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Memorandum

To: Andy Smith, Washington State Department of Ecology

Copies: Dan Silver, B&L Woodwaste Trust

From: Brett Beaulieu, Floyd|Snider

Date: December 12, 2022

Re: **Agricultural Field Plume Remedial Evaluation**

The intent of this memorandum is to evaluate and recommend a potential supplemental remedial approach to address contamination in the Agricultural Field Plume area. This evaluation and the proposed additional cleanup work are part of ongoing adaptive management of remediation at the B&L Woodwaste Site under the 2008 Cleanup Action Plan (2008 CAP). The B&L Woodwaste Trust and the Department of Ecology are adaptively managing site remediation as part of long-term operations and monitoring, which follows active remediation phases of the 2008 CAP under the terms of Consent Decree (CD) No. 082106107 (Ecology 2008).

BACKGROUND

The 2022 dye tracer findings[1] and arsenic time-concentration plots (Floyd|Snider 2022) together indicate that migration of groundwater arsenic from inside the barrier wall is associated with increases of arsenic at monitoring well locations D-8A, D-7A, MW-42, and west ditch (a.k.a. "Stream 12") surface water location SW-2 that have occurred since the 2017 shutdown of the groundwater treatment plant. This finding is consistent with the results of a soil investigation that found no indication of a soil source for the arsenic plume outside the landfill (Floyd|Snider 2020). The dye tracer results indicate that groundwater inside the landfill migrates to the ditch west of the landfill and into groundwater beneath the agricultural field. The pattern of groundwater arsenic concentrations suggests arsenic transport is occurring in a northerly to northwesterly direction generally parallel to this ditch and barrier wall, in addition to being transported northerly in ditch surface water. Refer to Figure 1.

Relevant ownership, land use, and hydrologic changes are expected to occur in this area in the next two to three years. The B&L Woodwaste Trust will own the agricultural field "triangle" following a property transfer from WSDOT. As part of the SR-167 project, Hylebos Creek will be relocated to cross the agricultural field, which will be converted to new riparian wetlands and

[1] A dye tracer study report with these findings is planned to be submitted after the conclusion of dye monitoring in 2023.

tributary drainages. Refer to Attachment 1. A section of the west ditch will be filled by WSDOT from the southwest corner of the landfill to the edge of the agricultural field triangle. This planned filling, which was developed in consultation with the B&L Woodwaste Trust and Ecology, is intended to allow vehicle access to the agricultural field triangle and divert the flow of surface water to the west, into the planned riparian restoration area and new tributary channels of the relocated Hylebos Creek. WSDOT also plans to build a vegetated berm along the boundary between the triangle and the riparian restoration area.

The redirection of ditch surface water to the west and the filling of the section of ditch will eliminate the existing flow of surface water in the remaining section of the west ditch. Groundwater, including groundwater containing elevated arsenic, is expected to continue to discharge to the unfilled section of ditch, which will continue to drain northerly into the ditch along the Interurban Trail that will drain directly to the relocated Hylebos Creek. The change in the volume of flow in the west ditch after it is isolated is unknown, but flows are expected to be reduced considerably without surface water flow from the south. Therefore, arsenic concentrations in this water may increase, as they will not be subject to the same degree of dilution. In addition, the redirected ditch water is expected to affect groundwater flow directions in the vicinity of the new westerly channel and potentially in the agricultural field triangle.

ADAPTIVE MANAGEMENT REMEDIAL EVALUATION

Focused remedial objectives based on anticipated conditions following WSDOT restoration

The recent findings and anticipated site condition changes present focused remedial objectives. The B&L remediation program took its current form in 2017 with the shutdown of the groundwater treatment plant and active hydraulic containment. The program consists of monitoring and maintenance of passive containment elements, the landfill cap and perimeter barrier wall. Monitoring data indicate that the current passive containment elements do not prevent arsenic-impacted groundwater from migrating into the agricultural field and potentially beyond the northern property edges of the agricultural field triangle and landfill and will not prevent arsenic-impacted surface water from discharging to the relocated Hylebos Creek.

Two focused remedial objectives are expected to be protective of groundwater and surface water beyond the limits of the agricultural field triangle and landfill parcel boundaries. Containment of groundwater within the barrier wall would also meet these objectives over the long term. The two focused remedial objectives are the following:

1. Prevent arsenic currently discharging into the west ditch from draining to Hylebos Creek following the partial ditch fill by WSDOT
2. Prevent arsenic groundwater migration beyond the north agricultural field triangle and landfill parcel boundaries, including to the ditch along this boundary, by meeting the groundwater cleanup level at monitoring wells D-7A and MW-33

Potential remedial technologies and options considered

At the time of the plant shutdown, the planned contingencies to address leachate escaping the barrier wall were the restarting of the groundwater treatment plant to resume active hydraulic containment and management of the groundwater plume using in situ treatment. However, these contingencies were developed before the planned changes to the west ditch and before several years of monitoring data indicated that current passive containment elements are otherwise highly effective in meeting remedial objectives. Given the high cost to restart and operate the groundwater treatment plant, consideration was given to additional potential approaches to meeting the focused remedial objectives.

In general accordance with the procedures set forth in WAC 173-340-350(8)(b), a range of potential technologies and options was considered and screened for effectiveness, implementability, and approximate implementation and operations and maintenance (O&M) cost. Some options were developed beyond basic technologies for the screening stage based on the prior remediation at the site and the focused remedial objectives. As part of the evaluation, four options that offer the potential for more effective passive long-term containment were identified. These options (which include barrier wall deepening and extension, jet grouting, and focused excavation) may contain groundwater arsenic without operation of the groundwater treatment plant and, therefore, with potentially minimal O&M costs. Conceptual level order of magnitude costs were developed for these passive long-term containment options to support this screening. Refer to Attachment 2, Exhibit 2.A, for details.

The results of this screening are summarized below:

- Phytoremediation—**rejected** based on lack of effectiveness for deeper groundwater and arsenic mass accumulation in plant material.
- Partial ditch filling at the northwest corner of the landfill—**rejected** based on failure to meet threshold requirements. This option would be an effective way to prevent arsenic-containing surface water from draining to the relocated Hylebos Creek with minimal disturbed area and impacted wetlands. However, the pond that would be created would not comply with cleanup standards in surface water, as groundwater with elevated arsenic would continue to discharge to the pond. Because dilution from surface water flow in the west ditch would be eliminated, the pond would be expected to have high concentrations of arsenic in surface water and may accumulate ditch sediment with elevated arsenic concentrations.
- Full ditch filling—**retained** as an effective way to block the surface water pathway
- In situ treatment permeable reactive barrier (PRB)—**retained** as a technology that has been demonstrated to be effective and flexible at the site.
- In situ area treatment—**retained as a contingency option**; area treatment is not considered necessary to achieve remedial objectives.

- Hydraulic control in southwest corner by pumping wells, without treatment and discharge—**rejected** based on uncertain feasibility and effects of injection of the recovered water inside the barrier wall.
- Establishment and maintenance of a hydraulic barrier by adding clean water to the west ditch pond/existing west stormwater pond—**rejected** based on uncertain effectiveness of the hydraulic barrier, which would be difficult to control and has the potential to increase the movement and size of the agricultural field plume.
- Hydraulic control in the southwest corner by pumping wells, with treatment and discharge—**retained as a contingency option.** The high O&M cost, as demonstrated based on 2012-2017 operation, is considered disproportionate to the environmental benefits of achieving the current focused remedial action objectives.
- Passive containment: deepen barrier wall around southwest corner—**retained for potential further evaluation.** This option would be particularly effective if a deeper aquitard layer can be found at a feasible depth. A conceptual level estimated cost to deepen the hanging section of the barrier wall by 25 feet is approximately $750,000.
- Passive containment: jet grout aquitard beneath southwest corner—**retained for potential further evaluation.** This option would replace the gap in the natural aquitard with many overlapping injected grout columns to create a "bottom seal." If a cement-based grout is used, the geochemical effects on groundwater quality from elevated pH may need evaluation. A conceptual level estimated cost for this option is approximately $3.6 million.
- Passive containment: extend barrier wall around agricultural field triangle—**retained for potential further evaluation.** The extended barrier wall would likely face similar challenges with passive containment that prevent the current barrier wall from fully containing groundwater. A conceptual level estimated cost to construct a 20-foot deep barrier wall around the agricultural field plume is approximately $670,000.
- Passive containment: excavate woodwaste from the southwest aquitard gap corner of the landfill, place and cap the material within the landfill over the aquitard, and install a new barrier wall section at the aquitard edge—**retained for potential further evaluation.** The movement of source material into an area underlain by the aquitard is a potential long-term solution, because source material could more effectively be passively contained this way. It would require considerable regrading and disturbance of the existing landfill cap, and it may leave residual contamination in the southwest corner that continues to migrate in the short term. A conceptual level estimated cost for this approach is approximately $1.8 million.

Development of a Remedial Approach Based on Technology and Option Screening

Based on the results of the preliminary technology and option screening step, full ditch filling and in situ treatment PRB technologies appear suitable to address the focused remedial objectives

identified above. Using an adaptive management approach, a combination of these technologies is proposed for consideration at this stage, to be implemented on a similar timeframe as the ditch filling planned by WSDOT for the SR-167 project. These technologies offer solutions in the near term at lower cost than other options.

Several technologies and options were retained as contingency options or for potential further evaluation. In situ area treatment and hydraulic control with treatment and discharge have both been used at the site and remain potentially effective contingency options. The latter option would consist of reverting to the original 2008 CAP remedy by restarting the treatment plant to re-establish hydraulic containment. The four passive containment options are retained for further evaluation, which would be needed to better understand the effectiveness and cost of these options. Based on the current information, these options are not recommended to meet the focused remedial objectives in the timeframe of the ditch filling planned by WSDOT for the SR-167 project. If necessary, technologies that provide for long-term passive containment may be further evaluated following the SR-167 project.

PROPOSED REMEDIAL APPROACH: FULL DITCH FILLING AND IN SITU TREATMENT PRB

A summary description of the combined full ditch filling and in situ treatment PRB approach is provided below, followed by the estimated cost of the approach, a discussion of the anticipated permitting process, and a proposed schedule.

Summary Description

This approach would include filling of the remainder of the west ditch to prevent surface water flow, in conjunction with an in situ treatment PRB:

- A Nationwide Permit (NWP) 38 for cleanup of hazardous and toxic waste would be obtained prior to the PRB construction and ditch filling. This approach assumes compensatory mitigation may be required to offset permanent impacts as described below.
- The groundwater arsenic plume would be intercepted with a PRB beneath a portion of the west ditch that is not filled by WSDOT, with a short east–west section beneath the existing stormwater pond and extending to the barrier wall. Refer to Figure 2. The in situ treatment technology used previously at the site, EHC-M, which uses reductive precipitation of sulfides with microscale zero-valent iron (ZVI), is assumed as the default option, given its previous effectiveness. It is assumed that the PRB would be constructed using excavation and backfill (instead of injection) methods, for better control of media placement and potentially reduced costs. A PRB length of approximately 350 feet, a depth of approximately 10 feet from the base of the current ditch to the top of the aquitard, and an excavation width of 3 feet are assumed.
- Surface water flow to the north of the WSDOT fill section would be blocked by filling the remainder of the west ditch, a length of approximately 380 feet. A ditch profile

survey after ditch excavation in this area in 2012 (refer to Attachment 3) indicates a ditch width of approximately 10 feet and a depth of approximately 3 feet. Imported fill would be specified to be less than or equal to the permeability of surrounding native materials to prevent preferential groundwater transmission through the former ditch.

- A section of the existing west pond would also be filled to provide a roadway for access to the agricultural field and potential future drill rig access for additional EHC-M injections that may be needed to maintain the PRB over the long term. The lost storage capacity in the west pond is not needed, given that the groundwater interceptor trench no longer discharges to the pond. A culvert is assumed to be installed to maintain a connection between the two west pond areas after the west pond is bisected. A new chain link gate would be installed at the landfill property edge to provide a continuous access road.
- The west pond overflow to the west ditch would no longer be functional under this option. As noted above, this overflow is not needed, since the groundwater interceptor trench no longer discharges to the west pond, and the pond does not reach capacity.
- With the elimination of the west ditch, the capacity for stormwater drainage from this area of the agricultural field will be reduced. However, available information indicates that the west ditch is not important for stormwater drainage of the agricultural field triangle, which currently floods during the wet season. The west ditch water level is generally near the ground surface during the wet season and overflows its banks into the agricultural field triangle, contributing to flooding conditions. No drainage improvements or grading are assumed.

Estimated Implementation Costs

To support decision-making, an approximate, preliminary cost estimate was prepared for the proposed approach using working assumptions and past work at the site. Refer to Attachment 2, Exhibit 2.B, for preliminary cost estimate details. This estimate is intended to be accurate enough for remedial evaluation and planning purposes, at the approximate accuracy level of -30%/+50%. The estimated cost includes wetlands permitting, engineering, procurement, contractor oversight, and reporting. A contingency for potential stream/wetlands mitigation has been included.

The estimated cost to implement the full ditch filling and in situ treatment PRB is approximately $400,000. The PRB accounts for approximately $200,000 of this total estimated cost. The PRB cost estimate includes approximately $56,000 for off-site disposal of excavated soil, based on an assumption that excavated soils will not be suitable for on-site disposal; after analytical confirmation, it is possible that this soil would be approved to remain at the site. Wetlands permitting and natural resources consultant services for ditch filling accounts for approximately

$49,000 of the total cost. If necessary, mitigation planning, construction, and five years of monitoring and maintenance would cost an additional estimated $90,000.

Permitting for Impacts to Waters of the United States

Because the selected remedial approach will be conducted under a CD, it would be exempt from the state and local Applicable or Relevant and Appropriate Requirements (ARAR) procedures (e.g., permitting); however, it must still adhere to the substantive requirements of relevant permits and other local government approvals.

Based on the project approach, it is assumed an NWP 38 for cleanup of hazardous and toxic waste would be obtained from the U.S. Army Corps of Engineers (USACE). An NWP is a general permit issued on a nationwide basis for activities having minimal impacts; it is a process that is typically substantively streamlined compared to other federal permits for in-water work that require extensive review and the opportunity for public comment.

While the timeframe for obtaining an NWP under ideal conditions is generally projected to be about 3 months, the process to obtain the NWP under current conditions could take up to 18 months. This timeframe reflects the significant backlog and understaffing of the relevant regulatory agencies (including the USACE Seattle District) that has delayed permitting processes across the Puget Sound region. While preliminary research indicates that Endangered Species Act (ESA) consultation will not be required, as there are no ESA-listed species found in the project area, the 18-month duration assumes ESA consultation is required. If it is determined that ESA consultation is not required, the permit could be issued in less than 18 months. At the beginning of the effort, the project team would assess any opportunities to compress the schedule and work toward a target goal of less than 1 year to receive all required permits.

Based on the current understanding of existing conditions and the conditions that would be expected post-WSDOT work, it is assumed that some compensatory mitigation could be required to offset permanent impacts resulting from filling in a jurisdictional water of the United States. The need for mitigation would be assessed after further research and agency coordination, and the approach would be confirmed through a pre-application meeting. If required, the recommended approach for mitigation would be on-site mitigation, which could consist of enhancement of wetlands in the agricultural field triangle or enhancement planting of the ditch along the Interurban Trail north of the landfill (e.g., planting of native species along 380 linear feet [LF] to restore stream function; refer to Figure 2).

Schedule Considerations

The schedule for implementation of the proposed remedial approach is expected to be driven by the WSDOT schedule for the ditch filling and re-routing of the ditch surface water flow to the west and toward the re-located Hylebos Creek. Construction of this remedial approach is not expected to take place prior to the WSDOT work. Blocking the ditch before there is a tributary to receive the diverted water would likely result in uncontrolled flooding of portions of the

WSDOT-owned agricultural field and B&L Woodwaste property, with erosion and other potential impacts on the condition of the fields and the B&L infrastructure, including the newly filled ditch section.

The WSDOT construction of the wetlands restoration in the agricultural field, ditch rerouting, and ditch filling is currently scheduled for the summer of 2024. Therefore, the following general schedule is proposed for implementation of the remedial approach:

2023:

- Conclude dye tracer study and review site-wide monitoring data to confirm conditions
- Continue monitoring groundwater and surface water arsenic concentrations
- Continue coordination with WSDOT on schedule and planned construction updates
- Begin permitting process by preparing and submitting JARPA application materials
- Conduct necessary agency coordination to obtain permit to fill the wetlands ditch; a nationwide permit is effective for up to 6 years
- Develop design drawings sufficient for permitting and contractor procurement
- If required, prepare additional stream/wetlands mitigation plans

2024 (to be adjusted based on WSDOT progress):

- Perform contractor bidding and selection
- Construct PRB, ditch fill section, pond fill section/culvert, chain link fence gate
- Construct stream/wetlands mitigation, if necessary

2025:

- Monitor and evaluate effects on groundwater flow from the ditch filling and redirection of ditch surface water to the west

Following WSDOT SR-167 construction and ditch filling, the effects of the hydrologic changes to the system will be monitored through the existing groundwater and surface water monitoring program and water level measurement program. It is expected that a small number of new water level monitoring locations (piezometers and stilling wells) would be needed for this purpose. The need for additional remedial action, such as additional in situ treatment, a passive long-term containment option, or a restarting of active hydraulic containment and the groundwater treatment plant, will be assessed as appropriate, based on site conditions and using the adaptive management framework.

RECOMMENDATION

It is recommended that the proposed remedial approach described in this memorandum, combined full ditch filling and in situ treatment PRB, be implemented at the site.

REFERENCES

Floyd|Snider. 2020. *B&L Woodwaste Site West Boundary Soil Investigation Report*. Prepared for B&L Custodial Trust. November.

_____. 2022. Letter to Andrew Smith, Washington State Department of Ecology, from Brett Beaulieu, Floyd|Snider, re: B&L Woodwaste Site July 2022 Compliance Monitoring Report. 16 August.

Washington State Department of Ecology (Ecology). 2008. *Consent Decree No. 082106107*.

LIST OF ATTACHMENTS

Figure 1 Site Plan

Figure 2 Proposed Remedial Approach

Attachment 1 Planned Ditch Filling and Wetlands Restoration Near B&L Woodwaste (provided by WSDOT)

Attachment 2 Cost Estimate Details

- Exhibit 2.A Conceptual-Level Order of Magnitude Cost Estimate for Passive Containment Options
- Exhibit 2.B Preliminary Estimated Costs – Ditch Filling and In situ Treatment PRB

Attachment 3 Ditch Profiles from 2012 Construction Completion Report (Barghausen As-Built Survey Exhibits 5, 6, and 7)

Figures

Legend

- Upper Sand Aquifer Monitoring Location
- Lower Sand Aquifer Monitoring Location
- Compliance Surface Water Monitoring Location
- Monitoring Well or Piezometer
- Recovery Well Location
- Dye Introduction Location (November 2021)
- Overflow Culvert
- Surface Water Flow Direction
- Surface Drainage Feature
- WSDOT Planned Surface Drainage Flow Direction
- WSDOT Planned Surface Drainage Feature
- WSDOT Planned Wetland Mitigation Area
- Stormwater Ponds
- Property Boundary (Tax Parcel Data)
- Approximate Location of Barrier Wall
- Agricultural Field Plume, >5 µg/L Arsenic (Approximate)
- Aquitard Gap

Notes:
· Orthoimagery obtained from Nearmap, 2022.
· Hylebos Creek and other surface drainage feature locations shown were digitized from an image provided by USGS and dated June–July 2005.

Abbreviation:
WSDOT = Washington State Department of Transportation

0 50 100 200
Scale in Feet

N

PD-142
R-16
D-5L
D-5U
North Pond
SW-2
D-7B
D-7A
PZ-2A
PZ-2B
W-2
W-1
MW-33
R-23
West Pond
R-15
R-22
R-14
R-10
MW-41
MW-42
SW-12
PD-212
Agricultural Field Triangle
PZ-3A
PZ-3B
MW-34
Interurban Trail
West Ditch ("Stream 12")
D-8A
B&L Landfill Property
WSDOT Planned Berm
D-8B
R-9
PD-214
Dye Observed in West Ditch, April 11, 2022
SW-11
MW-40B
PZ-12
SW-5
R-8
PZ-4C
PZ-4A
PZ-4B
R-7
PZ-5B
PZ-5C
PZ-5A
Ditch Section to be Filled by WSDOT
SW-3

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Agricultural Field Plume Remedial Evaluation
B&L Woodwaste Site
Pierce County, Washington

Figure 1
Site Plan

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8/15/2022

Legend

- Upper Sand Aquifer Monitoring Location
- Lower Sand Aquifer Monitoring Location
- Compliance Surface Water Monitoring Location
- Monitoring Well or Piezometer
- Recovery Well Location
- Surface Water Flow Direction
- Surface Drainage Feature
- WSDOT Planned Surface Drainage Flow Direction
- WSDOT Planned Surface Drainage Feature
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- Stormwater Ponds
- Property Boundary (Tax Parcel Data)
- Approximate Location of Barrier Wall
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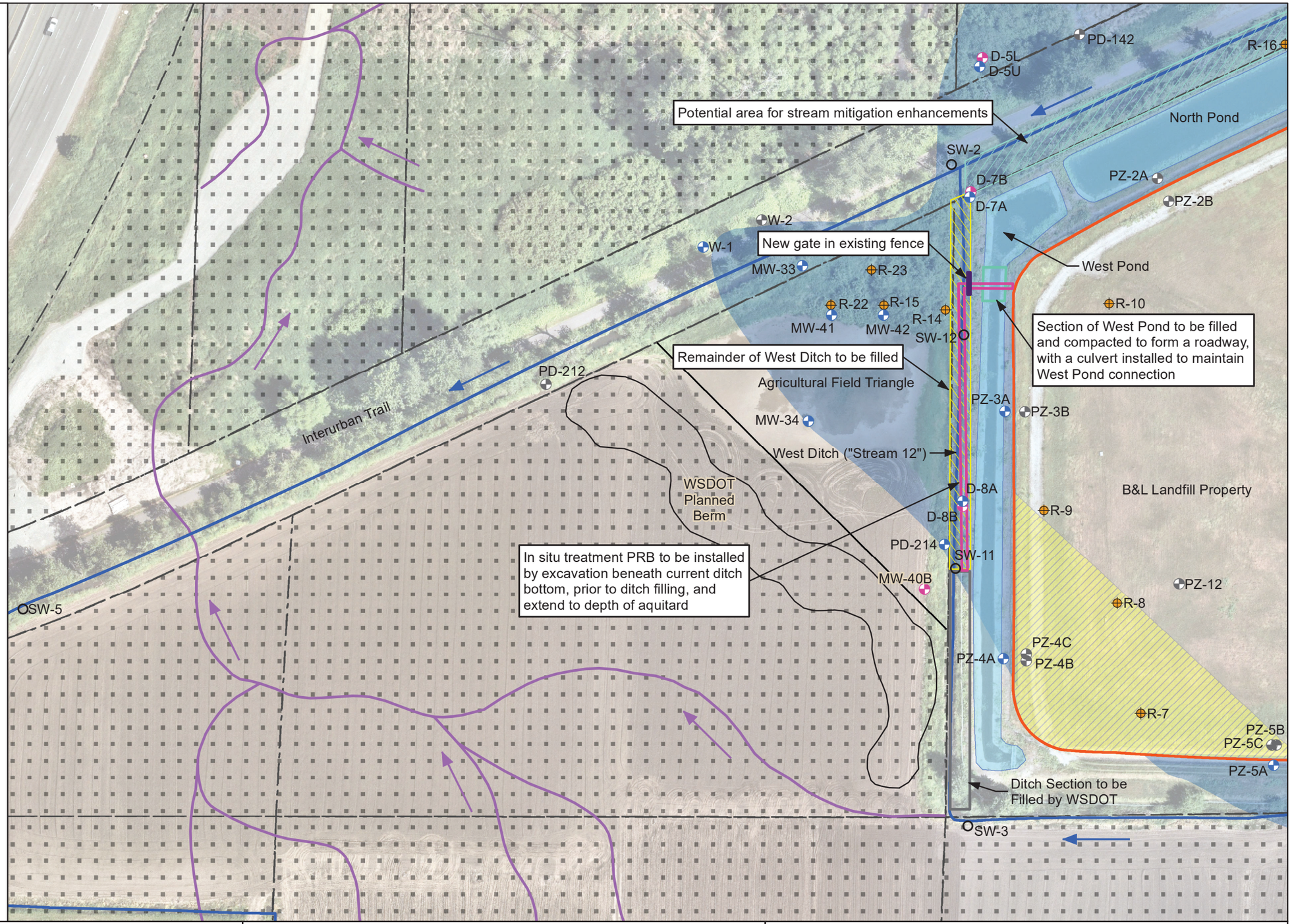
- Aquitard Gap



Notes:
- Orthoimagery obtained from Nearmap, 2022.
- Hylebos Creek and other surface drainage feature locations shown were digitized from an image provided by USGS and dated June–July 2005.

Abbreviations:
PRB = Permeable reactive barrier
WSDOT = Washington State Department of Transportation

0 50 100 200
Scale in Feet

N

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Agricultural Field Plume Remedial Evaluation
B&L Woodwaste Site
Pierce County, Washington

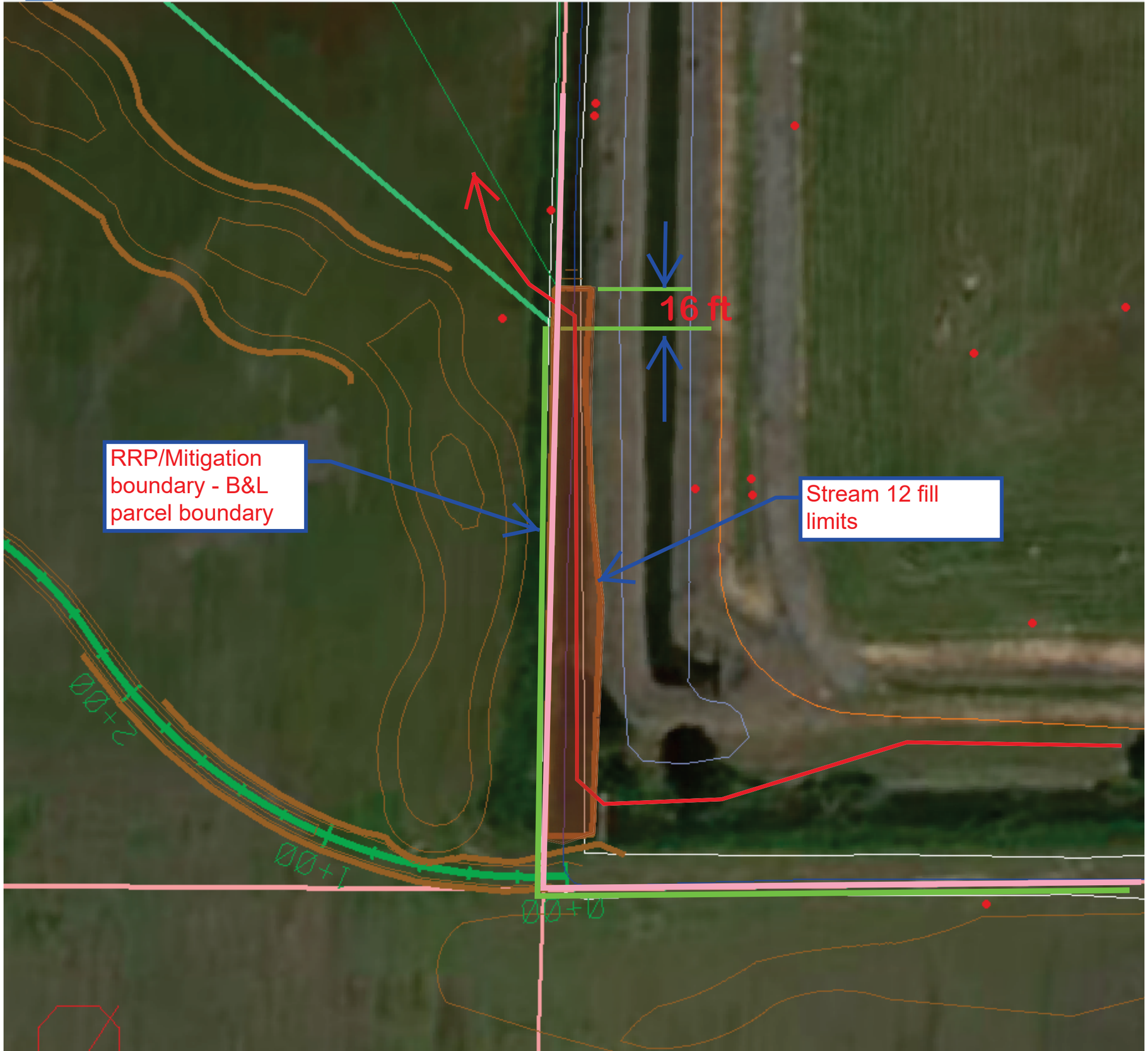
Figure 2
Proposed Remedial Approach

I:\GIS\Projects\B&L-O&M\MXD\Task 1540-Adaptive Management Activities\Updated PRB Cost Estimate 2022\Revised Remedial Approach, October 2022.mxd
10/18/2022

Attachment 1
Planned Ditch Filling and Wetlands Restoration Near B&L Woodwaste
(provided by WSDOT)


STREAM 12
RRP/Mitigation boundary limit
Limits of Stream 12 to be filled.

Potential future vehicle access along filled section of Stream 12.


16 ft
RRP/Mitigation boundary - B&L parcel boundary
Stream 12 fill limits
00+2
00+1
00+0

Attachment 2
Cost Estimate Details

Exhibit 2.A
Conceptual-Level Order of Magnitude Estimated Costs for Passive Containment Options

1. Deepen Barrier Wall in Southwest Corner					
Item	**Unit Cost**	**Units**	**Quantity**	**Cost**	**Assumptions**
Mob/demob	150,000	LS	1	$ 150,000	
TESC	30,000	LS	1	$ 30,000	
Trenching and backfilling	5	SF	12,500	$ 62,500	Trench above deeper slurry wall panel to 25 feet, stockpile, backfill and compact.
Slurry wall	5	SF	12,500	$ 62,500	500 linear feet of existing barrier wall would be deepened by 25 additional feet by constructing an adjacent panel.
Site restoration	100,000	LS	1	$ 100,000	Estimate for restoration of cap mixing pad and perimeter piezometers/transducers.
			Subtotal	$ 405,000	
Indirect - contractor		%	20.00%	$ 81,000	Submittals, H&S, Construction QA/QC, General GC conditions, Insurance, Bonding, Accounting
Indirect -other		%	30.00%	$ 121,500	Project management, permitting, engineering/design, construction management and reporting
Tax		%	10.00%	$ 40,500	
Contingency		%	25.00%	$ 101,250	
			TOTAL	**$ 750,000**	

2. Jet Grout Aquitard beneath Southwest Corner					
Item	**Unit Cost**	**Units**	**Quantity**	**Cost**	**Assumptions**
Mob/demob	150,000	LS	1	$ 150,000	Contractor estimate
TESC	30,000	LS	1	$ 30,000	
Jet grout	400	CY	5,055	$ 2,022,000	Contractor estimate for "bottom seal", a 3-foot thick layer of overlapping grout columns. Estimate assumes 30% overlap and area of 35,000 SF.
Disposal	70	CY	5,055	$ 353,850	Assumes transport and disposal at subtitle D landfill disposal
Site restoration	50,000	LS	1	$ 50,000	Estimate for restoration of cap surface
			Subtotal	$ 2,555,850	
Indirect - contractor		%	9.00%	$ 230,027	Submittals, H&S, Construction QA/QC, General GC conditions, Insurance, Bonding, Accounting
Indirect -other		%	12.00%	$ 306,702	Project management, permitting, engineering/design, construction management and reporting
Tax		%	10.00%	$ 255,585	
Contingency		%	10.00%	$ 255,585	
			Total	**$ 3,600,000**	

3. Extend Barrier Wall around Agricultural Field Triangle					
Item	**Unit Cost**	**Units**	**Quantity**	**Cost**	**Assumptions**
Mob/demob	150,000	LS	1	$ 150,000	
Erosion controls	40,000	LS	1	$ 40,000	
Slurry wall	5	SF	16,600	$ 83,000	830 linear feet of new barrier wall to 20 feet around agricultural field plume.
Site restoration	100,000	LS	1	$ 100,000	Estimate for restoration of groundwater recovery network, stormwater ponds, misc. site features.
			Subtotal	$ 373,000	
Indirect - contractor		%	20.00%	$ 74,600	Submittals, H&S, Construction QA/QC, General GC conditions, Insurance, Bonding, Accounting
Indirect -other		%	30.00%	$ 111,900	Project management, permitting, engineering/design, construction management and reporting
Tax		%	10.00%	$ 37,300	
Contingency		%	25.00%	$ 93,250	
			TOTAL	**$ 690,000**	

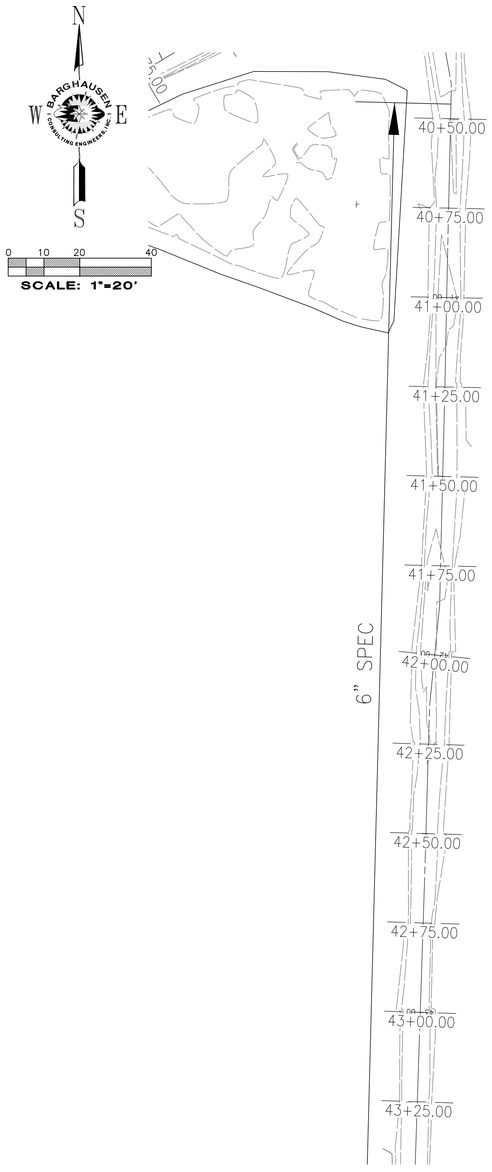
4. Excavate Southwest Corner, Place and Cap within the Landfill, and Install a New Barrier Wall Section at Aquitard Edge					
Item	**Unit Cost**	**Units**	**Quantity**	**Cost**	**Assumptions**
Mob/demob	150,000	LS	1	$ 150,000	
Excavation	20	CY	20,000	$ 400,000	Approximately 10,000 CY from southwest corner, plus 10,000 CY overexcavation for re-grading landfill.
Placement, grading, compact	20	CY	20,000	$ 400,000	
Capping	2	SF	50,000	$ 100,000	Based on Recon 2008, escalated: GCL liner (0.74/SF), PVC geomembrane (0.68/SF), cover soil placement from onsite source (0.23/SF)
Slurry wall	5	SF	8,000	$ 40,000	400 linear feet of new barrier wall to 20 feet along edge of aquitard.
Site restoration	50,000	LS	1	$ 50,000	Estimate for restoration of cap surface
			Subtotal	$ 1,140,000	
Indirect - contractor		%	10.00%	$ 114,000	Submittals, H&S, Construction QA/QC, General GC conditions, Insurance, Bonding, Accounting
Indirect -other		%	20.00%	$ 228,000	Project management, permitting, engineering/design, construction management and reporting
Tax		%	10.00%	$ 114,000	
Contingency		%	20.00%	$ 228,000	
			TOTAL	**$ 1,800,000**	

Exhibit 2.B
Preliminary Estimated Costs – Ditch Filling and In Situ Treatment PRB

Item	Unit Cost	Units	Quantity	Cost	Assumptions
Ditch Filling				**$74,450**	
Mob/demob/submittals	15,000	LS	1	$15,000	Cost assumed
Site setup and stormwater controls	5,000	LS	1	$5,000	Assumes dry season construction, no construction stormwater permit required, basic BMPs.
Ditch fill	50	Ton	626	$31,300	Place and compact locally imported material (25/ton + 25/ton placement). Based on ditch depth as-built, 10 feet wide by 3 feet deep by 380 feet long. Assumes hydroseed, no armoring. Assumes 1.48 ton per CY (423 CY).
Earthen pond bridge fill	50	Ton	188	$9,400	Place and compact locally imported material (25/ton + 25/ton placement). Based on West Pond depth as-built, 23 feet wide at top, 3 feet wide at bottom, 6.5 feet deep (84 ft cross sectional area) by 40 feet long.
Pond bridge slope gravel	5	SF	200	$1,000	Place fabric and 6" layer of 2" gravel over pond bridge slopes for armoring.
Culvert	3,000	ea	1	$3,000	40 foot long 24" HDPE including placement.
Chain link gate	3,000	ea	1	$3,000	Cost assumed
Road base	5	SF	750	$3,750	Place and compact 4" layer of crushed rock to form roadway over pond bridge and ditch fill.
Site restoration/hydroseeding	3,000	Acre	1	$3,000	Cost assumed for restoring landfill cap following imported soil stockpiling.
PRB				**$164,771**	
Excavation shoring	1000	LS	1	$1,000	Trench box shoring, Assuming rental and labor for one week.
Excavate, Segregate & Stockpile Soil	18	CY	389	$7,000	Excavation cost to dig approx. 10 ft down for 3 ft wide excation from ditch bottom to a total bgs depth of 13 ft, over total length of 350 feet. Includes management of drainage from wet soil back into ditch.
Import backfill material and tranportation	25	Ton	265	$6,635	Imported backfill from nearby source (e.g. Lloyds Enterprises) for 1:1 mix with mason sand plus EHC-M for PRB. Assumes purchase select borrow or similar without compaction/placement cost.
Import mason sand and transportation	42.29	CY	190	$8,018	Imported mason sand from nearby source (e.g. Lloyds Enterprises) for 1:1 mix with import backfill and EHC-M, per Evonik general recommendation for PRB permeability.
Evonik EHC-M	3	lbs	28,875	$72,188	Based on total PRB volume of 389 CY and soil density of 1.48 tons/cubic yard, a total mass of PRB soil of 1,155,000 lbs is assumed for estimating EHC-M treatment. The application rate of 2.5% EHC-M is based on a recommendation from Evonik for this type of PRB application, and is more concentrated than injection PRB application percentages applied previously at the site.
EHC-M Transport cost	7615	LS	1	$7,615	Freight quote directly from Evonik.
Soil Handling & mixing	16	CY	389	$6,300	Mixing of EHC-M/import backfill/mason sand using 22 CY lugger box and placement using tremie pipe.
Soil Disposal	80	Ton	700	$56,016	Assumes offsite tranport and disposal at subtitle D facility, with zero reuse in ditch filling or PRB backfill mix. Cost included to be conservative; on-site disposal is anticipated to be feasible following analytical confirmation.
			Tax	**$23,922**	
			Direct Construction Cost Subtotal with Tax	**$263,144**	
Permitting, Engineering and Oversight				**$138,370**	
Section 404 filling: Nationwide 38	48,370	LS	1	$48,370	Preparation of JARPA for Nationwide Permit 38, based on prior stream and wetlands characterization by WSDOT. Agency reapplication meeting and coordination. No mitigation assumed.
Plans/Specs/Work Plans	42,000	LS	1	$42,000	Remedial action work plan memorandum, with PRB and ditch fill design drawings and specifications, health and safety plan.
Procurement and contracting	3,000	LS	1	$3,000	Contractor solicitation and selection recommendation, contracting
Oversight/Submittal review	1,500	Day	20	$30,000	15 days of earthwork oversight, and 5 days of other contractor submittal review and coordination.
Reporting	15,000	LS	1	$15,000	Basic remedial action memorandum.
			TOTAL	**$400,000**	
Contingent Stream/Wetland Mitigation				**$90,000**	
Mitigation Plan	14,000	LS	1	$22,000	Baseline characterization based on WSDOT work, impact analysis, mitigation proposal and ESA document.
Mitigation construction	45,000	LS	1	$45,000	Enhancement planting of 380 linear feet of ditch (assumed 20' width, total 7600 square feet) with an estimated 3210 plants, 70 cubic yards of compost, construction and oversight labor.
Mitigation monitoring	3,000	Annual	5	$15,000	Assumes 20 hours per year at $90/hour plus oversight and reporting.
Mitigation maintenance	960	Annual	5	$5,300	Assumes 8 hours per year at $45/hour plus oversight and reporting.
			TOTAL with Stream/wetland mitigation	**$490,000**	

Attachment 3
Ditch Profiles from 2012 Construction Completion Report
(Barghausen As-Built Survey Exhibits 5, 6, and 7)

ASBUILT EXHIBIT 5



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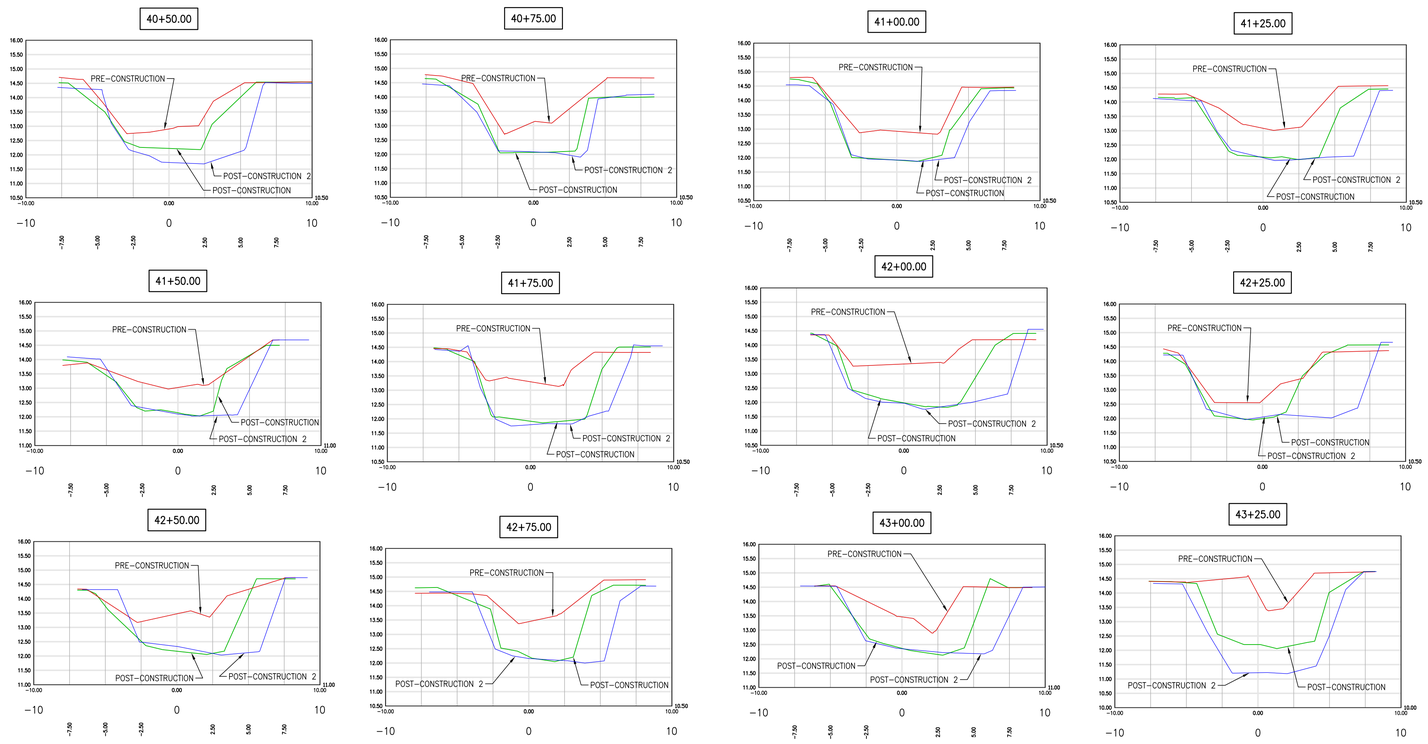

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CITY OF FIFE PIERCE COUNTY WASHINGTON

For:

ENGINEERING/REMEDIATION
RESOURCES GROUP, INC.
616 1ST AVE, SUITE 300
SEATTLE, WA 98104

18215 72ND AVENUE SOUTH
KENT, WA 98032
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CIVIL ENGINEERING, LAND PLANNING,
SURVEYING, ENVIRONMENTAL SERVICES

Scale: Horizontal 1"=X' Vertical
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Date 9/11/12
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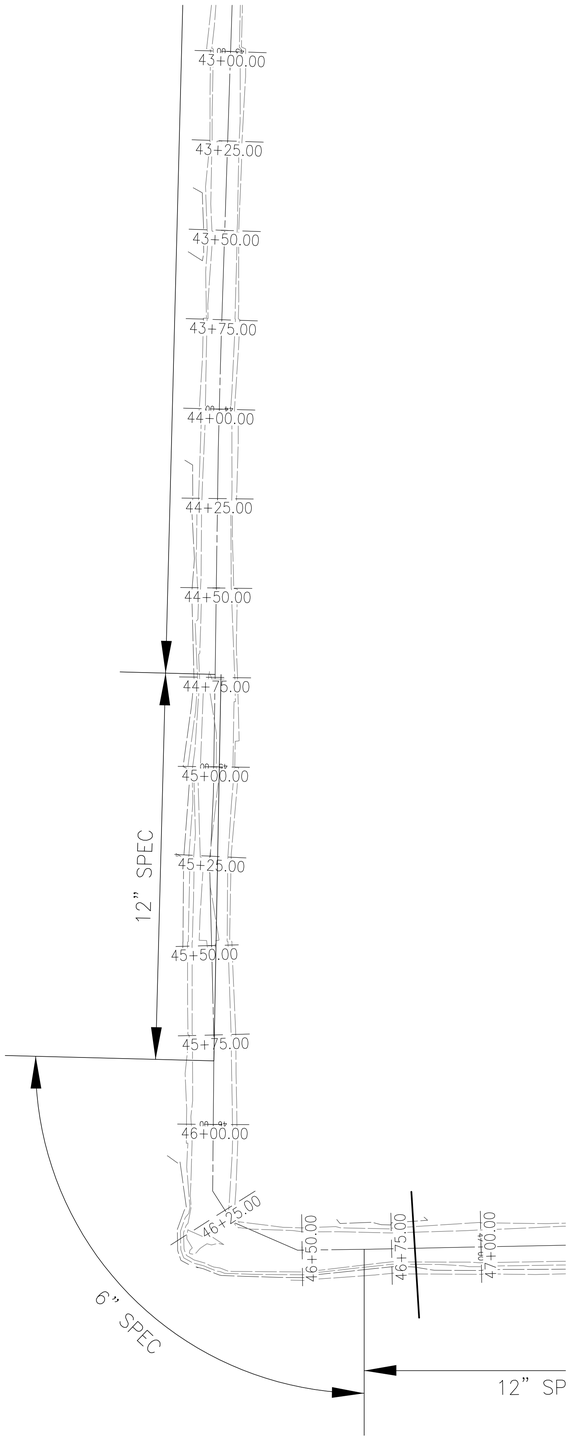
Job Number 14203
Sheet 5 of 10

ASBUILT EXHIBIT 6



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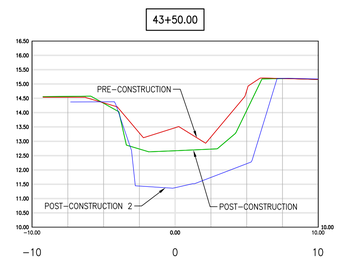

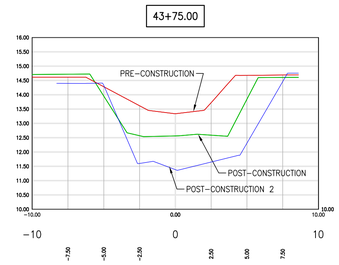

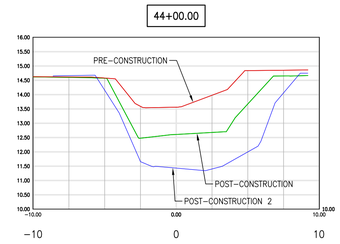

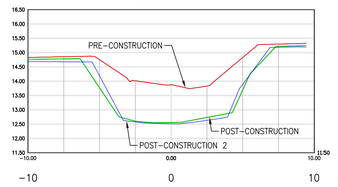

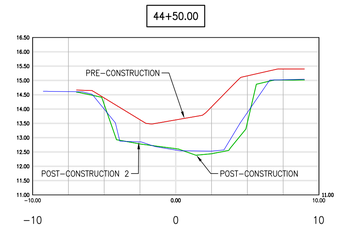

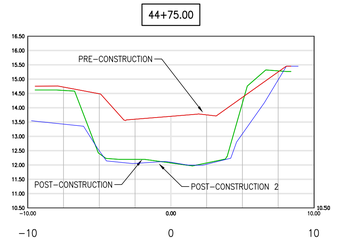

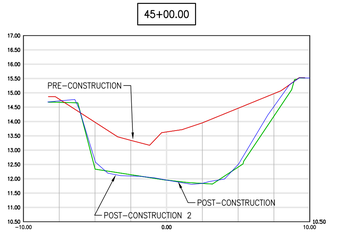

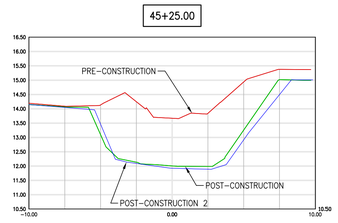

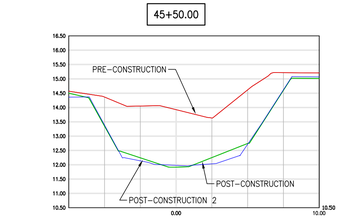

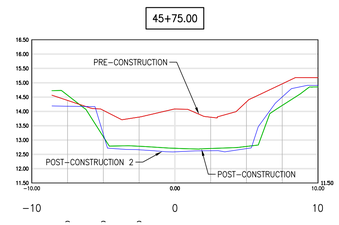

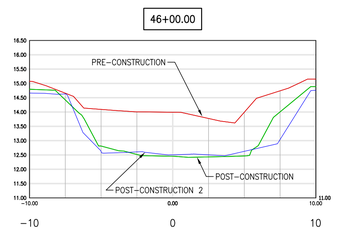

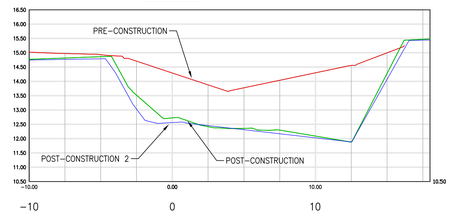

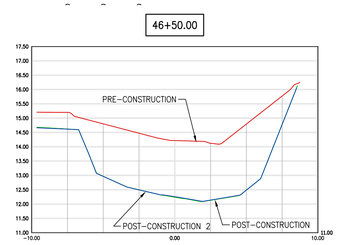

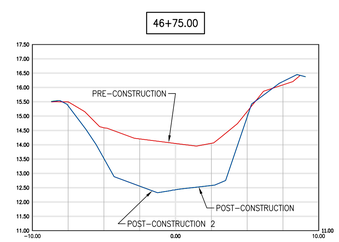

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BARGHAUSEN CONSULTING ENGINEERS, INC.

Job Number 14203
Sheet 6 of 10

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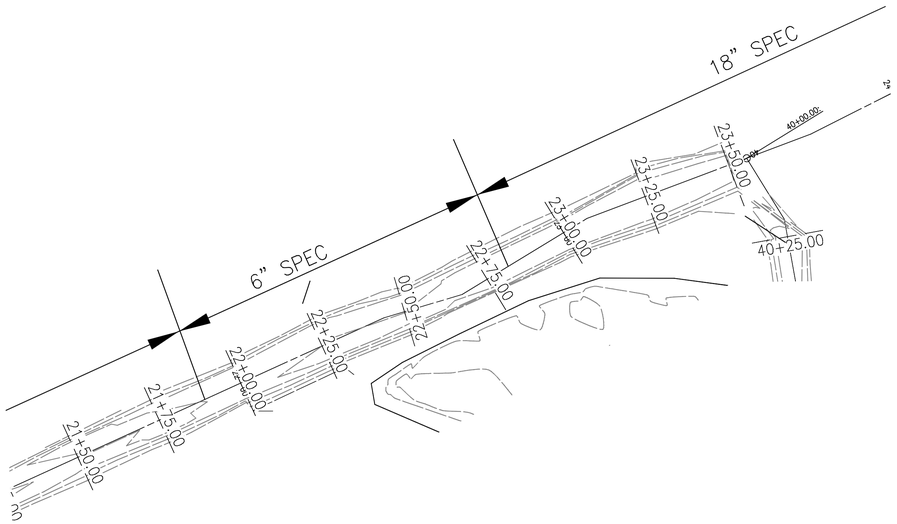
ASBUILT EXHIBIT 7



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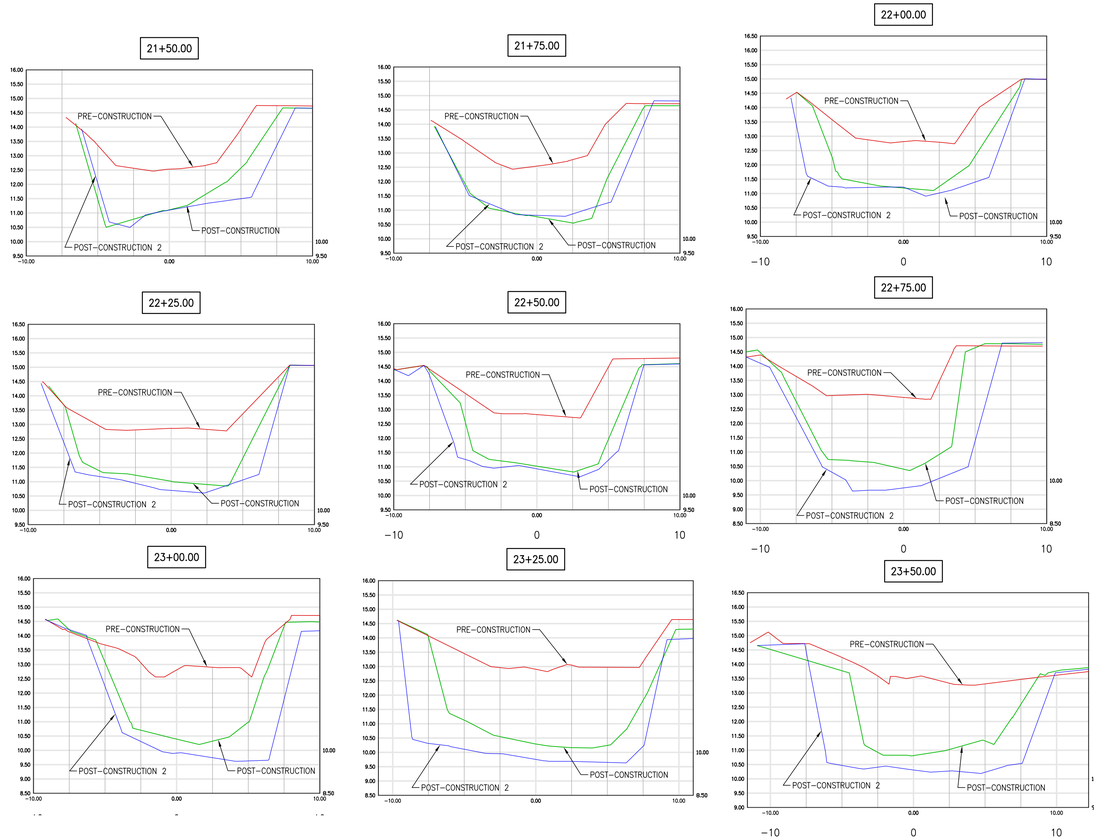

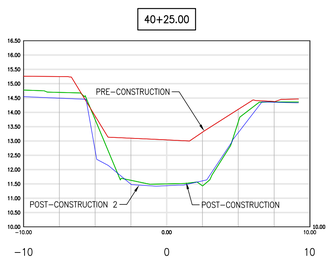

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