MEMORANDUM

Project No. AS100094J

January 29, 2025

To: Vance Atkins, Washington State Department of Ecology

cc: John Fisher, Bremerton School District

From:

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3268
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1/29/2025
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Re: **Crownhill Elementary: Proposed Vapor Intrusion Assessment Sampling and Analysis Plan**

Aspect Consulting, a Geosyntec Company (Aspect), has prepared this vapor intrusion (VI) assessment sampling and analysis plan (SAP) on behalf of the Bremerton School District (BSD) to supplement on-going cleanup actions related to the Crownhill Elementary Site[1] (Site). Cleanup activities at the Site are being conducted in accordance with the Model Toxics Control Act (MTCA) as promulgated in Chapter 173-340 of the Washington Administrative Code (WAC) and under Agreed Order No DE 11107 with the Washington State Department of Ecology (Ecology). This VI Assessment SAP was prepared in response to a letter from Ecology dated September 30, 2024, and Ecology's verbal request for a written plan made during a technical meeting with Aspect representatives on October 29, 2024.

In summary, Ecology is seeking additional Site investigation of potential VI to off-property structures. Ecology's VI guidance[2] established indoor air quality risks for trichloroethene (TCE) after the Site entered long-term compliance monitoring following remedial activities in 2013.[3]

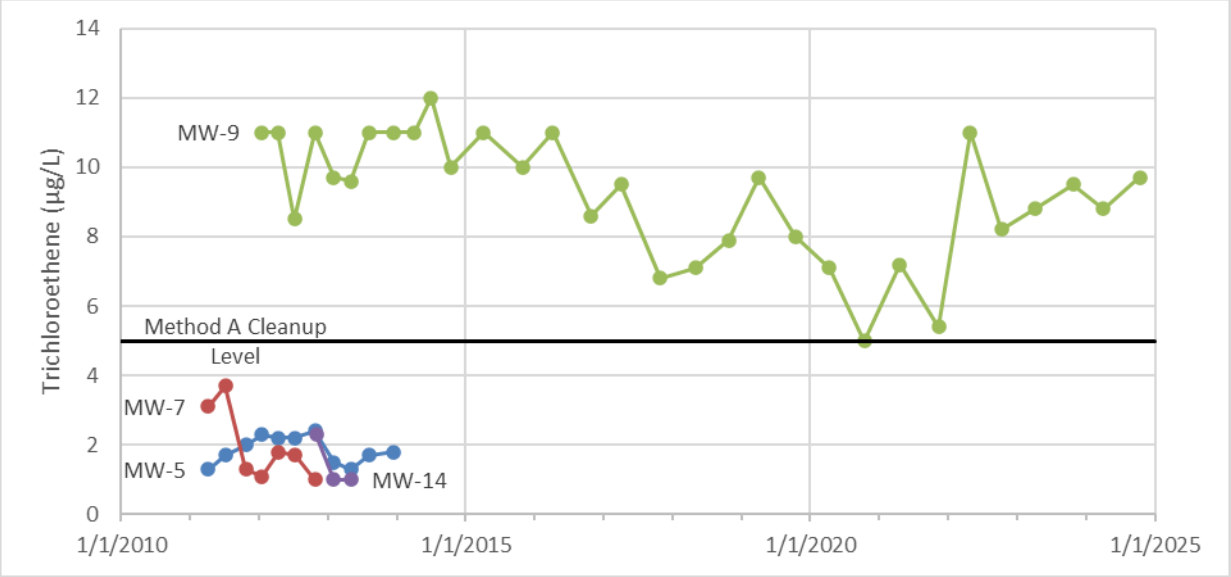
[1] Ecology Cleanup Site ID: 4487 is located at 1500 Rocky Point Rd NW in Bremerton, Washington (Property).
[2] Guidance for Evaluating Vapor Intrusion in Washington State, Publication No. 09-09-047, Washington State Department of Ecology, March 2022.
[3] Washington State Department of Ecology (Ecology), 2014, Cleanup Action Plan, Bremerton School District, Crownhill Elementary School Site, December 10, 2014.

During their recent periodic review of Site conditions, Ecology identified groundwater TCE concentrations exceeding the VI screening level. Considering the potential TCE sources, Aspect recommends a soil vapor investigation as a Tier 1 VI assessment. After a Site background summary, the balance of this VI Assessment SAP is organized following the requirements listed in WAC 173-340-820.

Site Background Summary

Historical landfilling activities resulted in soil and groundwater contamination and there has been a series of environmental investigations at the Site. A Remedial Investigation[4] (RI) was conducted from 2011 through 2013, and long-term monitoring has been conducted since 2013. The thickness of landfilled waste (see Figure 1) is generally less than 20 feet. The depth to groundwater is approximately 110 feet.

During the RI, TCE was identified as one of the Site indicator hazardous substances and was detected at several groundwater monitoring wells. TCE concentrations at upgradient monitoring well MW-9 (see location on Figure 1) ranged up to 12 µg/L, generally exceeding the 5 µg/L Method A groundwater cleanup level (see Graph 1 below). TCE concentrations at three other Site wells were detected below the groundwater cleanup level. TCE was not detected in ten other Site wells above the 1 µg/L reporting limit. Long-term groundwater sampling for TCE was not required at wells where concentrations were initially observed below the groundwater cleanup level.



Graph 1: Historical TCE Concentrations in Groundwater

[4] Aspect Consulting, LLC (Aspect), 2014, Remedial Investigation, Crownhill Elementary School, prepared for Bremerton School District, November 2014.

Ecology's VI guidance established the following screening levels based on chronic exposure Method B cancer risk:

- 1.4 µg/L in groundwater
- 11 micrograms per cubic meter (µg/m^3) in sub-slab soil gas

These screening levels are not site-specific and represent conservative assumptions regarding attenuation between groundwater or sub-slab soil gas and indoor air.

The risk of VI to on-property structures was evaluated with sub-slab sampling conducted in 2010, 2015, and 2021, as reported in the 2020 Annual Report[5] which also documented changes in sub-slab screening levels. Historically, TCE was not detected except in one sample (0.48 µg/m^3) below the screening level of 11 µg/m^3.

On September 30, 2024, as part of their periodic review of cleanup progress, Ecology delivered a letter to BSD regarding "Request for Evaluation of TCE Risks at the Site." In the letter, Ecology requested a set of activities to better delineate the extent of the TCE groundwater plume and assess the risk for potential VI and impact to indoor air, including:

- Install groundwater monitoring wells north and east of MW-9 (see Figure 1)
- Deliver a sampling and analysis plan for the TCE groundwater investigation
- Conduct sampling (potentially multiple rounds) and submit results to Ecology with recommendations

This request was triggered by the presence of off-Property residential properties potentially located within 100 horizontal feet of groundwater exceeding the screening level. The conceptual model is that groundwater represents the primary TCE source.[6]

Site conditions support Tier 1 shallow soil vapor sampling[7] to more directly assess the potential VI than expanding the groundwater sampling network. The conceptual model is that TCE-impacted landfill waste and TCE-impacted soils directly beneath landfilled waste represent the primary TCE source. Groundwater TCE concentrations potentially reflect the overlying source strength, with the greatest source concentrations near MW-9. Variable groundwater TCE concentrations over time likely represent variable rates of natural attenuation, including upward discharge to atmospheric air, dilution due to precipitation infiltration, and chemical degradation, for example. Shallow soil vapor sampling at the Property boundary represents a potential compliance point between any source (impacted groundwater, impacted waste, and impacted soils beneath waste) and the structure.

[5] Aspect Consulting (Aspect), 2021, 2020 Annual Report: Remedy Implementation Crownhill Elementary School Site, March 3, 2021.
[6] The long-term average groundwater TCE concentration is approximately 9 µg/L. Deep soil vapor in equilibrium with groundwater would have a concentration of approximately 2,000 µg/m^3 TCE based on Henry's Law. Shallow soil vapor would have a concentration of approximately 70 µg/m^3 TCE based on default attenuation factors.
[7] Ecology VI guidance states: "Tier 1 evaluations are based on the presumption that it may be possible to screen out the VI pathway without sampling inside a building."

Purpose, Responsibilities, and Schedule

The purpose of this focused VI assessment is to reliably characterize the shallow soil gas TCE concentrations near the Property boundary and compare to the soil gas screening level for potential VI and indoor air quality impacts for off-property structures. The BSD retains responsibility for this focused investigation as the named potentially liable party in the Agreed Order. On behalf of the BSD, Aspect will implement the focused investigation with the following schedule, pending Ecology approval.

- Drilling and probe installation: Within 60 days of Ecology approval of this VI Assessment SAP, subject to driller availability and logistical coordination with BSD.
- Vapor sampling: Initial round within 30 days of probe installation, then quarterly for a total of 4 successive sampling events.
- Reporting: Quarterly summary of analytical results with preliminary findings and recommendations provided via email within 30 days of receipt of the laboratory report. The 2025 Annual Report, to be delivered in March 2026, will formally document findings and recommendations.

Sampling and Monitoring Locations

Three shallow soil vapor probes will be installed near the Property boundary. Two will be installed along the northeast parcel boundary near the mid-point of adjacent parcels with off-property structures. A third probe will be installed near the midpoint of the north property boundary. The soil vapor probe locations are shown on Figure 1.

Soil vapor probes will be installed by a licensed driller using a direct-push drill rig and in accordance with well installation regulations (WAC 173-160). The probes will be constructed of 0.75-inch-inner diameter polyvinyl chloride (PVC) casing screened from approximately 5 to 10 feet below ground surface. Each probe will be completed using a silica sand filter pack placed from the bottom of the boring to 6 inches above the top of the screen, with an annular seal of bentonite placed above the filter pack to 3 feet below ground surface. Probes will be finished with a concrete surface seal and flush-mounted monument above the bentonite seal. An as-built construction log will be compiled for each installation.

Soil cuttings will be field screened during drilling for signs of VOC impacts using visual and olfactory methods, and by headspace analysis using a photoionization detector (PID). The geology will be logged in general accordance with the ASTM International (ASTM) standard D2488 for visual classification of soils using the Unified Soil Classification System (USCS). Soils will be sampled for disposal characterization.

Prior to installation, Aspect will subcontract a private utility locate company to screen drilling locations for underground utilities. Drill cuttings generated during drilling will be collected and stored off site in sealed, Department of Transportation-approved steel drums at the BSD bus barn located at 5520 Burwell Street, Bremerton, Washington. The drums will be labeled pending profiling and disposal.

All completed probe locations will be quantitatively surveyed for mapping purposes using a GPS antenna capable of sub-meter location measurements.

Sampling and Monitoring Methods and Frequencies

Passive soil vapor samples will be collected at approximately 90-day intervals to demonstrate potential VI during variable seasonal conditions. A total of 4 samples will be collected at each sampling location. These sampling frequencies and methods are consistent with Ecology's VI guidance.

Passive soil vapor samplers will be deployed for approximately 30 days to allow for method reporting limits of approximately 4.5 $\mu g/m^3$, below the sub-slab screening level of 11 $\mu g/m^3$. The Waterloo Membrane System is the specific type of passive sampler that will be used. The passive sampler will be installed by hanging the sampler at the midpoint of the screened interval. The probe will be sealed with a cap to prevent dilution from atmospheric air. One field duplicate sample and one trip blank will be collected for quality assurance and quality control.

Before the passive sampler is deployed and after it is retrieved, soil gas conditions will be monitored using a calibrated GEM-5000 field meter. These monitoring data will help inform a focused feasibility study for mitigation of VI risks, if necessary. Probes will be purged at approximately 0.5-L per minute until monitoring parameters equilibrate demonstrating representative soil gas conditions. The following monitoring parameters will be measured:

- Soil gas concentrations (methane, carbon dioxide, oxygen, hydrogen sulfide, carbon monoxide)
- Barometric pressure
- Relative soil gas pressure

Laboratory Methods and Quantitation Limits

Passive soil vapor samplers will be handled under chain-of-custody procedures and shipped to the Eurofins Air Toxics, LLC laboratory in Fulsom, California for analysis of TCE (only) using modified EPA Method TO-17. The TCE quantitation limit for a 30-day deployment is approximately 4.5 $\mu g/m^3$, below the sub-slab screening level of 11 $\mu g/m^3$. The laboratory will provide a Level II report by e-mail in PDF and EXCEL formats within 10 business days of sample receipt.

Reporting

A summary of analytical and monitoring results with preliminary findings and recommendations will be provided to Ecology via email within 30 days of receipt of the laboratory report.

The 2025 Annual Report, to be delivered in March 2026, will formally document the Tier 1 VI assessment, including compiled sampling results and monitored conditions, findings and recommendations.

Limitations

Work for this project was performed for the Bremerton School District (Client), and this memorandum was 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 memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix A titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

Attachments: Figure 1 – Site Plan
Appendix A – Report Limitations and Guidelines for Use

V:\100094 BSD Crownhill Elementary RIFS\Deliverables\2024 Ecy 5-Yr Review Response\Final\TCE Sampling and Analysis Plan_Final.docx

FIGURE

1724 Dora Avenue NW (Note 2)

North Landfill Area

MW-2

Estimated Extent of TPH Cleanup Level Exceedance

Estimated Extent of TCE Cleanup Level Exceedance

BERTHA AVE NW

MW-9

MW-16 (Note 1)

MW-14

EW-17

MW-13

MW-12

MW-8

MW-5

MW-15

Geotextile at 1 Foot Below Ground Surface (Summer 2013 Interim Action)

Estimated Extent of Arsenic Cleanup Level Exceedance

ROCKY POINT RD

PORTABLE CLASSROOM BUILDING

SSV-6

SSV-1

MAIN SCHOOL BUILDING

MW-4

SSV-2

SSV-5

SSV-4

MW-6

MW-3

MW-10

SSV-3

MW-1

South Landfill Area

Bertha Ave NW Parking Area

Geotextile at 1 Foot Below Ground Surface (Summer 2013 Interim Action)

MW-7

Geotextile at 1 Foot Below Ground Surface (Spring 2012 Interim Action)

MW-11

MARINE DR

DORA AVE

0 100 200 Feet

GIS Path: T:\projects_8\CrownHillElementary\Delivered\Ecology 5 Year Review 2024\01-Site Plan.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/24/2025 || User: Kristen.Jurica || Print Date: 1/24/2025

Well Locations:

- Extraction Well Included in Monitoring Program
- Monitoring Well Included in Monitoring Program
- Monitoring Well Not Included in Monitoring Program
- McKinney Domestic Well (Note 2)
- Soil Vapor Probe
- Proposed Temporary Soil Vapor Probe
- Approximate photo location & orientation for semiannual cover system inspections

Note:

(1) LNAPL has been observed in Wells EW-17, MW-8, MW-13, MW-14, and MW-16.
(2) The McKinney well water sample is collected from the outdoor faucet on the north side of the residence at 1724 Dora Avenue NW.

Other Site Features and Interpretation:

- Interpreted Extent of Landfill Activity
- Estimated Extent of Groundwater Cleanup Level Exceedances in 2014 (Ecology, 2014)
- Bremerton School District Property Boundary
- Bremerton United Methodist Church Property Boundary
- Inferred Direction of Groundwater Flow

Site Plan

Crownhill Elementary
Proposed Vapor Intrusion Assessment
Sampling and Analysis
Bremerton, Washington

Aspect CONSULTING	DEC-2024	BY: MML / KMJ	FIGURE NO. 1
	PROJECT NO. 100094	REVISED BY: ---/---	

APPENDIX A

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND USE GUIDELINES

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on this report or the product of our services without the express written consent of Aspect Consulting (Aspect). This limitation is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual conditions or limitations and guidelines governing their use of the report. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and recognized standards of professionals in the same locality and involving similar conditions.

Services for Specific Purposes, Persons and Projects

Aspect has performed the services in general accordance with the scope and limitations of our Agreement. This report has been prepared for the exclusive use of the Client and their authorized third parties, approved in writing by Aspect. This report is not intended for use by others, and the information contained herein is not applicable to other properties.

This report is not, and should not, be construed as a warranty or guarantee regarding the presence or absence of hazardous substances or petroleum products that may affect the subject property. The report is not intended to make any representation concerning title or ownership to the subject property. If real property records were reviewed, they were reviewed for the sole purpose of determining the subject property's historical uses. All findings, conclusions, and recommendations stated in this report are based on the data and information provided to Aspect, current use of the subject property, and observations and conditions that existed on the date and time of the report.

Aspect structures its services to meet the specific needs of our clients. Because each environmental study is unique, each environmental report is unique, prepared solely for the specific client and subject property. This report should not be applied for any purpose or project except the purpose described in the Agreement.

This Report Is Project-Specific

Aspect considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

Environmental Regulations Are Not Static

Some hazardous substances or petroleum products may be present near the subject property in quantities or under conditions that may have led, or may lead, to contamination of the subject property, but are not included in current local, state or federal regulatory definitions of hazardous substances or petroleum products or do not otherwise present potential liability. Changes may occur in the standards for appropriate inquiry or regulatory definitions of hazardous substance and petroleum products; therefore, this report has a limited useful life.

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time (for example, Phase I ESA reports are applicable for 180 days), by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope failure or groundwater fluctuations. If more than six months have passed since issuance of our report, or if any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Phase I ESAs – Uncertainty Remains After Completion

Aspect has performed the services in general accordance with the scope and limitations of our Agreement and the current version of the “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process”, ASTM E1527, and U.S. Environmental Protection Agency (EPA)'s Federal Standard 40 CFR Part 312 "Innocent Landowners, Standards for Conducting All Appropriate Inquiries".

No ESA can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with subject property. Performance of an ESA study is intended to reduce, but not eliminate, uncertainty regarding the potential for environmental conditions affecting the subject property. There is always a potential that areas with contamination that were not identified during this ESA exist at the subject property or in the study area. Further evaluation of such potential would require additional research, subsurface exploration, sampling and/or testing.

Historical Information Provided by Others

Aspect has relied upon information provided by others in our description of historical conditions and in our review of regulatory databases and files. The available data does not provide definitive information with regard to all past uses, operations or incidents affecting the subject property or adjacent properties. Aspect makes no warranties or guarantees regarding the accuracy or completeness of information provided or compiled by others.

Exclusion of Mold, Fungus, Radon, Lead, and HBM

Aspect’s services do not include the investigation, detection, prevention or assessment of the presence of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detection, assessment, prevention or abatement of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Aspect’s services also do not include the investigation or assessment of hazardous building materials (HBM) such as asbestos, polychlorinated biphenyls (PCBs) in light ballasts, lead based paint, asbestos-containing building materials, urea-formaldehyde insulation in on-site structures or debris or any other HBMs. Aspect’s services do not include an evaluation of radon or lead in drinking water, unless specifically requested.