CLEANUP ACTION PLAN

Crownhill Elementary School

Prepared for: Bremerton School District

Project No. 100094 • September 3, 2014 Public Review Draft

Aspect CONSULTING

earth + water

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1 Introduction and Background

This Cleanup Action Plan (CAP) defines the selected cleanup action for the Bremerton School District Crownhill Elementary School Site (Site). The Crownhill Elementary School (School) is located at 1500 Rocky Point in Bremerton, Washington. As stated in Agreed Order No. DE7916 between the Washington Department of Ecology (Ecology) and the Bremerton School District (BSD), *the Site includes property owned by BSD and is defined by the extent of contamination caused by the release of hazardous substances at the Site, which may extend to adjacent properties*. Adjacent properties are primarily residential, with the Bremerton United Methodist Church (Church) located on the adjacent property to the south (see Figure 1).

Contaminants at concentrations above cleanup levels were found only on the School and Church properties, not on adjacent residential properties. These properties were used for sand and gravel mining up to the 1930s, and the mined area was backfilled with municipal and industrial wastes in the 1930s and 1940s. The original school building was constructed in 1956, and partially burned down in 1993. A series of environmental investigations were conducted during the period between that fire and construction of the current school building, completed in 1996. Additional investigations were conducted beginning in 2009, culminating in the preparation of a Remedial Investigation (RI) report (Aspect, 2013). The purpose of the RI was to collect data necessary to adequately characterize the nature and extent of Site contamination, so that cleanup action alternatives could be developed and evaluated in the Site Feasibility Study (FS; Aspect, 2014).

The goal of the cleanup action is protection of human health and the environment from hazardous substances at the Site. Based on the RI results, soil contamination correlates closely with the occurrence of landfilled materials. Using multiple lines of evidence (e.g., historical photographs, site assessment activity, construction observations), two generalized areas of landfill accumulation (designated the ‘north’ and ‘south’ landfill areas) were identified in the RI. These areas, the interpreted boundaries of which are shown on Figure 1, cover approximately 5.5 acres.

The RI implemented a grid-based sampling approach to delineate areas of soil contamination to a depth of 15 feet below ground surface (bgs). Detected concentrations of arsenic, lead, and total petroleum hydrocarbon (TPH) in the diesel and motor oil ranges are summarized on Figures 16 through 19 of the RI report. Contaminant concentrations exceeding soil cleanup levels (Table 1) were identified within one foot of ground surface in a portion of the south landfill area, and an interim action was successfully implemented at that location in spring 2012. That interim action consisted of removing impacted soil to a 1-foot depth, installing a geotextile fabric (which does not reduce water infiltration but provides a “marker” between clean and contaminated soils, and reduces the potential for exposure to underlying contaminated soils), and constructing a clean soil and sod cover layer at least one foot thick.

Ecology subsequently required that a second interim action be conducted at two locations on the School property where lead cleanup level exceedances were identified in the 1- to 3-foot depth range, to better ensure the long-term integrity of the cover layer. In summer 2013 those areas were covered with a geotextile fabric (placed directly on the undisturbed ground surface), and an additional 1-foot thickness of fill soil was imported and hydroseeded to supplement the pre-existing clean soil cover layer.

The spring 2012 and summer 2013 interim action areas are shown on Figure 2 along with two other RI sampling locations where soil cleanup level exceedances were detected above 3-foot depth. The lead exceedance at exploration NG-M4 is currently covered by pavement. Follow-up sampling at exploration SG-J10 (located on Church property) indicated that the marginal arsenic exceedance at that location is cover by a minimum 1-foot thickness of "clean" soil.

Results of sub-slab soil vapor sampling conducted in 2010 indicated that vapor intrusion into the School building was not a concern. As a precaution to ensure that the soil-to-indoor-air exposure pathway remains protective over the long term, it was recommended that the standard practice of running the HVAC system throughout the school day be continued.

While typically limited to depths of less than 15 feet bgs, landfilled materials were found as deep as 40 feet bgs at some locations. Vadose zone soils (i.e., soils above the water table) beneath a deep portion of the north landfill area are impacted by petroleum hydrocarbons, and separate-phase petroleum-based product (referred to as light non-aqueous-phase liquid, or LNAPL) is floating on the water table at 120 to 130 feet bgs. Table 3 provides a summary of LNAPL thicknesses measured in four monitoring wells through April 2014. As discussed in the RI, LNAPL thickness was difficult to measure accurately, and measurements were highly variable from one monitoring round to the next.

Although a wide range of petroleum hydrocarbon liquids were likely disposed of at the Site, many decades of weathering (since landfilling activities ceased by the mid-1950s) have left behind a high-viscosity mixture of relatively low-solubility compounds. LNAPL in vadose zone soils, which comprises the majority of petroleum hydrocarbon mass at the Site, is likely trapped in the soil pore spaces (i.e., no longer moving downward), and the thickness and areal extent of LNAPL at the water table are unlikely to increase over time. The LNAPL is effectively isolated from the ambient environment.

TPH in the diesel and motor oil ranges has leached to groundwater beneath the impacted soils and LNAPL, forming a localized dissolved contaminant "plume." Localized plumes of dissolved arsenic and trichloroethene (TCE) are also present in Site groundwater, which flows in a southwesterly direction. Figure 1 shows the estimated areal extent of groundwater with cleanup level exceedances, which is confined to the School property. Similar to the LNAPL, impacted groundwater is likely no longer spreading due to the age of the release.

In the FS, Site cleanup alternatives were developed and comparatively evaluated with respect to criteria specified in the Washington State Model Toxics Control Act (MTCA; Chapter 173-340 WAC). Cleanup alternatives addressing landfilled materials and near-surface impacted soils were developed separately from those addressing deep petroleum

hydrocarbon and groundwater impacts. These area/media-specific alternatives were then combined into Site-wide remedial alternatives. Based on the results of detailed evaluation of the Site-wide remedial alternatives with respect to the MTCA criteria, the FS identified a "preferred alternative," which is the cleanup action selected for implementation.

This CAP describes the selected cleanup action and provides additional information in accordance with WAC 173-340-380(1)(a).

2 Remedial Action Objectives

Remedial action objectives (RAOs) are medium-specific or site-specific goals for protecting human health and the environment. RAOs for this Site include the following:

- Minimize the potential for direct-contact exposure to landfilled materials and soils with contaminant concentrations exceeding cleanup levels;
- Continue to ensure that the air in Site structures is not unacceptably impacted by soil vapor intrusion;
- Remediate LNAPL to the maximum extent practicable;
- Minimize the potential for ingestion of groundwater with contaminant concentrations exceeding cleanup levels; and
- Meet groundwater cleanup levels at a conditional point of compliance established at the School property boundary.

3 Description of Selected Cleanup Action

Based on the results of extensive grid-based sampling conducted during the RI, the existing cover over landfilled materials and near-surface impacted soils consists of a minimum 1-foot thickness of clean soil or a "hard" surface such as pavement. Under the selected cleanup action, the existing cover will be periodically inspected and maintained over the long term to prevent direct contact exposures. A Cover System Inspection and Maintenance (I&M) Plan will be developed addressing inspection procedures, maintenance, and documentation requirements. The I&M Plan will include a brief , separate summary of site conditions and requirements for performing invasive work in soil, to be provided to all supervisors and workers who may perform such invasive work. Environmental covenants on the School and Church properties will prohibit or restrict Site activities that would interfere with the integrity of the existing cover or continued protection of human health. The areas to be covered by the environmental covenants are shown on Figures 3 and 4, respectively, for the School and Church properties.

To address the soil vapor intrusion pathway, the HVAC system in the main school building will be run continuously during the school day, and sub-slab vapor and/or indoor

air sampling will be conducted periodically to reconfirm that vapor intrusion is not a concern. In addition, vapor intrusion potential will be evaluated and/or vapor controls incorporated into any future buildings constructed in the immediate vicinity of the north or south landfill areas.

On a periodic basis, LNAPL on the water table beneath the north landfill area will be removed from existing monitoring wells and properly disposed of. An LNAPL Removal Work Plan will be developed addressing removal methods, removal frequency, and temporary storage, recycling/disposal, and reporting requirements. Periodic LNAPL removal will continue until the rate at which LNAPL enters a well is reduced to the point that further periodic removal from that well is impracticable.

Groundwater quality and LNAPL layer thickness will be monitored periodically and conditional points of compliance for LNAPL migration and for achieving groundwater cleanup levels will be established at monitoring wells MW-6 and MW-10, respectively (Figure 1). A Groundwater/LNAPL Monitoring and Contingency Plan will be developed addressing monitoring procedures, monitoring frequency, groundwater sampling and analysis protocols, and reporting requirements. The plan will also specify how monitoring results are evaluated and the steps to be taken in the event that potential migration of LNAPL or contaminated groundwater is indicated. If LNAPL is detected in MW-6, the plan will require that more aggressive measures be considered/implemented to prevent further LNAPL migration. Similarly, exceedance of a groundwater cleanup level for arsenic, lead, TCE, or TPH at MW-10 (Table 1) during periodic monitoring will trigger consideration of active measures to prevent further migration of the dissolved contaminant plume.

The environmental covenant on the School property will also prohibit drinking water well installation or invasive activities that may result in exposure to LNAPL or groundwater contamination.

The long-term LNAPL and groundwater monitoring proposed in this alternative is distinct from monitored natural attenuation (MNA) in that there is no expectation that the contamination will attenuate over a “reasonable restoration time frame.” Similar to the containment solution for the landfilled materials, the goal is to ensure that the LNAPL and groundwater contamination do not spread beyond their current boundaries.

4 Rationale for Selecting Cleanup Action

In the FS comparative evaluation, the cleanup alternatives were evaluated against the following MTCA criteria in accordance with WAC 173-340-360(2):

Threshold Criteria

- Protection of human health and the environment;
- Compliance with cleanup standards and applicable state and federal laws; and
- Provision for compliance monitoring;

Other Criteria

- Use of permanent solutions to the maximum extent practicable;
- Provision for a reasonable restoration time frame; and
- Consideration of public concerns.

The selected cleanup action meets the requirements of the "threshold criteria," uses permanent solutions to the maximum extent practicable, and is cost-effective.

The spring 2012 interim action remediated an area, primarily on the Church property, that contained contaminated soils within 1 foot of ground surface. Two additional areas where contaminated soils were identified in the 1- to 3-foot depth range were subsequently addressed in the summer 2013 interim action. The existing cover in place over the Site, which consists of a minimum 1-foot thickness of clean soil or pavement, will be effective in preventing direct contact with the limited areas of residual impacted near-surface soil so long as it is periodically inspected and maintained. In-place containment of landfilled materials is the presumptive remedy for landfill sites.

Continued routine operation of the HVAC system at the School, and periodic testing of sub-slab vapor and/or indoor air quality, will ensure that vapor intrusion is not a concern within the School.

LNAPL floating on the water table, located approximately 120 feet beneath the School property, will be physically removed from existing monitoring wells on a periodic basis. Due to the age of the release, the LNAPL and localized plumes of impacted groundwater, which are all confined to the School property, are likely no longer spreading. This will be confirmed through periodic monitoring of LNAPL layer thickness and groundwater quality. It is not practicable or cost-effective to try to treat the LNAPL and impacted groundwater at this Site using *in situ* technologies (e.g., thermal remediation).

To prevent exposure to deep contamination remaining at the Site, environmental covenants will be recorded on the School and Church properties to ensure that invasive activities, including the drilling of drinking water wells, are not allowed.

5 Other Cleanup Alternatives Evaluated in FS

5.1 Area/Media-Specific Alternatives for Landfilled Materials and Near-Surface Impacted Soils

In addition to the selected cleanup action to address landfilled materials and near-surface impacted soils (Alternative A2), the FS evaluated the following alternatives:

- **Alternative A1 – No Additional Action.** The completed Interim Action in the south landfill area would remain in place, but the existing cover over landfilled materials and near-surface impacted soils would not be maintained, and future Site activities would not be restricted by institutional controls.

- **Alternative A3 – Landfill Cap**. Except for the building footprint and paved areas, the existing cover systems at the Site do little to impede water infiltration, which can result in leaching of contaminants to groundwater. In this alternative, a cap designed to meet Washington State standards for closure of a solid waste landfill would be installed over the landfill areas and areas of impacted soils.

5.2 Area/Media-Specific Alternatives for Deep Petroleum Hydrocarbon and Groundwater Impacts

In addition to the selected cleanup action to address deep petroleum hydrocarbon and groundwater impacts (Alternative B2), the FS evaluated the following three alternatives:

- **Alternative B1 – No Action**. No LNAPL removal or long-term monitoring of groundwater quality and LNAPL layer thickness would take place, and installation of drinking water wells would not be prohibited by institutional controls.
- **Alternative B3 – *In Situ* Treatment of Water Table LNAPL**. In this alternative, the LNAPL layer on the water table beneath the north landfill area would be treated *in situ* with the goal of maximizing removal of LNAPL mass. Multiple *in situ* technologies could potentially be used to treat petroleum hydrocarbon-based LNAPL. For the purposes of evaluating this alternative and estimating costs, it was assumed that electrical resistance heating (ERH) was selected for implementation.
- **Alternative B4** – ***In Situ* Treatment of LNAPL, Impacted Vadose Zone Soils, and Groundwater**. In this alternative, TPH-impacted vadose zone soils as well as water table LNAPL would be treated *in situ* using ERH, with the goal of maximizing removal of LNAPL mass. After ERH treatment was completed, *in situ* chemical oxidation would be used to treat TPH and TCE dissolved in groundwater.

5.3 Evaluation of Site-Wide Cleanup Alternatives

Area/media-specific alternatives A1 and B1 were screened against the MTCA threshold criteria, and were eliminated from further consideration because they would not satisfy those criteria. The remaining area/media-specific alternatives were then combined into the following Site-wide alternatives for detailed evaluation:

- **Alternative A2/B2** – Periodic inspection and maintenance of the existing cover and physical removal of LNAPL from existing wells;
- **Alternative A3/B3** – Landfill cap and *in situ* treatment of LNAPL at the water table; and
- **Alternative A3/B4** – Landfill cap and *in situ* treatment of impacted vadose zone soils, LNAPL at the water table, and groundwater.

Alternatives A3/B3 and A3/B4 were not selected because their higher costs compared to Alternative A2/B2 are disproportionate to their incremental benefits. Remediating

LNAPL at this Site via *in situ* treatment (Alternatives B3 and B4) may not be practicable, and the likelihood of achieving groundwater cleanup levels throughout the School property is highly uncertain. The impacted groundwater and water table LNAPL at 120 to 130 feet bgs are effectively isolated from the ambient environment; their extents are confined to the School property and are likely stable or shrinking. Alternative A2/B2 is effective at preventing direct contact exposure to the localized areas where cleanup level exceedances exist in near-surface soil. The primary purpose of a landfill cap (Alternative A3) would be to reduce infiltration of surface water, which causes leaching of contaminants to groundwater. However, the impracticability of completely removing water table LNAPL undermines the benefit of reduced infiltration. And this benefit would be minimal in any case the groundwater contamination is localized and does not appear to be spreading.

6 Cleanup Standards

Cleanup standards consist of cleanup levels for hazardous substances present at a site, the location where cleanup levels must be met (point of compliance), and other regulatory requirements that apply to the site ("applicable state and federal laws"). Soil, groundwater, and air cleanup standards applicable to this Site are outlined below.

6.1 Soil

Table 1 lists soil cleanup levels for the constituents of concern (COCs) identified in the FS. The standard point of compliance for the direct-contact exposure pathway (i.e., throughout the site from the ground surface to 15 feet bgs) is not applicable to this containment remedy. Per WAC 173-340-700(4)(c):

> *Where a cleanup action involves containment of soils with hazardous substances above cleanup levels, the cleanup action may be determined to comply with cleanup standards, provided the compliance monitoring program is designed to ensure the long-term integrity of the containment system, and the other requirements for containment in this chapter are met.*

A compliance monitoring program will be designed to ensure the long-term integrity of the containment system, and other requirements for containment in WAC 173-340-700 will be met. Therefore, the cleanup action is determined to comply with soil cleanup standards.

6.2 Groundwater

Table 1 also lists groundwater cleanup levels for the COCs identified in the FS. The standard point of compliance for meeting groundwater cleanup levels (i.e., throughout the site aquifer) is not practicable at this Site due to the depth of the groundwater table, the quantity of LNAPL present, and its location beneath landfilled materials. Instead, a conditional point of compliance is established at monitoring well MW-10 near the School property boundary. Monitoring results indicate that groundwater cleanup level

exceedances are currently confined to the School property. Groundwater quality monitoring will be conducted periodically to confirm that cleanup levels for arsenic, lead, TCE, and TPH continue to be met at well MW-10.

Compliance with groundwater cleanup standards also encompasses the MTCA requirement to remove soil with NAPL exceeding residual saturation. This requirement will be addressed through periodic physical removal of LNAPL (e.g., via bailing) from existing wells until the rate at which LNAPL enters the wells is reduced to the point that further periodic removal is impracticable. In addition, a conditional point of compliance for LNAPL migration is established at monitoring well MW-6. If LNAPL is detected in MW-6 during periodic monitoring, more aggressive measures to prevent further LNAPL migration will be considered for implementation in accordance with the Groundwater/LNAPL Monitoring and Contingency Plan.

6.3 Air

Table 2 lists cleanup levels for constituents of potential concern (COPCs) in air. COPCs in air were identified in consultation with Ecology during development of the site-specific Soil Vapor Intrusion Assessment Work Plan (Aspect, 2010). The point of compliance for achieving air cleanup levels is the ambient air throughout the Site. Compliance with air cleanup standards was demonstrated by sub-slab vapor sampling conducted inside the school building in November 2010. Sub-slab vapor and/or indoor air sampling will be conducted periodically inside the school building to re-confirm that vapor intrusion is not a concern.

7 Tentative Cleanup Implementation Schedule

The tentative schedule for implementation of the selected cleanup action calls for development of the environmental covenants, the Cover System I&M Plan, the LNAPL Removal Work Plan, and the Groundwater/LNAPL Monitoring and Contingency Plan in the second half of 2014 (pending finalization of this CAP). Interim groundwater and LNAPL monitoring are ongoing (on approximately a quarterly basis), and interim LNAPL bailing from existing wells is scheduled to begin in April 2014. Periodic cover system I&M, LNAPL removal, and groundwater/LNAPL monitoring under the final remedy will commence as soon as the respective plans are approved by Ecology.

8 Institutional Controls

Institutional controls in the selected cleanup action will include environmental covenants on the School and Church properties to be recorded with Kitsap County. The covenants will prohibit or restrict activities on the Site that would interfere with the integrity of the existing cover or continued protection of human health.

Specific restrictions and requirements for Site use (School and Church properties) will likely include:

- A requirement to monitor and maintain the integrity of the existing cover features that provide protection against direct contact exposure, and to provide reports to Ecology, in accordance with the Cover System I&M Plan;
- A requirement to notify Ecology's project manager via email or letter prior to any invasive work within the top 1-foot depth in the north and south landfill and surrounding areas as shown on Figures 3 and 4. Such work shall be supervised by BSD's Facilities Supervisor. Workers shall be notified of subsurface conditions.
- A requirement to use only personnel with hazardous waste health and safety training for any invasive work to greater that 1-foot depth in the north and south landfill areas, to notify such personnel of subsurface conditions, and to provide notice to and receive approval from Ecology prior to performing the work; and
- A requirement to evaluate vapor intrusion potential and/or incorporate vapor controls into future buildings constructed in the immediate vicinity of the north and south landfill areas.

Institutional controls required for the School Property only will likely include:

- A requirement to conduct periodic LNAPL removal in accordance with the LNAPL Removal Work Plan;
- A requirement to conduct periodic groundwater quality and LNAPL layer thickness monitoring, and to perform contingency actions in accordance with the Groundwater/LNAPL Monitoring and Contingency Plan;
- A requirement to continue the standard practice of running the School's HVAC system throughout the school day, and to reevaluate vapor intrusion potential at a minimum frequency of once every 5 years; and
- A prohibition against water well installation for any purpose other than groundwater/LNAPL monitoring or remediation.

9 Applicable State and Federal Laws

Cleanup standards established for the Site incorporate applicable state and federal laws and regulations in the form of chemical-specific regulatory criteria for soil and water as described in the FS. Other local, state, and federal laws and requirements that potentially apply to the cleanup work at the Site include:

- State Environmental Policy Act (WAC 197-11)
- Resource Conservation and Recovery Act (RCRA)

- Washington State Minimum Functional Standards for Solid Waste (WAC 173-304)
- Washington State Dangerous Waste Regulations (WAC 173-303)
- USDOT/WSDOT Regulations (WAC 173-160)

10 Compliance with WAC 173-340-360

The selected cleanup action complies with the provisions of WAC 173-340-360. It will be protective of human health and the environment, comply with cleanup standards and applicable state and federal laws, and provide for compliance monitoring. LNAPL will be removed from the water table to the extent practicable using normally accepted engineering practices. Soils with hazardous substance concentrations that exceed soil cleanup levels will be contained to the maximum extent practicable. Containment will be monitored on a long-term basis, and a contingency plan will specify actions to be taken in the event that potential contaminant migration is indicated.

As discussed in the FS, the selected cleanup action is also considered to use permanent solutions to the maximum extent practicable, and to provide for a reasonable restoration time frame.

11 Contamination Remaining on Site

11.1 Landfilled Materials and Near-Surface Impacted Soils

The north and south landfill areas delineated on Figure 1 cover an area of approximately 5.5 acres. While typically limited to depths of less than 15 feet bgs, landfilled materials were found as deep as 40 feet bgs at some locations. An existing cover over landfilled materials and near-surface impacted soils consists of a minimum 1-foot thickness of clean soil or a “hard” surface such as pavement. Under the selected cleanup action, the existing cover will be periodically inspected and maintained over the long term to prevent direct contact exposures. Figure 2 shows the localized areas of the Site with near-surface (above 3-foot depth) soil cleanup level exceedances. Detected concentrations of arsenic, lead, and TPH to 15-foot depth are summarized on Figures 16 through 19 of the RI report (Aspect, 2013).

Environmental covenants on the School and Church properties will prohibit or restrict Site activities that would interfere with the integrity of the existing cover. The standard practice of running the HVAC system throughout the school day will be continued, and sub-slab vapor and/or indoor air sampling will be conducted periodically to reconfirm that vapor intrusion is not a concern in the school building.

11.2 LNAPL

Soils beneath a deep portion of the north landfill area contain an estimated 660,000 kg of petroleum hydrocarbon-based LNAPL. Most of this contaminant mass is LNAPL present in the pore spaces of vadose zone soils. A small portion of the LNAPL (estimated at 60,000 kg) is floating on the water table, covering an estimated 12,000-square-foot area beneath the north landfill area. Following many decades of weathering (since landfilling activities ceased by the mid-1950s), the present-day LNAPL is a high-viscosity mixture of relatively low-solubility compounds. As such, its mobility in the subsurface is expected to be extremely limited.

Under the selected cleanup action, the Environmental Covenant for the School property will prohibit invasive activities such as drinking water well installation that could result in exposure to LNAPL. In addition, LNAPL will be physically removed from existing monitoring wells to the extent practicable, and LNAPL layer thickness will be monitored to confirm that the areal extent of water table LNAPL is stable or shrinking. If LNAPL is detected at well MW-6 (the conditional point of compliance for LNAPL migration) during periodic monitoring, more aggressive measures to prevent further LNAPL migration will be considered for implementation in accordance with the Groundwater/LNAPL Monitoring and Contingency Plan. .

11.3 Contaminants Dissolved in Groundwater

Dissolved concentrations of TPH (in the diesel and motor oil ranges), arsenic, and TCE exceed groundwater cleanup levels. Figure 1 shows the estimated extent of groundwater cleanup level exceedances. These contaminant “plumes” are confined to the School property and, due to the age of the release, are likely no longer spreading.

Under the selected cleanup action, the Environmental Covenant for the School property will prohibit invasive activities such as drinking water well installation that could result in exposure to contaminated groundwater. In addition, groundwater quality will be periodically monitored to confirm that the areal extent of dissolved contamination is stable or shrinking. If an exceedance of the cleanup level for arsenic, lead, TCE, or TPH is detected at well MW-10 (the conditional point of compliance for groundwater), active measures to prevent further plume migration will be considered for implementation in accordance with the Groundwater/LNAPL Monitoring and Contingency Plan.

12 References

Aspect, 2010, Soil Vapor Intrusion Assessment Work Plan, Crownhill Elementary School, Bremerton, Washington, Prepared for Bremerton School District, dated July 21, 2010.

Aspect, 2013, Remedial Investigation Report, Crownhill Elementary School, Prepared for Bremerton School District, dated October 2013 (Public Review Draft).

Aspect, 2014, Feasibility Study Report, Crownhill Elementary School, Prepared for Bremerton School District, dated March 7, 2014 (Public Review Draft).

13 Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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TABLES

Table 1 - Soil and Groundwater Cleanup Levels

Cleanup Action Plan, Crownhill Elementary, Bremerton, Washington

Constituent of Concern	Soil Cleanup Level (mg/kg)	Groundwater Cleanup Level (µg/L)
Total Petroleum Hydrocarbon (TPH)		
Diesel Range	2,000	500
Motor Oil Range	2,000	500
Metals		
Antimony	5.4	(Note 1)
Arsenic	20	5
Chromium III	1,000	(Note 1)
Copper	260	(Note 1)
Lead	250	15
Zinc	6,000	(Note 1)
Volatile Organic Compounds (VOCs)		
Trichloroethene (TCE)	0.03	5
Polycyclic Aromatic Hydrocarbons (PAHs)		
cPAHs TEF	0.14[(2)]	(Note 1)

cPAH carcinogenic PAH
mg/kg milligrams per kilogram
TEF toxicity equivalency factor
µg/L micrograms per liter

Notes

1) Not identified as a constituent of concern in groundwater.
2) The cPAHs TEF is calculated from the concentrations of seven carcinogenic PAHs, using the method described in WAC 173-340-708.

Table 2 - Air Cleanup Levels

Cleanup Action Plan, Crownhill Elementary, Bremerton, Washington

Constituent of Potential Concern [2]	Air Cleanup Level [3]
Freon 12 (Dichlorodifluoromethane)	91
Vinyl chloride	(Note 4)
1,1-Dichloroethene	91
trans-1,2-Dichloroethene	27
1,1-Dichloroethane	(Note 5)
cis-1,2-Dichloroethene	(Note 5)
Chloroform	0.11
Benzene	0.32
1,2-Dichloroethane	0.096
Trichloroethene	0.37
Tetrachloroethene	9.6
Ethylbenzene	460
Xylenes (total)	46
1,2,4-Trimethylbenzene	3.2
Naphthalene	1.4
Hydrogen sulfide	0.91

Notes:

1) All concentrations are in units of micrograms per cubic meter ($\mu g/m^3$).
2) Constituents of potential concern (COPC's) were identified in consultation with Ecology during development of the site-specific Soil Vapor Intrusion Assessment Work Plan (Aspect, 2010).
3) Based on the more restrictive of the carcinogenic and non-carcinogenic MTCA Method B values presented in Ecology's CLARC database.
4) Carcinogenic value not currently provided in CLARC database. Instead, a link is provided to "additional information."
5) No value provided in CLARC database ("not researched" or "researched - no data").

Table 3 - LNAPL Thickness Measurements

Cleanup Action Plan, Crownhill Elementary, Bremerton, Washington

Monitoring Well ID[(1)]	Date	Measured LNAPL Thickness[(2)] in ft
MW-8	10/26/12	0.2
	01/31/13	0.1
	05/03/13	0.03
	08/07/13	0.23
	12/17/13	0.86
	04/02/14	0.39
MW-13[(3)]	11/01/12	1.46
	11/21/12	0.99
	01/31/13	0.1
	05/03/13	0.31
	08/07/13	0.49
	12/17/13	4.9
	04/02/14	1.35
MW-14	11/01/12	nd
	01/31/13	nd
	05/03/13	nd
	08/07/13	0.12
	12/17/13	0.10
	04/02/14	0.08
MW-16	11/01/12	nd
	01/31/13	0.5
	05/03/13	0.48
	08/07/13	2.61
	12/17/13	2.83
	04/02/14	3.02

LNAPL light non-aqueous-phase liquid

nd no detectable separate-phase liquid thickness

Notes:

1) Well MW-8 was installed in December 2011. Wells MW-13, MW-14, and MW-16 were installed in October 2012. Refer to Figure 1 for well locations.
2) LNAPL thickness was measured using an oil/water interface probe. As discussed in Section 4.2.4 of the RI, the viscous, sticky nature of the LNAPL resulted in inconsistent readings. Therefore, these thickness measurements must be regarded as estimates only.
3) An LNAPL bailing test was conducted at Well MW-13 on 11/21/12 (after the thickness recorded above was measured), in which approximately 900 milliliters of LNAPL were removed from the 2-inch-diameter well over a 2-hour test period. This likely impacted subsequent thickness measurements in this well.

FIGURES

North Landfill Area

MW-2

Estimated Extent of TPH Exceedance

MW-9

Estimated Extent of TCE Exceedance

(Note 1) MW-16

(Note 1) MW-13

MW-14 (Note 1)

(Note 1) MW-8

MW-12

MW-15

MW-5

Estimated Extent of Arsenic Exceedance

PORTABLE CLASSROOM BUILDING

MW-4

MW-6

MAIN SCHOOL BUILDING

MW-3

MW-10

South Landfill Area

MW-1

MW-7

MW-11

ROCKY POINT RD

BERTHA AVE NW

MARINE DR

DORA AVE

N

DRAFT

0 100 200

Feet

Well Locations:

- Monitoring Well
- Perched Zone Monitoring Well (Not Sampled)

Other Site Features and Interpretation:

- School Building Footprint
- Pavement
- Bremerton School District Property Boundary
- Inferred Direction of Groundwater Flow
- Parcel boundary
- Interpreted Extent of Landfill Activity
- Bremerton United Methodist Church Property Boundary
- Estimated Extent of Groundwater Cleanup Level Exceedances

Note:

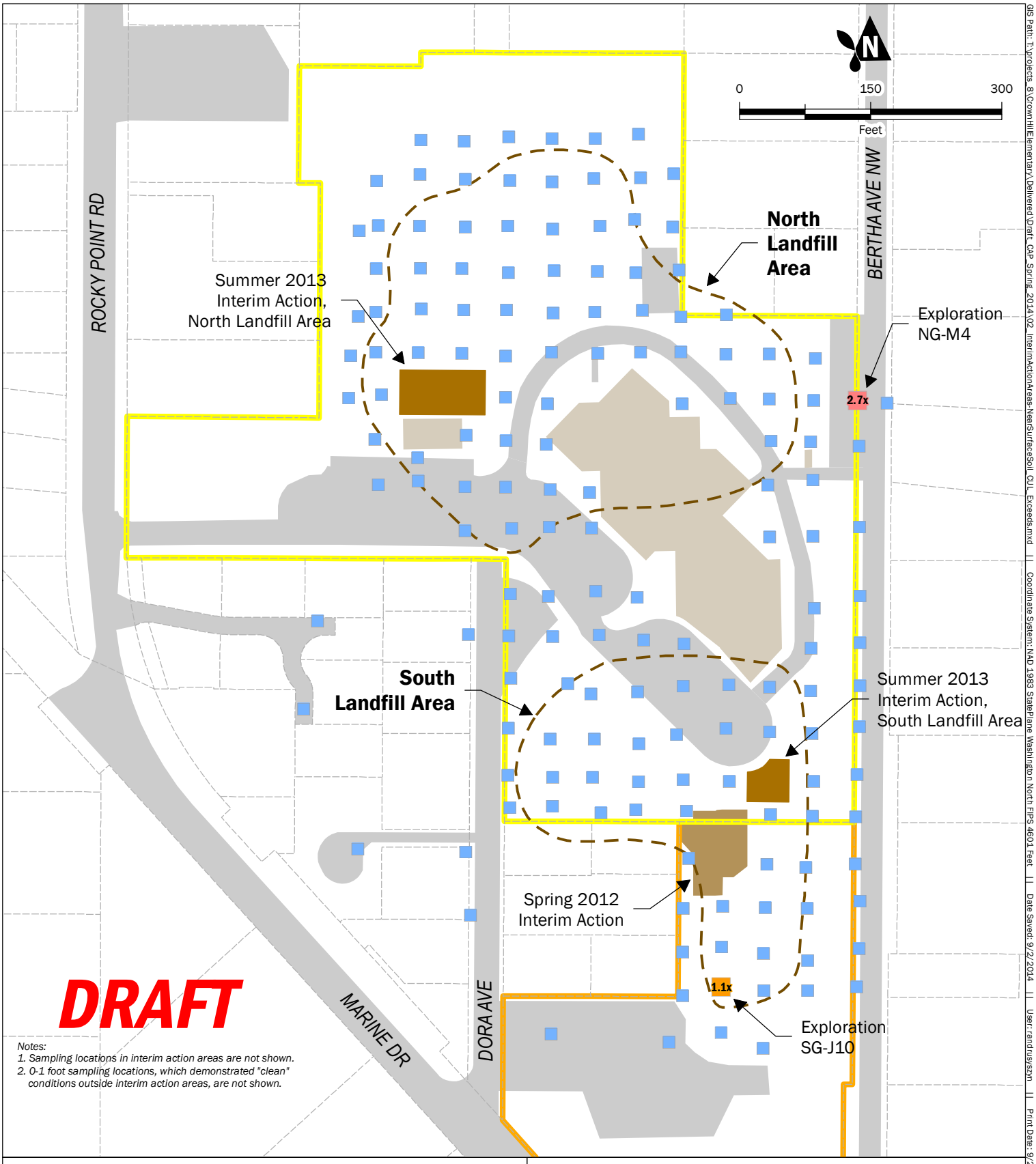
(1) LNAPL was detected in Wells MW-8, MW-13, MW-14, and MW-16 on at least one occasion. Refer to Table 3.

Groundwater Cleanup Level Exceedances

Crownhill Elementary CAP
Bremerton, Washington

Aspect CONSULTING	SEP-2014	BY: DLH / PPW	FIGURE NO. 1
	PROJECT NO. 100094	REV BY: SCC	

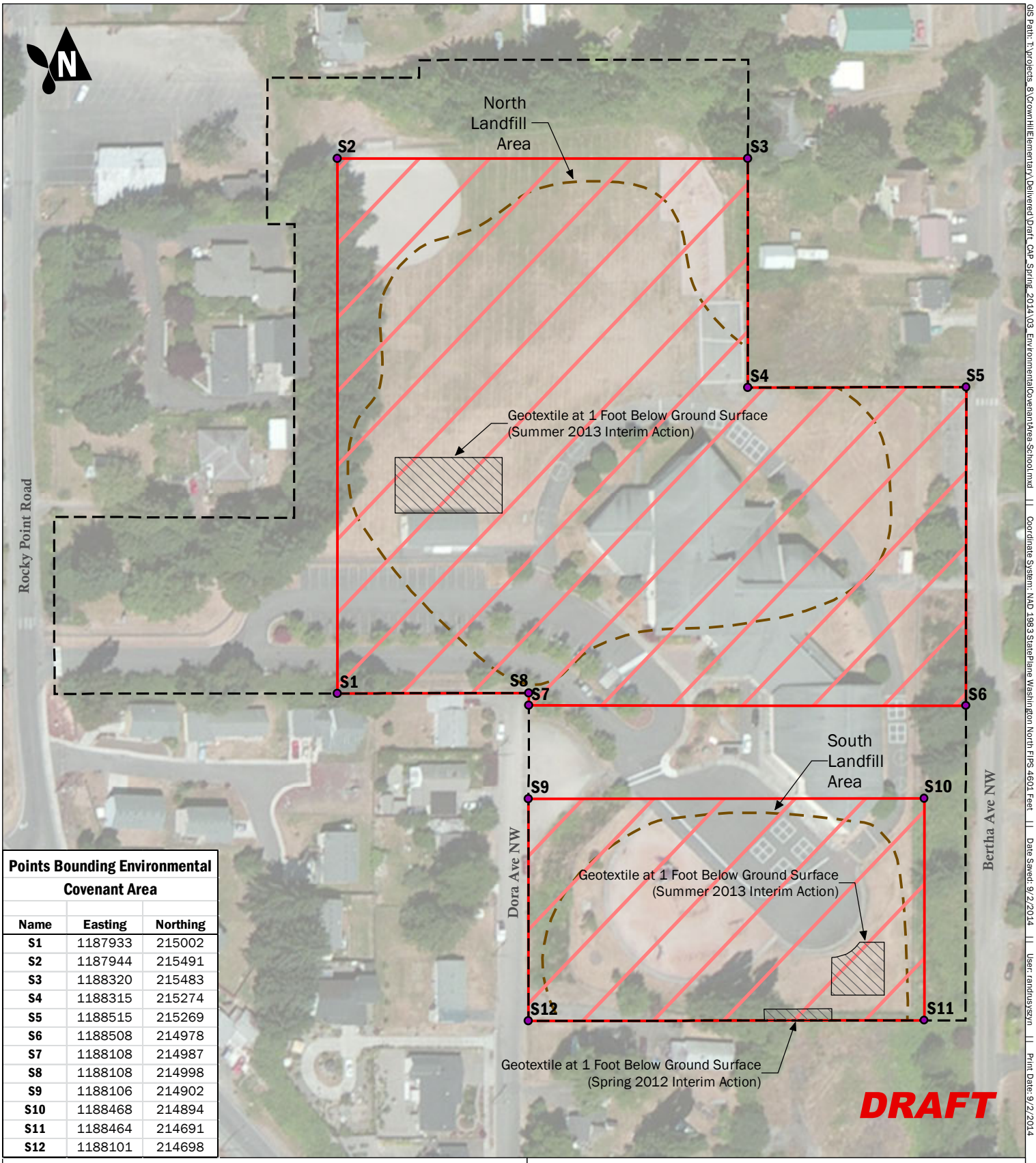
GIS Path: T:\projects_8\CrownHillElementary\Delivered\Draft_CAP_Spring_2014\05_GW_Cleanup_Level_Exceedances_LNAPL_Area.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 9/2/2014 || User: randrusyszyn || Print Date: 9/2/2014



Interim Action Areas and Near-Surface Soil Cleanup Level Exceedances

Crownhill Elementary CAP
Bremerton, WA

Aspect CONSULTING	SEP-2014	BY: DAH / PPW	FIGURE NO. 2
	PROJECT NO. 100094	REV BY: SCC	



Points Bounding Environmental Covenant Area

Name	Easting	Northing
S1	1187933	215002
S2	1187944	215491
S3	1188320	215483
S4	1188315	215274
S5	1188515	215269
S6	1188508	214978
S7	1188108	214987
S8	1188108	214998
S9	1188106	214902
S10	1188468	214894
S11	1188464	214691
S12	1188101	214698

Area of Environmental Covenant
Soil and Structure Prohibitions

Interpreted Extent of Landfill Activity

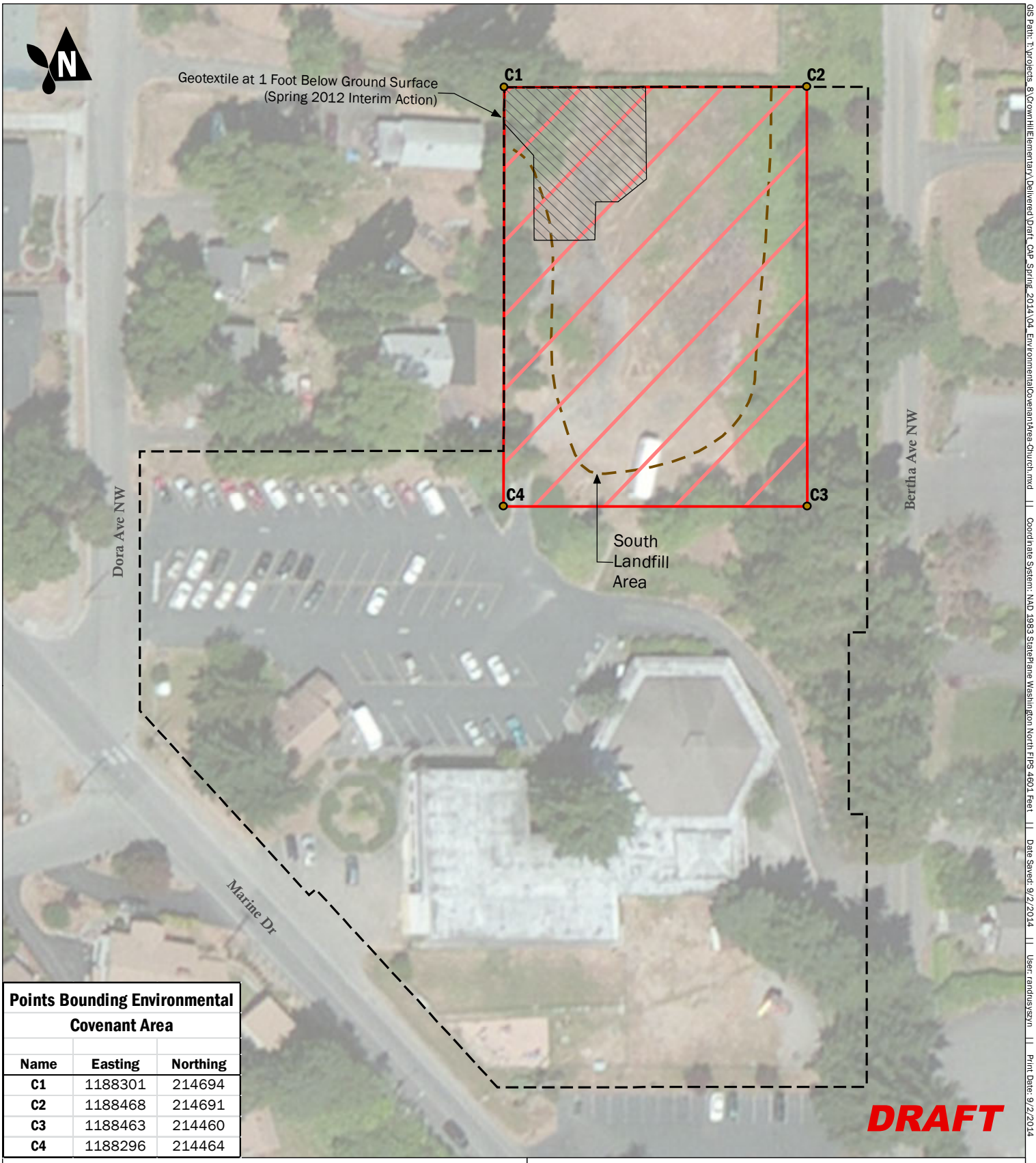
Bremerton School District
Property Boundary

0 120 240
Feet

Environmental Covenant Area, School Property

Crownhill Elementary CAP
Bremerton, Washington

Aspect Consulting	SEP-2014	BY: HRL	FIGURE NO. 3
	PROJECT NO. 100094	REV BY: SCC	



Points Bounding Environmental Covenant Area		
Name	**Easting**	**Northing**
C1	1188301	214694
C2	1188468	214691
C3	1188463	214460
C4	1188296	214464

Area of Environmental Covenant
Soil Prohibitions

Interpreted Extent of Landfill Activity

Bremerton United Methodist Church
Property Boundary

0 80 160
Feet

Environmental Covenant Area, Church Property

Crownhill Elementary CAP
Bremerton, Washington

Aspect CONSULTING	SEP-2014	BY: HRL	FIGURE NO. 4
	PROJECT NO. 100094	REV BY: SCC	

GIS Path: T:\projects_8\Crownhill Elementary\Delivered\Draft_CAP_Spring_2014\04_Environmental\CovenantArea_Church.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 9/2/2014 || User: randrus\sycn || Print Date: 9/2/2014

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