 60
65 70		CL	▨	▼ 72.0 ∇	Light grayish brown CLAY with some silt. Moist. Harder drilling.	2149.8	65 70
75 80		ML	▨	80.0	Dark brown, clayey, mica rich SILT. Moist to wet.	2141.8	75 80

COMMENTS

APPROVED BY: ______________________ **DATE:** __________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-2

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington

DRILLING CONTRACTOR Environmental West Exploration

PROJECT NUMBER 0907194.000

DRILLING METHOD Air Rotary

LOCATION Northing:305123.51 Easting:2524879.67

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

OVA EQUIPMENT

GROUND ELEVATION 2264.55 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 80.0 ft

▽ **FIRST ENCOUNTERED WATER** 75.0 ft / Elev 2189.6 ft

▼ **STABILIZED WATER** 75.7 ft / Elev 2188.9 ft

LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/11/10

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		ML		1.5	Dark brown SILT with trace clay. Moist.	2263.1	
5		ML		6.0	Brown clayey SILT with trace basalt gravel. Dry.	2258.6	5
		GM		9.0	Silty, fine to course, angular to subangular basalt GRAVEL with trace latah gravel. Dry. Silt decreases with depth.	2255.6	
10 15		GP		15.0	Fine to course, angular to subangular, vesicular, basalt GRAVEL with trace silt. Dry.	2249.6	10 15
		GM		16.5	Silty basalt GRAVEL. Dry.	2248.1	
20		GP			Angular to subangular, fine to course, basalt GRAVEL with intermittent silty and clayey basalt gravel. (Boulders)		20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-2

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
25 30		GP		33.0	Angular to subangular, fine to course, basalt GRAVEL with intermittent silty and clayey basalt gravel. (Boulders) *(continued)*	2231.6	25 30
35 40 45 50					Basalt. Cuttings mostly angular and course. Hard Drilling. Intermittent silt/clay strata. Dry from 33' bgs to 75'bgs. Moist to wet from 75'bgs to 78.5' bgs, then dry.		35 40 45 50

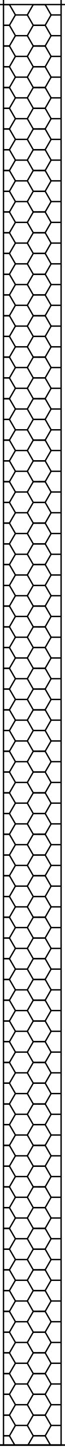
(Continued Next Page)

COMMENTS

APPROVED BY: ____________________ **DATE:** __________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-2

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					Basalt. Cuttings mostly angular and course. Hard Drilling. Intermittent silt/clay strata. Dry from 33' bgs to 75'bgs. Moist to wet from 75'bgs to 78.5' bgs, then dry. *(continued)*		
55							55
60							60
65							65
70							70
75				∇ ▼			75
80				80.0		2184.6	80

COMMENTS

APPROVED BY: ____________________ **DATE:** __________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-3

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:305866.78 Easting:2523800.69
OVA EQUIPMENT
GROUND ELEVATION 2180.61 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 69.0 ft
∇ **FIRST ENCOUNTERED WATER** 60.0 ft / Elev 2120.6 ft
▼ **STABILIZED WATER** 55.6 ft / Elev 2125.0 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/11/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
5		GM		5.0	Silty, angular to subangular basalt GRAVEL. Moist.	2175.6	5
				6.0	Basalt Boulder	2174.6	
10		ML		10.0	Reddish brown SILT with trace clay and course, angular latah gravel. Slightly moist.	2170.6	10
		CL		14.5	Bluish gray and reddish brown silty CLAY. Slightly moist. (Saprolite?) Becomes clayey SILT at 13' bgs.	2166.1	
15 20		ML			Light brown, soft SILT with trace to some angular to mostly subangular basalt gravel. Dry. Trace to some fine to medium sand from 17' bgs to 17.5' bgs.		15 20

(Continued Next Page)

COMMENTS

APPROVED BY: ______________ **DATE:** ________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-3

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
		ML		23.0	Light brown, soft SILT with trace to some angular to mostly subangular basalt gravel. Dry. Trace to some fine to medium sand from 17' bgs to 17.5' bgs. *(continued)*	2157.6	
25 30		ML		30.5	Gravelly SILT. Gravel is mostly course, angular to subangular basalt. Dry.	2150.1	25 30
35 40		ML		40.0	Brown SILT with fine sand. Dry to slightly moist.	2140.6	35 40
45		SP		45.0	Fine to medium SAND with silt and fine to course basalt gravel.	2135.6	45
		GP		48.0	Subangular to subrounded, course to fine basalt GRAVEL with some to trace silt.	2132.6	
50					Basalt with intermittent interbeds of silt, clay and fine sand. Moist beginning at 55' bgs.		50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

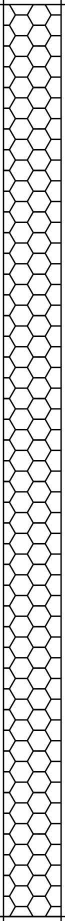
PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-3

PAGE 3 OF 3

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					Basalt with intermittent interbeds of silt, clay and fine sand. Moist beginning at 55' bgs. *(continued)*		
55				▼			55
60				▽			60
65							65
				69.0		2111.6	



COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-4

PAGE 1 OF 2

PROJECT LOCATION Mead, Washington

PROJECT NUMBER 0907194.000

LOCATION Northing:305152.23 Easting:2524141.14

OVA EQUIPMENT

GROUND ELEVATION 2170.69 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 50.0 ft

∇ **FIRST ENCOUNTERED WATER** 50.0 ft / Elev 2120.7 ft

▼ **STABILIZED WATER** 47.7 ft / Elev 2123.0 ft

LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/11/10

DRILLING CONTRACTOR Environmental West Exploration

DRILLING METHOD Air Rotary

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
5		GM		7.0	Silty basalt GRAVEL. Moist.	2163.7	5
10		ML		10.0	Brown SILT with fine sand and trace basalt gravel. Slightly moist.	2160.7	10
		GM		12.0	Silty basalt GRAVEL. Dry.	2158.7	
		ML		14.0	Brown SILT with fine sand. Dry.	2156.7	
15 20		GP			Basalt boulders with intermittent silt strata in between. Silt strata slightly moist, otherwise dry. Basalt cuttings are angular to subangular, fine to course, and vesicular.		15 20

(Continued Next Page)

COMMENTS

APPROVED BY:

DATE:

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-4

PAGE 2 OF 2

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		GP	⁘		Basalt boulders with intermittent silt strata in between. Silt strata slightly moist, otherwise dry. Basalt cuttings are angular to subangular, fine to course, and vesicular. *(continued)*		
25							25
30							30
35							35
				37.0		2133.7	
			▨		Basalt.		
40							40
45							45
				▼			
50				50.0 ∇		2120.7	50

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

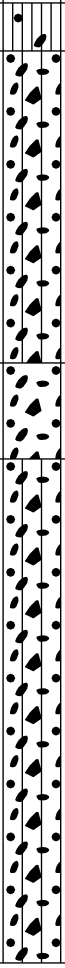
BORING NUMBER BH-5

PAGE 1 OF 4

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:305216.84 Easting:2525077.77
OVA EQUIPMENT
GROUND ELEVATION 2289.56 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 103.0 ft
∇ **FIRST ENCOUNTERED WATER** 100.0 ft / Elev 2189.6 ft
▼ **STABILIZED WATER** 99.1 ft / Elev 2190.5 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/10/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent



DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
				ML		1.0	Brown gravelly SILT. Dry.	2288.6	
5				GM		7.5	Course to fine, angular to subangular, silty basalt GRAVEL. Dry. Percent silt content variable from increasing to decreasing at approximately 1' intervals.	2282.1	5
				GP		9.5	Fine to course, angular to subrounded basalt GRAVEL with silt. Dry.	2280.1	
10 15 20				GM			Fine to course, angular to subangular, silty, vesicular basalt GRAVEL. Dry.		10 15 20

(Continued Next Page)

COMMENTS

APPROVED BY:

DATE:

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-5

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
				GM		21.0	Fine to course, angular to subangular, silty, vesicular basalt GRAVEL. Dry. *(continued)*	2268.6	
25 30 35 40 45				GP		45.0	Fine to course, angular to subangular, highly vesicular basalt GRAVEL with trace to some silt. Basalt boulder from 41.5' to 43'.	2244.6	25 30 35 40 45
50				ML		50.0	Brown SILT with trace to some gravel. Moist. Trace clay from 49' to 50'.	2239.6	50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-5

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
				GP		54.0	Fine basalt GRAVEL with trace to some moist silt.	2235.6	
55				GM		55.0	Silty basalt GRAVEL. Moist.	2234.6	55
60				ML		64.5	Brown, clayey SILT with trace to some gravel. Gravel is mixture of garnet+quartz bearing plutonic lithology to ingenous basalt. From 58' to 61', gravels are mostly mica and quartz bearing. From 61' to 64.5', gravels are strictly basalt.	2225.1	60
65				GP		69.0	Mostly course, some fine basalt GRAVEL, trace silt. Dry. Possible boulder.	2220.6	65
70 75				GM		77.0	Fine to course basalt GRAVEL with intermittent increasing to decreasing percent silt content. Trace plutonic gravel at 73.5'. Slightly moist to dry.	2212.6	70 75
80				GM			Fine to course basalt GRAVEL with reddish brown silt and fine sand, trace plutonic gravel. Moist.		80

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-5

PAGE 4 OF 4

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
				GM		81.0		2208.6	
85				GP		85.0	Fine to course basalt GRAVEL with brown silt. Dry.	2204.6	85
90				GM		94.0	Fine to course silty basalt GRAVEL. Slightly moist. Gravel become mostly fine from 86' to 87'. Some angular latah gravel from 93' to 94'.	2195.6	90
95	SS BH-5 d 95	☒	42-6 50-3	ML		98.5	Bluish cream and rusty orange-red clayey SILT. Rusty orange red sediment in swirl pattern within the bluish gray (saprolite?). Dry, then becomes moist at 97'.	2191.1	95
100				ML		▼ ▽ 103.0	Brown, soft, mica rich SILT with trace fine to medium sand. Wet at 100'.	2186.6	100

COMMENTS

APPROVED BY: ______________________ **DATE:** __________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

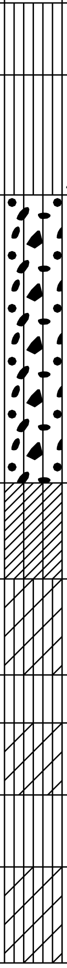
BORING NUMBER BH-6

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:303751.83 Easting:2524105.04
OVA EQUIPMENT
GROUND ELEVATION 2098.41 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 60.0 ft
▽ **FIRST ENCOUNTERED WATER** 60.0 ft / Elev 2038.4 ft
▼ **STABILIZED WATER** 57.0 ft / Elev 2041.4 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/12/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent



DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		ML		1.5	Brown clayey SILT with subrounded basalt and quartz monzonite gravel. Dry.	2096.9	
		ML		4.0	Brown, soft SILT with trace basalt gravel. Dry.	2094.4	
5 10		GM		10.0	Subangular to subrounded, silty basalt GRAVEL. Dry.	2088.4	5 10
		CL		12.0	Cream silty CLAY. Moist.	2086.4	
		ML		14.0	Cream clayey SILT. Moist.	2084.4	
15		ML		15.0	Brown to reddish brown, soft SILT with trace clay. Dry.	2083.4	15
		ML		16.5	Light brown clayey SILT. Moist.	2081.9	
		ML		18.0	Brown to light brown soft SILT. Moist.	2080.4	
20		ML			Brown to light brown clayey SILT. Moist.		20

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-6

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
		ML		21.0	Brown to light brown clayey SILT. Moist. *(continued)*	2077.4	
25 30 35		CL		35.0	Light brown to brown silty CLAY. Moist. Becomes mica rich at 23'.	2063.4	25 30 35
40		ML		41.0	Brown clayey SILT. Moist.	2057.4	40
45 50		CL			Brown, silty, mica rich CLAY. Becomes moist to wet at approximately 55'.		45 50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________ **DATE:** __________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-6

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
			▨		Brown, silty, mica rich CLAY. Becomes moist to wet at approximately 55'. *(continued)*		
55		CL	▨				55
			▨	▼			
60			▨	60.0 ∇		2038.4	60

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-7

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:306552.73 Easting:2523076.91
OVA EQUIPMENT
GROUND ELEVATION 2073.21 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 60.0 ft
FIRST ENCOUNTERED WATER ---
▼ **STABILIZED WATER** 43.6 ft / Elev 2029.6 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/13/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
5				ML		7.0	Dark brown SILT with trace clay, some fine, angular to subrounded quartz monzonite gravel. Moist.	2066.2	5
				SP		9.0	Brown, fine to medium SAND, trace silt. Wet.	2064.2	
10				GP		12.0	Angular to subrounded basalt and quartz monzonite GRAVEL with medium to fine sand. Wet.	2061.2	10
15 20				ML			Gravelly SILT with fine to medium sand. Gravels are fine and subangular. Decreasing moisture with depth.		15 20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-7

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
				ML		21.0		2052.2	
25				SP		25.0	Brown, fine SAND with silt, trace clay, trace fine gravel. Moist. Increasing clay content with depth.	2048.2	25
				ML		27.0	Brown SILT with clay, some to trace fine to medium sand. Some bluish gray clay clasts.	2046.2	
30				SP		30.0	Medium SAND with fine sand and silt, some rounded, fine quartz monzonite, mica rich gravel. Increasing silt and gravel content with depth.	2043.2	30
				SP		33.0	Reddish brown, fine to medium SAND with silt. Moist to wet.	2040.2	
35				ML		35.0	SILT with clay and fine gravel.	2038.2	35
				CL		39.0	Light brown, silty CLAY with fine to medium sand and fine gravel. Dry.	2034.2	
40				CL		41.0	Cream CLAY with reddish brown fine sand and mica rich silt. Dry.	2032.2	40
				CL		42.0	Cream, silty, mica rich CLAY. Dry.	2031.2	
45				ML		▼ 48.0	Reddish brown, soft SILT with trace to some clay and trace fine, subrounded quartz monzonite gravel. Moist.	2025.2	45
50				ML			Reddish brown SILT with fine to medium sand and fine rounded to subrounded quartz monzonite gravel. (Weathered Bedrock). Slightly moist. Wet at approximately 59' bgs.		50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-7

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
55 60				ML			Reddish brown SILT with fine to medium sand and fine rounded to subrounded quartz monzonite gravel. (Weathered Bedrock). Slightly moist. Wet at approximately 59' bgs. *(continued)*		55 60
	SS BH-7 d 60	☒	16 12			60.5	Quartz monzonite	2012.7	
						61.5		2011.7	

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

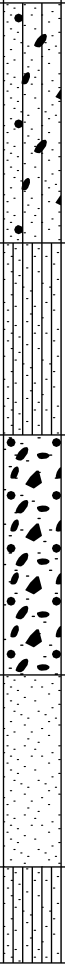
PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-8(a)

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:306777.19 Easting:2523644.00
OVA EQUIPMENT
GROUND ELEVATION 2227.14 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 34.0 ft
FIRST ENCOUNTERED WATER ---
STABILIZED WATER ---
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/5/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent



DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
		SP			Brown, fine to medium SAND, trace silt, some fine to course gravel. Moist. Incresing silt with depth.		
5				5.0		2222.1	5
		ML			Brown to light brown SILT with fine sand and trace fine, angular to subangular gravel. Moist.		
				9.0		2218.1	
10		GP			Fine to course, angular to subangular baslat GRAVEL with some medium sand. Increasing sand content with depth.		10
				14.0		2213.1	
15		SP			Brown, medium to fine SAND, trace silt. Increasing silt content with depth.		15
				18.0		2209.1	
		ML			Brown to light brown SILT with fine sand. Dry.		
20							20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-8(a)

PAGE 2 OF 2

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
		ML		22.0	Brown to light brown SILT with fine sand. Dry. *(continued)*	2205.1	
		SP		24.0	Gravelly fine SAND with silt. Gravel are angular to subangular basalt.	2203.1	
25 30				34.0	Basalt.	2193.1	25 30

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-8(b)

PAGE 1 OF 2

PROJECT LOCATION Mead, Washington

PROJECT NUMBER 0907194.000

LOCATION Northing:306786.94 Easting:2523641.03

OVA EQUIPMENT

GROUND ELEVATION 2226.78 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 35.0 ft

FIRST ENCOUNTERED WATER ---

STABILIZED WATER ---

LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/5/10

DRILLING CONTRACTOR Environmental West Exploration

DRILLING METHOD Air Rotary

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					See log BH-8(a)		
5							5
10							10
15							15
20							20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-8(b)

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					See log BH-8(a) *(continued)*		
25		SP		23.0	Light brown, fine to medium SAND, some silt. Dry. Increasing silt with depth.	2203.8	25
30				27.0	Basalt. Cuttings are mostly course with trace fine. Intermittent silt until 34' bgs, then no silt.	2199.8	30
35				35.0		2191.8	35

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-9

PAGE 1 OF 2

PROJECT LOCATION Mead, Washington

DRILLING CONTRACTOR Environmental West Exploration

PROJECT NUMBER 0907194.000

DRILLING METHOD Air Rotary

LOCATION Northing:304678.05 Easting:2523477.20

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

OVA EQUIPMENT

GROUND ELEVATION 2065.65 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 20.0 ft

∇ **FIRST ENCOUNTERED WATER** 0.5 ft / Elev 2065.2 ft

▼ **STABILIZED WATER** 5.7 ft / Elev 2060.0 ft

LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/7/10

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					▨	∇	Brown, soft SILT with fine sand and clay. Becomes light grayish brown at 5' bgs. Intermittent increasing and decreasing clay content. Moist to wet at 12' bgs.		
2.5									2.5
5.0				ML					5.0
						▼			
7.5									7.5
10.0									10.0

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-9

PAGE 2 OF 2

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
							Brown, soft SILT with fine sand and clay. Becomes light grayish brown at 5' bgs. Intermittent increasing and decreasing clay content. Moist to wet at 12' bgs. *(continued)*		
12.5									12.5
15.0				ML					15.0
17.5									17.5
20.0						20.0		2045.7	20.0
	SS BH-9 d 20	☒	16 50	ML			Very stiff to hard, brown clayey SILT with red, swirling silt bands and mica (saprolite?)		
						21.5		2044.2	

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-10

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:305242.03 Easting:2524703.30
OVA EQUIPMENT
GROUND ELEVATION 2238.78 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 55.0 ft
FIRST ENCOUNTERED WATER ---
▼ **STABILIZED WATER** 45.0 ft / Elev 2193.8 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/6/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
				SP		2.0	Dark brown fine SAND with silt and gravel. Moist.	2236.8	
				SP		4.0	Grayish brown, fine gravelly SAND.	2234.8	
5 10				GP		10.0	Fine to course, angular to subangular, vesicular basalt GRAVEL, trace fines.	2228.8	5 10
				ML		12.0	Dark brown SILT with fine sand. Slightly moist.	2226.8	
15 20							Angular to subangular basalt cuttings with intermittent increasing and decreasing silt content. Dry. Becomes moist at 49' bgs.		15 20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-10

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
							Angular to subangular basalt cuttings with intermittent increasing and decreasing silt content. Dry. Becomes moist at 49' bgs. *(continued)*		
25									25
30									30
35									35
40									40
45						▼			45
50						50.0		2188.8	50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-10

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
	SS BH-10 d 50		50 50	SP		53.0	Gravelly, silty fine SAND. Wet.	2185.8	
55				GP		55.0	Fine to course, silty basalt GRAVEL. Very hard drilling at 55' bgs.	2183.8	55

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-11

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington

PROJECT NUMBER 0907194.000

LOCATION Northing:303812.46 Easting:2524478.96

OVA EQUIPMENT

GROUND ELEVATION 2182.95 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 68.0 ft

∇ **FIRST ENCOUNTERED WATER** 65.0 ft / Elev 2118.0 ft

▼ **STABILIZED WATER** 62.0 ft / Elev 2121.0 ft

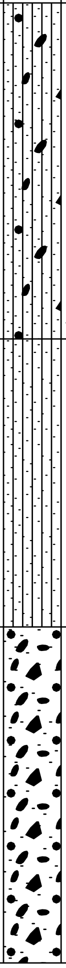
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/7/10

DRILLING CONTRACTOR Environmental West Exploration

DRILLING METHOD Air Rotary

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
5		ML		7.0	Brown SILT with fine sand and course, angular basalt gravel. Slightly moist. Decreasing gravel content with depth.	2176.0	5
10		ML		13.0	Brown, soft, mica rich SILT with fine sand. Slightly moist at 12' bgs.	2170.0	10
15 20		GP			Angular to subangular, fine to course, vesicular, basalt GRAVEL with intermittent increasing and decreasing sand and silt content. Dry to slightly moist.		15 20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-11

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
					Angular to subangular, fine to course, vesicular, basalt GRAVEL with intermittent increasing and decreasing sand and silt content. Dry to slightly moist. *(continued)*		
25							25
30							30
35		GP					35
40							40
45							45
50							50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-11

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
55		GP		56.0	Angular to subangular, fine to course, vesicular, basalt GRAVEL with intermittent increasing and decreasing sand and silt content. Dry to slightly moist. *(continued)*	2127.0	55
60 65				▼ ▽ 68.0	Basalt. Very Hard Drilling. Cuttings are angular, non-vesicular. Becomes moist to wet at 65' bgs, then dry at 66' bgs.	2115.0	60 65

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-12

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:304186.20 Easting:2524808.80
OVA EQUIPMENT
GROUND ELEVATION 2202.22 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 95.0 ft
FIRST ENCOUNTERED WATER ---
▼ **STABILIZED WATER** 77.0 ft / Elev 2125.2 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/5/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
			⬡		Basalt with trace silt. Dry.		
5							5
				6.0		2196.2	
		SP	▨		Light brown, fine to course SAND with silt. Dry.		
				9.5		2192.7	
10			⬡		Basalt with intermittent increasing and decreasing sand and silt.		10
15							15
20							20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-12

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
					Basalt with intermittent increasing and decreasing sand and silt. *(continued)*		
25				25.0		2177.2	25
		ML			Light brown to brown SILT. Dry.		
				28.0		2174.2	
					Basalt (boulders?) with intermittent increasing and decreasing sand and silt. Very hard drilling at 46' bgs and 83' bgs. Sand and silt strata moist after 50' bgs.		
30							30
35							35
40							40
45							45
50							50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-12

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
			⬡		Basalt (boulders?) with intermittent increasing and decreasing sand and silt. Very hard drilling at 46' bgs and 83' bgs. Sand and silt strata moist after 50' bgs. *(continued)*		
55			⬡				55
60			⬡				60
65			⬡				65
70			⬡				70
75			⬡				75
			⬡	▼			
80			⬡				80

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-12

PAGE 4 OF 4

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
85				87.0	Basalt (boulders?) with intermittent increasing and decreasing sand and silt. Very hard drilling at 46' bgs and 83' bgs. Sand and silt strata moist after 50' bgs. *(continued)*	2115.2	85
90 95		CL		95.0	Bluish gray CLAY with some silt. Moist to wet. Becomes SILT with clay at depth.	2107.2	90 95

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-13

PAGE 1 OF 3

PROJECT LOCATION Mead, Washington

PROJECT NUMBER 0907194.000

LOCATION Northing:306433.85 Easting:2523802.09

OVA EQUIPMENT

GROUND ELEVATION 2224.52 ft **HOLE DIAMETER** 6"

TOP OF CASING ELEVATION **HOLE DEPTH** 74.0 ft

▽ **FIRST ENCOUNTERED WATER** 70.0 ft / Elev 2154.5 ft

▼ **STABILIZED WATER** 67.8 ft / Elev 2156.7 ft

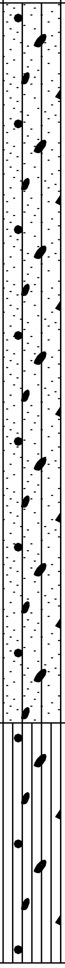
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/4/10

DRILLING CONTRACTOR Environmental West Exploration

DRILLING METHOD Air Rotary

STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent



DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
5 10 15				SP			Brown to light brown, silty fine SAND with some angular basalt gravel.		5 10 15
20				ML		15.0	Brown to light brown SILT with angular to subangular basalt gravel.	2209.5	20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-13

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
25				ML		25.0	Brown to light brown SILT with angular to subangular basalt gravel. *(continued)*	2199.5	25
				ML		26.5	Brown to light brown SILT.	2198.0	
30 35				ML		35.0	Brown to light brown, gravelly SILT.	2189.5	30 35
40				ML		40.0	Light brown SILT with trace fine sand. Moist.	2184.5	40
45 50				ML			Brown SILT with fine sand, trace gravel. Moist.		45 50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________ **DATE:** __________

PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-13

DEPTH (feet)	SAMPLE TYPE NUMBER	SAMPLE RECOVERY	BLOW COUNTS (per 6 inches)	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
55 60				ML		62.0	Brown SILT with fine sand, trace gravel. Moist. *(continued)*	2162.5	55 60
65						68.0 ▼	Basalt (boulder?).	2156.5	65
70				ML		70.0 ∇	Brown to light brown SILT. Moist.	2154.5	70
	SS BH-13 d 70	☒	37 100	SP		74.0	Brown, fine to medium silty SAND. Wet. Increasing gravel with depth.	2150.5	

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

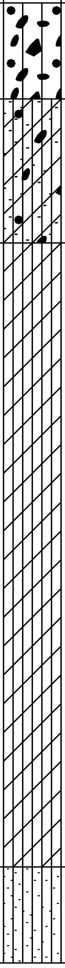
PROJECT NAME Heglar Kronquist
CLIENT Kaiser

BORING NUMBER BH-15

PROJECT LOCATION Mead, Washington
PROJECT NUMBER 0907194.000
LOCATION Northing:305183.91 Easting:2524429.70
OVA EQUIPMENT
GROUND ELEVATION 2215.61 ft **HOLE DIAMETER** 6"
TOP OF CASING ELEVATION **HOLE DEPTH** 73.0 ft
∇ **FIRST ENCOUNTERED WATER** 70.0 ft / Elev 2145.6 ft
▼ **STABILIZED WATER** 66.9 ft / Elev 2148.7 ft
LOGGED BY Kevin Knesek, ARCADIS **DATE** 5/13/10

DRILLING CONTRACTOR Environmental West Exploration
DRILLING METHOD Air Rotary
STAMP (IF APPLICABLE) AND/OR NOTES

Supervising Geologist: Steve Reed - Exponent



DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION .	ELEVATIONS (feet)	DEPTH (feet)
		GP		2.0	Angular to subangular, silty basalt GRAVEL.	2213.6	
5		ML		5.0	Light brown clayey SILT with angular basalt gravel. Moist.	2210.6	5
10 15		ML		18.0	Light brown SILT with some to trace clay. Dry. Intermittent increasing and decreasing clay content. Moist at 15' bgs.	2197.6	10 15
20		ML			Light brown to brown SILT with some fine sand. Mica rich. Moist. Increasing sand with depth.		20

(Continued Next Page)

COMMENTS

APPROVED BY: **DATE:**

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
25 30		ML		31.0	Light brown to brown SILT with some fine sand. Mica rich. Moist. Increasing sand with depth. *(continued)*	2184.6	25 30
		ML		34.0	Brown to grayish brown clayey SILT with fine sand. Moist.	2181.6	
35 40 45 50		CL			Brown to grayish brown silty CLAY. Moist. Becomes dark brown at 58' bgs.		35 40 45 50

(Continued Next Page)

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

PROJECT NAME Heglar Kronquist

CLIENT Kaiser

BORING NUMBER BH-15

PAGE 3 OF 3

DEPTH (feet)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	DEPTHS (feet)	LITHOLOGIC DESCRIPTION	ELEVATIONS (feet)	DEPTH (feet)
55 60		CL	▨	61.0	Brown to grayish brown silty CLAY. Moist. Becomes dark brown at 58' bgs. *(continued)*	2154.6	55 60
65 70		ML	▨	▼ ▽ 73.0	Dark brown clayey SILT. Moist. Wet at 70' bgs.	2142.6	65 70

COMMENTS

APPROVED BY: ______________________________ **DATE:** ____________

Appendix B

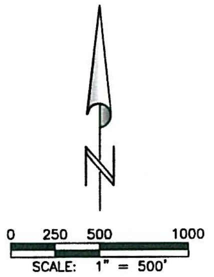
May 2010 Survey Data

AC Adams & Clark, Inc.	Adams & Clark, Inc. 1720 W Fourth Ave. Spokane, Wa 99201 (509) 747-4600	Job No. 2010 - 01 - 044 Exponent Kaiser/Heglar Survey

DESIGNATION	NORTHING	EASTING	STRUCTURE ELEVATION	GROUND ELEVATION	NOTES
3B	305,311.28'	2,523,975.20'	2,179.86'		North Top of Well Casing
3BBC	306,702.09'	2,523,793.04'	2,239.53'		North Top of Well Casing
3BCC	305,865.11'	2,523,954.71'	2,184.17'		North Top of Well Casing
3BCD-1	305,439.38'	2,524,700.22'	2,256.07'	2252.4'	North Top of Well Casing
3BCD-2	305,354.36'	2,524,403.61'	2,217.87'	2214.3'	North Top of Well Casing
3BCD-3	305,278.52'	2,524,869.07'	2,262.37'		North Top of Well Casing
3CBA	304,448.49'	2,524,793.90'	2,223.31'		North Top of Well Casing
3CBD-3	304,285.75'	2,524,426.77'	2,120.06'		North Top of Well Casing 3.75' down to Ground Elevation
4AAD	306,551.73'	2,523,126.63'	2,082.43'		North Top of Well Casing
4AAD-1	306,537.00'	2,522,883.03'	2,046.44'		North Top of Well Casing
4AAD-2	306,721.67'	2,522,807.93'	2,032.88'		North Top of Well Casing
4BCD	305,507.69'	2,519,153.33'	1,844.37'		North Top of Well Casing
5ADD	304,877.97'	2,518,131.20'	1,838.71'		North Top of Well Casing
ALF-1	305,467.33'	2,524,500.97'		2,226.58'	
ALF-2	305,563.20'	2,524,628.55'		2,241.19'	
ALF-3	305,492.88'	2,524,635.02'		2,245.55'	
ALF-4	305,426.32'	2,524,641.14'		2,246.59'	
ALF-5	305,486.05'	2,524,766.97'		2,260.01'	
AOS-1	305,432.89'	2,524,836.55'		2,261.18'	
AOS-2	305,538.59'	2,524,760.26'		2,259.05'	
AOS-3	305,356.20'	2,524,374.30'		2,211.84'	
BH-1	304,888.19'	2,524,577.95'		2,221.75'	
BH-2	305,123.51'	2,524,879.67'		2,264.55'	
BH-3	305,866.78'	2,523,800.69'		2,180.61'	
BH-4	305,152.23'	2,524,141.14'		2,170.69'	
BH-5	305,216.84'	2,525,077.77'		2,289.56'	
BH-6	303,751.83'	2,524,105.04'		2,098.41'	
BH-7	306,552.73'	2,523,076.91'		2,073.21'	
BH-8(NORTH)	306,786.94'	2,523,641.03'		2,226.78'	
BH-8(SOUTH)	306,777.19'	2,523,644.00'		2,227.14'	
BH-9	304,678.05'	2,523,477.20'		2,065.65'	
BH-10	305,242.03'	2,524,703.30'		2,238.78'	
BH-11	303,812.46'	2,524,478.96'		2,182.95'	
BH-12	304,186.20'	2,524,808.80'		2,202.22'	
BH-13	306,433.85'	2,523,802.09'		2,224.52'	
BH-15	305,183.91'	2,524,429.70'		2,215.61'	
D-1	305,426.28'	2,524,706.59'		2,253.34'	
D-2	305,429.29'	2,524,771.51'		2,258.47'	
D-3	305,528.96'	2,524,662.27'		2,248.81'	
D-4	305,485.74'	2,524,649.82'		2,248.07'	
GV-1	305,507.17'	2,524,454.74'		2,219.69'	10.1' up to Gas Vent Opening
GV-2	305,447.46'	2,524,459.88'		2,222.17'	9.0' up to Gas Vent Opening
GV-3	305,387.55'	2,524,465.09'		2,222.75'	9.2' up to Gas Vent Opening
GV-4	305,536.75'	2,524,527.25'		2,225.81'	10.1' up to Gas Vent Opening
GV-5	305,467.31'	2,524,530.97'		2,231.24'	9.2' up to Gas Vent Opening
GV-6	305,396.92'	2,524,537.60'		2,232.36'	10.1' up to Gas Vent Opening
GV-7	305,583.86'	2,524,593.18'		2,234.08'	8.9' up to Gas Vent Opening
GV-8	305,494.32'	2,524,602.58'		2,241.04'	9.6' up to Gas Vent Opening
GV-9	305,404.37'	2,524,612.01'		2,243.16'	10.1' up to Gas Vent Opening
GV-10	305,413.80'	2,524,685.77'		2,251.57'	9.6' up to Gas Vent Opening
GV-11	305,532.48'	2,524,744.35'		2,257.99'	10.4 up to Gas Vent Opening
GV-12	305,479.05'	2,524,752.35'		2,258.58'	9.9' up to Gas Vent Opening
GV-13	305,423.96'	2,524,759.59'		2,257.57'	9.6' up to Gas Vent Opening
GV-14	305,471.14'	2,524,792.02'		2,260.38'	10.3' up to Gas Vent Opening
GV-17	305,572.95'	2,524,668.29'		2,248.49'	2.5' up to Gas Vent Opening (broken)
SW-1	303,842.97'	2,524,719.79'	2,149.69'		Top of Structure
SW-2	304,247.37'	2,524,442.59'		2,115.37'	
SW-3	304,291.23'	2,524,427.72'		2,116.48'	
SW-4	306,454.52'	2,523,973.91'	2,262.57'		Top of Structure
SW-5	305,249.51'	2,523,458.23'		2,058.38'	
SW-6	307,753.64'	2,521,244.07'		1,839.70'	
SW-7	297,095.61'	2,520,009.72'		1,864.72'	
SW-8	306,195.86'	2,522,460.49'		1,959.06'	

DANIEL B. CLARK
STATE OF WASHINGTON
12904
REGISTERED PROFESSIONAL LAND SURVEYOR

7-22-10



DANIEL B. CLARK
12904

7-22-10

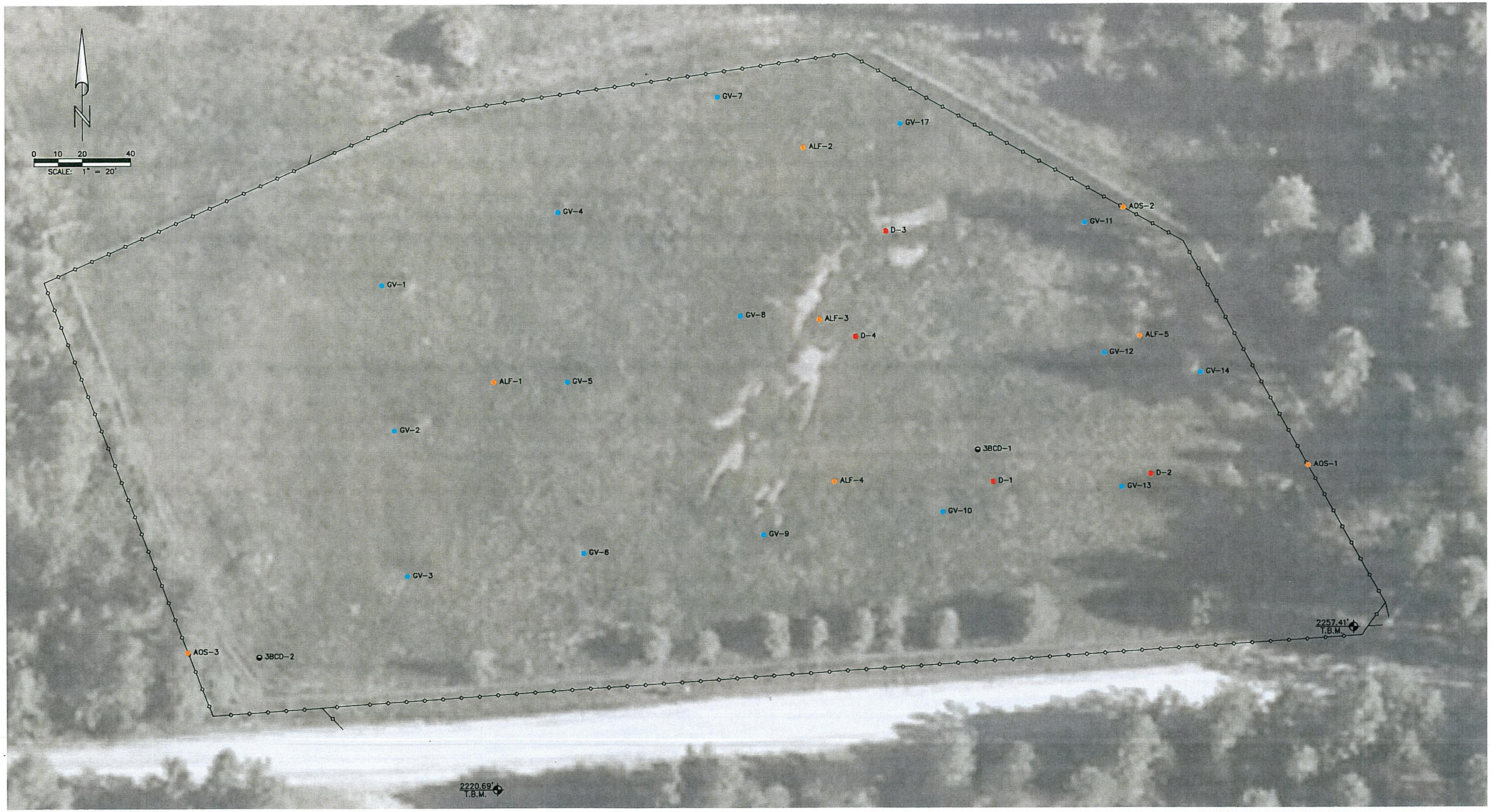
BENCHMARK NOTE:
FOUND 3" BRASS CAP IN
WSDOT MONUMENT CASE.
DESIGNATION: FOOTHILL
MONUMENT ID: 2287
ELEVATION = 1860.49'

DATUM NOTE:
NAVD88

SHEET 1 OF 2

AC
Adams & Clark, Inc.
1720 W. Fourth Ave.
Spokane, WA 99201-5302
(509) 747-4600 F(509) 747-8913
www.adamsandclark.com
Project No. 2010-01-044

20101044-TOPO.DWG JSH 06-30-2010



DANIEL B. CLARK
STATE OF WASHINGTON
12904
REGISTERED
PROFESSIONAL LAND SURVEYOR

7-22-10

SHEET 2 OF 2

Adams & Clark, Inc.
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Project No. 2010-01-044

20101044-TOPO.DWG JSH 06-30-2010

Appendix C

Water Quality Summaries

Table C-1. Water quality results for groundwater (detected constituents)

Chemical	Method	Units	Private Well 3b 5/12/2010	Monitor Well 3bcd-2 5/17/2010	Cistern 4aad 5/13/2010	Private Well 4bcd 5/12/2010	Private Well 5add 5/12/2010	Soil Boring BH-1 5/12/2010	Soil Boring BH-2 5/12/2010	Soil Boring BH-3 5/11/2010	Soil Boring BH-4 5/11/2010	Soil Boring BH-5 5/10/2010	Soil Boring BH-6 5/12/2010	Soil Boring BH-7 5/13/2010	Soil Boring BH-9 5/7/2010	Soil Boring BH-10 5/6/2010	Soil Boring BH-11 5/7/2010	Soil Boring BH-12 5/6/2010	Soil Boring BH-13 5/4/2010	Soil Boring BH-15 5/13/2010
Field Data																				
Temperature	-	degrees C	15.70	12.17	12.02	11.39	13.70	19.37	10.99	19.53	15.96	15.00	17.70	16.95	13.29	11.55	16.07	11.87	12.48	13.31
Specific Conductance	-	µmhos/cm	447	948	247	1,099	1,009	725	932	889	3,251	622	222	311	1,804	1,914	969	554	567	804
pH	-	su	7.35	7.14	6.95	7.44	7.10	7.35	8.72	7.22	7.74	8.17	7.37	7.30	7.40	-	8.14	-	-	7.14
Turbidity	-	NTU	16.10	64.7	2.17	2.68	4.57	183	86.1	701	665	831	169	303	288	80	766	435	841	78.5
Chloride	-	mg/L	10	80	7.5	160	95	70	< 60	< 115	> 400	25	7.5	15	> 400	> 400	105	< 25	< 20	40
Analytical Laboratory Data																				
Fluoride	300.0	mg/L	0.40	0.27	0.43	0.25	0.22	0.36	0.35	0.18 *J*	0.14 *J*	0.43	0.38	0.3	0.3	0.23	0.27	0.34	0.3	0.54
Alkalinity, Total as $CaCO_3$	2320B	mg/L	245	311	118	400	352	234	138	215	171	281	223	214	310	220	276	263	173	360
Phosphate as Orthophosphate	365.3	mg/L	0.181	0.239	0.292	0.550	0.556	0.077	0.098	0.209	0.013 *U*	0.264	0.114	0.095	0.200	0.083	0.120	0.147	0.089	0.196
Solids, Total Dissolved	2540C	mg/L	259	563	198	572	526	391	540	491	1,910	375	210	230	967	1,330	535	378	327	465
Ammonia as Nitrogen	350.1	mg/L	0.020 *U*	0.070 *U*	0.02 *U*	0.020 *U*	0.025 *U*	0.046 *U*	0.116	0.020 *U*	0.020 *U*	0.020 *U*	0.064 *U*	0.069 *U*	0.021 *J*	0.442	0.020 *U*	0.02 *U*	0.02 *U*	0.031 *U*
pH	4500HB	pH	--	--	--	--	--	--	--	--	--	--	--	--	--	7.34 *J*	--	6.91 *J*	7.46 *J*	--
Nitrite as Nitrogen	353.2	mg/L	0.012 *U*	0.049 *U*	0.005 *J*	0.012 *U*	0.010 *U*	0.058 *U*	0.183	0.035 *U*	0.041 *U*	0.020 *U*	0.006 *J*	0.024 *J*	0.030 *U*	0.074	0.017 *U*	0.005 *U*	0.005 *U*	0.007 *J*
Nitrate as Nitrogen	353.2	mg/L	0.045 *J*	15.9 *J*	0.036 *U*	2.88 *J*	6.04 *J*	1.82 *J*	26.0 *J*	15.8 *J*	34.9 *J*	8.8 *J*	0.052 *U*	3.22 *J*	6.59 *J*	52.2	9.93 *J*	0.009 *U*	9.02	0.061 *U*
Orthophosphate as Phosphorus	365.3	mg/L	0.059	0.078	0.095	0.179	0.181	0.025	0.032	0.068	0.004 *U*	0.086	0.037	0.031	0.065	0.027	0.039	0.048	0.029	0.064
Sulfate	300.0	mg/L	2.62	34.7	2.19	22.8	22.9	18.3	41.4	21.3	32.2	18.4	3.4	9.51	33.3	47.0	30.0	30.8	36.2	31.7
Bicarbonate alkalinity as $CaCO_3$	2320B	mg/L	245	311	118	400	352	234	138	215	171	281	223	214	310	220	276	263	173	360
Chloride	300.0	mg/L	2.11	57.9	2.35	105	71.4	57.4	50.1	93.9	810	13.4	1.77	6.42	368	388	89.7	15.8	11.5	30.3
Aluminum (dissolved)	200.7	µg/L	--	59	--	--	--	66.0	30.0 *U*	153	310	94.0	30.0 *U*	529	174	132	30.0 *U*	1,070	1,350 *J*	30.0 *U*
Antimony (dissolved)	200.8	µg/L	--	0.11	--	--	--	29.7	0.231	0.12	0.11	0.09	0.26	0.11	0.295	0.107	0.112	0.082	0.39	6.8
Antimony	200.8	µg/L	0.030 *J*	--	0.05 *J*	0.247	0.362	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (dissolved)	200.8	µg/L	--	0.30 *U*	--	--	--	3.1	0.2 *U*	0.52	0.55	0.91	1.07	0.51	1.6	0.2 *U*	0.6 *U*	2.1	1.98	35.4
Arsenic	200.8	µg/L	0.7	--	0.79	12.0	20.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium (dissolved)	200.7	µg/L	--	54.8	--	--	--	93.1	45.1	70.6	533	30.8	151	55.3	279	99.0	65.5	150	47.3	179
Barium	200.7	µg/L	100	--	55.9	130	124	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium (dissolved)	200.8	µg/L	--	0.009 *J*	--	--	--	0.018 *J*	0.006 *U*	0.01 *J*	0.013 *J*	0.008 *J*	0.013 *J*	0.105	0.017 *J*	0.006 *U*	0.006 *U*	0.042	0.074	0.01 *J*
Beryllium	200.8	µg/L	0.006 *U*	--	0.005 *J*	0.006 *U*	0.006 *U*	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (dissolved)	200.8	µg/L	--	0.038 *U*	--	--	--	0.172	0.126	0.036 *U*	0.052 *U*	0.063	0.064	0.092	0.017 *J*	0.022	0.009 *J*	0.051	0.07	0.109
Cadmium	200.8	µg/L	0.020	--	0.033	0.022	0.057	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium (dissolved)	200.7	µg/L	--	80,600	--	--	--	68,600	99,400	70,500	186,000	64,900	29,300	29,600	131,000	152,000	105,000	58,000	54,600	73,800
Calcium	200.7	µg/L	44,100	--	22,100	91,200	93,400	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium (dissolved)	200.8	µg/L	--	0.50 *U*	--	--	--	0.23	0.05 *J*	0.7 *U*	0.66 *U*	1.02 *U*	0.04 *U*	1.28	0.45	0.25 *U*	0.25 *U*	1.39	2.02	0.07 *U*
Chromium	200.8	µg/L	0.21	--	0.08 *U*	2.89	3.24	--	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt (dissolved)	200.8	µg/L	--	0.211 *U*	--	--	--	1.23	7.82	2.64	11.8	0.133	0.43	3.35	5.62	12.5	2.02	4.23	2.47	0.351
Cobalt	200.8	µg/L	0.170	--	0.365	0.342	0.378	--	--	--	--	--	--	--	--	--	--	--	--	--
Copper (dissolved)	200.8	µg/L	--	1.73	--	--	--	0.61	0.86	13.6	1.49	0.62 *U*	0.33	0.980	1.46	1.51	0.93	2.56	4.24	0.44
Copper	200.8	µg/L	12.8	--	0.24	6.97	7.22	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron (dissolved)	200.7	µg/L	--	723 *J*	--	--	--	55.4 *J*	636 *J*	274	643	86.9	6,570 *J*	1,730 *J*	440	199	20.2	2,070	2,570	29.9 *J*
Iron	200.7	µg/L	1,190 *J*	--	102 *J*	11.4 *J*	87.3 *J*	--	--	--	--	--	--	--	--	--	--	--	--	--
Lead (dissolved)	200.8	µg/L	--	0.154 *U*	--	--	--	0.094	0.017 *J*	0.121	0.103	0.063	0.055	1.11	0.481	0.06 *U*	0.014 *J*	0.684	2.3	0.06
Lead	200.8	µg/L	0.128	--	0.095	0.418	0.705	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium (dissolved)	200.7	µg/L	--	35,600	--	--	--	27,200	37,400	19,000 *J*	60,100 *J*	24,700 *J*	12,700	9,440	47,200 *J*	53,000 *J*	33,300 *J*	22,800 *J*	17,900	29,100
Magnesium	200.7	µg/L	16,900	--	9,210	47,200	42,100	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese (dissolved)	200.7	µg/L	--	38.4	--	--	--	60.9	833	221	402	1.2 *U*	740	150	56.0	1,210	174	560	218	28.7
Manganese	200.7	µg/L	10.3	--	21.4	0.2 *U*	1.3 *J*	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury (dissolved)	245.1	µg/L	--	0.02 *U*	--	--	--	--	--	0.02 *U*	0.02 *U*	0.02 *U*	0.02 *U*	0.02 *J*	0.02 *U*	0.02 *U*	0.02 *U*	0.02 *U*	0.02 *U*	0.02 *U*
Nickel (dissolved)	200.8	µg/L	--	3.40 *U*	--	--	--	2.3	10.9	5.5	8.4	1.05	2.57	9.66	6.87	15.6	4.77	5.27	5.22	1.66
Nickel	200.8	µg/L	1.22	--	0.52	2.03	2.28	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium (dissolved)	200.7	µg/L	--	7,590	--	--	--	5,650	5,880	9,920	43,500	3,850	6,410	3,880	7,990	14,900	6,140	7,220	5,170	6,040
Potassium	200.7	µg/L	5,360	--	3,320	7,260	7,040	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium (dissolved)	200.8	µg/L	--	0.7 *J*	--	--	--	2.9 *J*	0.3 *U*	0.3 *U*	1.3	0.4 *J*	0.3 *U*	1.6	1.1 *U*	0.7 *U*	0.5 *U*	0.5 *U*	0.3 *J*	0.6 *J*
Selenium	200.8	µg/L	0.3 *U*	--	0.4 *J*	0.8 *J*	0.8 *J*	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver (dissolved)	200.8	µg/L	--	0.004 *U*	--	--	--	0.004 *U*	0.004 *U*	0.004 *U*	0.007 *U*	0.004 *U*	0.019 *J*	0.004 *U*	0.015 *J*	0.01 *J*	0.004 *U*	0.004 *U*	0.01 *J*	0.009 *J*
Silver	200.8	µg/L	0.004 *U*	--	0.032	0.013 *J*	0.013 *J*	--	--	--	--	--	--	--	--	--	--	--	--	--
Sodium (dissolved)	200.7	µg/L	--	59,400	--	--	--	31,400	35,400	56,800	287,000	23,700	17,100	17,000	127,000	140,000	26,900	31,900	17,800	49,600
Sodium	200.7	µg/L	22,700	--	11,300	60,600	42,800	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium (dissolved)	200.8	µg/L	--	0.043 *U*	--	--	--	0.028	0.005 *J*	0.005 *J*	0.033	0.004 *J*	0.053	0.063	0.005 *U*	0.012 *J*	0.005 *U*	0.006 *J*	0.015 *J*	0.043
Thallium	200.8	µg/L	0.005 *U*	--	0.044	0.005 *U*	0.005 *U*	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (dissolved)	200.8	µg/L	--	0.50 *U*	--	--	--	17.0	0.14 *J*	1.28	1.48	8.13	0.07 *U*	1.43	1.3	0.71	0.9	1.89	4	1.46
Vanadium	200.8	µg/L	3.37	--	1.84	2.5	3.25	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (dissolved)	200.8	µg/L	--	2.10 *U*	--	--	--	1.4	36.9	4.82 *U*	11 *U*	1.11 *U*	5.05	10.7	1.5	1.5 *U*	0.6	5.4	7.73	1.12
Zinc	200.8	µg/L	109	--	2.38	26.7	83.6	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	624	µg/L	--	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl) phthalate	625	µg/L	--	0.47 *J*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes: *J* - estimated value
U - not detected by laboratory or qualified as not detected (data validation)
-- - not analzyed
Higher concentration of sample and field duplicate shown.

Table C-2. Water quality results for springs and streams (detected constituents)

			Spring	Spring	Spring	Spring	Drainage	Creek	Creek	Drainage
			SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8
Chemical	Method	Units	5/14/2010	5/14/2010	5/14/2010	5/14/2010	5/14/2010	5/14/2010	5/17/2010	5/13/2010
Field Data										
Temperature	-	degrees C	11.38	11.46	13.67	13.05	19.50	11.79	17.30	13.75
Specific Conductance	-	µmhos/cm	669	694	1,577	571	1,403	66	419	1,327
pH	-	su	7.40	7.51	7.74	8.13	8.35	8.32	8.17	8.09
Turbidity	-	NTU	1.15	0.40	0.90	5.79	6.45	5.23	7.53	4.65
Chloride	-	mg/L	35	35	340	20	320	10	15	320
Analytical Laboratory Data										
Fluoride	300.0	mg/L	0.27	0.31	0.24	0.25	0.25	0.060 *J*	0.22	0.26
Alkalinity, Total as CaCO3	2320B	mg/L	254	237	228	174	216	21.6	162	230
Phosphate as Orthophosphate	365.3	mg/L	0.313	0.319	0.258	0.114	0.046	0.114	0.454	0.298
Solids, Total Dissolved	2540C	mg/L	408	408	821	342	739	44.0	261	759
Nitrite as Nitrogen	353.2	mg/L	0.0060 *U*	0.007 *U*	0.006 *U*	0.013 *U*	0.039 *U*	0.010 *U*	0.043 *U*	0.01 *J*
Nitrate as Nitrogen	353.2	mg/L	9.26 *J*	9.93 *J*	18.0 *J*	12.0 *J*	14.8 *J*	0.113 *U*	1.63 *J*	10.8 *J*
Orthophosphate as Phosphorus	365.3	mg/L	0.102	0.104	0.084	0.037	0.015	0.037	0.148	0.097
Sulfate	300.0	mg/L	42.3	40.4	36.3	40.7	36.7	2.20	18.4	32.4
Bicarbonate alkalinity as CaCO3	2320B	mg/L	254	237	228	174	216	21.6	162	230
Chloride	300.0	mg/L	20.0	21.7	301	9.77	252	2.69	8.30	239
Arsenic	200.8	µg/L	--	2.53	2.08	--	--	--	--	--
Barium	200.7	µg/L	--	119	211	--	--	--	--	--
Beryllium	200.8	µg/L	--	0.004 *J*	0.003 *U*	--	--	--	--	--
Calcium	200.7	µg/L	70,600	74,000	118,000	65,000	104,000	4,840	48,400	108,000
Chromium	200.8	µg/L	--	0.76	0.77	--	--	--	--	--
Cobalt	200.8	µg/L	--	0.077	0.112	--	--	--	--	--
Copper	200.8	µg/L	--	0.53	0.47	--	--	--	--	--
Iron	200.7	µg/L	--	25.3 *J*	18.8 *J*	--	--	--	--	--
Magnesium	200.7	µg/L	25,200	26,500	39,600	18,500	36,300	1,060	13,500	36,600
Nickel	200.8	µg/L	--	1.17	1.72	--	--	--	--	--
Potassium	200.7	µg/L	4,460	4,880	11,300	3,350	10,100	851	3,140	9,060
Selenium	200.8	µg/L	--	0.7 *J*	0.9 *J*	--	--	--	--	--
Silver	200.8	µg/L	--	0.018 *J*	0.021	--	--	--	--	--
Sodium	200.7	µg/L	25,200	27,500	111,000	17,200	96,100	4,510	17,000	84,900
Vanadium	200.8	µg/L	--	6.46	5.26	--	--	--	--	--
Zinc	200.8	µg/L	--	2.37	0.96 *U*	--	--	--	--	--

Notes: *J* - estimated value

U - not detected by laboratory or qualified as not detected (data validation)

-- - not analzyed

Higher concentration of sample and field duplicate shown.

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August 31, 2010

Ms. Teresita Bala
Washington State Department of Ecology
Eastern Regional Office
4601 N. Monroe Street
Spokane, WA 99205-1295

Subject: Addendum to Technical Report, Monitor Well Installation Recommendations dated July 23, 2010
Project No. 0907194.000

Dear Ms. Bala:

Thank you for meeting with us on August 10, 2010, to discuss the above-referenced Technical Report regarding Phase 2 of the remedial investigation. Per your request, we have prepared this addendum to document the modifications we agreed upon during the August 10 meeting. This addendum is made part of the Technical Report by reference. The following analyses are being added to the proposed scope of activities:

- Analyze dissolved arsenic and dissolved aluminum for two quarterly events at all monitor well locations
- Analyze volatile organic compounds (VOCs) and polychlorinated biphenyls (PCBs) for two quarterly events at the monitor well location with the highest field chloride concentration measured during well installation.

In addition, please note that all monitor wells may be completed as 2-in. wells, if we determine that hydraulic testing is feasible with smaller diameter wells.

Per your request, we have included an electronic copy of the Technical Report as an enclosure to this addendum. A cross section through the landfill has been prepared and is also enclosed (Cross Section D-D’).

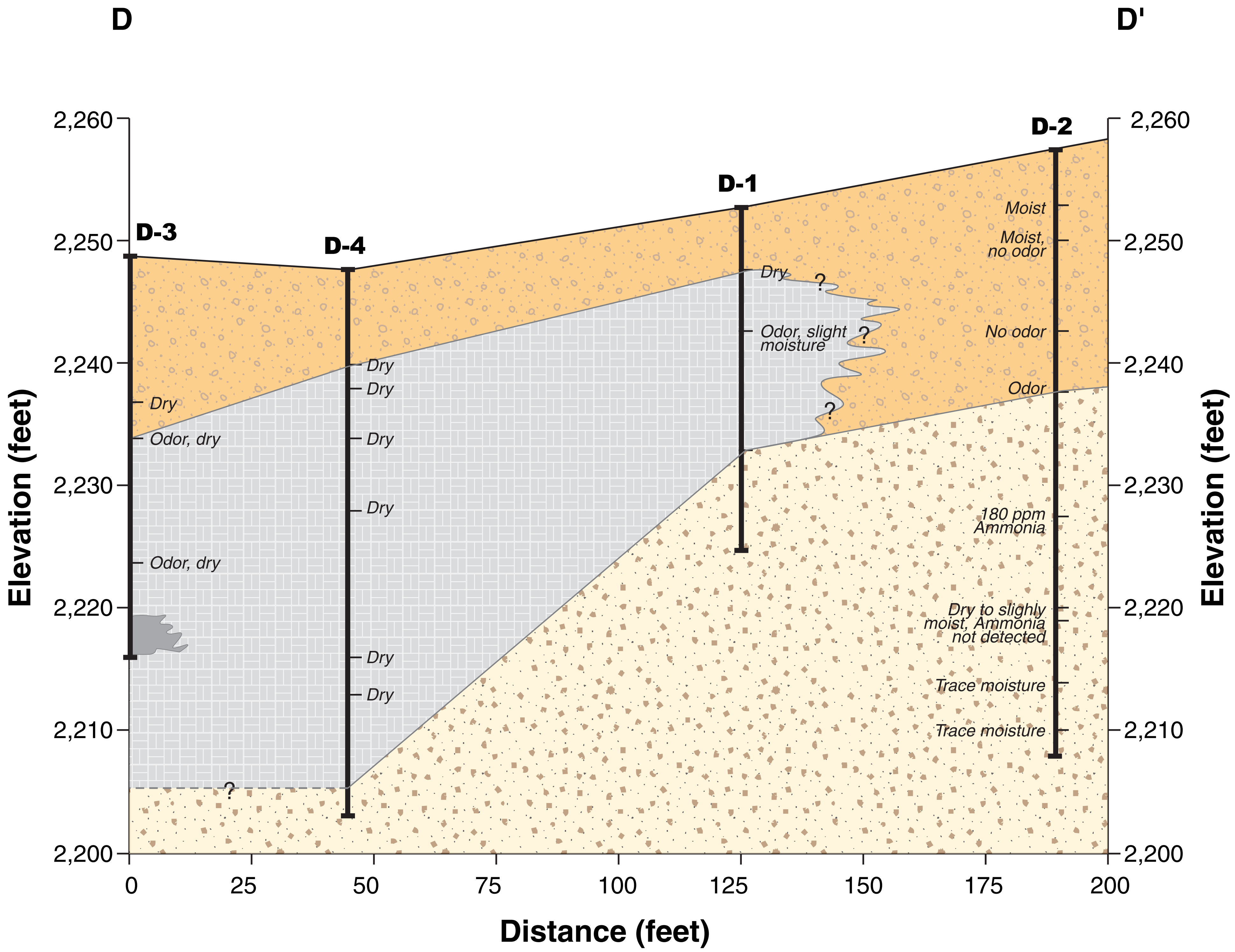
Sincerely,

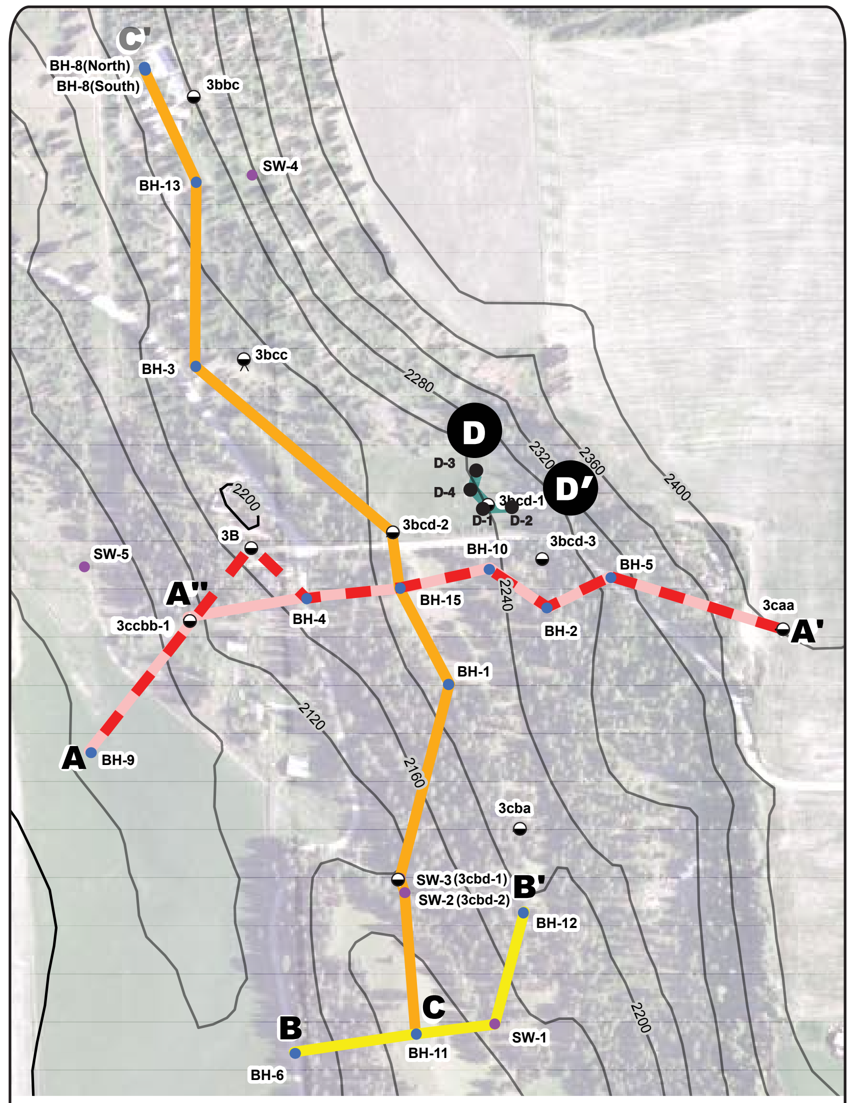
Melissa R. Kleven

Melissa R. Kleven, P.E. (WA, OR, and MT)
Managing Engineer

Enclosures

cc: Bill Vinzant, Kaiser Aluminum
Bud Leber, Kaiser Aluminum





LEGEND

- ▓ Metal Fragments
- ▨ Silt, Sand, Clay with some Gravel
- ▦ Dross
- ░ Landslide Material
  (silty, clayey basalt gravel and
  boulders, some thin sands)

Notes:

All locations not surveyed in May 2010 are approximate.

Ammonia data are estimated values measured in the field.

Cross Section D–D'
Heglar Kronquist Landfill
Mead, Washington