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ENGINEERING DESIGN REPORT

Chlor-Alkali RAU, GP West Site
Bellingham, Washington

Prepared for: Port of Bellingham

Project No. 26000033 • September 23, 2026 • FINAL

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Geosyntec Consultants, Inc.



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Acronyms and Abbreviations

AO	Agreed Order
ASB	Aeration Stabilization Basin
Aspect	Aspect Consulting, a Geosyntec company
ASTM	ASTM International
BCY	bank cubic yards
bgs	below ground surface
BMC	Bellingham Municipal Code
BMP	best management practice
BNSF	BNSF Railway Company
BST	Bellingham Shipping Terminal
CAP	Cleanup Action Plan
CDF	controlled density fill
CFR	Code of Federal Regulations
City	City of Bellingham
CMMP	Contaminated Materials Management Plan
cm/sec	centimeters per second
CO_2	carbon dioxide
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPOC	conditional point of compliance
CPS	construction plans and specifications
CQA	construction quality assurance
CSBC	crushed surfacing base course
CSGP	Construction Stormwater General Permit
CWM	Chemical Waste Management
DNS	Determination of Nonsignificance
DR	dose response
Ecology	Washington State Department of Ecology

EDR	Engineering Design Report
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
GAC	granular activated carbon
GGBFS	ground granulated blast furnace slag
GP	Georgia-Pacific Inc.
GPS	global positioning system
HBM	hazardous building material
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HIW	horizontal injection well
HMA	hot mix asphalt
IDP	Inadvertent Discovery Plan
ISN	in situ neutralization
ISS	in situ solidification
kip	1,000 pounds-force
LCY	loose cubic yards
LDR	land disposal restriction
MDD	maximum dry density
mg/kg	milligrams per kilograms
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
$\mu g/m^3$	micrograms per cubic meter
MTCA	Model Toxics Control Act
NA	natural attenuation
NAVD88	North American Vertical Datum of 1988
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
QAPP	Quality Assurance Project Plan

OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PC	Portland cement
pcf	pounds per cubic foot
PEL	permissible exposure limit
PG	performance grade
pH	negative logarithm of hydrogen ion concentration
PLC	programmable logic controller
Port	Port of Bellingham
PPE	personal protective equipment
PRB	permeable reactive barrier
PRDI	pre-remedial design investigation
psi	pounds per square inch
PVC	polyvinyl chloride
RAO	remedial action objective
RAU	Remedial Action Unit
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SEPA	State Environmental Policy Act
Site	Georgia-Pacific West Site
SMP	Shoreline Master Program
SSDP	Shoreline Substantial Development Permit
SWPPP	Stormwater Pollution Prevention Plan
TCLP	Toxicity Characterization Leaching Procedure
TEQ	toxic equivalent

TESC	temporary erosion and sediment control
TPH	total petroleum hydrocarbons
UCL	upper confidence level
UCS	unconfined compressive strength
UIC	Underground Injection Control
VI	vapor intrusion
WAC	Washington Administrative Code
WSB	Wastewater Settling Basin
WSDOT	Washington State Department of Transportation
XRF	x-ray fluorescence
ZVI	zero-valent iron
γ_d	dry unit weight

1 Introduction and Project Background

This Engineering Design Report (EDR) outlines the design criteria and describes the engineering design for the cleanup actions for the Chlor-Alkali Remedial Action Unit (RAU) within the Georgia Pacific (GP) West site in Bellingham, Washington.

In January 2005, the Port of Bellingham (Port) acquired from GP, the former GP Mill property located at 300 West Laurel Street (Figure 1). In August 2009, the Washington State Department of Ecology (Ecology) and the Port executed Agreed Order No. DE 6834 (AO) that required the Port to perform a Remedial Investigation (RI) and Feasibility Study (FS) for the former GP Mill property named the GP West Site (Site). In August 2013, an amendment to the AO separated the GP West Site into the Pulp/Tissue Mill and Chlor-Alkali RAUs. In December 2014, the Port and Ecology executed Consent Decree No. 142027008 requiring cleanup of the Site, which included the Pulp/Tissue Mill RAU Cleanup Action Plan (CAP; Ecology, 2014) as Exhibit C. In September 2021, Ecology issued the CAP for the Chlor-Alkali RAU (Ecology, 2021b). In March 2022, Ecology issued a minor modification to the AO that included a revised Schedule of Deliverables for Remedial Design for the RAU, including the Draft Engineering Design Report (EDR; Aspect, 2025) as deliverable D.6 (Ecology, 2022a). In May 2026, Ecology issued a draft amendment to the CD that included a revised Schedule of Deliverables for Remedial Design for the RAU, including this Final EDR as deliverable B.1. It is anticipated that the Third Amendment to the CD will be executed by the end of September.

In July 2022, Ecology issued the CAP for the Lignin Operable Unit (OU) of the Chlor-Alkali RAU (Ecology, 2022b). The Lignin OU cleanup has been completed, as described in Section 1.1.2, and is not included in this Final EDR. Figure 1 depicts locations of both RAUs and the Lignin OU within the Chlor-Alkali RAU.

The Chlor-Alkali RAU remedial design efforts, including this EDR, and subsequent cleanup construction plans and specifications (CPS), are to be completed in accordance with the amended Consent Decree to implement the final cleanup action.

For the rest of this report, “RAU” refers to the Chlor-Alkali RAU unless otherwise specified.

1.1 Selected Cleanup Action

Ecology’s selected cleanup action for the RAU consists of the following elements (Ecology, 2021b):

Prior Cleanup Actions. Prior cleanup actions completed within the RAU are described in Section 3 of the FS (Aspect, 2018b). The most significant of these were as follows:

- **1976–1977 Wastewater Settling Basin (WSB) Cleanup**. In this action, GP excavated mercury-contaminated sludge from the historical WSB and treated it by a proprietary solidification process termed Chemfix. The roughly 8,000

loose cubic yards (LCY) of treated material were contained (capped) within the RAU (Chemfix Area).

- **1980 WSB Cleanup**. In 1980, GP decommissioned the WSB and replaced its function with improved wastewater treatment methods. During decommissioning, mercury-contaminated sludge accumulated within the basin was again removed; this time, by disposal at Chemical Waste Management's (CWM) Subtitle C landfill in Arlington, Oregon. The basin was then backfilled with imported fill material.

- **2013–2014 Caustic Plume-Cell Building[1] Interim Action**. This interim action involved removal of approximately 4,410 tons of soil and structural debris containing visible elemental mercury from the historical Chlorine Plant area. Excavated soil was solidified ex situ in an on-site treatment process and then disposed of at a Subtitle C landfill. In addition, excavated mercury-contaminated debris (concrete and wood pilings) was treated by macroencapsulation and disposed of at a Subtitle C landfill (Aspect, 2014a).

- **2017 Mercury Soil Treatment and Disposal Interim Action**. In this interim action, approximately 570 tons of soil and debris, which had been excavated and stockpiled within the footprint of the former Cell Building during the 2013–2014 Interim Action, was solidified on-site and then disposed of at a Subtitle C landfill. The debris within the stockpiled soil was segregated and treated by macroencapsulation and disposed of at a Subtitle C landfill (Aspect, 2018a).

New Cleanup Actions. The selected cleanup action includes the following new cleanup activities:

- **Removal of Obstructions and In Situ Treatment of Soils Containing Visible Elemental Mercury.** Following completion of the prior interim actions, the volume of residual Chlorine Plant area soil with potential visible elemental mercury is estimated at roughly 17,660 loose cubic yards (LCY. Much of this soil is situated within dense arrays of wooden piles that supported the foundations for the Cell Building and other Chlorine Plant infrastructure. The remaining concrete grade beams and pile caps resting on the piles will first be removed. Then Fill Unit soil will be moved, as needed, to expose the wooden piles down to the underlying native silt aquitard so that they can be cut off at the Fill Unit/aquitard interface (approximately 14- to 15-foot depth). Removing the piles in this manner will maintain the physical integrity of the aquitard to the maximum degree practical. Following removal of subsurface structures to the aquitard surface, the mercury-contaminated soil will be placed back on top of the aquitard and then treated via in situ

[1] The mercury-cell electrolysis process was housed in the Cell Building.

solidification (ISS) to reduce mercury leachability and volatilization potential.[2]

- **Neutralization of Groundwater in the Caustic Core.** Fill Unit groundwater within the Caustic Core (pH[3] > 10 standard units) will be neutralized (pH reduced to a more-neutral level), by sparging carbon dioxide (CO_2) below the water table through three horizontal directional drilled wells. Reducing the high groundwater pH will reduce mercury solubility and mobility in groundwater.

- **Removal of WSB Soils Near the Log Pond with Mercury Concentrations > 300 milligrams per kilogram (mg/kg).** Nearshore soils with mercury concentrations exceeding a 300 mg/kg remediation level are of concern with respect to the soil-to-groundwater-to-surface water pathway. Soil containing greater than 300 mg/kg mercury will be excavated from the northern[4] portion of the WSB area and disposed of off-Site.

- **Removal of Total Petroleum Hydrocarbon (TPH)-Impacted Soils in Southeast Corner of the Cell Building.** An estimated 1,300 bank cubic yards (BCY) of shallow TPH-contaminated soil in and around the southeast corner of the Cell Building will be excavated and disposed of off-site. Because a portion of these TPH-contaminated soils overlie soil containing visible elemental mercury, they will be removed prior to conducting the ISS for this area.

- **Consolidation and Capping of Residual Soils Exceeding Cleanup Levels.** An estimated 1,500 BCY of mercury-impacted soil on the BNSF Railway Company (BNSF) and the Port portions of the Stormwater Swale will be excavated and disposed of off-site, or consolidated and capped in another area of the Chlor-Alkali RAU where fill is required.

- **Monitored Natural Attenuation (MNA) of Groundwater.** MNA will address residual contamination in groundwater that exceeds applicable groundwater cleanup levels. Based on the RI data, cleanup-level exceedances in Fill Unit groundwater include mercury, miscellaneous metals,[5] naphthalene, and carcinogenic polycyclic aromatic hydrocarbon (cPAH)[6] concentrations. Mercury exceedances have also been identified in a localized

[2] Impacted soils may be moved within the treatment area ("area of contamination") to the extent required for pile removal and subsequent in situ treatment without generating remediation waste under the Resource Conservation and Recovery Act (RCRA; Aspect, 2018b).
[3] pH is the negative logarithm of hydrogen ion concentration.
[4] For consistency with previous environmental reports for the Site, this document uses project north (aka "Mill north") as its directional reference, with project north approximately 45 degrees west of true north (see north arrows on figures).
[5] Arsenic at well EMW-12S, and arsenic, copper, and nickel at well EMW-16S (Aspect, 2013).
[6] cPAH concentrations are the total toxic equivalent concentration of benzo(a)pyrene (total cPAH [TEQ]) calculated in accordance with Model Toxics Control Act (MTCA) (Washington Administrative Code [WAC] 173-340-708(8)(e)). All references to cPAH concentrations hereafter are total cPAH (TEQ).

area of the underlying Lower Sand aquifer, due to a human-made breach in the aquitard (Aspect, 2018b). Contaminants in groundwater are expected to continue to naturally attenuate through a combination of sorption, bioattenuation, volatilization, dispersion, and/or tidal mixing. Contingent actions will be considered for implementation if MNA fails to restore groundwater at a reasonable rate and is determined not to be protective of human health and the environment (remedy failure). Contingent actions could include enhanced source attenuation or downgradient groundwater treatment and/or control. Design of a contingent action would be conducted if potential failure of MNA is indicated based on groundwater compliance monitoring results, at which time substantial additional information would be available to assess the causes of failure and the most effective and practicable means to remedy it.

- **Institutional Controls.** The Port and Ecology will execute an environmental covenant for the RAU that includes institutional controls restricting certain activities and uses of the RAU property to protect the integrity of the selected cleanup action and thereby protect human health and the environment in the long-term.

1.1.1 RAU Cleanup Action Divided into Five Projects

The CAP specifies that the earthwork components of the final cleanup action will be implemented as five cleanup construction projects given the unique technical requirements for the various cleanup elements. The CAP assumed two soil removal cleanup actions in different areas of the Site would be conducted as one construction project (Project A). These two cleanup actions have subsequently been split into two discrete projects (Projects A1 and A2).

The five cleanup construction projects are depicted on Figure 2 and are as follows:

- Project A1: Stormwater Swale soil removal
- Project A2: Wastewater Settling Basin soil removal
- Project B: In situ neutralization of Caustic Core groundwater
- Project C: TPH-contaminated soil removal from the southeast corner of the Cell Building, removal of select historic subsurface obstructions (i.e., those required to be removed to facilitate ISS implementation), and ISS of elemental mercury-impacted soil in the Chlorine Plant area
- Project D: Capping following completion of the other cleanup projects

This EDR documents engineering concepts and design criteria for each of the five cleanup projects. Following finalization of this EDR for the entire cleanup, CPS will be prepared for each project in accordance with the Consent Decree Amendment Schedule of Deliverables (Ecology, 2022a).

1.1.1.1 Adjustment to Cleanup Project Sequencing

The CAP-defined division of the cleanup action components into individual construction projects may be adjusted to accommodate future land-use planning, if agreed to by Ecology and the Port. For example, at the time of preparation of this EDR, the Port is initiating design and permitting to construct a new rail spur from the BNSF mainline into the Bellingham Shipping Terminal (BST). Although the alignment of the new spur is not currently defined, it likely will cross one or more of the five cleanup project areas. That would necessitate adjusting the CAP-defined sequencing for the cleanup components to complete cleanup-related earthwork within the rail spur alignment prior to starting construction of the spur. While the redevelopment integration may change sequencing for cleanup construction, it would not change the CAP's technical requirements or standards for cleanup. Any scope or schedule changes agreed to by Ecology and the Port would be formally documented in writing, pursuant to the terms of the amended Consent Decree's Extension of Schedule sections (refer to Section 12).

1.1.2 Cleanup of Lignin Operable Unit

The RAU CAP required capping of cPAH-contaminated soil within the Lignin OU of the RAU. However, Ecology's subsequent CAP for the Lignin OU (Ecology, 2022b) changed that remedy from soil capping to soil removal, which was completed in December 2022 (Aspect, 2023a). Following completion of the soil removal action, four quarters of confirmation groundwater monitoring demonstrated that groundwater cleanup levels are achieved for the Lignin OU (Aspect, 2024a). Because the Lignin OU cleanup action has been completed and cleanup standards are achieved, this EDR does not address additional remedial action for the Lignin OU.

1.2 Goals for Final Cleanup Action

Remedial action objectives (RAOs) are specific goals for protecting human health and the environment assuming an unrestricted (nonindustrial) land use within the RAU. RAOs for the RAU are as follows:

- Prevent direct contact with and erosion of contaminated soils.
- Prevent vapor intrusion (VI) from elemental mercury-contaminated unsaturated soils or groundwater within the historical Chlorine Plant area of the RAU.
- Prevent mercury leaching to groundwater from mercury-contaminated soil and prevent discharge to the Whatcom Waterway of pH- and mercury-contaminated groundwater.
- Prevent direct contact with TPH/polycyclic aromatic hydrocarbon-contaminated (PAH) soils in both the Chlorine Plant area and the Million Gallon Tanks subarea.
- Prevent discharge to the Whatcom Waterway of cPAH/naphthalene-contaminated groundwater emanating from the Million Gallon Tanks subarea.
- Prevent VI from naphthalene-contaminated unsaturated soils or groundwater in the Million Gallon Tanks subarea.

- Prevent discharge to the Whatcom Waterway of metals-contaminated groundwater outside of the pH-impacted areas (referred to as the Miscellaneous Metals area).

1.3 Cleanup Standards and Remediation Levels

As described in the CAP, a cleanup standard consists of a cleanup level for a hazardous substance present at a site, combined with the location where the cleanup level must be met (point of compliance), and other regulatory requirements that apply to the site ("applicable state and federal laws"). A remediation level is a concentration (or other method of identification) of a hazardous substance above which a particular cleanup action component will be required as part of a cleanup action. Soil and groundwater cleanup levels for the RAU are based on unrestricted land use. The soil and groundwater cleanup standards and remediation levels applicable to the RAU are outlined below.

1.3.1 Soil

Table 1 lists soil cleanup levels and remediation levels for the soil contaminants identified in the RI and CAP. Soil cleanup levels based on groundwater protection are different for soils above the water table (unsaturated) versus soils below the water table (saturated). Soil cleanup levels based on unrestricted direct contact are the same value for unsaturated and saturated soils (e.g., total cPAHs; Table 1).

The point of compliance for soil cleanup levels based on groundwater protection is all depths within the corresponding unsaturated or saturated soil zone. The standard point of compliance for the direct-contact exposure pathway is from the ground surface to 15 feet below ground surface (bgs). However, for areas implementing soil containment (capping) as the remedy, compliance with direct-contact soil cleanup standards is determined per Washington Administrative Code (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.*

Footnotes in Table 1 describe the locations where the listed soil mercury remediation levels apply.

As described in Section 9, an environmental covenant for the RAU will specify inspection and maintenance requirements to maintain the long-term integrity of the soil caps. Other requirements for containment specified in WAC 173-340-700 will also be met.

1.3.2 Groundwater

Table 2 lists groundwater cleanup levels and remediation levels for the groundwater contaminants of concern. As described in the CAP, Ecology established a conditional point of compliance (CPOC) in the sediment bioactive zone (point of groundwater discharge) for achieving groundwater cleanup levels based on protection of marine sediment and surface water (Ecology, 2021b). The CAP also established groundwater remediation levels based on marine protection that apply at shoreline monitoring wells

located upgradient of the respective CPOCs for the Law-1 and Caustic Plume areas; the remediation levels are applied during groundwater MNA compliance monitoring for the cleanup action (Section 8).

The shoreline CPOC does not apply to groundwater cleanup levels that are based on VI risk,[7] which are applicable wherever occupied buildings are constructed in the future (standard point of compliance applies).

1.4 Report Organization

Following this introductory section, the sections of this report are as follows:

- **Section 2** – Pre-Remedial Design Investigations Summary
- **Section 3** – Common Elements of Cleanup Construction Elements
- **Section 4** – Design for Project A1: Stormwater Swale Soil Removal
- **Section 5** – Design for Project A2: Wastewater Settling Basin and Stormwater Swale Soil Removals
- **Section 6** – Design for Project B: Caustic Core Groundwater Neutralization
- **Section 7** – Design for Project C: Chlorine Plant Area Total Petroleum Hydrocarbon Soil Removal and Mercury ISS
- **Section 8** – Design for Project D: Capping
- **Section 9** – Compliance Monitoring
- **Section 10** – Institutional Controls (Environmental Covenant)
- **Section 11** – Permits and Substantive Requirements
- **Section 12** – Cleanup Completion Reporting
- **Section 13** – Schedule
- **Section 14** – References

[7] Applies for elemental mercury in the Chlorine Plant area and naphthalene in the immediate vicinity and downgradient of the Million Gallon Tanks subarea.

2 Pre-Remedial Design Investigations Summary

In accordance with the amended AO (Ecology, 2022a), two pre-remedial design investigations (PRDIs)—PRDI 2 and PRDI 3—were completed to refine a range of parameters for designing the CAP-required cleanup action.[8] The following sections describe the objectives, methods, and outcomes from PRDI 2 and PRDI 3.

2.1 PRDI 2: Subsurface Obstruction Removal and ISS Treatability Testing

The cleanup action includes removal of remnant subsurface obstructions followed by ISS treatment of soils containing visible elemental mercury in the Chlorine Plant area. The purpose of PRDI 2 was to evaluate, by field pilot testing, means and methods for removing subsurface obstructions for a portion of the Cell Building foundation, and to conduct laboratory treatability testing to evaluate ISS mix designs. The PRDI 2 Project Plan described the field pilot testing and laboratory treatability testing approach to support remedial design for this component of the cleanup action (Aspect, 2022). The PRDI 2 Data Report summarized the results and findings of the PRDI 2 Project Plan implementation (Aspect, 2023b).

2.1.1 PRDI 2 Methods

The PRDI 2 field and laboratory methods are summarized in this section, and additional detail is available in Aspect's report (2023b).

2.1.1.1 Field Pilot Testing of Obstruction Removal

To conduct the required ISS treatment, it will be necessary to first remove obstructions (e.g., large concrete elements and underlying timber pilings) within the mercury-contaminated fill down to the contact between the mercury-contaminated fill and underlying native silt aquitard unit (depth of 14 to 15 feet bgs).

The timber pilings are understood to extend through the aquitard unit into the underlying Lower Sand unit, and removal of the portion of the pilings above the fill-aquitard contact poses challenges. First, there is a natural downward hydraulic gradient across the aquitard unit from the shallow Fill Unit to the Lower Sand. As such, there is the potential for mercury contamination, and especially liquid mercury (specific gravity = 13.6), to migrate downward if not for the competent low-permeability aquitard. Site data indicate that the aquitard has effectively limited downward migration of mercury contamination into the underlying Lower Sand, and the aquitard needs to remain intact during and following the obstruction removal and ISS. Adding to the challenge is the fact the aquitard is comprised of relatively soft soil, and there is artesian pressure in the Lower Sand unit under it. As such, once the contaminated fill soil is temporarily removed to expose the pilings to the aquitard surface, the artesian pressure on the bottom of the aquitard is not counteracted by the weight of soil (pressure) on top of it, and that pressure imbalance creates the potential for liquefaction (breach) of the aquitard. Excavation conducted during the 2013–2014 interim action, and again during the field pilot testing described in this section, demonstrated the aquitard surface remained stable when

[8] PRDI 1 supported design of the Lignin OU cleanup action, which is not addressed in this EDR.

exposed for short periods of time. Nonetheless, a primary objective for the obstruction (piling) removal is that it does not compromise the physical integrity of the aquitard unit.

Given the challenges associated with the obstruction removal, a field pilot test was conducted in October-November 2022 to evaluate the means and methods of obstruction removal for a portion of the Cell Building foundation. The field pilot test evaluated means and methods for removal of three concrete pile caps, identified as J5, J4, and L4, and associated concrete grade beams and timber pilings that comprised the foundation for a portion of the Cell Building.

The specific objectives for the field pilot test were as follows:

1. Establish optimal means and methods of grade beam and pile cap removal.
2. Establish optimal means and methods for cutting timber pilings at the aquitard surface and removing them.
3. Evaluate stability of the aquitard during removal of Fill Unit soil and obstructions.
4. Evaluate the water management (dewatering) level of effort to accomplish obstruction removal to the aquitard.
5. Evaluate mercury vapor emissions and mitigation methods.
6. Evaluate grade change after obstruction removal and backfill of excavated soils.

The use of an excavator-mounted hydraulic cracker effectively removed the grade beams, including the steel reinforcement. Removal of surrounding soils and use of Dexpan® (demolition grout) was effective in fracturing the pile caps, so the hydraulic breaker could demolish the pile caps with minimal disturbance of the underlying timber pilings.

The timber pilings were successfully cut at or just below the fill-aquitard contact using a hydraulic shear attachment mounted on an excavator. The shear quickly and efficiently cut and lifted the pilings with minimal disturbance of the aquitard or the remaining section of piling extending into and beneath it.

All structural debris removed during the field pilot test was transported to the CWM Subtitle C landfill in Arlington, Oregon, where it was treated by macroencapsulation to meet federal land disposal restrictions (LDRs) for hazardous debris,[9] and then disposed of at the Subtitle C landfill.

Following the obstruction removal, the contaminated soil was returned to the excavation as backfill. No ISS soil mixing was conducted during the field pilot test. In addition, approximately 90 tons of gravel borrow was imported as backfill to account for volume lost due to the removal of structural debris. After placement of the backfill, the pilot test excavation area was restored by constructing an asphalt pavement section to match the surrounding existing asphalt surface.

The water generated from dewatering was treated on-site to remove settleable solids, and then trucked to the Port's pump station that conveys water to their Aeration Stabilization

[9] Per 40 Code of Federal Regulations (CFR) 268.45.

Basin (ASB) in accordance with the Port's National Pollution Discharge Elimination System (NPDES) Permit No. WA-000109-1.

The area of excavation open was minimized to limit mercury vapor emissions, but when areas of excavation were open, air monitoring was conducted for mercury within the breathing zone for the purpose of worker health and safety. Aspect also conducted periodic work zone perimeter monitoring for fugitive emissions at four locations. The air monitoring was conducted using a hand-held mercury air monitoring instrument (i.e., a Jerome® J505 mercury vapor analyzer).

2.1.1.2 Laboratory Treatability Testing

Laboratory treatability testing consisted of creating laboratory-scale molds of Site soil to evaluate a range of mix designs and their ability to achieve the ISS performance criteria. Soil, groundwater, and tap water were collected during the field pilot test for use in the laboratory treatability testing. The laboratory treatability testing evaluated eleven ISS-mix designs using two soil homogenates. The evaluation was based on strength, hydraulic conductivity, and leachability performance criteria.

2.1.2 PRDI 2 Findings

The results and conclusions of the completed PRDI 2 activities are summarized below. Additional details are available in the PRDI 2 Data Report (Aspect, 2023b).

2.1.2.1 Field Pilot Testing of Obstruction Removal

The completed field pilot test successfully removed the three pile caps and associated grade beams and timber pilings.

The aquitard appeared stable during removal of timber pilings with only a slight disturbance when excavations extended deeper than the brown organic-rich layer into underlying the dark gray silt layer. Terminating excavation in the organic-rich upper portion of the aquitard appeared to be effective in keeping the aquitard stable.

Dewatering was generally required during the pilot test, but flow rates were minimal. This is consistent with observations from the 2013–2014 interim action and indicates that dewatering of the Fill Unit will not create a major issue for the obstruction removal efforts.

Throughout the pilot test, mercury vapor emissions outside the excavation were minimal, under 5 micrograms per cubic meter ($\mu g/m^3$), and negligible at the perimeter monitoring locations. Because emissions complied with the action levels defined in the PRDI 2 Project Plan, no mercury vapor mitigation was required during the pilot test. With a larger excavation area during full-scale obstruction removal and ISS treatment, there may be greater mercury vapor emissions. However, the mercury air monitoring conducted during the pilot test combined with monitoring conducted during the two prior Chlorine Plant interim actions—one in the summer and one in November—show that mercury emissions are substantially decreased in cooler weather. This can be a special consideration for establishing the Project C construction schedule.

2.1.2.2 Laboratory Treatability Testing

The completed laboratory treatability testing concluded that a mix design of 15 percent total cement content,[10] as a mixture of 7.5 percent granular blast furnace slag and 7.5 percent Type I Portland Cement (PC), satisfies the Treatability Testing performance criteria and was selected as the reagent mix design for the ISS cleanup action. This mix achieved a greater than 95 percent reduction in mercury leachability from the mercury-contaminated soils, while also achieving the defined ISS performance criteria for strength (> 50 pounds per square inch [psi]) and hydraulic conductivity (< 1 x 10^{-6} centimeters per second [cm/sec]).

2.2 PRDI 3: ISN Treatability Testing and Other Data Collection

The purpose of PRDI 3 was to provide the basis of design for three CAP components: in situ neutralization (ISN) of Caustic Core groundwater, soil removal from the WSB area, and soil capping for various areas at the Site. The PRDI 3 Project Plan described the field and laboratory approach to collect data for the final design of these elements (Aspect, 2023b). The PRDI 3 data and findings were presented in the PRDI 3 Data Report (Aspect, 2024c).

2.2.1 PRDI 3 Methods

The PRDI 3 field and laboratory methods are summarized in this section. Additional detail is available in Aspect's report (2024c).

2.2.1.1 ISN of Caustic Core Groundwater

Four activities were completed to support the groundwater ISN design, consisting of initial groundwater sampling, monitoring well installation and groundwater sampling, supplemental groundwater sampling, and ISN treatability testing.

- **Initial Groundwater Sampling (April 2023).** Because the last groundwater quality sampling in the Caustic Core and surrounding area occurred in 2015 (Aspect, 2015), a monitoring well inventory and groundwater sampling event was completed in April 2023 to define current groundwater quality conditions (wet season), help scope PRDI 3 activities, and contribute to the basis of the ISN design. The April 2023 sampling results were initially presented in the PRDI 3 Project Plan (Aspect, 2023b).
- **Monitoring Well Installation and Groundwater Sampling (September 2023).** Based on the April 2023 groundwater sampling results, three new Fill Unit groundwater monitoring wells were installed to refine the extent of groundwater pH exceeding the remediation level of pH 10 (i.e., defining the extent of the Caustic Core). After the three new Fill Unit monitoring wells were installed and developed, a second groundwater sampling event was conducted in September 2023 to capture dry-season conditions.

[10] All mix percentages expressed as percentage of dry soil weight.

- **Two Supplemental Rounds of Groundwater Sampling (March and June 2024).** Two additional groundwater monitoring events were conducted in March and June 2024 to verify an anomalous 2023 groundwater pH reading and the Caustic Core extents for purposes of ISN design, and to supplement the geochemical data for key locations.
- **ISN Treatability Testing.** ISN treatability testing consisted of two phases: (1) bench-scale pH titrations using four soluble reagents (ferrous sulfate, ferric sulfate, aluminum sulfate, and ferric chloride) with Site groundwater and Site soil-groundwater slurry, and (2) column testing of two insoluble reagents (siderite and Evonik's Metafix®) and two soluble chemical reagents (aluminum sulfate and ferrous sulfate) to evaluate neutralization of Caustic Core groundwater. Flow-through column testing was conducted at the Site, using groundwater from EMW-19S, to maintain the anaerobic and reducing Site conditions.

2.2.1.2 Soil Removal from WSB Area

Supplemental soil sampling and analysis from the former WSB area was conducted in two phases (October and December 2023) to inform the design for excavation of soil exceeding the CAP's 300 mg/kg remediation level. The sampling results were used to define the excavation lateral and vertical extents, and provided analytical data for waste designation of the mercury-contaminated soils to be excavated. A total of 19 soil borings were advanced to 20 feet bgs using direct-push drilling methods. Field screening included watching for visual indications of suspected wastewater sludge residual, and use of a handheld x-ray fluorescence (XRF) spectrometer to estimate concentrations of mercury in soil across the entire length of soil core retrieved. Selected soil samples were submitted for laboratory analysis of total mercury.

2.2.1.3 Subsurface Investigation of Excavation Areas

Test pits were conducted to document dimensions and conditions of subsurface structures and utilities that may represent obstructions to excavation, or may require physical protection (or temporary removal and replacement), in areas planned for excavation during the ISS[11] and ISN components of the RAU cleanup action. Nine test pits were completed in four locations planned for ISS treatment, and three test pits were completed in preliminary locations for ISN treatment. Each test pit location was backfilled with the soil excavated from it, which were lightly compacted and then paved with asphalt to match the surrounding existing surface grade.

Test pits were completed by an excavation operator to depths of approximately 6 feet below grade or shallower if a structure or utility expected at the location was observed clearly enough at a shallower depth to allow its accurate documentation. Given the shallow water table across the area of interest, dewatering was conducted at the ISS test pits, as needed, to expose subsurface obstructions in unsaturated conditions for documentation. The water generated from excavation dewatering was collected and conveyed to the Port's pump station for the ASB.

[11] PRDI 2 addressed ISS of mercury-impacted soil, but did not include test pitting (Aspect, 2024a).

Each test pit was logged and photographed by an Aspect field geologist. During the ISS test pit excavation, Aspect also conducted air monitoring for mercury within the breathing zone for the purpose of worker health and safety using a handheld Jerome® mercury vapor analyzer. Measured mercury vapor concentrations in the breathing zone did not exceed the 100 µg/m^3 permissible exposure limit (PEL) established by the Occupational Safety and Health Administration (OSHA); therefore, application of mercury vapor suppression methods was not required.

2.2.1.4 Soil Capping

In October 2023, a mapping reconnaissance of current surface conditions was conducted within CAP-required areas of soil capping to inform cap remedial design for the RAU. The visual reconnaissance documented the type of surface (e.g., concrete, asphalt, unpaved) and its general condition (e.g., competent versus degraded) to determine its suitability as an environmental cap. The condition of the current surface cover and condition within the required capping areas, based on the visual survey, was divided into three categories:

- Category 1: Hard Cap In Suitable Condition
- Category 2: Hard Cap Absent or In Unsuitable Condition
- Category 3: Surface Obscured, Condition Uncertain

In addition, 40 shallow test pits were conducted to better delineate lateral extents of the Chemfix Area, which is to remain capped in perpetuity, per the CAP. The purpose of the test pits was to observe and define the limits of the geotextile beneath the asphalt and sand/base course without disrupting the geotextile or underlying materials to the extent practicable. The test pit methods included saw cutting the asphalt, using a small excavator to remove the asphalt, and, when needed, hand methods (shovel) to remove underlying base course material and uncover the geotextile. Once each test pit was completed, the excavated base course was backfilled into the excavation and lightly compacted by tamping with the backhoe bucket, followed by paving with hot-mix asphalt (HMA) to match the existing surface grade.

2.2.2 PRDI 3 Findings

The results and conclusions of the completed PRDI 3 activities are described in this section.

2.2.2.1 ISN of Caustic Core Groundwater

The Caustic Plume encompasses groundwater within and downgradient of the former Chlorine Plant that exceeds the pH 8.5 cleanup level based on protection of marine water. The Caustic Core is a subset of the Caustic Plume with the highest pH (pH >10). In the CAP, the Caustic Core consisted of four wells based on 2015 monitoring data: AMW-02, CP-MWA1, EMW-19S, and AMW-03. Based on the 2023–2024 data, the pH at AMW-02 is demonstrated to be less than 10; therefore, the interpreted Caustic Core extent has decreased accordingly. Consistent with groundwater pH, dissolved mercury concentrations in Caustic Plume groundwater have also generally decreased since 2015. Overall, groundwater pH within the Caustic Plume, including the Caustic Core, has slowly, but gradually, decreased over time; however, groundwater pH exceeding the

remediation level of pH 10 persists within the Caustic Core at three Fill Unit monitoring wells (CP-MWA1, EMW-19S, and AMW-03). These wells are the target for the ISN cleanup action.

The highest median and mean pH were measured during the September 2023 (peak dry season) monitoring event. To be conservative, the interpreted September 2023 groundwater pH distribution and delineation of the Caustic Core represents the baseline condition for purposes of ISN design in this EDR. Figure 2 presents the Caustic Core extents based on the PRDI 3 data.

The ISN treatability test results identified ferrous sulfate as the most effective reagent for the ISN cleanup action. The titration test demonstrated its effectiveness at achieving the pH cleanup level of 6.2 to 8.5 standard units, and the column testing indicated that the adjusted pH produces a four order-of-magnitude reduction in dissolved mercury concentrations.

Ferrous sulfate has very high solubility, making it not ideal for granular media emplaced in a trench to intercept high pH groundwater (permeable reactive barrier [PRB]). If ferrous sulfate were emplaced in trenches, the geotechnical design would need to consider the rapid dissolution and settling of the trench backfill, which could be mitigated by allowing dissolution during construction so that sufficient inert backfill is emplaced to prevent consolidation after construction. Alternatively, this design consideration could be avoided by relying on the high solubility properties and delivering the ferrous sulfate as a solution via infiltration galleries (horizontal piping in trenches) or using injection-based delivery via vertical or horizontal wells (particularly where subsurface obstructions prevent trenching). The design for ISN reagent delivery is developed in Section 6.

2.2.2.2 Soil Removal from WSB Area

Based on the collective soil characterization data, the lateral and vertical extents of soil containing mercury concentrations greater than 300 mg/kg is presented on Figure 3, with depths ranging from 10 to 19 feet bgs, depending on location. Section 5 presents the soil quality data in greater detail, along with the planned excavation limits. The excavation plan includes temporary shoring given the large excavation depth in proximity to the Log Pond and BST, and the segregation and handling of "overburden" (soil with total mercury concentrations less than the remediation level), which will be stockpiled and reused as excavation backfill in accordance with the CAP.

Based on extensive Toxicity Characterization Leaching Procedure-mercury (TCLP) testing and fish bioassay testing of investigation-derived-waste soil cuttings during PRDI 3, the mercury-contaminated soil excavated from the WSB will designate as nonhazardous waste for Subtitle D landfill disposal.

2.2.2.3 Subsurface Investigation of Subsurface Obstructions within ISS/ISN Excavation Areas

The test pits were useful in documenting locations and general dimensions of subsurface structures within the planned ISS and ISN excavation areas, which factor into design of the ISS and ISN cleanup components. Notably, very large concrete footers,[12] which supported historical aboveground chlorine storage tanks, were verified in ISN test pits

[12] Approximate dimensions of 14.5 feet wide by 70 feet long by 5 feet deep.

ATP-01z through ATP-03z. These monolithic subsurface obstructions are a significant ISN design consideration that would impede or prevent the construction of trenches, if used, to deliver ISN reagent.

2.2.2.4 Soil Capping

The surface-condition information is used in the capping design in Section 8 to establish areas that will require new hard capping (termed Categories 2 and 3) to meet CAP requirements. Given expected changes to Site use (and thus surface conditions) during the time period between the October 2023 reconnaissance and when the capping will be designed and constructed, areas that had hard cap in suitable condition (Category 1) or that were obscured from observation (Category 3) during the 2023 reconnaissance will need to be field verified again during final design (plans/specifications) for capping. The capping design will also be integrated with planning and design for future redevelopment structures and utilities as that information becomes available following completion of this EDR.

Within the Chemfix Area, for which lateral extents are inferred from historical information that is schematic without survey control, the test pits did not locate the geotextile membrane on the western side of the Chemfix Area. Therefore, one deep test pit, ATP-11D, was advanced within the expected footprint of the Chemfix Area to a total depth of approximately 7 feet bgs, which confirmed the presence of the Chemfix material (light gray cementitious-like material), beginning at approximately 5 feet bgs, with no overlying geotextile. The test pits also indicated the Chemfix Area extends roughly 30 feet farther north, and roughly 20 feet less far to the east, than indicated by the available historical information.

The Chemfix Area polygon presented in the CAP has been refined based on these test pit results for purposes of capping design (Figure 2). The lack of geotextile on the western side of the Chemfix Area will be factored into cap design for that area (Section 8).

3 Common Elements of Cleanup Construction Projects

This section describes components that are common to each of the five cleanup construction Projects, rather than repeating the information for each Project in the subsequent sections. Project-specific requirements within the common elements are identified where applicable.

3.1 Preconstruction Submittals

Prior to start of construction for each cleanup Project, the Port's selected Contractor will prepare and submit for Engineer approval the following preconstruction submittals that will be specific to individual Project requirements:

- **A Stormwater Pollution Prevention Plan (SWPPP)** describing erosion, sedimentation, and stormwater control best management practices (BMPs) to manage and prevent stormwater runoff and fugitive dust emissions from leaving the construction site. The SWPPP and BMPs will be implemented by the Contractor and comply with City of Bellingham (City) requirements throughout completion of the soil removal action.
- **Excavation and Backfill Plan** detailing the Contractor's planned means and methods for soil excavation; materials segregation and stockpiling on-site; loading and off-site transportation of excavated materials; excavation backfill and compaction; and, if required, paving of excavated areas. The plan will also identify the permitted off-site facilities for disposal or recycling of materials generated during excavation.
  - For Project A, which requires temporary shoring of the deep excavation within the WSB, an **Excavation, Temporary Shoring, and Backfill Plan** will also be prepared. In addition to the Excavation and Backfill Plan requirements detailed above, this plan will include the Contractor's planned means and methods for temporary excavation shoring, including specific shoring elements and locations; installation methods and equipment; and calculations stamped by a qualified, licensed professional engineer in the State of Washington. The plan will also contain specific measures for temporary support and protection of any adjacent existing utilities and/or structures, as needed.
  - For Project C, involving ISS, an **ISS Plan** will be prepared in lieu of the Excavation and Backfill Plan. The plan will detail the Contractor's planned means and methods for removing surface obstructions in all remediation areas (including recycling or disposal), and excavation and off-site disposal of TPH-contaminated soils. Also, within the areas to be treated using ISS, the plan will detail temporary soil excavation/stockpiling and removing subsurface obstructions down to the aquitard (base of ISS treatment); off-site disposal of removed hazardous debris; steps for conducting the ISS treatment; implementing mercury vapor controls, including a contingency

for mobilizing and working within a vapor enclosure and air treatment within the enclosure; loading and off-site transportation of ISS swell materials that cannot be contained on-site; and paving of the ISS-treated areas. The plan will also identify the permitted off-site facilities for disposal or recycling of excavated materials specified for those endpoints.

- **Water Management Plan** detailing the Contractor's planned means and methods for excavation dewatering, collection of runoff within stockpile or other areas, and treatment and discharge of the construction-generated water to comply with applicable permit requirements.
- **Health and Safety Plan** that describes the Contractor's Project-specific control zones, procedures, and personal protective equipment (PPE), safety-related monitoring, emergency response, route to hospital, and personnel health and safety training certifications, etc., as required under 40 Code of Federal Regulations (CFR) 1910.120.
- **Construction Schedule** that identifies construction activities and milestones with estimated durations.

3.2 Mobilization and Site Preparation

Cleanup mobilization and preparation activities for each Project include the following actions:

- Conduct a public one-call utility locate and subcontract a private utility locate service to identify utility locations within areas of subsurface disturbance.
- Mobilize construction equipment, materials, and utilities (e.g., construction trailer, electrical generators, water tanks).
- Mobilize, install, and test water management equipment, as necessary.
- Construct a bermed and lined stockpile area(s) with a segregated area for stockpiling excavated contaminated materials pending transportation for off-site landfill disposal or on-site placement/capping, and a separate area for stockpiling inert debris (e.g., uncontaminated concrete rubble) pending transportation for off-site recycling.
- Construct temporary erosion and sedimentation controls (TESC) so that no materials track out, and no construction stormwater or fugitive dust leaves the Site throughout cleanup earthwork, in accordance with the SWPPP.
- Decommission existing monitoring wells within or adjacent to earthwork areas, in accordance with the provisions of Chapter 173-160 WAC.
- Establish perimeter fencing for security of each cleanup action area, as warranted, in consultation with the Port.

3.3 Temporary Erosion and Sediment Controls

To prevent erosion, appropriate TESC measures will be used for both areas of cleanup earthwork, in accordance with the SWPPP. If material track-out is noted after a construction vehicle exits the Site, the Contractor will be required to immediately remove the tracked-out material and modify the construction exit to prevent further track-out. Other TESC measures may include appropriately placed silt fencing, straw wattles, rock check dams, and plastic covering of soil stockpiles. The Contractor will also apply BMPs (applying water to exposed soils), as needed, to prevent fugitive dust emissions from leaving the Site during the cleanup earthwork. Trucks used for the cleanup construction will be required to follow City-designated truck routes when driving to and from the Site.

3.4 Temporary Excavations

Construction and earthwork are typically most economical when performed during dry-weather conditions. Appropriate erosion control measures should be implemented prior to beginning earthwork activities, in accordance with the local and state regulations. The presence of potential obstructions, such as small boulders, buried logs, or other debris, should be anticipated within excavation areas.

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts greater than 4 feet in height that are not protected by trench boxes or otherwise shored should be sloped in accordance with Part N of Chapter 296-155 WAC for worker safety. The fill and native deposits present across each Project's planned cleanup area are expected to classify as OSHA Soil Classification Type C. Temporary excavation slopes in Type C Soil should be inclined no steeper than 1.5H:1V (horizontal:vertical). Experience with recent excavations at the Site has demonstrated the soils exhibit some apparent cohesion such that excavation slopes inclined at 1H:1V may be completed safely for the relatively short durations the excavation are open; however, given the highly variable fill soil, this may not be feasible in all excavations. If the Contractor proposes to incline temporary excavation slopes steeper than 1.5H:1V, the slopes should be monitored daily for stability by a competent person identified by the Contractor in consultation with the Engineer.

The cut-slope inclination estimated above is for planning purposes only and should be evaluated in the field by the Contractor in consultation with the Engineer. Flatter slopes may be necessary if groundwater seepage exists, if traffic or construction surcharges are present, or where less-stable soils are present. Job site safety is the Contractor's responsibility, and the Contractor must monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly. The Contractor will also be responsible for controlling groundwater and surface water inflows, and should employ sloping, slope protection, ditching, sumps, dewatering, and other measures necessary to prevent sloughing of soil.

3.5 Monitoring for Archaeological Resources

Excavation work conducted for the cleanup action will be completed in accordance with an Inadvertent Discovery Plan (IDP), which defines the stop-work and notification procedures to perform in the event of discovering potential archaeological materials

while completing the excavation. Appendix A includes an example IDP, which may be revised, as appropriate, for each cleanup project conducted for the RAU remedy.

The RAU cleanup excavation work will occur primarily in non-native fill soils; therefore, there is a low likelihood for encountering archaeological materials. However, if the native soil horizon is encountered beneath the fill, the materials excavated from it and immediately above it will be observed by the Engineer overseeing the excavation activities, with attention paid to looking for evidence of potential archaeological materials (e.g., animal bone, fire-modified rock, concentrations of shell, ground/flaked stone tools and flaked stone tool-making debris, burned earth, cordage or fiber, organically stained sediments, charcoal, ash, and exotic rocks and minerals).

If the Engineer observes potential archaeological materials in the excavation, the Engineer will stop the excavation work and make notifications, in accordance with the IDP. A professional archaeologist may be mobilized to the excavation location to observe and assess the materials encountered and determine the appropriate path forward, in accordance with applicable laws and regulations. In that case, cleanup-related work can proceed in locations away from that excavation location unless such work would interfere with the protection and evaluation of potential archaeological materials encountered.

3.6 Stockpile Management

Stockpiles of material excavated during a Project (e.g., contaminated soil awaiting loading for disposal, overburden[13] soils awaiting reuse as backfill, or debris awaiting recycling) will be stockpiled within a designated stockpile area that will not hinder completion of the cleanup activities. The location of the stockpile area may change through the course of construction, if needed. Materials will be transported within the cleanup work area in a way to limit spillage of materials between the excavation location and the stockpile location.

Within each Project's designated stockpile area, stockpiles of materials representing different waste streams (for disposal, recycling, or reuse) will be segregated such that intermixing does not occur. Each stockpile of contaminated material will be underlain by plastic sheeting with a minimum 10-mil thickness, with adjacent sheeting sections continuously overlapped by a minimum of 3 feet. The ground surface on which the sheeting will be placed will be free of objects that could damage the sheeting. In addition, a layer of geotextile or plywood will be required on top of the sheeting to protect it. The perimeter of each stockpile area will be bermed to prevent stormwater run-on into or runoff out of it.

Each stockpile of contaminated material will be covered when not in active use by plastic sheeting of minimum 10-mil thickness. Each stockpile cover will be anchored (e.g., using sandbags) sufficiently to prevent it from being removed by wind. The stockpiles will be covered when not in use, and, if needed, during periods of rain and wind to prevent transport outside of the stockpile area. In addition, when mercury-contaminated soils are temporarily stockpiled pending ISS, the Contractor will be required to implement all

[13] Soil with contaminant concentrations below applicable cleanup levels or remediation levels and suitable for reuse as excavation backfill.

measures required to mitigate the generation of fugitive mercury vapors from the stockpile area, including use of a mercury vapor suppressant solution or foam (refer to Section 7.5).

Water accumulating in the stockpile area will be pumped to the Project-specific water management system described in Section 3.7.

3.7 Excavation Dewatering and Water Management

Dewatering of Project excavations will be conducted to maintain unsaturated excavation conditions, which will facilitate soil excavation, handling, loading for transport, and excavation backfilling. Means and methods for dewatering will be determined by the selected Contractor and, based on past excavation and dewatering projects across the Site, are likely to include temporary sumps within the open excavation. The Contractor will present for Engineer approval their proposed means and methods for excavation dewatering and management of that water in a Water Management Plan prior to construction (see Section 3.1).

Groundwater extracted during excavation dewatering, and any water accumulating within the contaminated soil stockpile area, will be conveyed to the Contractor's temporary on-site water treatment system where it will be treated, as needed, to meet all permit requirements for discharge.

It is assumed, for purposes of this EDR, that the City will not allow discharge of dewatering water to their sanitary sewer system. It is currently anticipated that the Port's ASB, to which all stormwater on the Site is currently discharged and is permitted to accept "non-routine discharges," including dewatering water, will become unavailable for discharge by the end of 2027.

If a cleanup Project is completed prior to the ASB going offline, the water generated from excavation dewatering can be conveyed to the Port's on-site pump station for the ASB,[14] in accordance with the Port's NPDES permit for the facility, contingent on receiving written permission from Ecology's Water Quality staff managing the NPDES permit.[15] In that case, the water would be treated prior to discharge to meet the permit requirements and monitored by visual observation to confirm no floating sheens and by measurement of total settleable solids content using an Imhoff cone.

If the ASB is not available at the time of Project execution, the dewatering water would be discharged to surface water via Port storm drain in accordance with a NPDES Construction Stormwater General Permit (CSGP) with project-specific Administrative Order issued by Ecology's Water Quality program. In this case, the Port would obtain the CSGP with Administrative Order, but, upon the execution of the contract for the Project, the Port would transfer the permit in full to the Contractor using Ecology's Transfer of Coverage form. The Contractor would then be responsible to comply with all Administrative Order provisions, including testing the initial treatment batch to

[14] Located next to the Whatcom Waterway within the Pulp/Tissue Mill RAU.
[15] Permission requires the Port transmitting a letter to Water Quality, at least 30 days prior to start of discharge, that provides requisite information related to the proposed discharge's compliance with the NPDES permit condition S7 for non-routine and unanticipated discharges of water.

demonstrate achievement of permit indicator levels prior to any discharge, obtaining Ecology approval for flow-through operation and discharge based on the batch testing results, and conducting monitoring and reporting to Ecology throughout the duration of treatment and discharge.

Prior to demobilization of the temporary water-treatment system, the Contractor will clean tank(s) used for temporary storage and settling of solids, including profiling and proper off-site disposal at a permitted facility of any accumulated solids within the tank(s).

3.8 Loading and Off-Site Disposal of Excavated Materials

Prior to the start of each Project, each Project's contaminated material waste stream will be profiled, based on available sample data, to obtain preapproval for proper off-site disposal at a landfill permitted to accept it. Depending on landfill requirements at the time, additional sampling may be required. The Contractor will be responsible for selecting and subcontracting with the landfill(s) permitted to accept each of the waste streams identified in the CPS. The Contractor will provide the Port's Engineer with copies of the certificates of disposal for material disposed of off-site, and the Engineer will include them in the As-Built Cleanup Report for the project.

The truck route for each cleanup project will not include residential streets. Trucks hauling contaminated materials from the Site will remain covered from the time they leave the Site until they off-load at the designated facility.

3.9 Investigation-Derived Waste

The water generated during the development and purging of the monitoring wells will be discharged to the Port's ASB. If the ASB is no longer available for use, the purge water will be placed in labeled Washington State Department of Transportation-approved (WSDOT) drums for profiling and proper off-site disposal. Soil cuttings generated from drilling of new monitoring wells will also be placed in labeled WSDOT-approved drums for sampling and profiling for appropriate off-site disposal.

The direct-push probe rods from monitoring well installation will be decontaminated prior to the first boring and between each monitoring well boring using a steam cleaner. Rinsate from decontamination of equipment, and water produced during development for replacement wells, will be managed as described above for purge water.

Drilling fluid (mixed solids and liquids) from installing the horizontal injection wells (HIWs) will be managed separately, as follows. Mixed solids and liquids from drilling activities will be stored in watertight roll-off boxes, and liquids (primarily development water) will be containerized separately. Drilling cuttings/mud will be stabilized/solidified on-site (e.g., using ZapZorb and Calciment®) and will be disposed of as nonhazardous waste in accordance with WAC 173-303. Nonhazardous waste designation will be verified with analytical results.

4 Design for Project A1: Stormwater Swale Soil Removal

As described in Section 1, Project A is split into two discrete soil removal projects in the former Stormwater Swale and WSB areas (Figure 2). This section presents the remedial design of Project A1:Stormwater Swale Soil Removal.

As envisioned in the CAP, the Port has elected to permanently remove all soil exceeding the 24 mg/kg cleanup level from the Stormwater Swale on both BNSF and Port property and dispose at a Subtitle D landfill, or consolidate and cap in another area of the Chlor-Alkali RAU where fill is required. The excavation will be backfilled to existing grade with clean imported material. Compliance with cleanup levels will be demonstrated with soil verification sampling at the excavation limits, and therefore the Stormwater Swale area remedy will not require a hard cap or institutional controls.

Based on the existing sample data, the extent of soils with mercury concentrations greater than 24 mg/kg located within the former Stormwater Swale is expansive, but shallow, extending to depths of approximately 1 foot[16]. Figure 10 depicts the soil mercury data, the lateral extents of mercury cleanup level exceedances, and, within that area, the planned lateral extent of Stormwater Swale area soils to be excavated.

The following sections describe the primary components of the Project A1 cleanup action beyond the common elements described in Section 3.

4.1 BNSF Coordination

During final design for Project A1, the Port will coordinate with BNSF regarding access and other requirements for performing the soil removal and backfill activities on BNSF property.[17] As required by BNSF, all cleanup-related work will be performed more than 25 feet from the centerline of the nearest active rail line; Figure 10 depicts the approximate location of the BNSF's 25-foot setback.

4.2 Stormwater Swale Excavation

The initial step in the excavation process will be temporary removal of the Port's chain link fence that runs along the Port-BNSF property boundary within the planned work area (up to approximately 700 linear feet), and installing a temporary construction fence on the BNSF 25-foot setback. The Contractor will also locate the Clearwater Line, an active stormwater pressurized main that will remain in place during construction.

The mercury-contaminated soil will be excavated to a depth of 2 feet bgs, or an approximate elevation of 12.5 feet NAVD88.[18] The estimated soil quantity to be

[16] Subsequent to sample collection, approximately 1 foot of concrete rubble was placed in the Stormwater Swale area resulting in the current depth of mercury-contaminated soils of up to 2 feet bgs.
[17] Following their review of the draft FS for the Chlor-Alkali RAU and a meeting with Ecology and the Port, BNSF transmitted to Ecology comments on the document, including the statement "BNSF stands ready to work with the performing parties on an appropriate access agreement facilitating access to railroad property." (BNSF, 2017).
[18] All elevations are relative to the North American Vertical Datum of 1988 (NAVD88).

excavated based on the planned removal limits shown on Figure 10 is approximately 1,500 BCY (all estimated quantities are shown in the table in Section 4.3). The excavated soil will be temporarily stockpiled, if needed, and exported off-site for disposal at a Subtitle D Landfill, or stockpiled for reuse as fill underneath one of the Chlor-Alkali RAU hard capped areas. The shallow excavation is not expected to encounter the water table; however, any stormwater accumulating within the excavation will be removed and managed on-site, as described in Section 3.7, to allow handling of unsaturated soils. The excavation will be extended laterally or vertically, as needed, to meet cleanup levels, as determined from excavation compliance verification soil sampling described in the following subsection.

4.2.1 Stormwater Swale Excavation Compliance Sampling and Overexcavation

Excavation compliance verification soil samples will be collected from the BNSF-property excavation sidewalls and base to confirm that the residual soil comply with the 24 mg/kg soil mercury cleanup level for unrestricted land use. Compliance verification soil sampling will be conducted in accordance with the Compliance Monitoring Plan for Soil – Stormwater Swale Excavation in Appendix B.

The excavation verification soil samples will be collected on a systematic 50-foot grid across the excavation bottom. On the excavation bottom, a 3-point composite sample will be collected within each 50-foot by 50-foot square to document that the cleanup level is met at depth—vertically bounded. In addition, one discrete sample will be collected along the shallow excavation sidewalls within the same grid (every 50 linear feet) to document that the lateral extents of soil exceeding the cleanup level have been removed[19].

Given the shallow depth of excavation, the verification soil samples will be collected by hand using a decontaminated stainless-steel spoon or disposable spoon. The excavation verification soil samples will be submitted to an Ecology-accredited analytical laboratory for analysis of mercury (U.S. Environmental Protection Agency [EPA] Method 7471). Typically, 24- or 48-hour turnaround will be requested for the verification sample analyses to not delay the field decision making and overall progress for the soil removal action.

Where the detected concentration of mercury in an excavation sidewall soil sample exceeds the 24 mg/kg cleanup level, the length of sidewall represented by the sample will be overexcavated a minimum 1 foot laterally and a new sidewall-verification sample will be collected. Likewise, where the mercury concentration in an excavation-bottom sample exceeds the cleanup level, the excavation area represented by the sample will be deepened by a minimum 0.5 foot, followed by collection of a new bottom-verification sample.

The excavation lateral and vertical extents will be extended to the maximum extent practicable, as constrained to south by BNSF 25-foot setback and the presence of the

[19] This sampling density will result in an at least 35 samples to verify compliance.

Clearwater Line within the excavation limits. The Clearwater Line will remain in place and protected during construction.

As the excavation progresses and samples representing contaminated soils are removed and replaced by new verification sample data, compliance of the residual in-place soils on the BNSF property with the target cleanup level will be evaluated by applying the Model Toxics Control Act (MTCA) 3-part compliance criteria (WAC 173-340-740(7)(d) and (e)), where compliance is defined as follows:

- The 95 percent upper confidence limit (95 percent UCL) on the mean concentration is less than the target cleanup level.
- All residual soil concentrations are less than or equal to two times the target cleanup level.
- The frequency of soil sample exceedance is less than 10 percent.

Excavation will proceed until the dataset representing in-place soils on BNSF property comply with the 24 mg/kg cleanup level applying the MTCA 3-part criteria.

4.3 Excavation Backfill, Grading, and Quantities

The excavation will be backfilled using imported gravel borrow as defined in WSDOT's *Standard Specifications for Road, Bridge and Municipal Construction* Section 9-03.14(1) (Standard Specifications; WSDOT, 2025). The backfill will be compacted to 95 percent of the maximum dry density (MDD) as determined by ASTM International (ASTM) D1557 (ASTM, 2021). The backfill finish grade will be generally flat and match surrounding grades.

The restoration activities will also include reconstructing the removed portion of chain link fence along the Port-BNSF property boundary.

The estimated quantities associated with the Stormwater Swale Soil Removal project are presented below.

Stormwater Swale Soil Removal Estimated Quantities

Excavation Volume (BCY)	Excavated Soil for Disposal or Reuse (Tons)	Imported Backfill Volume (BCY)
1,500	2,300	1,500

Notes: BCY = bank cubic yards

4.4 Consolidation and Hard Capping of Excavated Soils on Port Property

As stated in Section 1.1, the Port is currently planning for the construction of a new rail spur (from the BNSF mainline) and five loading tracks within the BST. The CAP's consolidation and hard capping of the excavated soil around the Port's portion of the Stormwater Swale area is an encumbrance to the rail spur project based on that project's geotechnical requirements. Therefore, instead of disposal of a Subtitle D Landfill, the

Port may propose for Ecology concurrence that the excavated soils be consolidated and capped within an area where fill is required for the rail spur project, conceptually depicted on Figure 2.

If Stormwater Swale soil is consolidated and capped on the Port property, the hard cap will consist of minimum 3 inches of HMA overlying 4 inches of compacted crushed surfacing base course (CSBC). The HMA will be Class 0.5-inch and Performance Grade binder of PG 64-22 compacted to a minimum of 92 percent reference density, per ASTM D2041. The plan for managing excavated Stormwater Swale soil will be reviewed and approved by Ecology in the CPS for Project A1.

5 Design for Project A2: Wastewater Settling Basin Soil Removal

As described in Section 1.1.1, Project A is split into two discrete soil removal projects in the former Stormwater Swale and WSB areas (Figure 2). This section presents the remedial design of Project A2: Wastewater Settling Basin Soil Removal. The cleanup will excavate and landfill soil from the historical WSB area that contains mercury concentrations exceeding the 300 mg/kg remediation level defined in the CAP. Soil with mercury concentrations less than the remediation level will be returned to the excavation as backfill, and supplemented with imported clean fill. The excavation backfill will be compacted, and the excavation area will then be capped with HMA pavement.

The excavation will extend to depths of 11 to 19.5 feet bgs and require temporary shoring and dewatering. The extensive sampling conducted during PRDI 3 and summarized in Section 2.2.2.3 was conducted to pre-define the excavation limits using the PRDI 3 sample results that comply with remediation levels. Therefore, no soil confirmation sampling is necessary during the implementation of Project A2.

The following sections describe the primary components of the Project A2 cleanup action beyond the common elements described in Section 3.

5.1 WSB Excavation

Soil with mercury concentrations exceeding the 300 mg/kg remediation level (termed "contaminated soil" for this section) will be removed and disposed of at a permitted Subtitle D landfill. Soil with mercury concentrations less than the 300 mg/kg remediation level (termed "overburden" for this section) will be temporarily stockpiled within the work area and then reused as excavation backfill.

The contaminated soil is generally located at depth because it is due to remnant sludge on the bottom and sides of the historical WSB before it was filled in 1980. Figure 3 depicts the soil mercury data for the WSB area in plan view, with samples exceeding 300 mg/kg displayed in red font. Figure 3 also depicts the lateral extents of the approximately 11,000-square-foot remedial excavation required to remove contaminated soil from the WSB area.

Based on the soil characterization data, the contaminated soil is distributed northeast ("downstream") of the historical inlet pipe to the WSB shown on Figure 3. The thickest accumulation of contaminated soil is located near the inlet pipe, thinning from there toward the north and east. At the two borings located closest to the inlet pipe (WSB-110 and WSB-112), mercury concentrations exceeding the remediation level were detected in samples at depths of 11.0, 12.0, 16.0 and 16.5 feet bgs. At both locations, sample results significantly less than the remediation level occur at depths of 6.5, 7.0, 19.5, and 20.0 feet bgs. These results indicate the contaminated soil at these boring locations is less than 13 feet thick.

At eight of the other nine borings with remediation level exceedances, the exceedances were detected in a single sample at depths ranging between approximately 8 and 18 feet bgs (Figure 3). The variable depths at which the remediation level exceedances occur are

likely due to a combination of how the WSB was constructed (internally sloping earthen sidewalls and variable bottom depths) and differences in the depth and completeness of excavation during GP's two historical sludge-removal efforts. At the two northeastern-most borings, WSB-119 and -120, the remediation level exceedances were limited to a 3-inch layer of black sludge-like material observed at depths of 17.5 and 16.5 feet bgs, respectively.

The one exception to contaminated soil occurring at depth is boring WSB-109, located near the east side of the WSB (Figure 3). At that location, a mercury concentration of 1,700 mg/kg was detected in a 3-inch layer of black sludge-like material encountered at a depth of 1.5 feet bgs (an exceedance of 450 mg/kg was also detected in the 10-foot sample from this boring; Figure 3). The anomalous and isolated shallow occurrence of sludge-like material at WSB-109 is likely due to inadvertent materials mixing during the 1980 WSB sludge excavation and filling processes.

Because of the variable depths of contaminated soil within the excavation's lateral extent, the excavation will be completed in eight cells that extend to the depth of samples with results complying with the remediation level, establishing compliance with the remediation level at the excavation limits. The excavation depth necessary to comply with remediation levels ranges from 11 to 19.5 feet below grade (elevations of +4.0 to -5.0 feet NAVD88), abutting the Port's BST on the west and in proximity to the tidally influenced Log Pond (Whatcom Waterway) on the north. Figure 4 depicts the excavation plan's eight cells with their respective bottom elevations. Figure 4 also depicts a conceptual plan for temporary excavation shoring support that is required based on the large excavation depths (near the Log Pond) and the excavation's immediate proximity to the active BST that precludes sloped excavation sidewalls. The excavation shoring is discussed further in Section 5.1.1.

In addition, Figure 4 depicts locations for three subsurface cross sections: A-A' aligned north-south through the central portion of the excavation, B-B' aligned north-south through the eastern portion of the excavation, and C-C' aligned east-west through the central portion of the excavation. The three cross sections, Figures 5, 6, and 7, respectively, illustrate, for each alignment, the depths (elevations) of the overburden soil to be excavated and reused as backfill, the contaminated soil to be excavated and disposed of at a Subtitle D landfill, and the underlying native soil, along with the distribution of soil samples with mercury concentrations greater than and less than 300 mg/kg (red and green symbols, respectively). While the WSB area is relatively flat, there is some variability in ground surface elevations.[20] Therefore, the excavation bottoms for the overburden and contaminated soil are identified as elevations not depths (Figures 4 through 7), which are performance standards to be surveyed by the Contractor during excavation.

Because the shored excavation extents are established at locations and depths with sample data confirming mercury concentrations less than the 300 mg/kg remediation level, excavation verification sampling and analysis will not be conducted.

[20] Figure 4 shows topographic elevation contours (NAVD88).

5.1.1 Temporary Excavation Support

The WSB excavations will extend to depths between 11 and 19.5 feet bgs (excavation bottom elevations of +4.0 to -5.0 feet NAVD88), which will require dewatering and the installation of temporary shoring, possibly combined with sloped excavation cuts where feasible. Figure 4 shows the excavation footprint and required lateral extents of temporary shoring on the entire western and northern sides, and a portion of the eastern side, of the excavation. The lateral extent of required temporary shoring may be refined during final Project design (CPS) in consultation with the Port and considering adjacent land-use activities or other considerations at that time. As stated in Section 3.1, the Contractor will be responsible for submitting for Engineer review, prior to construction, an Excavation, Temporary Shoring, and Backfill Plan that includes the detailed shoring design prepared by a licensed engineer.

The rest of this section provides an overview of subsurface conditions pertinent to shoring design, feasible temporary shoring options, considerations, and design inputs to be used by the Contractor.

- The subsurface conditions in the excavation area consist of fill that extends to the bottom of the excavation overlying native deposits. The fill was placed during the 1980 backfilling of the WSB and consists of silty sand, sandy silt, sand with silt, gravelly sand, silty gravel with sand, and sandy gravel. The fill material is relatively loose and noted to contain deleterious materials including wood and brick fragments and roots. While not expected in significant quantities, the Contractor should be prepared for the presence of cobbles, boulders, and larger woody debris, as well as other obstructions in the fill. The native soils underlying the fill are tide-flat and nearshore type deposits that consist of silt, silty sand, and sand. The native soils are relatively loose/soft and noted to contain organics, woody debris, and seashell fragments.

- Groundwater in the excavation area is expected to be quite shallow with only minor tidal influence. A groundwater table depth of 5 feet bgs (elevation +9.5 to +10 feet; Figures 5 through 7), with tidal fluctuations less than 0.5 feet,[21] should be assumed for design of temporary shoring.

- Interlocking driven steel sheet piles can provide a relatively impermeable shoring system for the excavation and are considered the most reliable temporary shoring option for the WSB excavation. When driven into the underlying native soils, the sheet pile system will be an effective cut off for inflowing groundwater. Vibratory installation methods are feasible; however, the Contractor should be prepared to remove/move obstructions or loosen dense portions of the fill via predrilling. Other temporary shoring methods, such as soldier piles and lagging, are also feasible, but typically are slower to construct and do not cut off groundwater flow.

- Some water seepage through the unshored sidewalls and bottom of the excavation will still occur under the proposed approach. We anticipate the

[21] Based on tidal study data collected in 2009–2010 (Aspect, 2013).

flows will be relatively low, depending on the open area of excavation at any time, and will be manageable by pumping from strategically placed sumps within the excavation bottom.

- Due to the low shear strength and passive resistance offered by the relatively weak native soils, for excavations as deep as 19 feet bgs, a row of internal braces or anchors will be required. Due to the soil and groundwater conditions, drilled and grouted tiebacks should not be used; therefore, internal braces or deadman anchors are considered the two feasible options for anchored sheet piles. For driven steel sheet piles with an exposed height of 19 feet, and a single brace 5 feet deep at a 5-foot spacing, it is estimated an embedment of 18.5 feet and sheet pile steel sections with a section modulus of 22 cubic inches per foot will be required with a brace/strut force of about 50,000 pounds-force (50 kips; if braces spaced at 10 feet, then brace/strut force of about 100 kips).
- There are two feasible methods of temporary excavation (general requirements for temporary excavations are described in Section 3.4) and shoring, as described below:

    1. Complete the excavation in rectangular cells with sheet piling on all four sides such that opposing walls can be braced against each other. With this approach, one row of internal bracing at about 5 feet bgs would be sufficient. It is estimated an embedment equal to about the exposed height of the excavation will be required (i.e., sheet pile length twice the excavation depth). This approach would minimize dewatering and eliminate the need for buried deadman anchors; however, it would require more installation and removal of sheet piling and likely a slower excavation in comparison to option 2 below.

    2. Complete the excavation as one mass excavation using a combination of sheet pile temporary shoring where required and sloped excavations where this is practical given surrounding land-use activities, etc. Temporary shoring will be required on the north, west, and northeast sides of the excavation due to Site constraints; however, sloped excavations ramping down into the excavation should be feasible on the south and southeast sides of the excavation (Figure 4). The temporary shoring in this option would need to be restrained either via buried deadman anchors behind the walls, or diagonal braces internal to the excavation extending from the walls to base (rakers), both of which are likely more challenging to install compared to internal bracing against opposite sides (option 1). Based upon preliminary calculations, deadman anchors would need to extend below groundwater and be tightly spaced or a continuous wall behind the main shoring wall, both of which likely make them cost-prohibitive. This approach may require more robust temporary dewatering than option 1; however, given the short excavation duration, it is anticipated groundwater inflow will still be manageable with strategically placed sumps with submersible pumps.

- Cantilevered sheet piles are likely feasible for excavation depths are up to approximately 13 feet. For cantilevered driven steel sheet piles with exposed heights up to 13 feet, it is estimated an embedment depth of 43 feet and steel sheet piles with a section modulus of 55 cubic inches per foot would be required.
- Slide rail temporary shoring is also potentially a feasible option for the WSB excavation. Slide rail shoring may require smaller excavation cells (compared to sheet piles) and a more robust dewatering system, but will be quicker to install compared to driven sheet piles.
- The lateral extent of required temporary shoring may be refined during final Project design in consultation with the Port and considering adjacent land use activities or other considerations at that time.

Ultimately, the Contractor is in the best position to select the most appropriate and cost-effective combination/type of temporary shoring, dewatering, and excavation staging to accomplish the WSB excavation. As stated above, the Contractor will be responsible for designing the integrated excavation, shoring, and dewatering methods, and presenting them for Port approval in an Excavation, Temporary Shoring, and Backfill Plan prepared by a licensed engineer prior to construction.

The temporary shoring system must be designed and constructed to support lateral loads exerted by the retained soil mass and unbalanced hydrostatic pressures. In addition, any surcharge from construction equipment, construction materials, or excavated soils should be included in the shoring design. Precautions must be taken during removal of the shoring to minimize disturbance to adjacent infrastructure. The temporary shoring will be designed using the earth pressure diagrams provided on Figures 8 and 9, which are based upon the soil properties tabulated below.

Recommended Soil Properties for Temporary Shoring Design

Soil Unit	Moist Unit Weight / Saturated Unit Weight (pcf)	Friction Angle (deg)	Cohesion (psf)
Fill	120 / 125	32	0
Native	100 / 110	28	0

Notes: pcf = pounds per cubic foot, psf = pounds per square foot, deg = degrees

If a deadman anchor is relying upon passive support gained from the saturated native soils, an allowable passive equivalent fluid weight of 110 pounds per cubic foot (pcf) may be used. If gaining passive support from fill soils, an allowable passive equivalent fluid weight of 360 pcf and 190 pcf may be used for unsaturated and saturated conditions, respectively. The Port's Engineer will review the Contractor's shoring design prior to construction.

5.1.2 Estimated Quantities of Excavated Materials

Based on the excavation plan and assuming vertical sidewalls (shoring) around the entire excavation, the estimated quantities of materials to be excavated from the WSB area are as shown in the table below.

Excavation Quantities by Cell

	Area (square feet)	Depth (ft bgs/ft elev.)	Total Volume (BCY)	Estimated Contaminated Soil Volume (BCY)	Estimated Overburden Soil Volume (BCY)
Cell 1	1,290	18.5 / -5.0	884	239	645
Cell 2	1,205	11.0 / +4.0	491	179	312
Cell 3	1,428	17.5 / -2.0	926	370	556
Cell 4	1,454	16.0 / -1.0	862	377	485
Cell 5	2,025	19.5 / -4.0	1,462	525	937
Cell 6	670	15.0 / 0.0	372	124	248
Cell 7	592	13.0 / +2.0	285	153	132
Cell 8	2,351	19.0 / -4.0	1,654	827	827
		TOTAL	6,900	2,800	4,100

Notes: ft bgs = feet below ground surface; ft elev. = feet elevation in NAVD88; BCY = bank cubic yards. Total values are rounded to the nearest hundred

Assuming a soil density of 1.5 ton per BCY, contaminated soil to be disposed at a Subtitle D landfill totals 4,200 tons. Assuming a volume increase (swell factor) of 15 percent once the overburden is excavated and handled, an overburden volume of approximately 4,715 LCY will be managed on-site and used for excavation backfill.

The quantity of overburden would increase if sidewalls on the eastern and/or southern sides of the excavation are sloped instead of shored. The additional volume generated would depend on the depth of cell being excavated and slope of the sidewall. For example, assuming a sidewall slope of 1.5H:1V, an overburden volume of approximately 7 BCY (8 LCY) per linear foot of sidewall would be generated for a 15-foot excavation depth (e.g., east side of Cell 4). For a 19-foot cut (e.g., east or south sides of Cell 8) with the same slope, an overburden volume of approximately 9 BCY (10 LCY) would be generated per linear foot of sidewall.

5.1.3 Segregation and Stockpiling of Excavated Soil

As stated above, the defined layer of overburden soil excavated from each excavation cell will be stockpiled for later reuse as excavation backfill (stockpiling requirements are outlined in Section 3.4). During excavation of each cell, the Contractor will confirm the defined elevations of excavation for overburden and for contaminated soil using optical survey methods with a precision of 0.1 feet or better.

Throughout excavation, the Engineer will observe the materials being excavated and will have field discretion to designate it for off-site disposal (instead of reuse). Soil excavated from the predefined overburden layers that appear to either contain WSB sludge (black, fine-grained material) or excessive silt content, organic matter, or debris (deleterious substances) that would make it geotechnically unsuitable for reuse would also be disposed of off-site.

5.1.4 Disposal of Contaminated Soil

Once excavated from the WSB, the contaminated soil will be designated as nonhazardous waste and will be transported to and disposed of at a permitted Subtitle D landfill.

5.1.5 Excavation Backfill, Compaction, and Paving

During placement and compaction of excavation backfill, the Contractor will control surface water and groundwater inflow such that the backfill material can be compacted to meet the contract specifications. The final surface will be graded and paved to cap residual soils exceeding cleanup levels and to meet stormwater drainage requirements (draining to catch basins at location[s] to be determined during 90 percent engineering design [CPS]), as well as match the surrounding area.

5.1.5.1 Backfill Material

The types and estimated volumes[22] of backfill materials—to replace the excavated overburden, the exported Subtitle D soil, as well as any excessively wet or deleterious excavated soils—are as follows, from surface down:

- A 4-inch layer of CSBC, as defined in WSDOT Standard Specifications Section 9-03.9(3) (WSDOT, 2025), will be placed at the top of the backfill sequence, upon which asphalt pavement will be placed and compacted. The top elevation of the CSBC will be determined based on the design elevations for the final paved surface being constructed, including sloping for drainage, etc. The 4-inch layer will require an estimated 140 BCY CSBC.

- The upper 3 feet of excavation backfill beneath the CSBC layer will consist entirely of imported gravel borrow, as defined in WDSOT Standard Specifications Section 9-03.14(1). This will create a layer of uncontaminated soil within which future shallow utilities or structures can be installed without managing contaminated soil. The 3-foot surficial layer will require an estimated 1,220 BCY gravel borrow.

- The vast majority of the excavation backfill will be a mixture of excavated overburden soils and imported gravel borrow. Because the overburden soil will be moderately silty, the Contractor will mix the excavated overburden soils with imported gravel borrow such that the backfill mixture can be consistently and reliably placed and compacted as defined in Section 5.1.5.2.

[22] Backfill volumes in this section assume all vertical sidewalls in the excavation; additional backfill volume would be required if portions of the eastern and southern sidewalls are sloped.

  - The estimated total volume of backfill required to replace the excavated material is 2,800 BCY to replace exported Subtitle D soil plus 4,100 BCY of overburden material, which equals 6,900 BCY.
  - Subtracting the 140 BCY of CSBC and 1,220 BCY of gravel borrow used for the uppermost backfill layers, 5,540 BCY of additional backfill will be required. This will be achieved by mixing the 4,100 BCY of stockpiled overburden with an additional 1,440 BCY imported gravel borrow—a ratio of roughly 25 percent gravel borrow and 75 percent overburden by volume. The mixing of 1 unit gravel borrow and 3 units overburden will be accomplished on-site, with Engineer verification of volumes mixed to achieve the 1:3 ratio, prior to placement of the backfill mixture.

- At the Engineer's discretion in the field, a layer of quarry spalls (meeting WSDOT Standard Specification Sections 9-13.1(1) and 9-13.1(5)) may first be placed in select areas of the excavation to stabilize its bottom prior to placement of other backfill. The need for, and thus estimated volume of, quarry spalls is uncertain, but is expected to be small. Any quarry spalls used would reduce the volume of gravel borrow to be mixed with overburden, and the 1:3 volumetric mixing ratio would be recalculated accordingly during the work.

The temporarily stockpiled overburden soils will be drained by gravity to the extent practical and protected from surface water and rainfall such that they are not excessively wet when mixed with the gravel borrow and reused as backfill.

5.1.5.2 Backfill Compaction Requirements

For compaction of the CSBC and upper 3 feet of gravel borrow, the material will be placed in lifts no greater than 8 inches thick (loose) and compacted to a minimum of 95 percent of the MDD, as determined by ASTM D1557 (Modified Proctor) (ASTM, 2021). The moisture content will be controlled to within plus/minus 3 percent of the optimum moisture content, as determined by ASTM D1557.

The mixture of imported gravel borrow and excavated overburden soils will be challenging to gather a reliable modified proctor test sample for; however, the Contractor will collect at least three samples and compact the mixed borrow-overburden backfill in lifts no greater than 12 inches thick (loose) to at least 90 percent of the MDD and/or to the satisfaction of the Engineer. The Contractor will adjust moisture content during compaction to produce a firm, stable, and unyielding lift. The compacted backfill surface will be free from pumping and rutting due to excessive moisture.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in lifts thin enough to achieve the required compaction. The equipment and methods used for compacting the backfill will be approved by the Engineer.

When the first backfill lift is placed in a given area, and/or any time the backfill material changes, the area will be considered a test section. The test section will be used to establish backfill placement and compaction procedures required to achieve proper compaction. The Engineer will observe placement and compaction of the test section to assist in establishing an appropriate compaction procedure, and will continue to monitor the Contractor's operations once an acceptable placement and compaction procedure is established.

5.1.5.3 Hard Capping of WSB Excavation Area

Because residual mercury concentrations within the WSB excavation area will exceed the 24 mg/kg cleanup level, a hard cap consisting of asphalt pavement will be constructed over the backfilled excavation area, in accordance with the CAP. As shown on Figure 2, the area surrounding the WSB excavation also requires hard capping, per the CAP. Depending on existing or planned land-use (and stormwater management) activities in this area at the time the CPS for Project A1 are prepared, the Port may choose to construct a hard cap across portions of the surrounding area at the same the WSB excavation is capped.

The hard cap will consist of a minimum of 3 inches of HMA overlying 4 inches of compacted CSBC. The HMA will be Class 0.5-inch and Performance Grade binder of PG 64-22 compacted to a minimum of 92 percent reference density per ASTM D2041. Around the perimeter of the new pavement, the edges of the new HMA will be tapered to match surrounding grade and make a smooth transition that is drivable by automobile. As stated above, grading of the asphalt cap for drainage will be determined during preparation of the CPS for Project A1.

6 Design for Project B: Caustic Core Groundwater Neutralization

The CAP (Ecology, 2021b) included ISN of Caustic Core groundwater by placing a neutralizing reagent below the water table in a series of trenches oriented perpendicular to groundwater flow (in PRBs). To support design of the ISN cleanup action, pre-remedial design treatability testing was conducted with various chemical reagents for pH neutralization/buffering. As summarized in Section 2.2 and detailed in the PRDI 3 Data Report (Aspect, 2024c), the ISN treatability testing results concluded that, of the reagents tested, ferrous sulfate was the best choice to neutralize the high-pH groundwater. It was assumed that the PRB backfill achieving treatment would be solid-phase ferrous sulfate mixed with clean imported sand.

The ISN treatability studies documented that ferrous sulfate is highly soluble. The need to consider the potential for settling of the PRB trench backfill because of the rapid dissolution, and the potential to mitigate that issue by delivering the ferrous sulfate as a solution via infiltration galleries or using injection-based delivery was noted (Aspect, 2024b).

Further design evaluation during preparation of this EDR concluded that the high rate of ferrous sulfate dissolution could lead to both instability/subsidence of the PRB fill mixture and limited longevity of the PRBs' neutralization capacity. Settling of the PRB fill material would likely require pavement replacement with additional fill placement in the trench alignments to restore grade. In addition, if the groundwater pH reduction, achieved by the initial dissolution of ferrous sulfate, did not achieve the ISN performance standard/remediation level (i.e., groundwater pH < 10 throughout Caustic Core), other remedial measures (e.g., reagent injections) would presumably be required to achieve the performance standard. In addition, based on more recent information, it is likely that the location of the proposed BST rail spur may cross over some portion of the Caustic Core, and it is prudent that the ISN cleanup action be compatible with the final rail spur design.

Therefore, other technologies to deliver the neutralizing reagent to the subsurface were investigated. One of the technologies considered was delivering neutralizing reagents through HIWs, installed by horizontal directional drilling (HDD), spanning the Caustic Core footprint. The HIWs provide the following advantages relative to PRBs:

1. **Ease of repeat treatment.** With permanent HIWs, reinjections can be conducted when additional reagent dosing is needed to achieve performance objectives, whereas reactive material can only be added once to PRBs.
2. **Less disruptive.** The treatment area has multiple subsurface utilities, which would need to be removed or protected for trenching, and it is the primary area of entry/exit to the BST for numerous vehicles. HIWs installed by HDD can be drilled underneath utilities without disrupting them. In addition, HDD is less disruptive to the Port's BST operations by not trenching throughout the active terminal's entry/exit area.

3. **Cost effective.** HIWs will have a lower cost compared to the PRB approach—largely due to generating far less contaminated soil requiring landfill disposal from drilling HIWs versus trenching to 15 feet bgs.

A second design change to the CAP's ISN approach is to change the neutralization reagent from ferrous sulfate (liquid form if injected into HIWs) to CO_2 gas. This change resulted from identifying the following two potential issues during analysis of the injection hydraulics for HIWs in the low-permeability dredge fill soils of the Fill Unit to be treated:

1. There is uncertainty regarding the vertical distribution (vertical radius of influence) of the injected reagent across stratification in the dredge fill, and the ability to treat the entire saturated thickness by injecting into HIWs at a single depth.

   Because of the stratification in the dredge fill, the fill's vertical permeability is at least an order of magnitude lower in the vertical direction (across bedding) than the horizontal direction (parallel to bedding). Data from the RI indicates that the highest-pH groundwater occurs near the bottom of the Fill Unit saturated thickness (refer to Section 7.1 of the RI [Aspect, 2013]). This warrants more concentrated treatment near the bottom of the fill; however, the reagent also needs to be distributed vertically to the water table to achieve the performance standard throughout the saturated zone. There is considerable uncertainty for achieving treatment of the fill's entire saturated thickness plus more-concentrated treatment near its bottom with injection of a liquid (ferrous sulfate) reagent into the HIW screen regardless of its depth within the saturated zone. For example, it is uncertain if the HIW screen were set deeper to address the highest-pH water, that the injected reagent would disperse upward enough to treat the shallower zone. Furthermore, it is uncertain if the HIW screen were set in the middle of the saturated zone in effort to treat the full thickness, that the injected reagent would disperse downward enough to effectively treat the highest-pH water at the bottom of the zone in a reasonable time frame.

   Conversely, sparging CO_2 gas near the bottom of the saturated zone should provide concentrated treatment in the highest-pH portion of the saturated zone and, because CO_2 gas is less dense than water, it will migrate upwards in the saturated zone over time, resulting in better vertical distribution and treatment than liquid reagent injections.

2. Mounding of the water table due to injection.

   The water table depth in the Caustic Core area is quite shallow (<5 feet bgs); therefore, only limited mounding of the water table can be accommodated to avoid contaminated groundwater mounding up to the surface ("surfacing") during injections. Sparging gas (CO_2) will result in some groundwater mounding, but it should produce less mounding than injection of a liquid reagent because the gas can dissolve into the groundwater and create less upward displacement of groundwater.

Sparging CO_2 gas into the Caustic Core groundwater will lower pH based on bicarbonate chemistry as demonstrated by the studies presented below. Depending on the specific geochemical conditions of the aquifer, it is likely that the CO_2 gas will stimulate anaerobic, neutral-pH conditions for mercury sulfide precipitation.

Use of CO_2 to neutralize alkaline water is commonly applied on construction sites,[23] and the effective reduction of groundwater pH by CO_2 sparging has been demonstrated in the literature. Multiple field implementations of CO_2 sparging for groundwater neutralization have been conducted throughout the country, with four examples described as follows:

- A CO_2 injection pilot study to neutralize high-pH (>12) groundwater was conducted at the Container Properties (former Rhone-Poulenc) facility on the Lower Duwamish Waterway in Tukwila, Washington (Wood, 2020)—a site with similar characteristics to the Caustic Core. In the study, CO_2 was selected to neutralize groundwater from a sodium hydroxide release[24] because it would have less chance for adverse effects on the adjacent surface water and site workers compared to a strong acid injection. CO_2 was injected near the bottom of saturated dredge fill (silty sand) overlying a silt aquitard unit. The pilot study results indicated that CO_2 injections successfully reduced the pH and decreased concentrations of dissolved metals, such as aluminum, lead, iron, and manganese. Secondary effects, such as the precipitation of amorphous silica and other solids, did not adversely affect the aquifer characteristics. Mounding was managed through injection cycles, consisting of 2 hours of active injection and 1 hour of rebound, which also promoted groundwater mixing.

- At a chlor-alkali site in Brunswick, Georgia, three phases of CO_2 sparging reduced high groundwater pH (11.3 on average) to near-neutral conditions (7.1 on average), with corresponding decreases in dissolved mercury concentrations within a subsurface caustic brine pool (Mutch, 2016).

- At the Lehigh Cement Company Closed Cement Kiln Dust Pile Site in Metaline Falls, Washington, Geosyntec designed, installed, and actively monitors a hydraulic barrier that intercepts contaminated groundwater and directs it toward a treatment corridor in which CO_2 diffuses from suspended silicone tubing into the extracted water since 2007 (Geosyntec, 2006). The system has successfully achieved a pH reduction from up to 11 to between 6.5 and 8.5. The pH reduction has generally reduced associated concentrations of dissolved metals to below cleanup levels (Geosyntec, 2025).

- At the JCI Jones Chemicals Site in Jacksonville, Florida, a full-scale implementation of CO_2 sparging through vertical wells in the saturated zone demonstrated reductions in elevated pH (>12) groundwater by 1 to 2 standard units, as well as a corresponding decrease in dissolved metals concentrations (Geosyntec, 2019).

Based on the information above, Project B includes the following three components to neutralize the Caustic Core groundwater:

[23] Typically, either by sparging CO_2 gas or placing dry ice (solid CO_2) into a tank of alkaline water.
[24] Same mechanism that created high pH groundwater in this RAU.

1. Three parallel HIWs will be installed by HDD to deliver CO_2 into the subsurface via sparging. The HIWs will span the length of the Caustic Core, and will be oriented approximately perpendicular to groundwater flow for optimal treatment (Section 6.2).
2. A CO_2 injection system will be constructed to deliver CO_2 from a centralized bulk storage tank to each wellhead via subsurface conveyance piping. CO_2 will be sparged into the HIWs along the bottom of the saturated Fill Unit and the CO_2 gas will migrate upwards, with the intent to neutralize the entire saturated thickness (Sections 6.3 and 6.4).
3. While performing the CO_2 injections, water levels and water quality parameters will be measured in performance monitoring wells to evaluate the extent and magnitude of pH neutralization in the Caustic Core and assess the need for reinjection to achieve the pH remediation level (pH <10) or lower[25] (Section 6.7.2).

6.1 Performance Objectives

The primary ISN performance objective is to reduce the pH of groundwater within the Caustic Core to below the remediation level of pH<10. Because mercury solubility and, therefore, mobility is enhanced in high-pH conditions, the pH reduction will likely immobilize dissolved mercury by reducing its solubility and controlling its downgradient migration in groundwater.

Section 6.7 describes groundwater performance monitoring to evaluate ISN performance.

6.2 Horizontal Directional Drilling Injection Technology

HIW technology is similar to vertical injection wells, except the HIWs are installed below ground parallel to the ground surface or at a shallow angle using HDD. Horizontal injection technology can facilitate treatment of large groundwater plumes by increasing the area of contact between the well screen and contaminated groundwater compared to a vertical well screen. Installation of the HIW can accommodate drilling beneath surface structures, utilities, and ongoing facility operations with only minimal disturbance, contrary to vertical wells. The general process for installing an HIW well via HDD methods is outlined below.

A pilot borehole is drilled into the ground at an approximate entry angle of 10 to 30 degrees. The pilot borehole is then navigated to a level (zero pitch) orientation at the specified target depth. For Project B, the surface-to-surface (entry-exit) HDD installation method will be performed to install the HIWs. For this installation method, the HDD rig is set up at the entrance of the bore path and the boring is advanced into the soil along a preplanned path through a combination of rotation and pushing of the drill bit and drill rods. The well screen portion of the borehole is generally flat at a zero-pitch orientation. Once the target screen depth for the well screen has been reached, the pilot borehole is advanced horizontally to the design-specified distance. Once the total screen length is achieved, the drill bit is navigated toward the surface at the exit end of the boring.

[25] The pH 8.5 cleanup level (Table 2) must be achieved in groundwater at the shoreline CPOC, but achieving that cleanup level is not an explicit RAO for Project B.

The HDD drill bit is equipped with a sonde transmitter technology, which allows for steering and navigation of the drill bit horizontally and vertically. A walkover navigation system operated by the HDD driller is generally used to determine the inclination, depth, and rotational position of the drill head. The driller's navigation technician follows the progress of the drill bit and, from the surface, uses a handheld receiver that receives radio signals from the navigation beacon located within the drill bit housing, which relays the data to the drill crew.

6.3 Injection Well Design and Layout

This section summarizes the HIW design criteria and the anticipated HIW drilling, installation, and development approach. The approach implemented during construction may change based on the final design with designation of specific performance standards versus flexibility afforded for Contractor means and methods.

6.3.1 Horizontal Injection Well Installation

Three HIWs will be drilled and installed by a Washington State-licensed driller experienced with HDD. The HIWs will be installed generally parallel to each other, approximately perpendicular to groundwater flow directions, and with approximate horizontal spacing of 40 feet to 70 feet. The conceptual design for the HIWs are shown on Figure 11, and are labeled HIW A through C, from east to west. The spacing shown on Figure 11 is not uniform among the three HIWs as the proposed HIW locations are based on the placement of groundwater monitoring wells. The HIWs will be installed at least 25 feet away from existing monitoring wells to avoid forming preferential pathways for drilling fluid to migrate away from the HDD boring, resulting in a loss of fluid circulation during drilling. The final layout and design details will be developed in the CPS for Project B.

The HIWs are anticipated to be drilled with a conventional HDD bit and assembly as the Site dredge fill soils are anticipated to be relatively homogenous and free of cobbles, debris, or other materials that would obstruct drilling. The driller will use a single pass drilling fluid management system in which the drilling fluids are mixed in a mud tank then pumped to the drill rig. The drilling fluid, whether bentonite or a biodegradable polymer drilling fluid (e.g., Baroid Bio-Bore™ or equivalent), will travel down the drill rod, cooling the bit assembly, and jetting the bore face. The drilling fluid will entrain soil cuttings from the borehole and flush the mixture back to the surface at the entry point (wellhead). This mixture is then pumped from the entry pit directly into a lined, watertight roll-off box. Section 3.9 describes management of the investigation-derived waste.

While drilling each HIW, the driller will set and mark at the surface the location of the drilling head at least every 10 to 15 feet from its entry to termination point. The Engineer will either use a handheld global positioning system (GPS) device or a surveyor will survey in the markings to record the horizontal coordinates for each location point to document the final HIW alignment.

The HIW screens will range in length from approximately 280 to 320 linear feet to span the Caustic Core footprint with extra coverage cross-gradient to accommodate uncertainty in the defined limits of the Caustic Core (Figure 11). Each HIW screen will

be set at a target depth of approximately 14 feet bgs—near the bottom of the Fill Unit, and within the highest-pH portion of the saturated fill zone, as depicted in cross section on Figure 12. The HIWs will be constructed of 3-inch-diameter high-density polyethylene (HDPE) or polyvinyl chloride (PVC) with custom-designed slotted screens to allow for even distribution of air flow across the length of the screen. The screen design will be completed during preparation of the CPS for Project B, but an overview of design criteria and the conceptual design are presented in Appendix C. The riser portion (blank portion) of the HIWs will extend approximately 75 feet from the north end of the screen.

Each HIW will be completed with surface grout seals. The boring annular space around the riser portion will be sealed with bentonite grout approximately 25 feet in length to seal the annulus from surface infiltration and prevent injected CO_2 gas from travelling to the surface (short-circuiting) through the boring annulus.[26] The grout will not be added too close to the screen to avoid grout infiltration into the well screen. Grout seals will be placed at both ends of the double-ended borehole via a tremie pipe inserted along the annulus of the borehole. For the entry side of each borehole, a shale trap packer will be placed at a bore length of approximately 30 to 35 feet or as far as possible. A slurry of PC grout and water, approximately 5 percent bentonite by weight, will be mixed and subsequently pumped down the tremie, which will be slowly withdrawn until grout is observed at the surface. For the exit side of the double-ended borehole at each well, the tremie pipe will be installed to a depth near the end of the screen as the well materials get pulled into the borehole.

6.3.2 Horizontal Well Development and Vault Installation

HIW development will be performed after the screens are in place. Well development removes residual drilling mud and drill cuttings from the well, improving hydraulic connection of the well with the surrounding formation. The installed HIWs will be developed by flushing the well with clean water. Once most of the heavy mud gets removed from the well and borehole annulus, the well screens will be jetted with a high-pressure, low-flow water jetting tool to dislodge sediments from the screen slots. In addition, an enzyme-breaker solution may be used during development to accelerate the breakdown of the biodegradable drilling fluid and to reduce the viscosity of residual drilling fluid that remained near the well screen.

After the installation of three HIWs, a shallow trench will be excavated between the HIW well heads and the centralized CO_2 storage/equipment location to install injection lines for CO_2 delivery to each well head. At the entry (north) end of the HIWs, steel-frame vaults will be installed for wellhead access. The vaults are anticipated to be approximately 36 inches deep by 60 inches by 60 inches, with a connection from the wellhead to the CO_2 conveyance piping, and cleanout access. The vaults and vault lids will be designed to support the heavy vehicle loads exerted by BST operations, which will be established in consultation with the Port. The ground surface at the exit (south)

[26] Typically, the entire length of the riser portion of the HIW is not sealed, just the upper half, or as needed, is sealed to prevent fluid movement within the annulus. During final design, Ecology's well construction coordinator will be consulted so that the HIW design complies with all requirements of Chapter 173-160 WAC.

end of the borehole will be restored consistent with surrounding surface conditions (likely a HMA pavement section).

6.3.3 Trenching and Conveyance Pipe Installation

A conveyance pipe will be installed in a shallow trench extending from the CO_2 storage and injection system (CO_2 compressor/CO_2 tank) area to each HIW wellhead access vault, at approximately 20 feet, 60 feet, and 100 feet from the CO_2 injection system. On Figure 11, the CO_2 storage/injection area is depicted immediately south of the Port's ABCD building, out of the BST's primary travel way. The location for that area, the conveyance pipeline, and the wellhead vaults (entrance of HIWs) will be established in consultation with the Port during final design for Project B, while preserving the general alignment of the HIW well screens across the Caustic Core.

Conveyance piping will be installed using conventional shallow trenching methods to connect wellheads to the CO_2 injection system. Each trench will provide clearance between the sides of the installed pipe and the trench walls, and there will be lateral separation of pipes in the common trench. Pipes will be installed in each trench by first backfilling the bottom of the trench with compacted granular (structural) bedding material. Once the bedding material is compacted to be firm and unyielding, the pipe will be laid and covered with bedding material. This lift will be compacted, with utility marking tape placed between the bedding material and the first lift of backfill, to allow for field location after the completion of the work. Backfill will then be placed in lifts and compacted until final grades are achieved. The Contractor shall coordinate with the Engineer to monitor compaction. The equipment and methods used for compacting the backfill will be approved by the Engineer. A typical trench detail will be provided in the CPS. The backfilled trench surface will be restored to match surrounding surface conditions (likely a HMA pavement section) in consultation with the Port.

Soil excavated from the conveyance piping trench will be profiled and disposed of at a Subtitle D landfill.

6.4 CO_2 Injection System Design

The CO_2 injection system will include a 15,000-pound storage tank for CO_2 and supporting equipment including electrical and mechanical components, as described in more detail below. The CO_2 storage/injection area will be fenced for security.

6.4.1 CO_2 Demand

Calculations estimating the CO_2 demand required to meet the pH remediation level are included in Appendix C. A numerical titration was performed to establish the total carbonate concentration of the Caustic Core under current conditions and the carbonate concentration at the remediation level of pH<10. The difference between these total carbonate concentrations is equivalent to the CO_2 demand of the system to achieve the desired pH. The estimated total CO_2 demand was calculated to be 80,000 pounds, using the most conservative groundwater quality data from the Caustic Core and a 25 percent safety factor. However, there may be additional losses due to CO_2 released to the atmosphere, or demand outside the expected treatment area. Section 6.7.2.1 presented a reinjection plan to evaluate whether additional treatment would be needed.

6.4.2 CO_2 Injection and Supporting Equipment

The CO_2 injection equipment setup will remain on-site and will be reused for additional CO_2 sparging events. The injection equipment will consist of a bulk CO_2 storage tank with a heated vaporizer and a control panel to regulate discharge gas flow and pressure. The control panel instrumentation will include flow, temperature, and pressure monitors. The control panel will also contain flow and pressure regulating valves to optimize flow and pressure during the CO_2 injection. Either a diesel generator or electricity (power drop from the Port's electrical lines) will be used to power the heater vaporizer on the trailer. The power will be operated only during periods of injection, and all equipment will be bolted to the ground and electrically grounded.

6.4.3 CO_2 Distribution Manifold and Programmable Logic Controller

CO_2 distribution controls and distribution lines to the HIWs will be located in a steel-sided container. CO_2 exiting the storage tank will enter the manifold and be routed to the HIWs through individual hose and piping runs (legs). CO_2 flow to each HIW will be controlled within the container using individual flow indicators/transmitters, pressure indicators, throttling valves, pressure relief valves, and pneumatically actuated butterfly valves.

Final design of the system may include use of a programmable logic controller (PLC) with a human-machine interface to control the actuated butterfly valves on the three manifold legs for each HIW. The PLC will monitor and record system operation and should be capable of managing and monitoring CO_2 flow to one or more HIWs at preprogrammed time intervals. If a PLC is included, the system will include a telemetry unit for remote monitoring of system operation.

6.5 Injection Implementation

The initial flow rate for the CO_2 injection is anticipated to be 20 standard cubic feet per minute (scfm) based on CO_2 injections at other sites (e.g., Mutch, 2012), guidance from the federal Environmental Security Technology Certification Program (Leeson et al., 2002), EPA (2004), and the U.S. Army Corps of Engineers Design Manual (2008). Initially, the injection flow rates and pressures will be low, and may increase over time to determine the optimum flow rate and pressure conditions. The injection system will include a pressure relief valve set to relieve excess pressure at an appropriate setpoint to prevent overpressurization of the system and to protect the wells. The CO_2 injection efficiency will be dependent upon many factors, including the CO_2 flow rate, extent of CO_2 travel through gas channels that are created, time for gas channels to reach the surface, and rate of mass transfer of CO_2 from the gas phase to the dissolved phase. Increasing the flow rate of CO_2 should push gas channels out further downgradient, which can increase the area of treatment influence, but also lead to less efficient use of CO_2 once channels reach the surface. Increasing injection efficiency may be possible by injecting for shorter periods of time, thereby limiting the amount of CO_2 to escape to the atmosphere. Furthermore, a longer rest period between injection events would allow the trapped CO_2 gas to dissolve into the water before the start of the next injection event.

During the injection event, some mounding is expected and may increase with seasonal changes of the groundwater table. The optimal time for CO_2 injection is when the groundwater table is at its lowest during the summer months. While performing the CO_2

injections, water levels and water quality will be measured in the performance monitoring wells to determine the extent of pH neutralization in the subsurface. Ultimately, injection operations will include adaptive management to optimize the pH neutralization.

Prior to implementing injections, the HIWs will be registered with the Underground Injection Control (UIC) program, as described in Section 11.1.2.

6.6 Operations and Maintenance

This section describes the operations and maintenance (O&M) that will be performed to maintain system components and the monitoring to be performed to evaluate system performance and achievement of the pH remediation level within the Caustic Core.

The CO_2 injection system will be designed to operate unattended. The telemetry module (if present) will be programmed to call the operator-in-charge in the event of a system shutdown. However, as with any mechanical equipment, periodic inspection and maintenance are essential for optimum performance and maximum life span of the equipment.

O&M procedures and frequency will be described in a future Operations, Maintenance, and Monitoring Plan that will include the following elements:

- Reviewing operating data (flow rate, pressure) on regular intervals.
- Detecting visual and auditory leaks.
- Adjusting valves and regulators, as needed, to fine-tune CO_2 dosage.
- Maintaining and replacing CO_2 distribution systems, when needed.
- Documenting CO_2 tank readings, and refilling the tank, when needed.
- Implementing procedures described in the manufacturer's maintenance manual for O&M of the CO_2 tank.

6.7 ISN Monitoring

The ISN monitoring program discussed in this section is designed to evaluate the progress toward achieving objectives presented in Section 6.1. Monitoring consists of two different monitoring programs and objectives—operational monitoring and performance monitoring—and are described below.

6.7.1 ISN Operational Monitoring

Operational monitoring will be conducted during the injections to guide the injection operations and modify them, as necessary. The operational monitoring and objectives consist of the following elements:

- **Injection rate and pressure.** The injection rate and pressure will be measured for each HIW at a minimum frequency of hourly.

- **Water level monitoring.** Manual water level monitoring of dose-response (DR) monitoring wells listed in the next bullet will be conducted at least twice daily, while injections are occurring.
- **DR monitoring.** DR monitoring will be conducted at the following locations according to the active injection well (see Figure 11):
  - **HIW A**: EMW-19S and CP-MW108
  - **HIW B**: CP-MW106 and CP-MW107
  - **HIW C**: CP-MWA1, CP-MW105, and AMW-03

  DR monitoring will consist of measuring pH with a multiparameter meter with flow-through cell. These results will inform the evaluation of system performance and CO_2 distribution and delivery.

Operational monitoring will be conducted to detect indications of CO_2 short-circuiting to underground utilities or other subsurface features, and/or surface daylighting. Short-circuiting could be indicated by a sudden increase in injection rate or a drop in injection pressure.

DR monitoring will be conducted approximately every 4 hours during injection system operation. The frequency of DR monitoring may be adjusted in the field, as needed.

6.7.2 ISN Performance Monitoring

Performance groundwater monitoring will be conducted to evaluate the ISN performance objective described in Section 6.1 (achieving a stable groundwater pH below 10 in all monitoring wells within the Caustic Core footprint). Transects of new and existing monitoring wells will be located approximately 25 feet downgradient of each HIW to evaluate whether the remediation level of pH<10 has been achieved. The HIW alignments and performance monitoring wells are shown on Figure 11. Monitoring well transects will consist of the following:

- EMW-19S and CP-MW108 west of HIW A
- CP-MW106 and CP-MW107 west of HIW B
- CP-MWA1, CP-MW105, and AMW-03 west of HIW C
- CP-MW104 downgradient

The installation of new monitoring wells CP-MW104 through CP-MW108 are described in Section 6.7.2.2. Baseline pH monitoring at the four new wells is described in Section 6.7.2.3.

Performance monitoring will be initiated at the end of the CO_2 injections. Field parameters will be measured at each well in the Caustic Core at 2 weeks post-injection, and then monthly thereafter. These performance monitoring activities will be conducted in accordance with the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP), which will be included with the CPS.

6.7.2.1 Reinjection Plan

After 1 year of ISN performance monitoring, if the ISN performance objective of pH 10 groundwater has not been met, a second injection event will be considered. The scope of the second injection event will depend upon the performance monitoring data but will likely be smaller than the initial injection event. At least another year of performance monitoring will be conducted after the second monitoring event to evaluate whether the ISN performance objective has been met, but this will be informed by data collected during the first post-injection monitoring period. Additional injection events will be conducted until the remediation level has been achieved.

If the ISN performance objective is not achieved within a reasonable time frame, the need for contingency actions will be evaluated. Potential contingencies may include additional injection events in the HIWs and/or more targeted CO_2 injections via vertical injection wells installed by traditional drilling methods.

6.7.2.2 Monitoring Well Network

The performance of the pH neutralization remedy will be assessed by monitoring at existing wells (AMW-03, CP-MWA1, and EMW-19S) and new wells (CP-MW104 through MW-MW108). Five new Fill Unit monitoring wells will be installed to evaluate the performance of the pH neutralization. The locations of the five new monitoring wells, CP-MW104 through CP-MW108, are shown on Figure 11.

These monitoring wells will be located within or adjacent to the Caustic Core, and will be directly downgradient of the three HIWs. Each monitoring well will be installed approximately 25 feet downgradient of the associated HIW, which is the closest a vertical well should be installed to the HIW to avoid forming potential preferential pathways for injected CO_2 to reach the atmosphere. CP-MW104 will be located downgradient of the Caustic Core, CP-MW108 will be located west of HIW A, CP-MW105 will be located west of HIW C, and CP-MW106 and CP-MW107 will be located west of HIW B.

The actual locations are subject to accessibility and utility clearance, as determined in the field. The five monitoring wells will be completed in the Fill Unit, with a 10-foot screened interval between approximately 5 and 15 feet bgs, subject to change, depending on conditions encountered in the field. Well construction methods will be included in the SAP.

6.7.2.3 Baseline pH Monitoring

Baseline groundwater pH monitoring will be conducted prior to CO_2 injections in accordance with the SAP. The baseline groundwater sampling of the four new monitoring wells will be conducted prior to the CO_2 injections.

7 Design for Project C: Chlorine Plant Area TPH-contaminated Soil Removal and Mercury ISS

As described in Section 1.1.1, Project C includes two components within the historical Chlorine Plant area:

1. Shallow TPH-contaminated soils around the southeast corner of the Cell Building will first be excavated and landfilled off-site. The shallow excavation will be left open pending the ISS treatment of deeper soils. The selected cleanup action included excavation and disposal of these TPH-contaminated soils, not including them as part of the soils to be treated by ISS, because there has been no indication they contain liquid mercury, they are shallow and readily accessible, and full removal of contamination contributes to cleanup permanence.
2. Removal of structural obstructions and then ISS treatment of fill soils containing visible elemental mercury down to the depth of the underlying silt aquitard (depth from ground surface ranging from 15 to 17.5 feet bgs) in five areas to control solubility and volatility of the mercury.

Figure 13 depicts the five areas for mercury ISS treatment (denoted ISS Areas A through E), the overlapping area for TPH-contaminated soil removal, and areas of additional excavation necessary to accommodate swell generated during ISS.

While the Contractor will be afforded some flexibility in means and methods to accomplish the Project C cleanup work, the Project contract documents will require the ISS-related work to be conducted in a sequenced manner to minimize the quantity of soil containing liquid elemental mercury that are exposed to the atmosphere thus minimizing generation of mercury vapors at any one time while maintaining an efficient workflow. The anticipated sequence of work is as follows and will be refined in the CPS:

- For ISS Areas B and C, demolition of the Port maintenance building, as described in Section 7.1.
- For each ISS area, removal of surface pavement and associated subgrade materials, as described in Section 7.1.
- For ISS Area A only, excavation and disposal of TPH-contaminated soils, as described in Section 7.2.
- For each ISS area in sequence, execute the entire obstruction removal (Section 7.3) process in cells sized by the Contractor to allow process completion in 1 day (anticipate cells on the order of 25 feet by 25 feet). Components of that complete process include the following:
    - Excavate mercury-contaminated fill soils to the depth of the aquitard and stockpile them as described in Section 7.3.1.
    - Remove concrete and timber piles down to the aquitard depth, as described in Sections 7.3.2 and 7.3.3, with off-site disposal of removed debris, as described in Section 7.3.4.

- Conduct excavation in four areas to a depth of 10 feet bgs as described in Section 7.4. Soil shall be exported for disposal at Subtitle D Landfill or stockpiled for reuse on-site as approved by Ecology.
- Return any stockpiled soil from the limits of soil containing elemental mercury and physically mix the soil with the specified cementitious reagent components (in grout form) for ISS treatment, as described in Section 7.4. The ISS-treated soil will encompass the soil containing elemental mercury limits and the areas of additional excavation to allow for swell with a top elevation of the ISS soil (monolith) no higher than elevation 14 feet NAVD88.

The following sections describe the sequential components of the Project C cleanup action to be applied for the ISS beyond the common elements described in Section 3.

7.1 Removal of Building, HMA Pavement, and Associated Subgrade Materials

The first step in Project C will be to demolish the Port Maintenance building and remove the existing HMA pavement across each cleanup area.

The ISS Area C is bound on the north by overhead power, on the east by generator and electrical equipment supplied by the overhead power, and the Port Maintenance building on the west. In order to remove obstructions and ISS in Areas B and C, it is necessary to demolish the Port maintenance building. Building demolition is more economical and practical than deenergizing the electrical equipment and overhead power owned by Puget Sound Energy, and structural support to protect the Port Maintenance building during Project C construction. Prior to construction, a hazardous buildings material (HBM) survey will be conducted to determine what if any HBM abatement will be necessary during building demolition.

The pavement removal in each area will occur just prior to starting cleanup for that area; pavement will not be removed from all cleanup areas at once to limit the duration that underlying (untreated) soil in an area is exposed. The removed pavement will be transported off-site for recycling.

Within the footprint of the Cell Building (ISS Area A), where the pavement was constructed as the final step of the 2017 interim action, the pavement is underlain by a combination of imported CSBC and crushed brick, which was placed to achieve a sloped surface for stormwater drainage purposes, with the thickest subgrade material in the center and tapering at the edges of pavement, as described in the Interim Action Report (Aspect, 2018a). Beneath the placed subgrade materials is an orange nonwoven geotextile that provides a high-visibility separation layer between the underlying contaminated materials and overlying uncontaminated materials. Beneath the northernmost portion of the pavement, a series of 8-foot by 20-foot steel road plates were placed beneath the geotextile to help stabilize the saturated dredge fill soils which were soft and deemed incapable of supporting equipment loads during the subsequent pavement construction. Figure 13 depicts the approximate location of the buried steel plates.

The removed separation geotextile will be disposed of at a Subtitle D landfill. Any removed steel road plates will be decontaminated by brushing off loose soil/debris followed by sequential rinsing with an acidic solution and then potable water. Materials removed by brushing will be captured and included in soil to be treated by ISS. The liquids generated by decontamination will be captured and routed to the Contractor's water management system for treatment and discharge as described in Section 3.7. After decontamination, any removed steel plates will be retained for future reuse by the Port. Likewise, the removed CSBC will be stockpiled and may be reused beneath the new HMA pavement constructed as an environmental cap across the completed ISS areas as per the CAP.

The veneer of crushed brick beneath the geotextile has been in contact with contaminated fill soil and will be disposed with the contaminated debris.

7.2 Excavation and Disposal of Shallow TPH-Contaminated Soils

Figure 13 depicts the estimated extent of shallow TPH-impacted soils around the southeast corner of the Cell Building to be excavated and disposed of off-site. Based on existing data (Aspect, 2014b), the estimated excavation depth in this area is 5 feet bgs, equating to an estimated excavation quantity of approximately 1,580 BCY (2,530 tons) to be disposed of at a Subtitle D landfill. Slightly more than one-half of the estimated volume of TPH-contaminated soil (820 BCY) is located outside the ISS Area A footprint. Foundation components within the excavation footprint would first be removed to access the TPH-impacted soils, using methods described in Section 7.3. Within this excavation area, excavation will be conducted in lifts not to exceed 2 feet, to allow visual observation for the presence of liquid mercury. If visible mercury is observed in soil being excavated, or within the excavation, that portion of the excavation will be terminated and that soil will be left in place for ISS treatment with the underlying soil.

Based on the data collected during the 2014 test pit investigation, the soil will profile as a non-hazardous, non-dangerous waste for disposal at a Subtitle D Landfill (Aspect, 2014b). Additional sampling will be conducted during CPS development, as required by the disposal facility to confirm waste profile for acceptance prior to construction.

7.3 Full Removal of Structural Obstructions to Allow ISS

Following removal of the surface pavement and associated materials and removal of TPH-contaminated soils, the next step in the ISS treatment program will be to remove subsurface structural obstructions (e.g., concrete grade beams and pile caps with underlying timber pilings) within the elemental mercury-contaminated fill down to the underlying aquitard unit (depth of 15 to 17.5 feet bgs). The obstruction removal will apply the same sequential methodology that was successfully applied during the 2022 field pilot test (see Section 2.1), as detailed below.

7.3.1 Soil Excavation to Expose Piles Down to Aquitard

The Contractor will temporarily remove and stockpile soil necessary to remove the concrete structural elements and their timber piles down to the aquitard surface. Within the footprint of the former Cell Building, variable subgrade conditions will be

encountered because of variability in the dredge fill materials and due to variable backfill from the 2013–2014 interim action. During the 2013–2014 interim action, with Ecology concurrence, some grade beams and pile caps were removed, and some contaminated fill was excavated to variable depths and backfilled with a combination of crushed brick material and soils generated from the BST Phase 1 stormwater improvements project (Aspect, 2018a).

The Engineer will oversee the temporary soil excavation and direct the Contractor, based on visual observations, regarding the depth to excavate to reach the aquitard. The Contractor will excavate the minimum quantity of soil needed to expose the timber pilings down to the aquitard interface with adequate space to cut the pilings at or just below that interface. The soil excavation will be done in a manner to minimize movement of the timber piles and to not compromise the integrity of the aquitard beneath the contaminated fill soil being excavated.

Soil excavated to expose the aquitard will be stockpiled temporarily, pending it being placed back into the excavation, within a designated stockpile area to be constructed in a location(s) that does not interfere with completion of the remediation work or with other Port or tenant operations on-site (see Section 3.6). Alternatively, the Contractor will be allowed to use lined roll-off boxes for temporary soil stockpiling. As stated in the CAP, the contaminated soil may be moved within the Project C work area (area of contamination) to the extent required for obstruction removal and subsequent ISS treatment without generating a remediation waste under the Resource Conservation and Recovery Act (RCRA).

7.3.2 Concrete Obstruction Removal

The Contractor will expose and demolish concrete obstructions (e.g., slabs, grade beams, pile caps) within the five ISS areas depicted on Figure 13. Figure 14 shows the footprints for the historical Chlorine Plant structures, as determined from GP's historical drawings, most of which had pile-supported concrete foundations because of the underlying soft (compressible) dredge-fill soils. Outside of areas excavated by the Port during the prior interim actions, the foundation elements remain in place.

Figure 14 depicts structural obstructions expected within the footprint of the former Cell Building (ISS Area A). The residual subsurface structures in ISS Area A are relatively well documented, based on GP's historical design drawings for the Cell Building foundation elements and observations from the prior interim actions and the PRDI 2 field pilot test. GP's historical drawings also indicate the types of pile caps of different dimensions, denoted P1 through P9 on Figure 14, where the number indicates the number of timber pilings supporting each. However, during the PRDI 2 field pilot test, some differences were observed between numbers of pilings in the ground versus what is indicated on the design drawings. Figure 15 presents information regarding subsurface structure(s) observed in test pits conducted within ISS Areas B, C, D, and E.

To minimize disturbance of the timber piles on which the pile caps rest, the Contractor will be required to demolish the pile caps by drilling holes into the concrete structure and filling the holes with expansive demolition grout (e.g., Dexpan®) and leaving it long enough to create fractures in the concrete (e.g., overnight). The 2022 field pilot test

demonstrated this process successfully fractured the concrete structure with minimal disturbance of the underlying timber piles (Aspect, 2024a). Removing the soil surrounding the concrete pile caps before the use of demolition grout allows the pile caps to expand. This results in larger fractures, which in turn requires less force from the hydraulic breaker and reduces disturbance of underlying timber pilings. The fractured pile caps will then be demolished using an excavator with a hydraulic breaker and removed for off-site disposal, as described in Section 7.3.4.

7.3.3 Timber Pile Removal

Once the shallow concrete obstructions are removed, the underlying timber piles will be cut at a depth of 0.5 to 1 foot below the top of the aquitard using an excavator-mounted hydraulic shear attachment or other Contractor-proposed and Engineer-accepted means. During the obstruction removal field pilot test, a shear attachment quickly and efficiently cut the pilings with minimal disturbance of the aquitard surface or the remaining section of piling extending into and beneath it (Aspect, 2024a). The remaining portions of these piles extending below the cut (and into the aquitard) are to remain in place with minimal disturbance. If the Engineer determines that the timber piles extending into the aquitard are displaced during the work to the degree that a void(s) is created to depth within the aquitard (potential preferential conduit for movement of untreated liquid mercury), the Contractor will be required to backfill the area around the disturbed pile within 24 hours using a self-hardening controlled density fill (CDF). The removed piles will be disposed of off-site, as described in Section 7.3.4.

7.3.4 Management of Removed Debris

Based on observations of liquid mercury droplets on concrete and timber pilings removed during the prior interim actions and field pilot test, the concrete and wood debris removed will be designated and managed as hazardous waste debris (D009 waste code). The combined concrete and wood debris removed will be reduced in size, as needed, to meet disposal facility acceptance requirements, and then loaded and transported under manifest to the CWM Subtitle C Landfill in Arlington, Oregon, where it will be treated by macroencapsulation to meet RCRA LDRs for hazardous debris in accordance with 40 CFR 268.45, and then disposed of in the Subtitle C landfill. This same approach was successfully used to manage hazardous debris generated during the prior two interim actions and the field pilot test.

7.4 Additional Excavation to Accommodate Swell

Based on the soil type to be treated and its swell characteristics when excavated (converting from BCY to LCY), the 15 percent-by-weight addition of reagents, and the ISS mixing methods, the cured ISS-treated material is anticipated to be up to 30 percent greater in volume than the in situ volume of the mercury-contaminated soil being treated. This volume increase is termed “ISS swell.”

The Contractor will be required to finish the ISS-treated soil at elevation 14 feet NAVD88 or below to match existing grades. This finish elevation will not restrict future land uses and will prevent future development from disturbing the ISS monolith. The removal of subsurface obstructions, and the export of TPH-contaminated soil, will create additional volume to accommodate the swell of the ISS-treated soils. However, assuming the estimated ISS swell of 30 percent by volume, additional excavation of soil adjacent to

the soil containing elemental mercury is necessary to create sufficient in situ volume for mixing the elemental mercury-containing soil with a finish elevation of 14 feet NAVD88. After the additional excavation areas are completed, the soil containing elemental mercury will be graded into these areas prior to the ISS mixing. It should be noted that the Contractor may propose alternate sequencing for implementing ISS within the required treatment areas and managing swell within the additional excavation areas, for review and acceptance by the Engineer.

There are four additional excavation areas as shown on Figure 13. The additional excavation areas will be advanced to a depth of 10 feet bgs to reduce the amount of dewatering and excavation structural support that would be required for deeper excavations. The dimensions of these additional excavation areas depicted on Figure 13 is conceptual, and will be designed in the CPS for Project C. Additionally, sampling will be conducted during the CPS development to characterize this soil for off-site disposal at a Subtitle D Landfill or for reuse on-site. If the soil from the additional excavation areas is deemed suitable for reuse, the details of reuse will be outlined and submitted to Ecology for approval in the CPS for Project C.

7.5 ISS Treatment

ISS treatment of elemental mercury-impacted soil will be performed in five treatment areas in the former Chlorine Plant area, as shown on Figure 13. In general, ISS treatment will treat mercury-contaminated fill from near surface grade down to the underlying aquitard unit (estimated depth of 15 to 17.5 feet bgs). ISS treatment will be performed after pavement removal, shallow TPH-contaminated soil removal in ISS Area A, obstruction removal, and the additional excavation activities, as described in the preceding sections.

The engineering design of the ISS treatment requires volumetric balance of the soil to be treated with ISS, the ISS swell, the volumes removed, and the finish ISS grading. This volumetric balance, and the associated quantity estimates are included in Appendix D with the detailed calculations for the ISS project.

7.5.1 ISS Mix Design

The results from the PRDI 2 Data Report (Aspect, 2024a) established an ISS mix design at a minimum 15 percent total cement content (by dry weight of soil) with 50 percent Type IL PC and 50 percent Grade 100 ground granulated blast furnace slag (GGBFS). The mix design was effective at a range of soil moisture contents from 56 to 61 percent.

The addition of cement will be specified in the field based on the unit weight of soil at ambient moisture content in the field:

$$\text{Cement addition rate [pounds cement/cy soil]} = 0.15 * \gamma_d[pcf] * 27\ cf/cy$$

γ_d = dry unit weight of soil

Prior to ISS mixing, the in situ moisture content of soil may be measured in each area to identify potential deviations from the treatability test and evaluate the total available water:cement ratio. Adjustments may be made if the in situ soil moisture content is

significantly lower (increase water:cement ratio) or higher (increase cement addition) than the 56 to 61 percent range tested in PRDI 2 to achieve adequate performance of the ISS mix design.

The Contractor will be required to have calibrated scales and flow meters, as needed, on-site to measure the weight of each component (soil, PC, GGBFS, water) in each batch of the ISS mix.

7.5.2 ISS Performance Criteria

Based on the evaluation provided in the PRDI 2 Data Report (Aspect, 2024a), the following performance criteria are adapted for the remedial action:

- For each ISS Area, an arithmetic mean of unconfined compressive strength (UCS) of at least 50 psi, with no individual samples less than 30 psi UCS.
- For each ISS Area, geometric mean of hydraulic conductivity less than or equal to $1x10^{-6}$ cm/sec, with no individual samples greater than $1x10^{-5}$ cm/sec.
- Based on the results of the treatability test, ISS treatment is expected to achieve greater than 95 percent reduction in mercury leachability[27]; consistent with the industry standards, the leachability performance of the ISS-treated soils will ultimately be demonstrated by groundwater monitoring.

7.5.3 ISS Equipment and Mixing

While ISS mix design is prescribed, the Contractor will be afforded flexibility in their means and methods to conduct ISS mixing, subject to Engineer approval in review of their ISS Plan preconstruction submittal (Section 3.1). It is expected that the ISS mixing will be performed by either a hydraulic drill rig equipped with a vertical auger or by mass mixing using bucket mixing or excavator-mounted tool (e.g., Allu mixer). Photographs 1 and 2, below, show typical equipment used for ISS mixing.

[27] During the PRDI 2 ISS treatability testing, the leachable mercury concentrations from treated soil, as determined by Leaching Environmental Assessment Framework (LEAF) testing, were reduced by 95 percent or more when compared to the Synthetic Precipitation Leaching Procedure (SPLP) testing results from the untreated soil (Aspect, 2024a).



Photograph 1. Hydraulic Drill Rig Equipped with Auger



Photograph 2. Excavator-Mounted Mass Mixing Tool (Allu Mixer)

Throughout ISS mixing, it is anticipated that a support excavator and hydraulic cutting tool capable of reaching down to the bottom of ISS treatment depth will be available on-site to remove obstructions and debris.

Additional equipment supporting the ISS mixing includes the following:

- Batch plant(s) with a silo(s) and storage tanks for cementitious reagents and water, and colloidal mixer(s) and electric pumps to prepare the ISS reagent grout mix. The batch plant would be situated in a designated support area near the soil stockpile area. Photograph 3 shows a typical batch plant layout and equipment.



Photograph 3. Typical Batch Plant Equipment and Layout for ISS

- Progressive cavity and centrifugal pump(s) to deliver the reagent grout to the mixing equipment. Booster pump(s) may be required if the grout needs to be delivered over long distances.
- Generator to supply the power for supporting equipment and mixing head or installations to connect that batch plant to other power sources.
- Manlift to service equipment including the Kelly bar of the drill rig, if a drill rig is used.
- Hydraulic sampling device to obtain discrete ISS construction quality assurance (CQA) samples.
- Roll-off boxes to store washout water and waste grout (if necessary).
- Ancillary equipment for positioning and telemetry.

The reagent grout mixture will be prepared in the batch plant and pumped to the mixing equipment located at the ISS areas and injected directly into the soils (treatment zone), while simultaneously physically mixing the soil with the grout in situ to achieve a homogeneously mixed soil-cement mixture.

7.5.4 ISS Sequencing

ISS will be performed in a sequence with pavement and obstructions removal as described in Sections 7.2 and 7.3, and designed to minimize the size of open treatment areas to

1. reduce direct contact for stormwater with contaminated materials; and
2. reduce exposure of contaminated materials resulting in lower emissions and necessary mercury vapor controls.

Mercury air monitoring conducted when managing soil containing elemental mercury during the first interim action in summer 2013 versus during the second interim action (November 2017) and the PRDI 2 obstruction removal pilot test (late October 2022) demonstrate clearly that mercury vapor emissions are substantially lower in cooler weather. Thus, the ISS operations will be conducted in cooler weather, if possible, as a control to reduce mercury emissions. The Contractor will be required to minimize emissions and implement vapor mitigation if air quality thresholds are exceeded (Section 7.6). It is anticipated the Contractor will conduct ISS mixing in a cell-based approach to achieve this. The cell-based approach and sequencing will be described in the Contractor's ISS Plan submittal, and approved by the Engineer prior to construction.

If the Contractor elects to conduct ISS mixing for all soil within an ISS area at once, it is anticipated they will use temporary cover systems to minimize emissions and comply with air quality thresholds.

7.5.5 ISS Construction Quality Assurance

The Engineer will collect CQA samples at select locations immediately following ISS mixing at a rate of either one per approximately 500 cubic yards of material treated or once every day of ISS production, with a minimum of one sample per day during full-

scale implementation of the ISS work. If the Contractor chooses to conduct multiple ISS operations in parallel (different ISS equipment working simultaneously in different areas), the CQA samples will be collected at that same frequency, per each ISS operation. CQA sample locations and target sampling depth (e.g., upper, middle, lower) will be selected by the Engineer.

Wet grab samples will be visually inspected to verify conformance with the following criteria:

- No visible free elemental mercury (i.e., not mixed within the soil/cement).
- ISS material is a generally homogeneous mixture such that the grout and soil are thoroughly mixed.
- Clumps of soil greater than 4 inches in any dimension are not present. Clumps are defined as intact soil that has not been mixed and does not include debris, pebbles, cobbles, or brick fragments coated with soil and/or grout.

If a wet grab sample fails one or more of the visual inspection criteria listed above, the ISS column or cell represented by the sample will be required to be remixed, and another wet grab sample will be collected after remixing.

For samples that pass the visual inspection criteria, samples for laboratory testing will be prepared using the following steps and in general accordance with ASTM D1632:

- Sieve the ISS material through 0.5-inch sieve.
- Add ISS material to molds in three separate lifts; within each lift, the material will be tamped and compacted within the mold to avoid air pockets.
- Once the mold is filled, level the top of the ISS material and place a cap on the mold.
- Cure the molded samples in a cooler with at least 0.5 inches of water at the bottom to maintain a moist condition for cement curing.

Unless molded samples fail to achieve at least 5 psi UCS (measured in the field by pocket penetrometer), the samples will be sent to an independent geotechnical laboratory and tested for the following:

- 28-day UCS using ASTM D1633 or ASTM D2166
- 28-day hydraulic conductivity using ASTM D5084

Additional field tests, including temperature, pH, and moisture content, may be performed to augment the CQA evaluation.

7.6 Air Monitoring and Mitigation

The elemental mercury present within the ISS areas is a highly volatile contaminant. During completion of Project C, the area and quantity of untreated soil that is exposed to the atmosphere, whether in situ or in a stockpile, at any one time will be minimized to limit mercury vapor emissions, as described in Section 7.6. In addition, because mercury volatility increases at higher temperatures, completion of the ISS work will be targeted for spring, fall, or winter (not summer) months. All workers, including Contractor and Engineer personnel, within the exclusion zone will be required to use Level C PPE, including air-purifying respirators with mercury-vapor cartridges.

The Engineer will conduct air monitoring for mercury prior to starting Project C to establish baseline conditions, and then from the time asphalt removal starts until 1 week following completion of all ISS mixing. Air monitoring will be conducted both within the breathing zone for the purpose of worker health and safety, and around the perimeter of the Project C work area to monitor fugitive emissions, using a using a hand-held mercury air monitoring instrument (Lumex®). The perimeter air monitoring will be conducted at the approximate four locations shown on Figure 13, although specific locations can be adjusted in the field based on access or other logistics. The following action levels for mercury in air, consistent with those applied for the prior interim actions and field pilot test, will be enforced throughout completion of Project C:

- **Within the worker breathing zone:** the 100 µg /m^3 OSHA PEL
- **At the perimeter monitoring locations:** a 5 µg /m^3 MTCA air remediation level that is a modified Method B (unrestricted) air cleanup level derived in the Interim Action Work Plan (Aspect, 2016)

If an air action level is exceeded, remediation operations will be suspended, and the Contractor will implement additional vapor suppression methods and/or adjust their operations to reduce mercury emissions to below the air action levels. To that end, the Contractor will be required to have on-site and available for expedited application (to exposed surfaces known or inferred to contain elemental mercury) a product demonstrated to be effective for suppressing mercury vapors (e.g., MERCON®, RusFoam® ADC foam, etc.). A 10-mil liner and visqueen cover materials (minimum 6-mil) must also be available for vapor suppression from the temporary soil stockpile area. To further reduce mercury air emissions, the Contractor will also maintain dust-free traffic routes and surfaces to the extent practical throughout the work.

7.6.1 Contingency Vapor Mitigation

If the vapor mitigation methods described above cannot adequately suppress vapors to achieve the action levels, a contingency will be included in the contract documents to mitigate vapors using a vapor enclosure and air treatment system like that used in the prior two interim actions. In that scenario, the Contractor will mobilize a vapor control enclosure(s) large enough to encompass the active ISS work area (cell) and/or soil stockpile area (if one or other is determined as primary source of vapors) and then conduct the remainder of the respective work within the enclosure. The top and sides of the enclosure will be water-tight and generally air-tight, including at the seam where the

enclosure walls meet the ground, and it must function during all weather conditions for the remaining duration of the ISS work.

A blower(s) will be installed at one end of the treatment enclosure to actively draw air from inside the enclosure for treatment. The blower will be sized to displace a minimum of three enclosure volumes of air per hour. The air treatment system will use activated carbon pretreated with sulfur or iodine to remove vapor-phase mercury. To prevent premature clogging of the activated carbon, the treatment system will also include means to effectively filter the air for particulate matter upstream from the activated carbon. The air discharge from the treatment system must achieve mercury concentrations at or below an action level of 50 µg/m^3 at the air treatment system discharge point,[28] as measured by the Engineer. If mercury concentrations measured at the discharge point exceed the action level, the Contractor will be required to terminate operations and reconfigure the treatment enclosure, the blower, and/or the air treatment system to achieve the action level. At the end of Project C, all filter media, activated carbon, and other materials from the air treatment system will be properly disposed of in accordance with applicable laws, regulations, and permits.

7.7 Hard Capping of Project C Cleanup Areas

Following completion of the TPH-contaminated soil removal and ISS, the finished grades in the Project C remediation footprints will match the respective surrounding grades. Because mercury concentrations in the ISS treatment areas and adjacent Chlorine Plant area soils exceed the 24 mg/kg soil cleanup level, the entire Project C limits (Figure 13) will be hard capped, as required by the CAP. There will be an interim cap constructed using impermeable ballast for the ISS areas underneath the future rail spur project (Figure 2), which will be replaced with a permanent HMA cap during rail spur construction. Any remaining Chlorine Plant areas requiring a hard cap will be included in the Project D.

The permanent hard cap for this area will consist of a minimum of 3 inches of HMA overlying 4 inches of compacted CSBC. The HMA will be Class 0.5-inch and Performance Grade binder of PG 64-22 compacted to a minimum of 92 percent reference density per ASTM D2041. Around the perimeter of the paved area, the edges of the new HMA will be tapered to match surrounding grade and make a smooth transition that is driveable by automobile. The detailed grading and drainage design for the cap will be determined during preparation of the CPS for Project C.

[28] As derived in the Interim Action Work Plan (Aspect, 2016) to comply with Chapter 173-460 WAC, *Controls for New Sources of Toxic Air Pollutants*.

8 Design for Project D: Capping

As described in Section 1.1.1, Project D includes placement of hard caps in areas where residual soil contaminant concentrations exceed soil cleanup levels, with a goal to limit stormwater infiltration and control the human and terrestrial ecological exposure and soil-erosion pathways. Because Projects A and C include construction of caps within areas disturbed to accomplish those cleanup actions (see Sections 4.4, 5.15, and 7.7, respectively), Project D involves capping of the other Site areas required by the CAP.

Figure 16 depicts the areas planned for hard capping, as per the CAP, and the condition of the current surface cover as observed during the October 2023 visual survey (part of PRDI 3), divided into three categories:

- Category 1: Hard Cap in Suitable Condition
- Category 2: Hard Cap Absent or in Unsuitable Condition
- Category 3: Surface Obscured, Condition Uncertain

Figure 16 also depicts the approximate areas planned for hard capping, as part of Projects A and C. Table 3 presents the October 2023 field observations of surface conditions for the numbered areas shown on Figure 16.

Areas designated as Categories 2 and 3 require new hard capping to meet CAP requirements, and areas designated as Category 1 met CAP requirements as of October 2023. However, given expected changes to Site use, and surface conditions, in the time between the October 2023 surface conditions survey and when the project-specific capping will be designed and constructed, a verification survey of surface conditions (suitability as a hard cap) will be conducted for each area to be capped during final design for Project D.

The capping design for all Projects will also be integrated with design of future redevelopment features (structures, utilities, etc.), as such information becomes available. In addition, capping will be designed and constructed to integrate drainage and management of stormwater with the site-wide stormwater management system and applicable local development regulations and ordinances. This may necessitate regrading areas being capped. The capping can integrate existing surface pavements in suitable condition (limited cracks or voids such that it is effective in restricting infiltration into or erosion of underlying soils) and with appropriate grading for stormwater drainage. New hard caps will be constructed for areas requiring capping that do not meet those criteria at the time of final Project design.

The following sections describe the capping for areas outside of Projects A and C and the specialized capping for the Chemfix Area.

8.1 Capping of Areas Outside of Projects A and C

The default hard cap design for the remaining capping areas, excluding the Chemfix Area, will consist of minimum 3 inches of HMA overlying 4 inches of compacted CSBC. The HMA will be Class 0.5-inch and Performance Grade binder of PG 64-22 compacted

to a minimum of 92 percent reference density per ASTM D2041. Around the perimeter of each paved area, the edges of the new HMA will be tapered to match surrounding grade and make a smooth transition that is drivable by automobile. Depending on the status of site-wide grading and stormwater drainage system or other redevelopment projects at that time, the hard capping approach may be adjusted from that default design.

As stated above, the detailed grading and drainage design for each capped area will be determined during preparation of the CPS for Project D.

8.2 Capping of Chemfix Area

In June 1977, Ecology issued Order Docket No. DE 77-336, requiring GP to manage the recently placed Chemfix material[29] through either off-site disposal or installation and long-term maintenance of an impervious cover. The Order stated the requirements for the impervious cover as follows:

> "The covering shall be constructed of either asphalt or concrete pavement. If asphalt is used, the surface over the Chemfix deposit, including a 10-foot border extension on all sides, shall be covered with an impervious plastic liner overlaid with sand prior to paving. The asphalt pavement shall extend at least 20 feet beyond the sludge deposit on the side toward the log pond and shall extend to join with existing paved surfaces on the other three sides. If concrete is used, either the surface area described above shall be paved or the surface over the Chemfix deposit, including a 10-foot border extension on all sides, shall be paved and joined to a concrete footing wall constructed around the deposit to a depth of six feet."

In response to the Order, GP submitted, and Ecology approved, engineering plans for constructing an asphalt cover over the Chemfix material (Ecology, 1977). Based on GP's drawing no. C-4546, GP constructed an asphalt cover consisting of (from bottom up) a layer of bank-run fill; a geotextile membrane (Typar, lapped and glued) extending beyond the lateral extent of Chemfix; a 6-inch layer of sand; and two layers of asphalt together totaling 5 to 6 inches in thickness and extending beyond the lateral extent of Chemfix.

In the October 2023 visual survey, the pavement across the entire Chemfix Area was designated unsuitable as a hard cap (Category 2; Area 9 on Figure 16). In addition, as summarized in Section 2.2.2.4, exploratory test pits completed as part of PRDI 3 did not reveal a geotextile membrane in the western portion of the Chemfix Area (see Figure 16). Therefore, a new hard cap will be constructed across the Chemfix Area, including use of a geomembrane, as required by Ecology's 1977 Order.

The hard cap design for the Chemfix Area will consist of minimum 3 inches of HMA over 4 inches of compacted CSBC over a low-permeability geomembrane[30] over a 3-inch layer of bedding sand. Depending on grade requirements established at the time of final design, the existing pavement/geomembrane material in that area may first be removed or may be left in place and built upon. The HMA will be Class 0.5-inch and Performance

[29] The Chemfix material was placed in July 1976 without prior notification to Ecology.
[30] Minimum 20-mil-thick, woven, HDPE with seams welded, to be further specified in construction plans/specifications for capping the Chemfix Area.

Grade binder of PG 64-22 compacted to a minimum of 92 percent reference density, per ASTM D2041. Around the perimeter of the capped area, the edges of the new HMA will be tapered to match surrounding grade and make a smooth transition that is drivable by automobile. Depending on the status of site-wide grading and stormwater drainage system or other redevelopment projects at that time, the hard capping approach may be adjusted from that default design. The detailed grading and drainage design for the Chemfix Area will be determined during preparation of the CPS for Project D.

9 Compliance Monitoring

The selected cleanup actions will include periodic compliance monitoring (protection, performance, and confirmation monitoring) of the remedial action, in accordance with WAC 173-340-410, as follows:

- **Protection Monitoring** is conducted to protect human health and the environment during construction and operation of the cleanup action.
- **Performance Monitoring** confirms that the cleanup action has attained cleanup standards, remediation levels, or other performance standards such as permit requirements.
- **Confirmation Monitoring** confirms the long-term effectiveness of the cleanup action once cleanup standards and remediation levels or other performance standards have been attained.

Compliance monitoring for active treatment technologies and for natural attenuation (NA) are discussed separately, below.

9.1 Active Treatment Technologies

Implementation of active groundwater treatment technologies (e.g., pH neutralization) will include protection and performance monitoring. Implementation of soil treatment technologies (e.g., soil removal and ISS) will include protection, performance, and confirmation monitoring. Protection monitoring will be provided as part of health and safety plans and other plans prepared for specific cleanup components as part of their respective CPS and updated accordingly throughout the cleanup actions. Performance monitoring for active treatment technologies will be conducted as generally described in Sections 4.2.1, 6.7.2, and 7.5.5, and specific monitoring programs will be defined in their respective CPS. The performance monitoring program described in the CPS will include criteria for when active treatment can cease and transition to NA. It is expected that cleanup levels will ultimately be achieved by NA, and that confirmation monitoring will be performed as part of NA monitoring (see Section 9.2).

9.2 Natural Attenuation Monitoring

This section describes long-term performance and confirmation monitoring to evaluate NA performance and ultimately confirm compliance with cleanup standards. This program will be described in a Groundwater MNA Plan that will include a SAP/QAPP.

The compliance groundwater monitoring program for NA presents the methods for performance and confirmation groundwater sampling and the decision criteria for the transition from performance sampling to confirmation sampling. For the purposes of groundwater monitoring, the Site has been subdivided into four groundwater plume areas, as illustrated on Figure 17, to allow flexibility in allocating sampling resources in an efficient manner: Caustic Plume and Law-1 Areas, Million Gallon Tanks Subarea, and the Miscellaneous Metals Area.

Performance sampling will consist of collecting groundwater samples for laboratory analysis at the selected sample frequency (1 year, 2 years, or 5 years) and comparing the laboratory analytical results to their respective site-specific cleanup levels to assess compliance with the RAOs. During performance monitoring, the compliance monitoring program will be reviewed at 5-year intervals to evaluate changes[31] in sampling locations and frequency to achieve the RAOs. Once the performance groundwater monitoring data confirm that the applicable RAOs have been met throughout the sampling subarea, final confirmation monitoring will be implemented. Confirmation monitoring will consist of four quarterly sampling events using the set of performance monitoring wells approved during the most recent 5-year review cycle. Following concurrence from Ecology that the RAOs have been achieved, all monitoring wells will be decommissioned[32]. The compliance monitoring program meets the MTCA requirement (WAC 173-340-410) to provide compliance monitoring to verify cleanup.

The compliance groundwater monitoring plan will include the following elements:

- Plume centerline and boundary wells, to confirm the plumes are stable or shrinking
- Wells with mercury and/or PAHs in the Fill Unit to evaluate the VI pathway
- Wells along the Whatcom Waterway and Bellingham Bay shoreline, to evaluate the groundwater-to-surface water pathway

Sampling frequency will be established in the Groundwater MNA Plan, and the frequency will be evaluated during the 5-year review cycle. Sampling frequency will decrease at wells exhibiting consistent stable or declining trends. For the purposes of this plan, it is assumed that wells will be sampled every 5 years after Year 10. If increasing trends are observed, sampling frequency may remain the same or be increased.

9.3 Contingency Actions

If a contingent action is deemed necessary to protect groundwater discharge in the long-term, additional information would be available at that time to determine the causes of MNA failure and an effective and practicable means to remedy it. If the cause of increasing contaminant concentrations in groundwater are evident based on monitoring activities, that may dictate the appropriate contingent action.

For example, if it is observed that increasing dissolved mercury concentrations are a result of changes to groundwater pH, then a contingent action could expand the pH treatment implemented in Project B to other areas. If monitoring indicates dissolved mercury poses a risk for discharge, in the absence of high pH, a PRB along the shoreline could accomplish in situ treatment of mercury in groundwater; this was the contingent action assumption included in the FS (Aspect, 2018b). Common PRB treatment materials include granular activated carbon (GAC), organoclay, wood mulch/compost, and zero-

[31] Changes to the sampling locations may include replacing wells or removing wells from the program for which sampling results have met the RAOs for at least four consecutive sampling events.
[32] Performance wells may be selected for decommissioning during the 5-year review process. This process would be on a well-by-well basis as long as remedy performance and confirmation monitoring can be achieved with the remaining well network.

valent iron (ZVI). For example, ZVI has been successfully used in PRBs to treat groundwater contaminated with heavy metals, including chromium, copper, zinc, and mercury (Weisener et al., 2005; Nam et al., 2017). If discharge of PAHs downgradient of the Million Gallon Tanks subarea is deemed to be not protective, GAC could be deployed by PRB or injection methods (colloidal form) to achieve sorption prior to discharge. Enhanced biodegradation might be an option for treating lower molecular-weight PAHs (not cPAHs).

Alternatively, groundwater containment could be applied to limit the migration of dissolved-phase contaminants to Bellingham Bay/Whatcom Waterway. Containment methods could include sheet pile walls, slurry walls, or groundwater extraction and treatment (pump-and-treat). While technically feasible, groundwater containment measures are likely to be deemed less practicable than in situ treatment methods.

Plans for implementing a contingent action would be developed in consultation with and approval by Ecology prior to implementing the action.

10 Institutional Controls (Environmental Covenant)

The Port and Ecology will execute an environmental covenant for the RAU that includes institutional controls restricting certain activities and uses of the RAU property to protect the integrity of the selected cleanup action and thereby protect human health and the environment. It is anticipated that institutional controls will include the following:

- Provide notification regarding the presence of residual in-place contaminated materials.
- Require Ecology review and approval of activities involving disturbance/management of residual contaminated materials (capped) or the cleanup action components, with particular care taken if conducting subsurface disturbance in areas of ISS-treated soils containing elemental mercury (Chlorine Plant area).
- Provide for long-term monitoring and stewardship of the cleanup action, including inspection and maintenance of hard-capped areas.
- Require that contaminant-specific VI potential be evaluated[33] and, if needed, based on the evaluation, VI controls be constructed for future buildings that would be occupied in the following two areas:
    - For mercury vapors in the Chlorine Plant area.
    - For naphthalene vapors in the Million Gallon Tanks subarea. [34]
    - For either area, the VI evaluation would be conducted in accordance with the Ecology VI guidance in place at that time (e.g., Ecology, 2022c) and would include soil gas sampling and analysis in locations where occupied structures are planned—applying specialized techniques for vapor-phase mercury. If VI mitigation is required based on the sampling results, appropriate VI controls would then be integrated into design and construction of the planned structures.

The Port will work with Ecology and the Washington State Attorney General's Office to define the covenant's specific restrictions and requirements applicable to the Site prior to the covenant being legally recorded with Whatcom County.

[33] The VI evaluation will be conducted in accordance with current Ecology VI guidance (e.g., Ecology, 2022c) and may include groundwater monitoring relative to VI-based groundwater screening levels and/or soil gas monitoring relative to soil gas screening levels protective of indoor air, with screening levels appropriate for the planned land use.

[34] The Site RI includes the available soil gas sampling data for both areas, collected 2009–2011 (Aspect, 2013).

10.1 Reuse of Soils Excavated during Post-Cleanup Redevelopment Projects

As redevelopment of the RAU occurs, the redevelopment project proponent may choose to permanently remove (excavate/properly dispose), instead of cap, residual contaminated soil if such an action is completed in consultation with, and with approval from, Ecology. Consistent with the Contaminated Materials Management Plan (CMMP) for the Site's Pulp/Tissue Mill RAU (Aspect, 2014c), contaminated soil generated by excavation or grading during redevelopment projects within the Chlor-Alkali RAU must either be placed beneath a hard cap that meets CAP requirements or be properly disposed of off-site within 2 years of its excavation/grading. Soil may be reused/capped on-site only if, at the discretion of the Port's Engineer based on industry-standard field screening methods, it is not grossly contaminated—no indications of nonaqueous phase liquid (e.g., petroleum or mercury) or strong chemical odors—and it is geotechnically suitable for the intended future land use.

Excavated soils to be temporarily managed on-site, prior to reuse/capping or off-site disposal, must be stockpiled in accordance with requirements of Section 3.6 or placed into appropriate containers (e.g., covered roll-off boxes) while on-site to avoid dispersal of potentially contaminated material via water or wind erosion. If material is to be disposed of off-site, it may be directly loaded for transport to a permitted disposal facility.

11 Permits and Substantive Requirements

In accordance with MTCA, the RAU cleanup action will be conducted under Consent Decree No. 142027008, as amended, and is exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 of the Revised Code of Washington (RCW), and of any laws requiring or authorizing local government permits or approvals. However, the cleanup action must still comply with the substantive requirements of such permits or approvals (WAC 173-340-520). In addition, the cleanup action is not exempt from federal permits and requirements.

The following sections outline how substantive requirements of procedurally exempt local permits will be met during implementation of the RAU cleanup action.

11.1 Federal Permits

11.1.1 National Pollutant Discharge Elimination System

The cleanup action will require treatment and discharge of construction stormwater and excavation-dewatering water, likely over the course of multiple cleanup projects. As described in Section 3.7, if a cleanup project is completed prior to the Port's ASB going offline such that water generated from excavation dewatering and stormwater runoff are discharged to it (Section 3.7), and TESC measures prevent discharge of stormwater or sediment from the Project construction limits (Section 3.3), there would be no discharge to surface waters of the state, and that cleanup project would not be a significant contributor of pollutants to waters of the state or violate water quality standards. Consequently, in accordance with Special Condition S1 of the CSGP, a CSGP would not be required for that cleanup action, unless otherwise determined by Ecology.

However, if the Port's ASB is not available to receive discharges at the time of cleanup execution, the water would be discharged to surface water via Port storm drain in accordance with an NPDES CSGP with project-specific Administrative Order issued by Ecology's Water Quality program. In that case, construction-generated stormwater and/or dewatering water discharged to surface waters of the state would comply with all requirements of the CSGP Administrative Order. The Port would obtain the CSGP with Administrative Order but, upon the execution of the contract for a cleanup project, the Port would transfer the permit in full to the Contractor.

11.1.2 Underground Injection Control Permitting

The HIWs for Project B are considered Class V underground injection wells that are subject to federal UIC Regulations. EPA has delegated regulation of Class V injection wells to Ecology under the state UIC Program (Chapter 173-218 WAC). The Site is being managed pursuant to AO No. DE 6834, between Ecology and the Port. In accordance with WAC 173-218-060(5)(b), a permit is not required when injection activity is performed under an AO or consent decree. However, the injection points will be registered with Ecology's UIC program using their online registration tool. Following injections, the UIC registration will be updated to reflect the completed injections.

11.2 State Environmental Policy Act

For a project to comply with the State Environmental Policy Act (SEPA), Chapter 43.21C RCW, a SEPA review is conducted in accordance with applicable regulatory requirements, including WAC 197-11-268, and Ecology guidance, as presented in Ecology Policy 130A (Ecology, 2004). The SEPA lead agency, Ecology, determined that the RAU cleanup action will not have a probable significant adverse impact on the environment and, on July 6, 2021, issued a Determination of Nonsignificance (DNS)[35] that then went through Ecology's mandatory public comment period.

11.3 Permit Substantive Requirements

The RAU cleanup action is subject to the following local requirements, but is procedurally exempt from them:

- Major Grading Permit as per the City of Bellingham Grading Ordinance, Bellingham Municipal Code (BMC) 16.70
- City of Bellingham Shoreline Master Program (SMP), BMC Title 22
- Critical Areas Permit as per the City of Bellingham Critical Areas Ordinance, BMC 16.55
- City of Bellingham Stormwater Requirements, BMC 15.42

The applicable substantive requirements of the state and local permits or approvals, and the general manner in which the cleanup action will meet them, are identified below. The Port will continue to coordinate with the City regarding implementation of the cleanup action projects. This includes the Port providing the City a letter describing, with references to specific portions of the CPS, how the cleanup action work will meet the substantive requirements of their permits listed below, and obtaining written concurrence from the City, as has been done for prior cleanup actions the Port has conducted on the Site.

11.3.1 City of Bellingham Major Grading Permit

Pursuant to the City Grading Ordinance (BMC 16.70.070), a Major Grading Permit is required from the City for grading projects that involve more than 500 cubic yards of grading. The permit-required standards and requirements will be integrated into the CPS for each cleanup project so that construction complies with the substantive requirements of the City grading ordinance. Those substantive requirements include location and protection of potential underground hazards, proper vehicle access point to prevent tracking of soil outside of the project site, erosion control, work hours and methods compatible with weather conditions and surrounding property uses, prevention of damage or nuisance, maintaining a safe and stable work site, compliance with noise ordinances and zoning provisions, and compliance with City traffic requirements when using City streets.

[35] Available at: https://apps.ecology.wa.gov/cleanupsearch/site/2279#site-documents

11.3.2 City of Bellingham Shoreline Substantial Development Permit

Portions of the RAU cleanup action will occur within the regulated shoreline area designated by the City SMP (BMC Title 22) as Waterfront District, with variable uses depending on location. The cleanup action must therefore meet the substantive requirements of a City Shoreline Substantial Development Permit (SSDP). To comply with the SSDP, the project must have no unreasonable adverse effects on the environment or other uses, no interference with public use of public shorelines, compatibility with surroundings, and no contradiction of purpose and intent of SMP designation.

11.3.3 City of Bellingham Critical Areas Ordinance

The cleanup projects will occur on land designated as a seismic hazard area by BMC 16.55 Critical Areas because the Site is on man-made fill. However, these cleanup projects are not development proposals and do not include construction of improvements. The planned soil removal and in situ treatment activities, and the final remediated Site condition, will not exacerbate seismic hazards within the work area or surrounding property.

11.3.4 City of Bellingham Stormwater Requirements

Pursuant to the City Stormwater Management Ordinance (BMC 15.42), the cleanup must meet the requirements of a City Stormwater Permit. The cleanup actions do not include construction of improvements, and the substantive requirements will be met by preparation of and compliance with a SWPPP to infiltrate construction stormwater and prevent its off-site runoff, control sources of pollution, and preserve natural drainage systems and outfalls.

12 Cleanup Completion Reporting

Upon completion of each cleanup project comprising the overall RAU cleanup action, a draft As-Built Report describing the methods and outcomes of the cleanup project will be prepared and submitted to Ecology for review and comment. Ecology comments will be addressed in a final As-Built Report. Each report will provide documentation for materials disposed of or recycled off-site during the project. Validated analytical data collected during the cleanup action will be uploaded to Ecology's Environmental Information Management (EIM) database.

13 Schedule

This EDR, once approved by Ecology, will serve as the primary basis for preparing CPS for the projects comprising the RAU cleanup action. The implementation of the RAU's cleanup action, including this final EDR and the CPS for all projects, will be completed in accordance with the requirements of the third amendment to the Site Consent Decree. As described herein, construction of a new rail spur for the BST and potentially other redevelopment projects will influence the sequencing and timing for cleanup construction. Therefore, the amended Consent Decree deliverable due dates and project sequencing may be modified with Ecology concurrence without further amendment to the Site Consent Decree.

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15 Limitations

Work for this project was performed for the Port of Bellingham (Client), and this report 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 report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Geosyntec 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 Geosyntec. Geosyntec's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

TABLES

Table 1. Soil Cleanup and Remediation Levels for Chlor-Alkali RAU

Project No. 26000033, Chlor-Alkali RAU Engineering Design Report, GP West Site

Constituent of Concern	Soil Cleanup Level[1] (mg/kg)		Soil Remediation Level (mg/kg)
	Unsaturated Soil	Saturated Soil	
Total Petroleum Hydrocarbon (TPH)			
Gasoline-Range TPH	--	--	
Diesel-Range + Oil-Range TPH	2,000	2,000	
Oil-Range TPH in Million Gallon Tanks Subarea	4000[2]	4000[2]	
Heavy Metals			
Arsenic	20	20	
Cadmium	1	1	
Chromium (Total)	5,200	260	
Copper	36	36	
Lead	250	81	
Mercury	24[3]	24[3]	300[4] visible elemental mercury[5]
Nickel	48	48	
Zinc	100	85	
Polycyclic Aromatic Hydrocarbons (PAHs)			
Acenaphthene	5.2	0.26	
Anthracene	71	3.5	
Fluoranthene	52	2.6	
Fluorene	7.4	0.37	
Pyrene	330	16	
1-Methylnaphthalene	35	35	
2-Methylnaphthalene	320	320	
Naphthalene	3.5	0.17	
Total cPAHs (TEQ)[6]	0.19	0.19	
Conventionals			
pH (in Standard pH Units)[7]	>2.5 and <11.0	>2.5 and <11.0	

Abbreviations: cPAH: carcinogenic PAH. mg/kg: milligrams per kilogram. TEQ: toxic equivalent concentration

Notes:

1. Refer to Section 5.2.2 of the RI (Aspect 2013) for derivation of soil screening levels that are adopted as cleanup levels for unrestricted land use, except for post-2013 adjustments noted in these footnotes.
2. Refer to Section 7.5.2.1 of the RI (Aspect 2013) for derivation of the unrestricted direct contact screening level that is adopted as the cleanup level for oil-range TPH in the Million Gallon Tanks subarea.
3. Based on unrestricted direct contact with soil. While not a cleanup level, a 100 mg/kg mercury concentration in unsaturated and saturated soil is determined to be protective of groundwater in near-neutral pH conditions, i.e. outside of the caustic core (pH < 10) (see FS Section 5.3.1.1; Aspect 2018b). No component of the selected cleanup action applies the 100 mg/kg concentration as a soil remediation level.
4. For soils within the former wastewater settling basin, mercury concentrations greater than a 300 mg/kg groundwater-protection-based remediation level will be removed (see FS Section 5.4.1.4; Aspect 2018b).
5. Visible elemental mercury is the remediation level for soils to be treated by *in situ* stabilization/solidification.
6. TEQ = Total toxic equivalent concentration of benzo(a)pyrene calculated in accordance with MTCA (WAC 173-340-708(e).
7. The soil pH cleanup level is based on preventing eye damage (corrosivity), and is met when the measured pH is within the listed range.

Table 2. Groundwater Cleanup and Remediation Levels for Chlor-Alkali RAU

Project No. 26000033, Chlor-Alkali RAU Engineering Design Report, GP West Site

Constituent of Concern	Groundwater Cleanup Level (µg/L)	Groundwater Remediation Level (µg/L)
Total Petroleum Hydrocarbon (TPH)		
Gasoline-Range TPH	1700[2]	
Diesel-Range + Oil-Range TPH	2100[3]	
Heavy Metals		
Arsenic	8[4]	
Cadmium	7.9	
Chromium (Total)	260	
Copper	3.1	
Lead	8.1	
Mercury	0.059	26 for Law-1 area; 7.6 for Caustic Plume area[6] 0.89[7]
Nickel	8.2	
Zinc	81	
Polycyclic Aromatic Hydrocarbons (PAHs)		
Acenaphthene	3.3	
Anthracene	9.6	
Fluoranthene	3.3	
Fluorene	3	
Pyrene	15	
Naphthalene	1.4[5]	8.9[7]
Total cPAHs (TEQ)[8]	0.02	
Conventionals		
pH (in Standard pH Units)[9]	>6.2 and <8.5	<10[10]

Abbreviations: cPAH: carcinogenic PAH. µg/L: micrograms per liter. TEQ: toxic equivalent concentration.

Notes:

1. Refer to Section 5.2.1 of the RI (Aspect 2013) for derivation of screening levels for non-potable groundwater (marine protection = highest beneficial use) that are adopted as cleanup levels for unrestricted land use, except for post-2013 adjustments noted in these footnotes.
2. Based on protection of aquatic life, based on the marine toxicity of gasoline (Ecology Implementation Memo No. 23; Ecology 2021a).
3. Based on protection of aquatic life, based on the marine toxicity of weathered diesel (Ecology Implementation Memo No. 23; Ecology 2021a).
4. Based on natural background groundwater quality (Ecology 2016a).
5. Based on protection of aquatic life (Ecology 2016b).
6. Groundwater remediation levels for marine protection apply at upland shoreline wells upgradient of the defined groundwater conditional point of compliance within the sediment bioactive zone as approved by Ecology. Derivation of groundwater remediation levels for mercury--one for the Law-1 area and one for the Caustic Plume area--is described in FS Sections 4.6.3.2 and 4.7.2.2 respectively (Aspect 2018b).
7. Protective of the VI exposure pathway for unrestricted land use.
8. TEQ = Total toxic equivalent concentration of benzo(a)pyrene calculated in accordance with MTCA (WAC 173-340-708(e).
9. The pH cleanup level and remediation level are met when the measured pH is within the listed range.
10. Applicable for the "Caustic Core" portion of the Caustic Plume.

Table 3. Observations from Oct. 2023 Surface Conditions Survey for Capping Areas

Project No. 26000033, Chlor-Alkali RAU, GP West Site, Bellingham, Washington

Area	Observations Regarding Surface Conditions (Oct. 10-11, 2023)
1	Asphalt thickness measured 5 inches at exposed edge. Condition good.
2	Asphalt over apparent buried tank slab, asphalt thickness measured 4 inches at exposed edge, condition generally degraded (unsuitable hard cap).
3	Within ABC lease area: degraded asphalt, measured 3-5 inches thick in some areas. Severe surface distress (unsuitable hard cap).
4	Within ABC lease area: mix of degraded asphalt, gravel base material, soil cover (unsuitable hard cap).
5	West of ABC lease area: area had open excavation to 3 feet bgs, no asphalt present (unsuitable hard cap).
6	Open excavation to 3.5' bgs. No asphalt (unsuitable hard cap).
7	West of ABC lease area: area had open excavation to 3' bgs, no asphalt present (unsuitable hard cap).
8	Asphalt confirmed, newer and generally in good condition, minor surface distress.
9	Inside ABC lease area: degraded asphalt (unsuitable hard cap).
11	Area north of ABC lease area: degraded asphalt under 2-3 inches of vegetated soil cover. Some areas did not encounter pavement (unsuitable hard cap).
12	Mix of concrete slabs, and bare soil (unsuitable hard cap).
13	Mix of damaged/degraded asphalt and concrete (unsuitable hard cap).
14	Combination of asphalt and concrete slabs: some surface distress and cracks, overall good condition.
15	Gravel fill area, no asphalt observed (unsuitable hard cap).
16	Open excavation/utility trench (unsuitable hard cap).
17	Area obscured by fill pile - surface conditions could not be observed.
18	Combined polygons 18,19,20: concrete circular tank slabs with soil fill in between, some degraded asphalt surrounding concrete. Tank slabs are adequate, soil and degraded asphalt between them is not.
19	
20	
21	Combined polygons 21,22: Railroad ballast, could not verify asphalt under fill material (unsuitable hard cap).
22	
23	Active construction zone; currently unsuitable hard cap but requires evaluation post-construction
24	Inside ABC lease area, north of entrance driveway: asphalt not present under vegetation cover to depth of 4-5 inches bgs (unsuitable hard cap).
25	Area could not be accessed due to obstructions, surface conditions could not be observed

Abbreviations: bgs: below ground surface

Notes:

During the Oct. 2023 survey, Area 10, located within Area 9, was recorded as "Surface obstructed by staged materials. Based on surrounding conditions, likely degraded asphalt (unsuitable hard cap)" (Aspect, 2024c). Subsequent observations during test pitting, after staged materials were moved, verified that area to be unsuitable, so it is now combined into Area 9.

The areas referenced are shown on Figure 17.

FIGURES



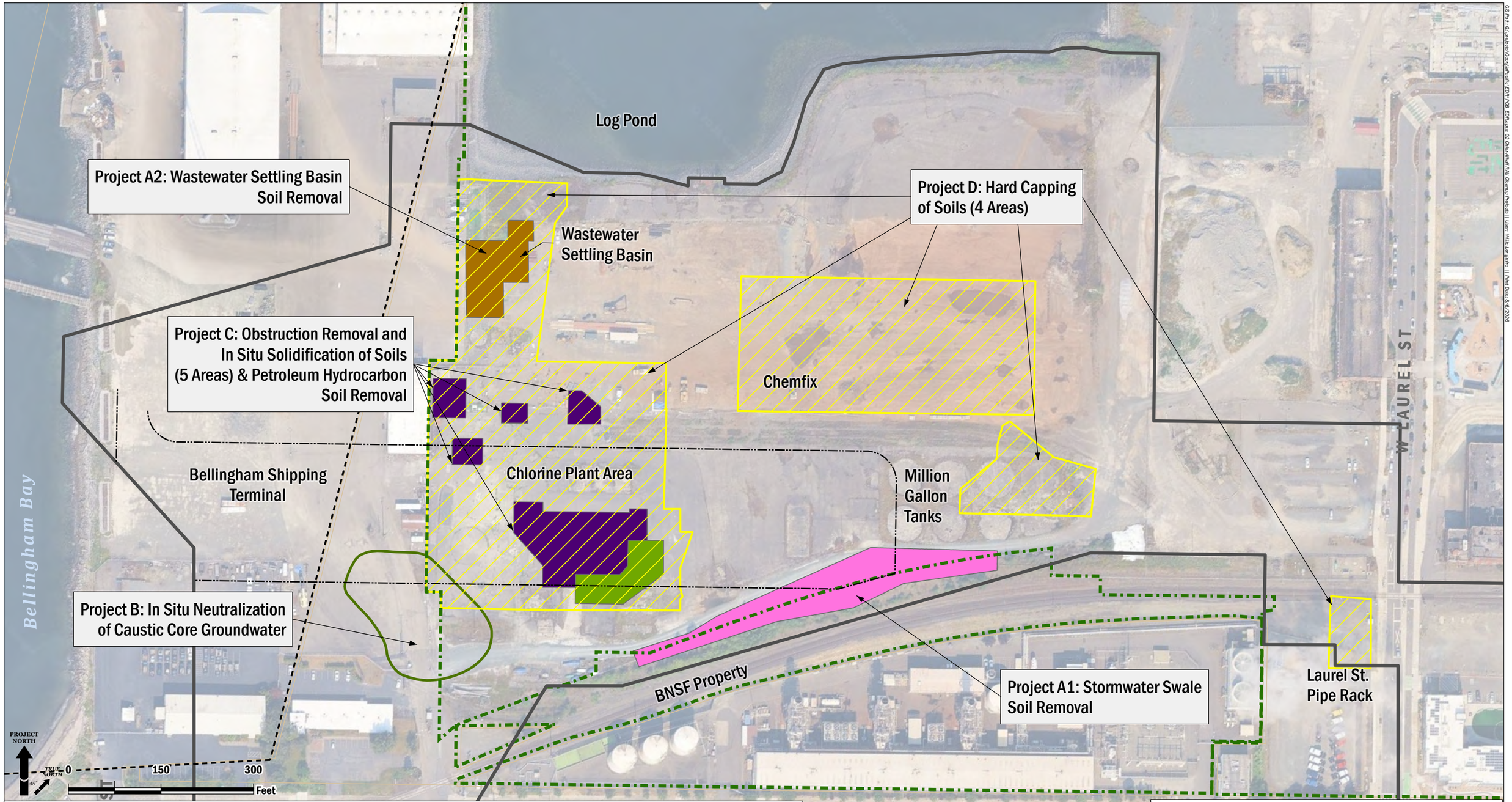
GP West Site with Remedial Action Units

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: SJG / HMD	FIGURE NO. 1
	PROJECT NO. 210368	REVISED BY: ---/---	

GIS Path: G:\projects\Georgia Pacific\EDR\POB_EDR.aprx || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 8/6/2026 || User: Willie.Longmire || Print Date: 8/6/2026

Basemap Layer Credits || Canvas_World_Light_Gray_Base: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Transportation: Esri, HERE, Garmin, (c) OpenStreetMap contributors
Imagery: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community



- In Situ Neutralization for Caustic Core Groundwater
- Obstruction Removal and In Situ Solidification of Soils
- Wastewater Settling Basin Soil Removal
- Petroleum Hydrocarbon Soil Removal Area
- Stormwater Swale Soil Removal
- Inner Harbor Line
- Conceptual Railroad Spur Paving Limits Subject to Change
- Hard Capping
- Property Boundaries from ALTA Survey (David Evans and Associates, 2004)
- Chlor-Alkali RAU Boundary

Notes:
- Aerial Source: 7/31/2022 Google Satellite Imagery
- The Lignin Operable Unit is part of the Chlor-Alkali RAU. However, its active cleanup has been completed and is therefore not shown.

Chlor-Alkali RAU Cleanup Projects

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: ACG / HMD	FIGURE NO. 2
	PROJECT NO. 210368	REVISED BY: SJG / WBL	

Data source credits: None || Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

GIS Path: G:\projects\Georgia Pacific\EDR\FDB_EDR.aprx; CO Chlor-Alkali RAU Cleanup Projects || User: WBL-Longmire || Print Date: 8/6/2026

GIS Path: G:\projects\Georgia-Pacific\EDR\PDB_EDR.aprx: 03 Soil Mercury Concentrations In and Around Wastewater Settling Basin Area | User: WillieLongmire | Print Date: 8/6/2026

L1-MW06
(3 - 5) 0.031
(5 - 7) 0.276
(13 - 14) 0.065
(16 - 17) 0.856

L1-MW02
(4 - 5) 0.219
(7 - 9) 6.49
(11 - 12) 3.37
(13 - 14) 0.075
(16 - 17) 0.143

L1-MW05
(3 - 5) 22.5
(7 - 9) 108
(11 - 12) 5.26
(13 - 14) 7.08
(16 - 18) 1.27

STB-01
(3.5 - 5) 0.9
(7.5 - 9) 0.1U
(11.5 - 13) 0.6
(15 - 16.5) 0.8

L1-MW01
(3 - 4) 0.195
(7 - 9) 1.02
(11 - 13) 3.72
(14 - 15) 51.5

L1-MW03
(4 - 5) 3.01
(7 - 9) 0.121
(11 - 12) 0.356
(13 - 14) 0.256
(15 - 16) 0.147

ESB-18S
(5 - 6.5) 0.13
(10 - 11.5) 0.43
(14 - 15.5) 74
(25 - 26.5) 0.11U

ESB-16S
(5 - 6.5) 140
(10 - 11.5) 31
(18 - 19.5) 5.7

WSB-119
(1.0) 76
(5.0) 14
(12.0) 0.59
(17.5) 630
(19.0) 1.2

WSB-102
(1.5) 19
(6.0) 170
(11.5) 200
(17.0) 130
(19.0) 14

WSB-103
(2.0) 1.8
(6.5) 11
(12.0) 7.9
(15.5) 15
(18.0) 8.7

WSB-120
(2.0) 0.22
(7.0) 0.1
(14.0) 0.28
(16.5) 780
(19.0) 0.82

WSB-101
(2.0) 0.31
(5.5) 3
(11.0) 2.2
(16.0) 5.4
(20.0) 0.34

WSB-104
(2.0) 62
(7.5) 180
(11.5) 110
(15.5) 540
(18.0) 0.77

WSB-118
(1.5) 0.33
(5.0) 17
(12.0) 0.1
(16.0) 0.58
(18.0) 2.6

STB-12
(3.5 - 5) 0.9
(7.5 - 9) 16

L1-MW04
(3 - 4) 62.0
(5 - 7) 48.7
(8 - 10) 1760
(10 - 12) 5.65
(13 - 15) 3.31

WSB-106
(3.0) 0.58
(6.5) 9.2
(13.0) 320
(17.5) 130
(20.0) 61

WSB-107
(1.5) 27
(6.5) 32
(11.0) 350
(16.0) 150
(18.0) 79

WSB-117
(2.0) 2.1
(7.0) 0.083
(11.0) 0.18
(15.0) 0.23
(17.0) 0.93

CP-MW05
(2.5 - 4) 32.2
(5 - 6.5) 4.67
(7.5 - 9) 23.7
(10 - 11.5) 101
(12.5 - 14) 375
(15 - 16.5) 14.6
(17.5 - 19) 33.8
(20 - 21.5) 4.02
(22 - 23) 0.078
(26 - 27) 0.031
(30 - 31) 0.015J
(34 - 35) 0.019
(38 - 39) 0.014J

WSB-105
(1.5) 33
(5.5) 3.4
(10.5) 15
(16.0) 30
(19.0) 0.3

SITE-6
(0 - 0.5) 1

WSB-109
(1.5) 1700
(7.0) 0.2
(10.0) 470
(13.0) 4.3
(15.0) 2.4

CP-MW03
(1.5 - 2.5) 0.709
(13 - 15) 1050

WSB-108
(1.5) 20
(6.0) 6.7
(11.0) 130
(16.0) 21
(17.5) 0.55

WSB-110
(1.5) 0.56
(6.5) 8.4
(12.0) 560
(16.0) 440
(19.5) 26

WSB-116
(1.5) 1.5
(8.0) 0.67
(11.5) 0.54
(16.0) 0.036
(18.0) 0.058

WSB-111
(1.5) 160
(6.0) 2.3
(11.5) 14
(16.5) 120
(20.0) 48

SITE-5
(0 - 0.5) 21

AS-04
(0 - 2.5) 0.217
(2.5 - 5) 0.065
(5 - 7.5) 0.063
(5 - 7.5) 0.064
(7.5 - 10) 0.119

WSB-112
(1.5) 1.4
(7.0) 2.6
(11.0) 410
(16.5) 580
(20.0) 9.1

Inlet Pipe to WSB

SITE-3
(0 - 0.5) 82

SITE-4
(0 - 0.5) 10

ESB-17S
(7 - 8.5) 0.37
(11 - 12.5) 0.14
(11 - 12.5) 1.53
(20 - 21.5) 1.1

WSB-115
(2.5) 53
(6.0) 97
(10.5) 22
(15.5) 9.9
(20.0) 3.9

STB-15
(3.5 - 5) 69
(7.5 - 9) 0.9

WSB-113
(2.0) 130
(6.0) 2.8
(13.0) 61
(16.5) 57
(19.0) 220

SITE-7
(0 - 0.5) 18

ESB-14S
(5 - 6.5) 0.60
(10 - 11.5) 200
(22 - 23.5) 0.13U

SITE-2
(0 - 0.5) 42

ESB-15S
(5 - 6.5) 0.11U
(10 - 11.5) 56
(22 - 23.5) 0.23

SITE-8
(0 - 0.5) 119

WSB-114
(0.5) 60
(6.0) 190
(13.0) 52
(17.5) 46
(19.5) 1.1

SITE-1
(0 - 0.5) 38

EMW-14S
(5 - 6.5) 3.6
(10 - 11.5) 160
(16 - 17.5) 47

EMW-15S
(5 - 6.5) 2.6

STB-04
(3.5 - 5) 3.1
(7.5 - 9) 0.1U

STB-13
(5 - 6.5) 1.1

40-ft Storage Containers

PROJECT NORTH
TRUE NORTH
45°
0 25 50
Feet

Mercury Concentrations in Soil

- Soil Hg < 300 mg/kg in all sample(s)
- Soil Hg > 300 mg/kg in any sample
- PRDI 3 Soil Boring
- Historical Soil Boring (RI Dataset)

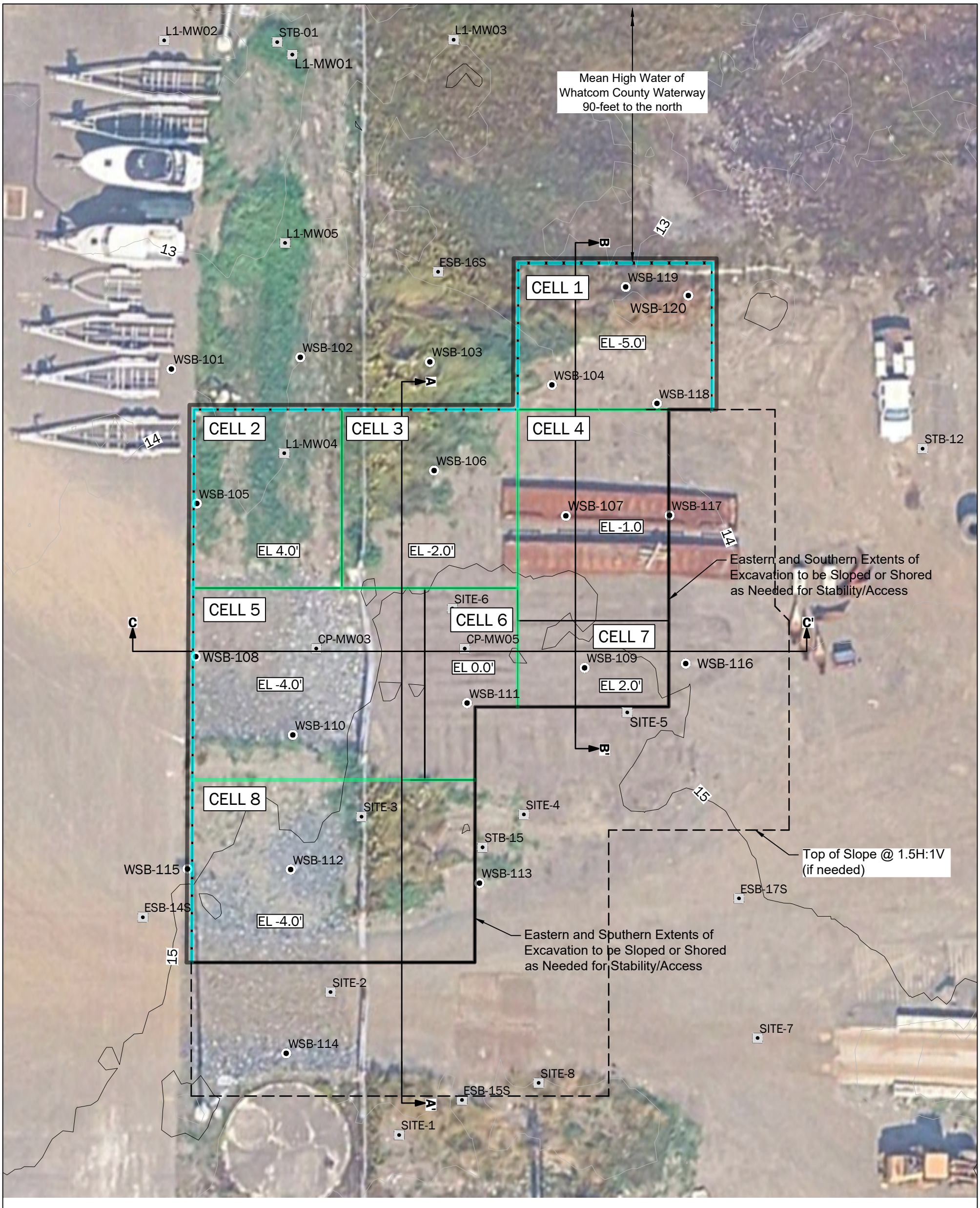
- Remedial Excavation Area
- Wastewater Settling Basin (Approx)
- Limit of Log Pond Cap
- Mean Higher High Water (MHHW) Line
- Fence
- Electrical Utility Trench

Soil Mercury Concentrations In and Around Wastewater Settling Basin Area

Pre-Remedial Design Investigation 3 Data Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: AET / DIM / HMD	FIGURE NO. 3
	PROJECT NO. 210368	REVISED BY: WBL	

Data source credits: SJG / NLK || Basemap Service Layer Credits: NA



Legend

- Required Temporary Shoring Location
- Possible Intermediate Temporary Shoring Locations
- EL 1.0' — Elevation at Bottom of Excavation*
- Minimum Excavation Extent
- PRDI 3 Soil Boring
- Historical Exploration

C C' — Cross-Section Location

15 — Topographic Elevation Contour

TRUE NORTH

PROJECT NORTH

0 20 40 Feet

*(Refer to Cross Sections A-A', B-B', and C-C' for bottom elevations of overburden excavation within excavation cells)

Source: Base map provided by Wilson Engineering, dated 10/2023. Vertical datum is NAVD 88.

Excavation and Conceptual Shoring Plan for Wastewater Settling Basin

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	Aug-2026	BY: HNH/CMV	FIGURE NO. 4
	PROJECT NO. 210368	REVISED BY: -	

A
Project North

A'
Project South

REQUIRED SHORING

AA - CC

CELL 3 | CELL 5 | CELL 8

WSB-103 Offset 6' E
WSB-106 Offset 7' E
CP-MW03 Offset 20' W
CP-MW05 Offset 11' E
WSB-110 Offset 23' W
WSB-112 Offset 24' W

South Excavation Limit to be Sloped/Shored as Needed for Stability/Access

Overburden Soil for Reuse

Soil for Subtitle D Disposal

EL. 5.0'

EL. 6.0'

EL. -2.0'

EL. -4.0'

EL. -4.0'

Elevation (Feet NAVD88)

20
10
0
-10

40 50 60 70 80 90 100 110 120 130 140 150 160 170 180

Distance (Feet)

Profile Legend

Lithology Graphics

- Fill
- Native

Mercury (Hg) Concentrations in Soil Samples

- Hg >300 ppm REL
- Hg <300 ppm REL

REL: Remediation level.

Material Handling

- Material for disposal (See Note 1)
- Overburden Soil for Reuse
- Inferred Groundwater Table (Fall 2023)

Aspect Explorations

B-01 (Offset 31' SE) — Borehole ID, Offset and direction
SPT Blow Count N Value — 8
Material Type (see Lithology Graphics)
Inferred Geologic Contact

0 10 20
Feet

Horizontal Scale 1" = 10'
Vertical Scale 1" = 5'
Vertical Exaggeration 2x

DISCLAIMER: The subsurface conditions presented in this geologic cross section are conceptual. Variations may exist between the soil and groundwater conditions depicted on this figure and those actually underlying the site. Refer to the contents of this report and boring logs for further context.

Notes:
1. Material noted as material for disposal within the excavation shall be removed and disposed of at a Subtitle D landfill.
2. Cross section surface and plan view generated from base CAD files provided by Wilson Engineering.
3. Site features are approximate.

Subsurface Cross Section A-A' for Wastewater Settling Basin

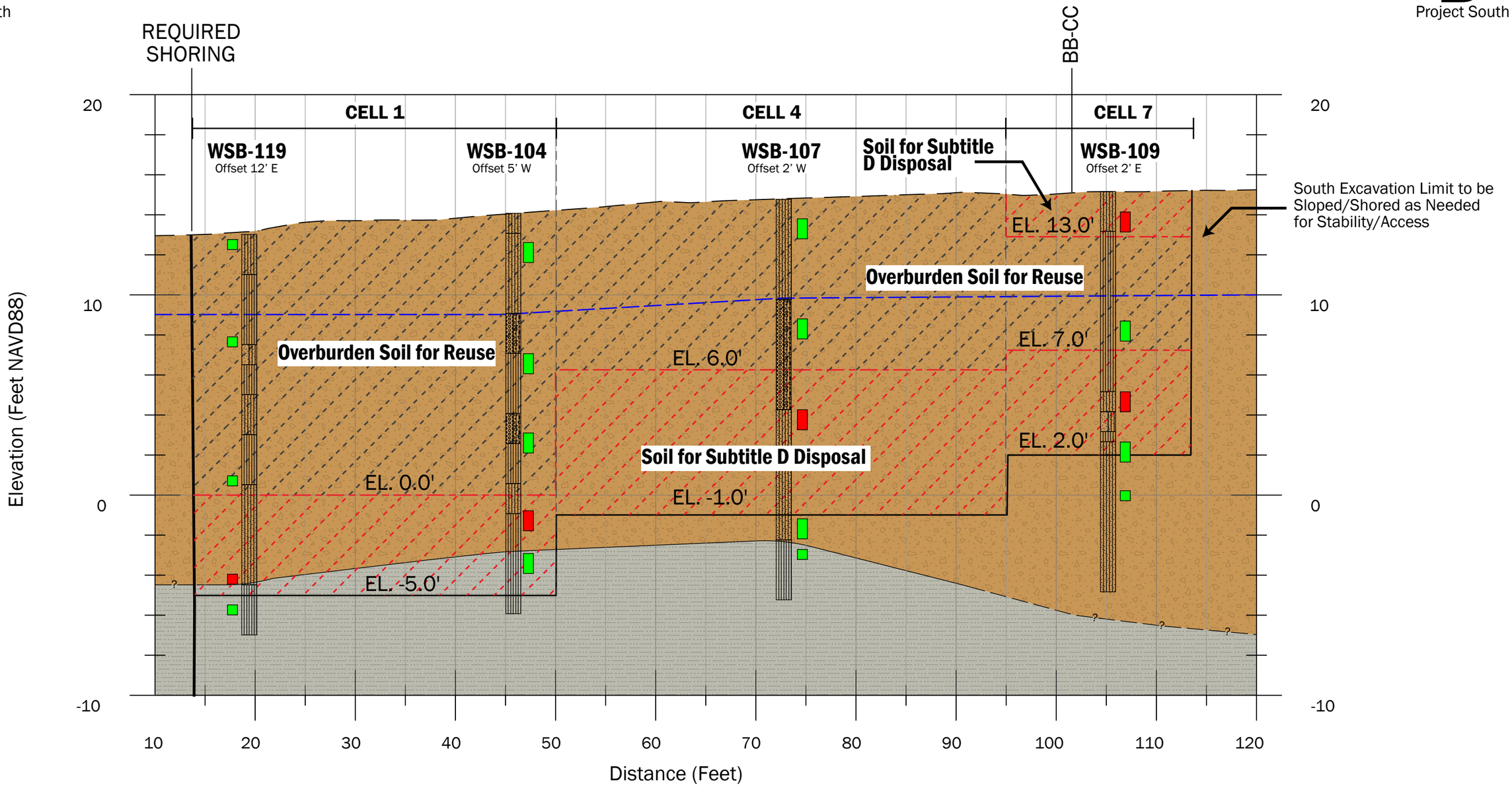
Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants

AUG-2026	BY: JBM	FIGURE NO. 5
PROJECT NO. AS210368B	REVISED BY: SG	

B
Project North

B'
Project South



Profile Legend

Lithology Graphics

- Fill
- Native

Mercury (Hg) Concentrations in Soil Samples

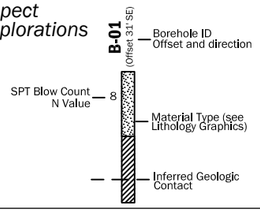
- Hg >300 ppm REL
- Hg <300 ppm REL

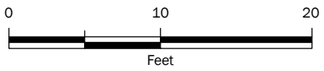
REL: Remediation level.

Material Handling

- Material for disposal (See Note 1)
- Overburden Soil for Reuse
- Inferred Groundwater Table (Fall 2023)

Aspect Explorations





Horizontal Scale 1" = 10'
Vertical Scale 1" = 5'
Vertical Exaggeration 2x

DISCLAIMER: The subsurface conditions presented in this geologic cross section are conceptual. Variations may exist between the soil and groundwater conditions depicted on this figure and those actually underlying the site. Refer to the contents of this report and boring logs for further context.

Notes:
1. Material noted as material for disposal within the excavation shall be removed and disposed of at a Subtitle D landfill.
2. Cross section surface and plan view generated from base CAD files provided by Wilson Engineering .
3. Site features are approximate.

Subsurface Cross Section B-B' for Wastewater Settling Basin

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: JBM	FIGURE NO. 6
	PROJECT NO. AS210368B	REVISED BY: SG	

C
Project West

C'
Project East

REQUIRED SHORING

AA-CC

BB-CC

Bellingham Shipping Terminal

CELL 5 | CELL 6 | CELL 7

WSB-108

WSB-110
Offset 18' S

CP-MW03

CP-MW05

Soil for Subtitle D Disposal

WSB-109
Offset 4' S

WSB-116
Offset 3' S

Southeast Excavation Limit to be Sloped/Shored as Needed for Stability/Access

Overburden Soil for Reuse

EL. 13.0'

EL. 7.0'

EL. 5.0'

Soil for Subtitle D Disposal

EL. 2.0'

EL. 0.0'

EL. -4.0'

CP-MW05 extends to approx. EL. -25'

Elevation (Feet NAVD88)

20
10
0
-10

30 40 50 60 70 80 90 100 110 120 130 140 150 160

Distance (Feet)

Profile Legend

Lithology Graphics

- Fill
- Native

Mercury (Hg) Concentrations in Soil Samples

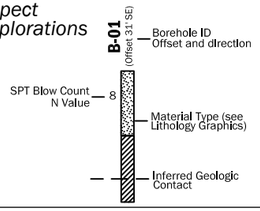
- Hg >300 ppm REL
- Hg <300 ppm REL

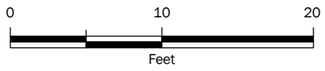
REL: Remediation level.

Material Handling

- Material for disposal (See Note 1)
- Overburden Soil for Reuse
- Inferred Groundwater Table (Fall 2023)

Aspect Explorations





Horizontal Scale 1" = 10'
Vertical Scale 1" = 5'
Vertical Exaggeration 2x

DISCLAIMER: The subsurface conditions presented in this geologic cross section are conceptual. Variations may exist between the soil and groundwater conditions depicted on this figure and those actually underlying the site. Refer to the contents of this report and boring logs for further context.

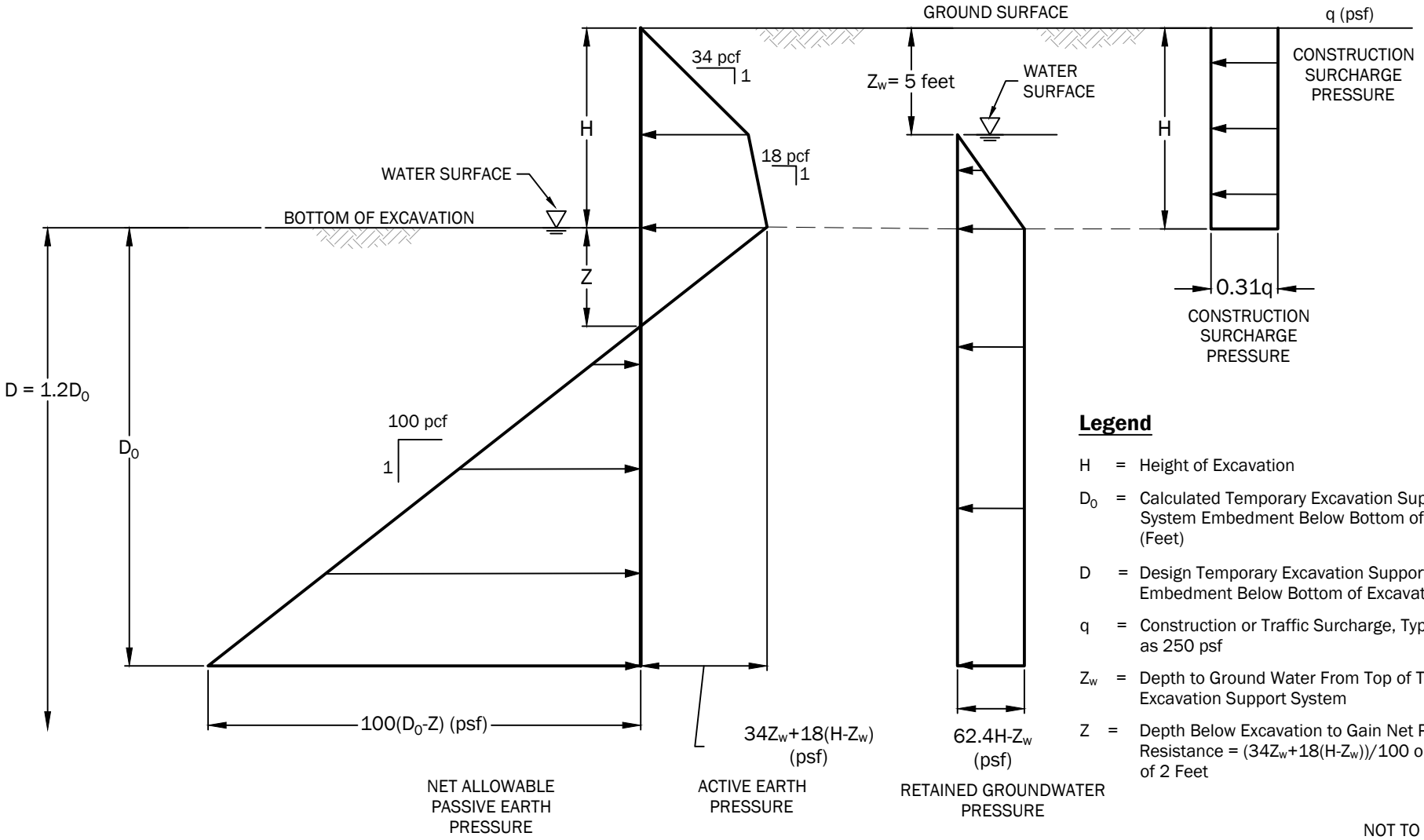
Notes:
1. Material noted as material for disposal within the excavation shall be removed and disposed of at a Subtitle D landfill.
2. Cross section surface and plan view generated from base CAD files provided by Wilson Engineering.
3. Site features are approximate.

Subsurface Cross Section C-C' for Wastewater Settling Basin

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants			
	AUG-2026	BY: JBM	FIGURE NO. 7
	PROJECT NO. AS210368B	REVISED BY: SG	

CANTILEVERED SHEET PILING EARTH PRESSURE DIAGRAM



Legend

- H = Height of Excavation
- D_0 = Calculated Temporary Excavation Support System Embedment Below Bottom of Excavation (Feet)
- D = Design Temporary Excavation Support System Embedment Below Bottom of Excavation (Feet)
- q = Construction or Traffic Surcharge, Typically taken as 250 psf
- Z_w = Depth to Ground Water From Top of Temporary Excavation Support System
- Z = Depth Below Excavation to Gain Net Passive Resistance = ($34Z_w$+18(H-Z_w))/100 or Minimum of 2 Feet

NOT TO SCALE

Notes:

1. This earth pressure diagram is applicable for temporary cantilevered steel sheet pile shoring
2. Pressures are in lb/ft² (psf). Linear dimensions are in feet (ft).
3. The calculated depth (D_0) should be increased by 20% to calculate the design depth (D).
4. Net allowable passive earth pressure includes a factor of safety of 1.5. The upper two feet of passive pressure should be ignored.
5. Hydrostatic pressures assume dewatering inside of the temporary excavation support system excavation to the base of excavation.
6. Refer to report text for additional discussion and recommendations.

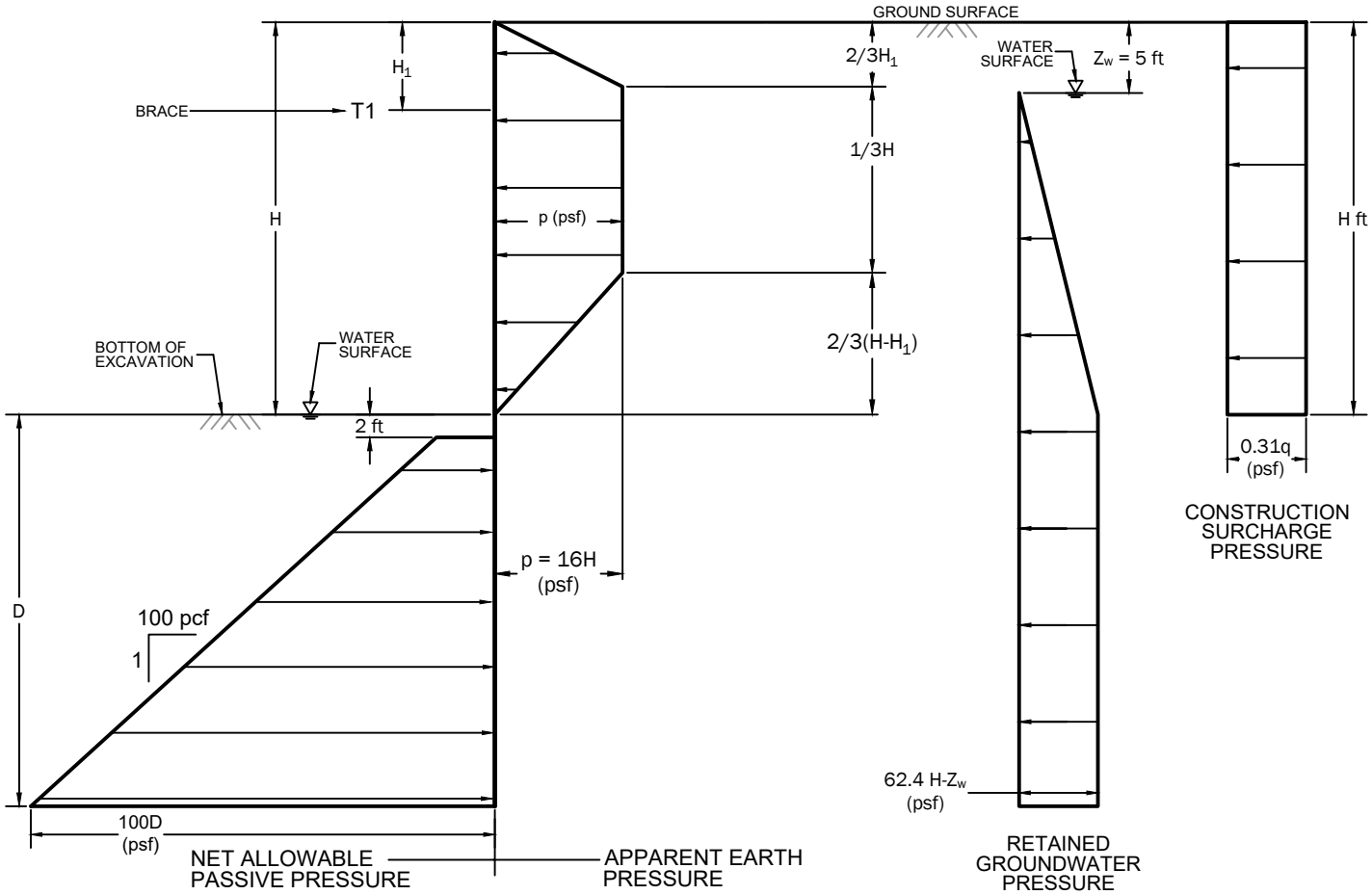
Earth Pressure Diagram for Cantilevered Sheet Pile Shoring

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	Aug-2026	BY: KDS/HNH/CMV	FIGURE NO. 8
	PROJECT NO. 210368B	REVISED BY: WBL	

CAD Path: Q:\Port of Bellingham\210368-B GP West Chlor\2025-01 EDR\210368 Sheet Pile cantilivered EPD.dwg Layout: 03 Cantilevered Sheet Pile EPD || Date Saved: 1/9/2025 10:19:53 AM || User: caroline.vanslyke

SHEET PILE TEMPORARY SHORING WITH A SINGLE ROW OF
BRACING/ANCHOR EARTH PRESSURE DIAGRAM



NOTES

1. This earth pressure diagram is applicable for temporary steel sheet pile shoring with a single row of bracing/anchor.
2. Pressures are in lb/ft² (psf). Linear dimensions are in feet (ft).
3. Net allowable passive earth pressure includes a factor of safety of 1.5.
4. Hydrostatic pressures assume dewatering inside of the temporary excavation support system excavation to the base of excavation.
5. Refer to report text for additional discussion and recommendations.

LEGEND

H = Height of Excavation (Feet)
D = Temporary Excavation Support System Embedment Below Bottom of Excavation (Feet)
q = Construction or Traffic Surcharge, Typically taken as 250 psf
Z_w = Depth to Ground Water from Top of Temporary Excavation Support System
p = Maximum Apparent Earth Pressure (Pounds Per Square Foot)
H_1 = Distance from Ground Surface to Uppermost Brace (Feet)
T_1 = Horizontal Load in Uppermost Brace

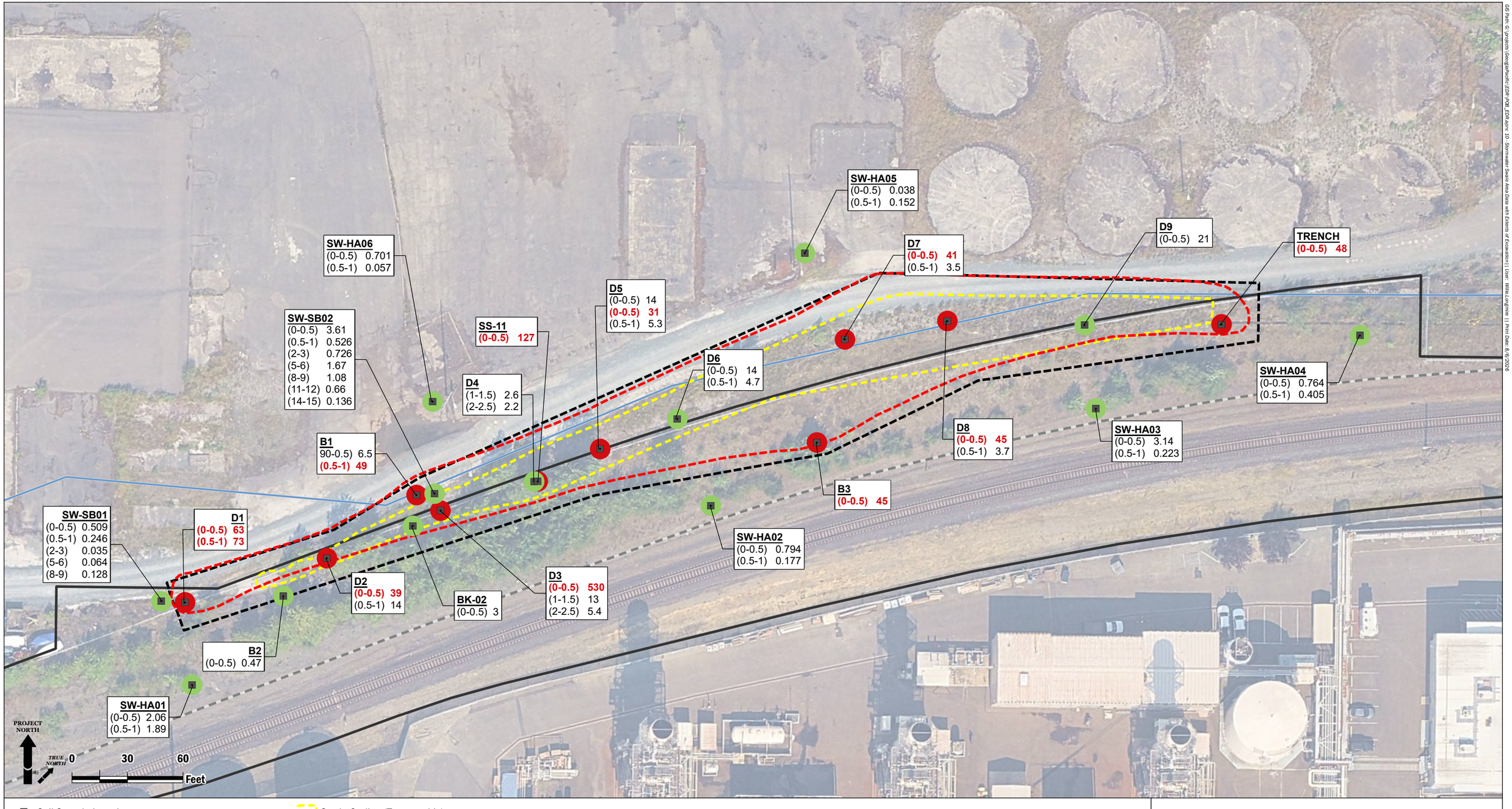
NOT TO SCALE

Earth Pressure Diagram for Sheet Pile Shoring with a Single Row of Bracing/Anchor

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	Aug-2026	BY: KDS/HNH/CMV	FIGURE NO. 9
	PROJECT NO. 210368B	REVISED BY: WBL	

CAD Path: Q:\Port of Bellingham\210368-B GP West Chlor\2025-01 EDR\210368 Sheet pile_single brc EPD.dwg Layout: TBD || Date Saved: 1/10/2025 10:23:21 AM || User: caroline.vanslyke



- Soil Sample Location
- Max Hg Concentration > 24 mg/kg
- Max Hg Concentration < 24 mg/kg
- BNSF Regulatory Foulage (25 feet from nearest track)
- Planned Soil Removal Limits
- Estimated Area of Mercury exceeding 24 mg/kg
- Swale Outline (Topographic)
- Clearwater Line
- Property Line (Fence Line)

Sample Location ID
(Depth Interval in ft) Hg in mg/kg
BLACK TEXT = concentration < 24 mg/kg
RED TEXT = concentration > 24 mg/kg

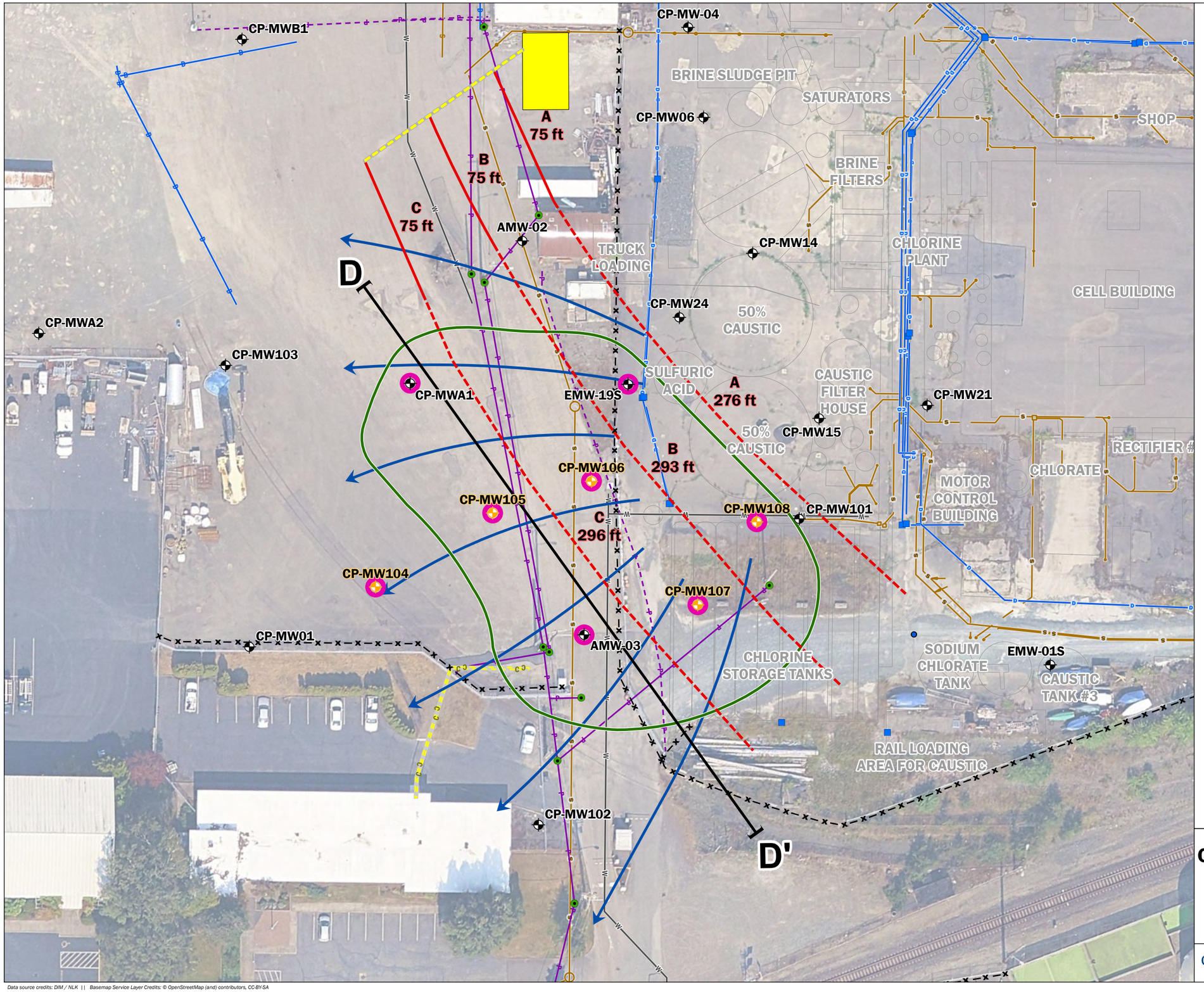
Stormwater Swale Area Data with Extents of Excavation

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: SJG / HMD	FIGURE NO. 10
	PROJECT NO. 210368	REVISED BY: WBL	

Data source credits: None | | Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

GIS Path: G:\projects\Georgia Pacific\EDR\ PDB_EDR.aprx; 10 - Stormwater Swale Area Data with Extents of Excavation | | User: WillieLongmire | | Print Date: 8/6/2026



- Monitoring Well
- Proposed Monitoring Well
- Performance Monitoring Location
- Proposed Horizontal Well Screen Interval
- Proposed Horizontal Well Entry or Exit Riser
- CO2 Storage/Injection Equipment (Location subject to change)
- CO2 Conveyance Pipeline Trench (Location subject to change)
- Caustic Core Groundwater (pH >10 based on 2023-2024 data)
- Generalized Groundwater Flow Direction
- Cross Section
- Fence
- Catch Basin
- Power Pole
- Storm Manhole
- Communication Line
- Sewer
- Stormwater
- Power (Underground)
- Power Line (Overhead)
- Water Line
- Historical GP Mill Features

PROJECT NORTH
TRUE NORTH
45°

0 50 100 Feet

Caustic Core Groundwater Neutralization Horizontal Well Alignment

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

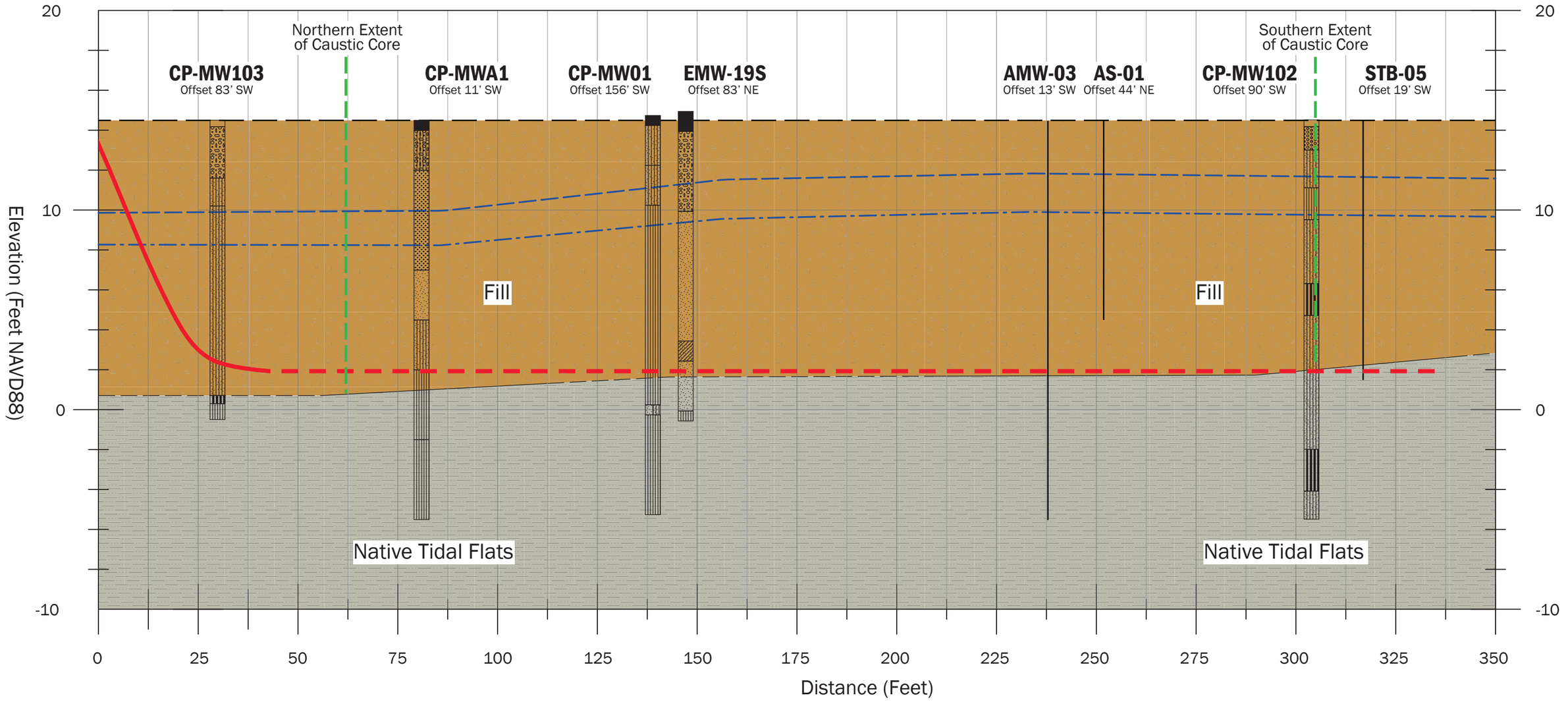
Geosyntec consultants	AUG-2026	BY: PS / NLK	FIGURE NO. 11
	PROJECT NO. AS210368	REVISED BY: WBL / HMD	

GIS Path: G:\projects\Georgia\Pacific\EDR\PDB_EDR.aprx; 11 Caustic Core Groundwater Neutralization Horizontal Well Alignment || User: MWatLongmire || Print Date: 8/6/2026

Data source credits: DIM / NLK || Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

D
Project Northwest

D'
Project Southeast



Profile Legend

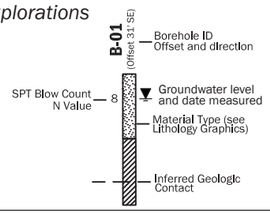
Lithology Graphics
- Fill
- Native Tidal Flats

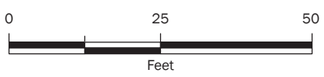
Contacts
- Contact - Known
- Contact - Inferred

Groundwater
- Inferred Seasonal High Groundwater (Spring 2024)
- Inferred Seasonal Low Groundwater (Fall 2023)

HDD Well
- Screened Portion of HDD Well
- HDD Well Riser (approx.)

Explorations





Horizontal Scale 1" = 25'
Vertical Scale 1" = 5'
Vertical Exaggeration 5x

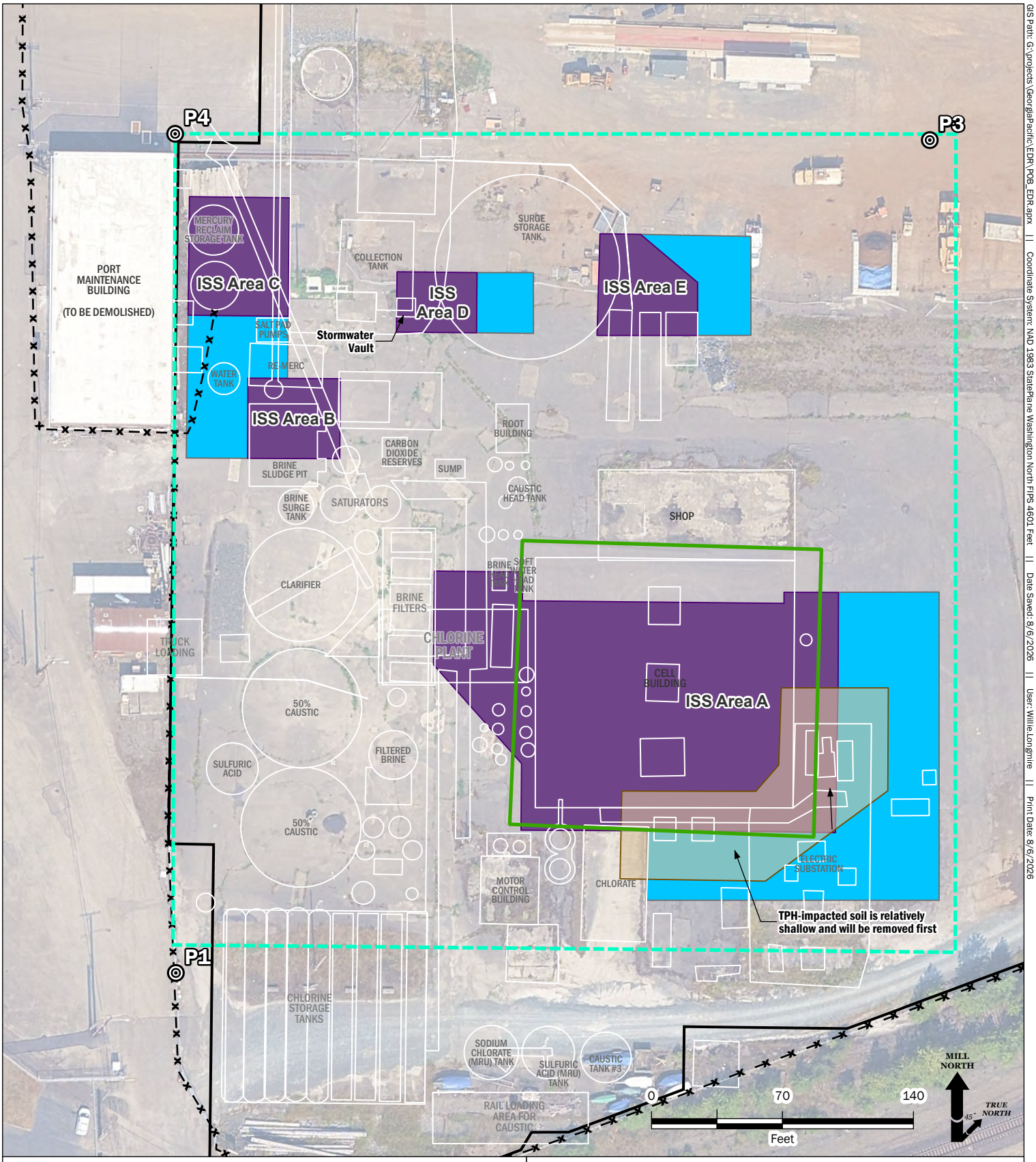
DISCLAIMER: The subsurface conditions presented in this geologic cross section are conceptual. Variations may exist between the soil and groundwater conditions depicted on this figure and those actually underlying the site. Refer to the contents of this report and boring logs for further context.

Notes:
1. Cross section surface and plan view generated from base CAD files provided by Wilson Engineering.
2. Site featureas are approximate.

Subsurface Cross Section D-D' for Caustic Core Horizontal Wells

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants			
	AUG-2025	BY: JBM	FIGURE NO. 12
	PROJECT NO. AS210368B	REVISED BY: SG/DMa	



Project C Limits

Project C Cleanup Action

- Obstruction Removal and In Situ Solidification of Soils
- TPH Soil Removal/Offsite Disposal
- Area of Additional Excavation
- Perimeter Air Monitoring Location

- Paved Area from 2017 Interim Action
- Fence
- Property Boundaries from ALTA Survey (David Evans and Associates, 2004)
- Historical Features

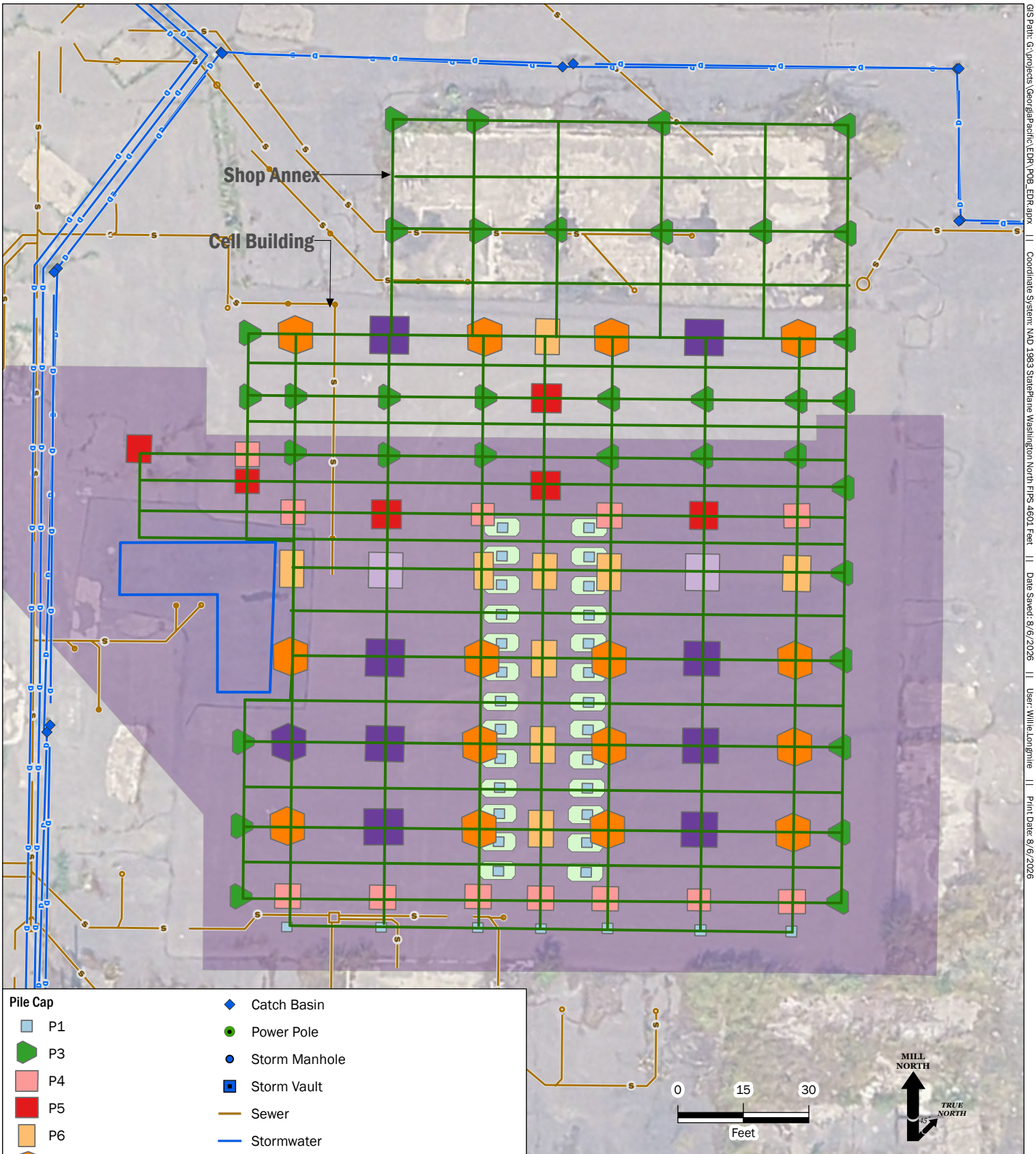
Project C Cleanup Action Limits

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: ACG / HMD	FIGURE NO. 13
	PROJECT NO. 210368	REVISED BY: WBL	

Basemap Layer Credits | | Google Satellite: © OpenStreetMap (and) contributors, CC-BY-SA

GIS Path: G:\projects\GeorgiaPacific\EDR\POB_EDR.aprx || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 8/6/2026 || User: Willie.Longmire || Print Date: 8/6/2026



Pile Cap

- P1
- P3
- P4
- P5
- P6
- P7
- P8
- P9
- Concrete Pad for Decomposer Structure

Cell Building Foundation Elements

- Grade Beam

- Catch Basin
- Power Pole
- Storm Manhole
- Storm Vault
- Sewer
- Stormwater
- Power (Underground)
- Power Line (Overhead)
- Water Line
- Area of PRDI 2 Field Pilot Test (2022)
- Obstruction Removal and In Situ Solidification of Soils

Note:
The depiction of remaining foundation elements is inferred based on historical drawings and field observations from the interim actions and PRDI 2 work. Only obstructions within the designated ISS area will be removed.

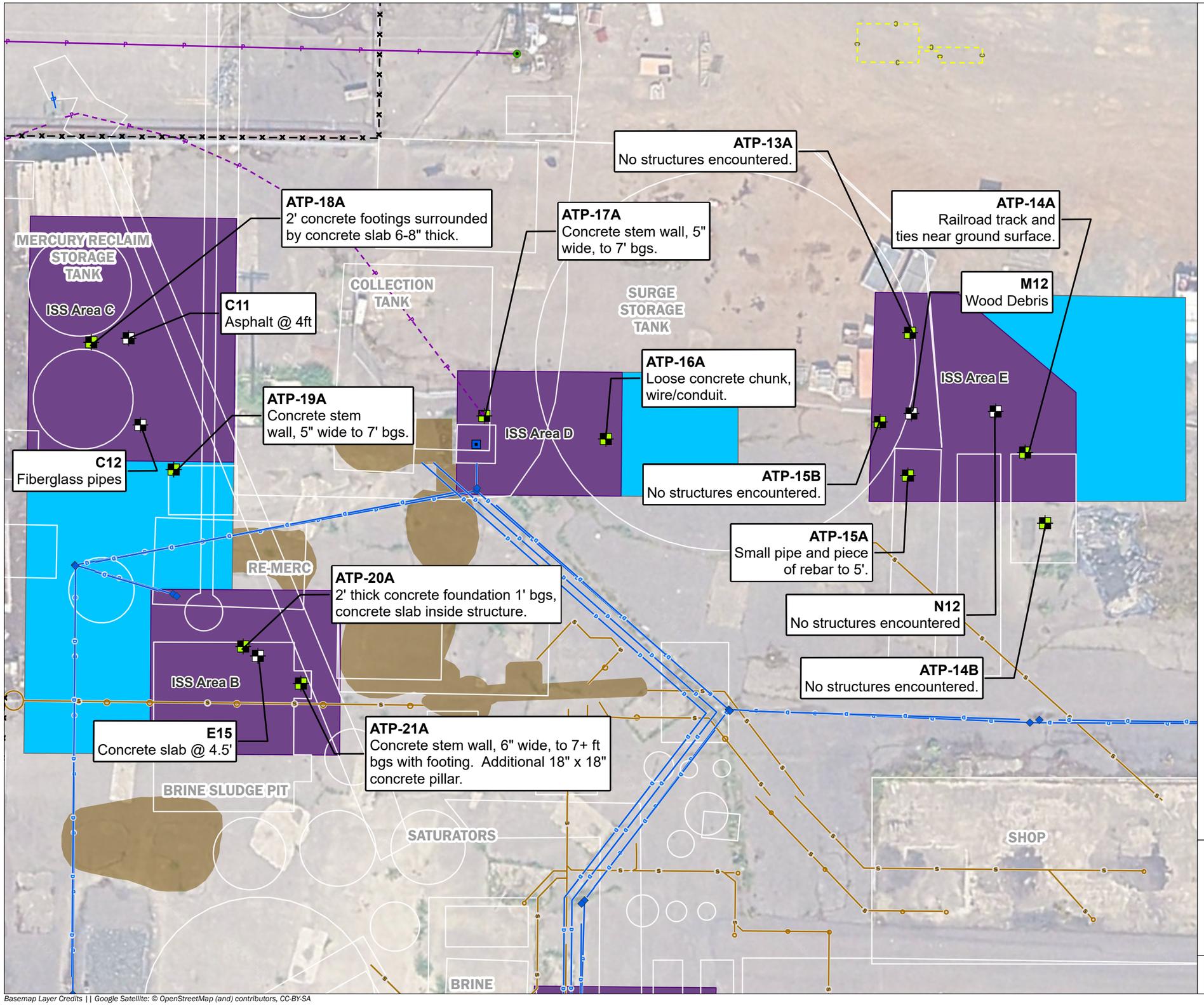
Structural Obstructions in ISS Area A (Cell Building)

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: ACG / HMD	FIGURE NO. 14
	PROJECT NO. 210368	REVISED BY: WBL	

GIS Path: G:\projects\GeorgiaPacific\EDR\POB_EDR.aprx || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 8/6/2026 || User: Willie.Longmire || Print Date: 8/6/2026

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Test Pit (Aspect, 2014b)

Test Pit (Aspect, 2024c)

Obstruction Removal and In Situ Solidification of Soils

Area of Additional Excavation

Previous Soil Removal/Offsite Disposal Areas, Caustic Plume-Cell Building Interim Action

Fence

Catch Basin

Power Pole

Storm Manhole

Storm Vault

Sewer

Stormwater

Power (Underground)

Power Line (Overhead)

Water Line

Communication Line

Note:
The information regarding subsurface structural obstructions in these areas is as documented from exploratory test pits conducted in 2014 (Aspect, 2014b) and during PRDI 3 (Aspect, 2024c).

MILL NORTH
TRUE NORTH
45°

0 25 50
Feet

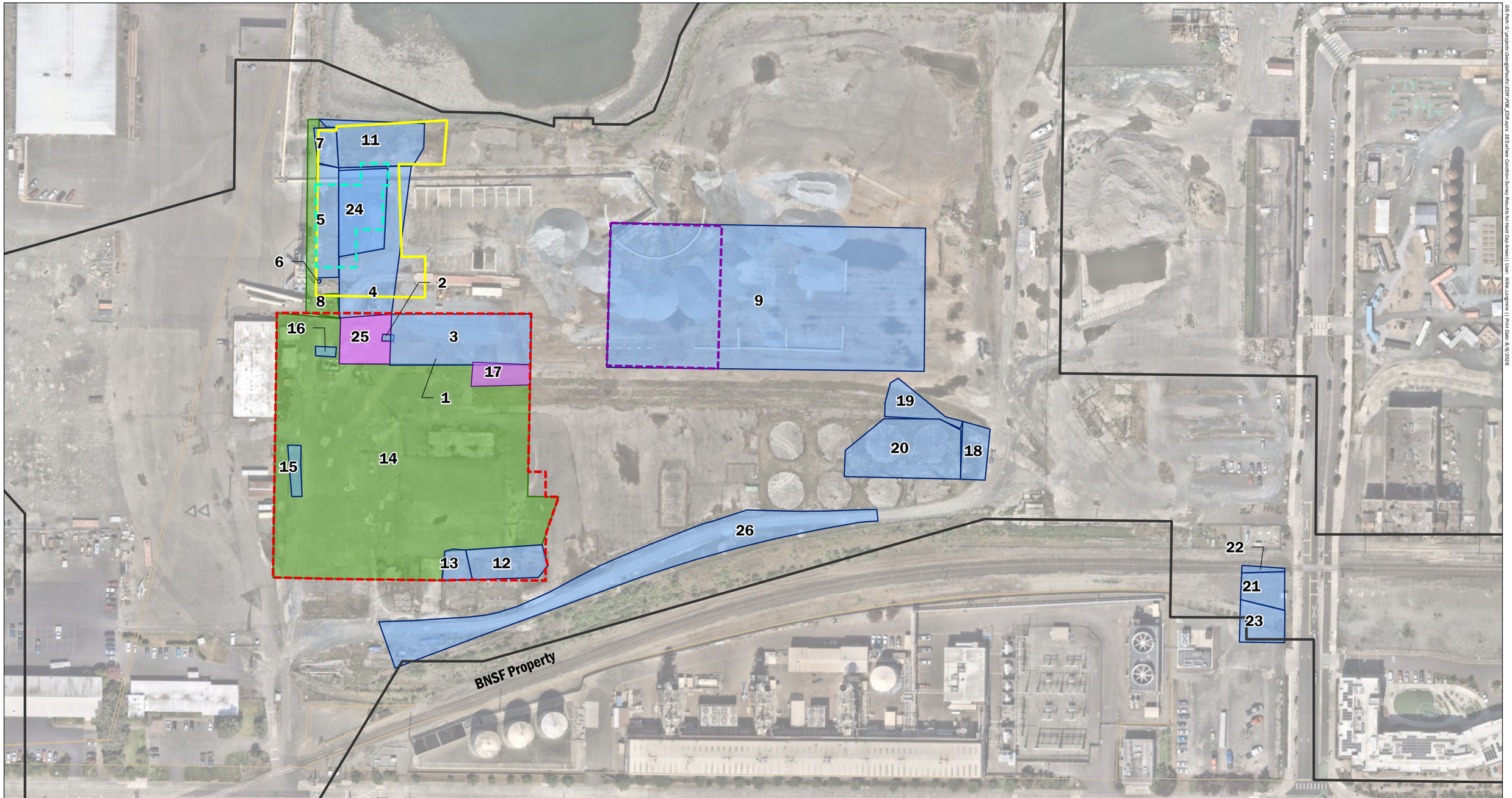
Structural Obstructions in ISS Areas B through E

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: AET / HMD	FIGURE NO. 15
	PROJECT NO. 210368	REVISED BY: WBL	

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GIS Path: G:\projects\Georgia\Pacific\EDR\PDB_EDR.aprx || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 8/6/2026 || User: Willie.Longmire || Print Date: 8/6/2026



Observed Surface Conditions (Oct. 2023)

- Category 1: Hard Cap In Suitable Condition
- Category 2: Hard Cap Absent or In Unsuitable Condition
- Category 3: Surface Obscured, Condition Uncertain
- Unpaved Area

- Area Capped Under Project A2 (Approximate)
- Area Capped Under Project C (Approximate)
- Portion of Chemfix Area Lacking Geotextile
- Bellingham Tax Parcels
- Chlor-Alkali RAU Boundary

Note:
- Surface condition survey conducted Oct. 10-11, 2023

PROJECT NORTH
TRUE NORTH
45°

0 70 140
Feet

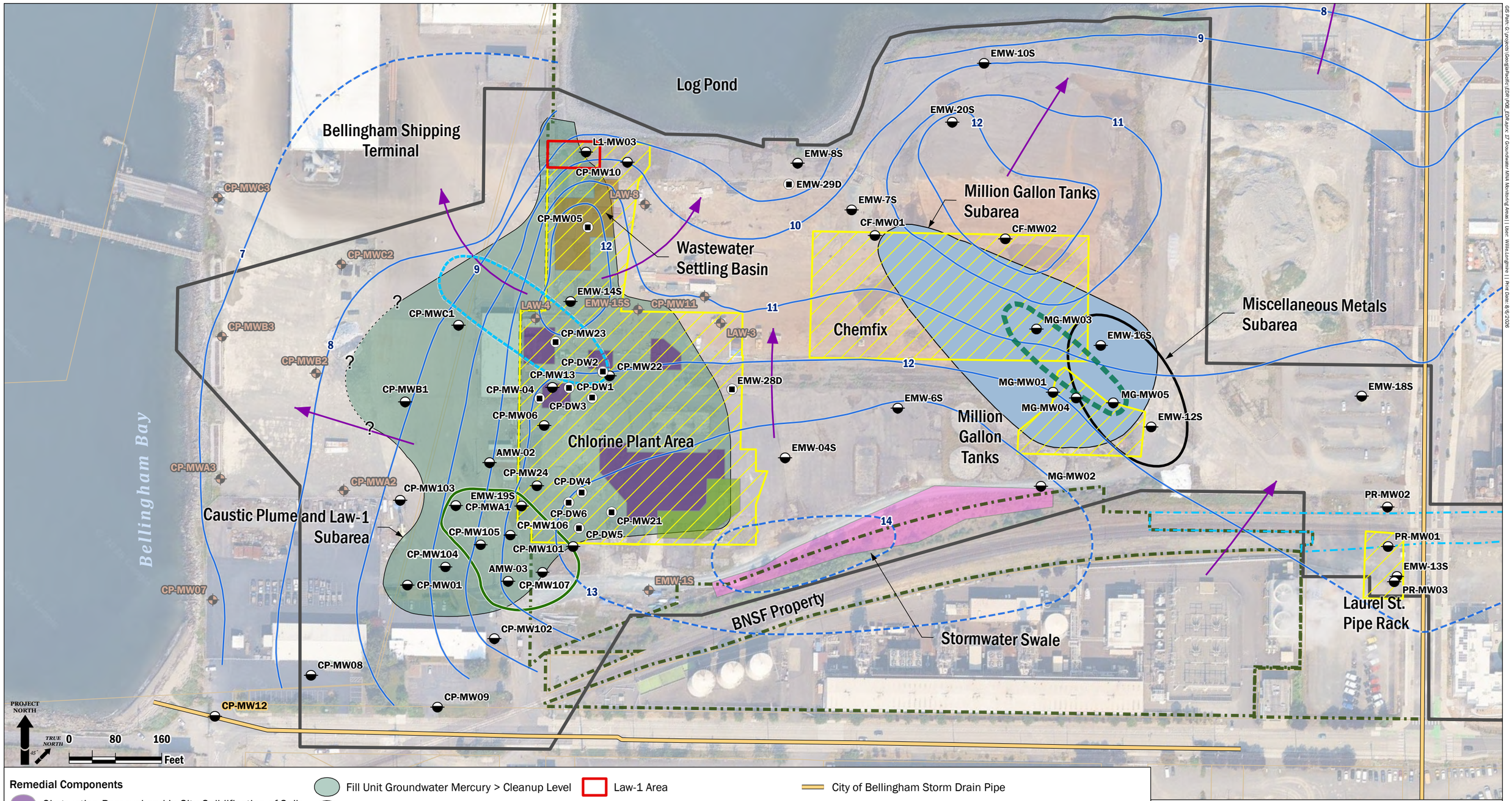
Surface Condition Survey Results for Hard Cap Areas

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: AET / HMD	FIGURE NO. 16
	PROJECT NO. 210368	REVISED BY: WBL	

Data source credits: None || Basemap Service Layer Credits: NA

GIS Path: G:\projects\Georgia Pacific\EDR\ PDB_EDR.aprx; 16 Surface Condition Survey Results for Hard Cap Areas | | User: WBL-longmire | | Print Date: 8/6/2026



Remedial Components

- Obstruction Removal and In Situ Solidification of Soils
- Wastewater Settling Basin Soil Removal
- Removal of Petroleum Hydrocarbon Soils
- Stormwater Swale Soil Removal
- Hard Capping

- Fill Unit Groundwater Mercury > Cleanup Level
- Fill Unit Groundwater cPAHs > Cleanup Level
- Fill Unit Groundwater Miscellaneous Dissolved Metals > Cleanup Level
- Fill Unit Groundwater Naphthalene > VI Remediation Level
- Lower Sand Groundwater Mercury > Cleanup Level
- Caustic Core Groundwater (pH >10 based on 2023-2024 data)

- Law-1 Area
- Monitoring Well - Inaccessible
- Existing Fill Unit Monitoring Well
- Existing Lower Sand Monitoring Well
- Fill Unit Groundwater Elevation Contours (March 2010)
- Generalized Fill Unit Groundwater Flow Direction

- City of Bellingham Storm Drain Pipe
- Property Boundaries from ALTA Survey (David Evans and Associates, 2004)
- Port Easement for BNSF Rail Line (approx.)
- Chlor-Alkali RAU Boundary
- Bellingham Tax Parcels

Note: Groundwater exceedance extents based on RI/FS data (Aspect, 2013 and 2018b), except for Full Unit mercury that is largely based on 2023 data (Aspect, 2024c).

Groundwater MNA Monitoring Areas

Engineering Design Report
Chlor-Alkali RAU - GP West Site
Bellingham, Washington

Geosyntec consultants	AUG-2026	BY: ACG / HMD	FIGURE NO. 17
	PROJECT NO. 210368	REVISED BY: WBL	

Data source credits: None | | Basemap Service Layer Credits: Google Maps

GIS Path: G:\Projects\Georgia Pacific\EDR\PDB_EDR.aprx; LT Groundwater MNA Monitoring Areas | | User: WILMLong\mre | | Print Date: 8/6/2026

APPENDIX A

Inadvertent Discovery Plan for Excavation Work

DEPARTMENT OF ECOLOGY
State of Washington

PLAN AND PROCEDURES FOR THE UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS[1]

PROJECT TITLE: Chlor-Alkali RAU Cleanup Excavations

COUNTY WASHINGTON: Whatcom

Section, Township, Range: Section 30 T38N R3E

1. INTRODUCTION

The following Inadvertent Discovery Plan (IDP) outlines procedures to perform in the event of discovering archaeological materials or human remains, in accordance with state and federal laws.

2. RECOGNIZING CULTURAL RESOURCES

A cultural resource discovery could be prehistorical or historical. Examples include:

a. An accumulation of shell, burned rocks, or other food-related materials
b. Bones or small pieces of bone
c. An area of charcoal or very dark stained soil with artifacts
d. Stone tools or waste flakes (e.g., an arrowhead. or stone chips)
e. Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years
f. Buried railroad tracks, decking, or other industrial materials

When in doubt, assume the material is a cultural resource.

3. ON-SITE RESPONSIBILITIES

STEP 1: *Stop Work*. If any employee, contractor, or subcontractor believes that he or she has uncovered a cultural resource at any point in the project, all work must stop immediately. Notify the appropriate party(s). Leave the surrounding area untouched, and provide a demarcation adequate to provide the total security, protection, and integrity of the discovery. The discovery location must be secured at all times by a temporary fence or other on-site security.

STEP 2: *Notify Archaeological Monitor or Licensed Archaeologist*. If there is an Archaeological Monitor for the project, notify that person. If there is a monitoring plan in place, the monitor will follow the outlined procedure.

[1] If you need this document in a format for the visually impaired, call Water Quality Reception at Ecology, (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

STEP 3: *Notify the Project Manager* of this project and contact the Ecology Staff Project Manager, or other applicable contacts:

Environmental Project Manager Name: Ben Howard Phone: 360.676.2500 Email: Benh@portofbellingham.com	Ecology Staff Project Manager Name: John Rapp Phone: 360.407.6265 Email: john.rapp@ECY.WA.GOV

Assigned Alternates:

Assigned Project Manager Alternate: Name: Gina Stark Phone: 360.676.2500 Email: GinaS@portofbellingham.com	Ecology Cultural Resource Specialist (Alternate): Name: Phone: Email:

The Project Manager or applicable staff will make all calls and necessary notifications. **If human remains are encountered**, treat them with dignity and respect at all times. Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed. **Do not call 911 or speak with the media. Do not take pictures unless directed to do so by Washington Department of Archaeology and Historic Preservation (DAHP). See Section 5.**

4. FURTHER CONTACTS AND CONSULTATION

A. **Project Manager's Responsibilities**:

- *Protect Find*: The Project Manager is responsible for taking appropriate steps to protect the discovery site. All work will stop immediately in a surrounding area adequate to provide for the complete security of location, protection, and integrity of the resource. Vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site. Work in the immediate area will not resume until treatment of the discovery has been completed following provisions for treating archaeological/cultural material as set forth in this document.

- *Direct Construction Elsewhere on-site*: The Project Manager may direct construction away from cultural resources to work in other areas prior to contacting the concerned parties.

- *Contact Senior Staff*: If the Senior Staff has not yet been contacted, the Project Manager must do so.

B. **Senior Staff Responsibilities**:

- *Identify Find*: The Senior Staff (or a delegated Cultural Resource Specialist), will ensure that a qualified professional archaeologist examines the area to determine if there is an archaeological find.

- If it is determined not to be of archaeological, historical, or human remains, work may proceed with no further delay.
- If it is determined to be an archaeological find, the Senior Staff or Cultural Resource Specialist will continue with all notifications.
- If the find may be human remains or funerary objects, the Senior Staff or Cultural Resource Specialist will ensure that a qualified physical anthropologist examines the find. **If it is determined to be human remains, the procedure described in Section 5 will be followed.**

- *Notify DAHP*: The Senior Staff (or a delegated Cultural Resource Specialist) will contact the involved federal agencies (if any) and the DAHP.
- *Notify Tribes*: If the discovery may be of interest to Native American Tribes, the DAHP and Ecology Supervisor or Coordinator will coordinate with the interested and/or affected tribes.

General Contacts

Federal Agencies:	**State Agencies**:
Agency: Name: Title: Number: Email:	Agency: Name: Title: Number: Email:

Department of Archaeology and Historic Preservation:

Dr. Allyson Brooks State Historic Preservation Officer 360.586.3066 Assigned Alternate:	Rob Whitlam, Ph.D. Staff Archaeologist 360.586.3050 Assigned Alternate:

The DAHP or appropriate Ecology Staff will contact the interested and affected tribes for a specific project.

Tribes consulted on this project are:

Tribe: Lummi Nation	Tribe: Upper Skagit Tribe
Name: Lena Tso	Name: Scott Schuyler
Title: THPO	Title: Cultural Resources
Phone: 360.312.2257	Phone: 360.854.7009
Email: lenat@lummi-nsn.gov	Email: sschuyler@upperskagit.com

Tribe: Swinomish Tribal Community	Tribe: Nooksack Tribe
Name: Larry Campbell	Name: Trevor Delgado
Title: THPO	Title: THPO
Phone: 360.466.7314	Phone: 360.592.5176, ext. 32234
Email: lcampbell@swinomish.nsn.us	Email: tdelgado@nooksack-nsn.gov

Further Activities

- Archaeological discoveries will be documented, as described in Section 6.
- Construction in the discovery area may resume, as described in Section 7.

5. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Do not take photographs by any means, unless you are preapproved to do so.

If the project occurs on federal lands or receives federal funding (e.g., national forest or park, military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 apply, and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on nonfederal lands, the Project Manager will comply with applicable state and federal laws, and the following procedure:

A. In all cases you must notify a law enforcement agency or Medical Examiner/Coroner's Office:

- In addition to the actions described in Sections 3 and 4, the Project Manager will immediately notify the local law enforcement agency or medical examiner/coroner's office.

- The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human, whether the discovery site constitutes a crime scene, and will then notify DAHP.

- Enter contact information below:

    - City of Bellingham Police Department
      360.778.8800

B. Participate in Consultation:

- Per Revised Code of Washington (RCW) 27.44.055, RCW 68.50, and RCW 68.60, DAHP will have jurisdiction over nonforensic human remains. Ecology staff will participate in consultation.

C. Further Activities:

- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in RCW 27.44.055, RCW 68.50, and RCW 68.60.

- When consultation and documentation activities are complete, construction in the discovery area may resume, as described in Section 7.

6. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS

Archaeological deposits discovered during construction will be assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

Project staff will ensure the proper documentation and field assessment will be made of any discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and a contracted consultant (if any).

All prehistorical and historical cultural material discovered during project construction will be recorded by a professional archaeologist on a cultural resource site or isolate form using standard and approved techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for minimal subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require further evaluation using hand-dug test units. Units may be dug in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Test units will be used only, when necessary, to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. Excavations will be conducted using state-of-the-art techniques for controlling provenience, and the chronology of ownership, custody, and location recorded with precision.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of cultural resources investigation will be screened through 0.125-inch mesh, unless soil conditions warrant 0.25-inch mesh.

All prehistorical and historical artifacts collected from the surface and from probes and excavation units will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribes.

Within 90 days of concluding fieldwork, a technical report describing any and all monitoring and resultant archaeological excavations will be provided to the Project Manager, who will forward the report for review and delivery to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s).

If assessment activity exposes human remains (burials, isolated teeth, or bones), the process described in Section 5 will be followed.

7. PROCEEDING WITH WORK

Work outside the discovery location may continue while documentation and assessment of the cultural resources proceed. A professional archaeologist must determine the boundaries of the discovery location. In consultation with Ecology, DAHP, and any affected tribes, the Project Manager will determine the appropriate level of documentation and treatment of the resource. If there is a federal nexus, Section 106 consultation and associated federal laws will make the final determinations about treatment and documentation.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Manager, DAHP, any affected tribes, Ecology (and the federal agencies, if any) determine that compliance with state and federal law is complete.

8. RECIPIENT/PROJECT PARTNER RESPONSIBILITY

The Project Recipient/Project Partner is responsible for developing an IDP. The IDP must be immediately available onsite, be implemented to address any discovery, and be available by request by any party. The Project Manager and staff will review the IDP during a project kickoff or preconstruction meeting.

We recommend that you print images in color for accuracy.

Implement the IDP if …

You see chipped stone artifacts.



- Glass-like material
- Angular
- “Unusual” material for area
- “Unusual” shape
- Regularity of flaking
- Variability of size



Implement the IDP if …

You see ground or pecked stone artifacts.









- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

Implement the IDP if …

You see bone or shell artifacts.



- Often smooth
- Unusual shape
- Carved
- Often pointed if used as a tool
- Often wedge shaped like a "shoehorn"



Bone Awls from Oregon and Bone Wedge from California

Implement the IDP if …

You see bone or shell artifacts.



- Often smooth
- Unusual shape
- Perforated
- Variability of size



Implement the IDP if …

You see fiber or wood artifacts.



- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare



Artifacts from Mud Bay, Olympia, Washington

Implement the IDP if …

You see historical period artifacts.







Artifacts from Downtown Seattle, Alaskan Way Viaduct (Upper Left and Lower) and Unknown Site (Upper Right)

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- Human activities leave traces in the ground that may or may not have artifacts associated with them
- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burnt-looking soils
- Accumulations of shell
- Accumulations of bones or artifacts
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Site on Muckleshoot Indian Reservation, near WSDOT ROW along SR 164

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- Often have a layered or “layer cake” appearance
- Often associated with black or blackish soil
- Often have very crushed and compacted shells



Implement the IDP if …

You see historical foundations or buried structures.



APPENDIX B

Compliance Monitoring Plan for Soil – Stormwater Swale Excavation

Geosyntec consultants

engineers | scientists | innovators

PORT OF BELLINGHAM Washington State

COMPLIANCE MONITORING PLAN FOR SOIL – STORMWATER SWALE EXCAVATION

Chlor-Alkali Remedial Action Unit of Georgia-Pacific West Site, Bellingham, Washington

Prepared for

Port of Bellingham
P.O. Box 1677
1801 Roeder Avenue
Bellingham, Washington 98227

Prepared by

Geosyntec Consultants, Inc.
801 5th Avenue, Suite 2200
Seattle, Washington 98104

Project AS210368B-13

September 23, 2026

Compliance Monitoring Plan for Soil – Stormwater Swale Excavation

Chlor-Alkali Remedial Action Unit of Georgia-Pacific West Site, Bellingham, Washington

Prepared for

Port of Bellingham

Delia Massey, PE
Senior Engineer
delia.massey@geosyntec.com

James Peale, LHG
Senior Principal Hydrogeologist
jpeale@geosyntec.com

Project Number: 26000033-013

September 23, 2026

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Appendix A: Inadvertent Discovery Plan for Stormwater Swale Soil Removal

ACRONYMS AND ABBREVIATIONS

ASB	Aerated Stabilization Basin
BCY	bank cubic yards
BMPs	best management practices
BNSF	Burlington Northern Santa Fe
BST	Bellingham Shipping Terminal
CAP	Cleanup Action Plan
CF	cubic feet
CMP	Compliance Monitoring Plan
CPS	Construction Plans and Specifications
CSWGP	Construction Stormwater General Permit
CY	cubic yards
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
Geosyntec	Geosyntec Consultants, Inc.
G-P	Georgia-Pacific
IDP	Inadvertent Discovery Plan
MDD	maximum dry density
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
NPDES	National Pollution Discharge Elimination System
NTU	nephelometric turbidity unit
Order	Agreed Order No. DE 6834
Port	Port of Bellingham
RAO	remedial action objectives
RAU	Remedial Action Unit
RCW	Revised Code of Washington
RI	Remedial Investigation
SF	square feet
SWPPP	Stormwater Pollution Prevention Plan

UCL	upper confidence limit
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1. INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Compliance Monitoring Plan (CMP) to describe construction preparation and oversight, compliance monitoring, and reporting requirements for an area of the final cleanup action selected by the Washington State Department of Ecology (Ecology). The final cleanup action will cover the stormwater swale portion of the Georgia-Pacific (G-P) West Site (Site) at the Chlor-Alkali Remedial Action Unit (RAU) (Figure 1). The Site is being cleaned up under the authority of the Washington State Model Toxics Control Act (MTCA), Chapter 70A.305 of the Revised Code of Washington (RCW), and the Model Toxics Control Act Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC).

In August 2009, Ecology and the Port of Bellingham (Port) entered into Agreed Order No. DE 6834 (Order), which required the Port to perform a Remedial Investigation (RI) and a Feasibility Study (FS) for the Site. The Site is defined by the extent of contamination caused by the release of hazardous substances from the former mill facility, which included a Chlorine Plant[1] and a Pulp and Tissue Mill and associated facilities.

In August 2013, a Site-wide RI was completed (Aspect 2013) and an amendment to the Order separated the Site into the Pulp/Tissue Mill and Chlor-Alkali RAUs, which are shown on Figure 1. The amended Order established independent timelines for cleanup of the two RAUs, which allowed for expedited cleanup and redevelopment at the Pulp/Tissue Mill RAU. For the Chlor-Alkali RAU, Ecology issued the final Cleanup Action Plan (CAP) in September 2021 (Ecology 2021). Since then, the Port has been conducting remedial design for cleanup of the Chlor-Alkali RAU under the Order.

The Chlor-Alkali RAU CAP-selected cleanup action for the stormwater swale included excavation of soils and hard capping to contain soils contaminated with mercury that pose a direct contact risk for unrestricted land use and institutional controls. The stormwater swale area straddles two properties, with Port property to the north and Burlington Northern Santa Fe (BNSF) rail right of way to the south. The CAP described excavation of mercury-contaminated soils from the BNSF portion of the stormwater swale area and consolidation and capping of these soils on the Port property.

The stormwater swale area is where the Port plans to construct a rail spur from the BNSF mainline to the Bellingham Shipping Terminal (BST). The remedial design includes the excavation and off-Site disposal of all mercury-contaminated soils on both the Port and BNSF properties. The excavation limits will be sampled to verify compliance with cleanup levels, eliminating the need for capping and institutional controls for the stormwater swale area. Once the excavation limits are confirmed to comply with the mercury cleanup level, the excavation will be backfilled and restored to existing grades.

Geosyntec has also prepared Construction Plans and Specifications (CPS) for the stormwater swale excavation project (Geosyntec 2026). The CPS for the stormwater swale excavation project

[1] The terms “Chlor-Alkali Plant” and “Chlorine Plant” are used interchangeably.

provides construction requirements for the Port's selected construction contractor (Contractor). This CMP references the CPS and focuses on activities during construction that are the responsibility of Geosyntec as the Port's authorized on-Site representative, referred to in the Specifications as "the Engineer."

2. SOIL REMOVAL OBJECTIVES AND TARGET CLEANUP LEVELS

The cleanup action for the stormwater swale will be conducted to achieve the remedial action objective (RAO) to permanently remove mercury-contaminated soils to achieve cleanup levels for unrestricted soil direct contact. No soil posing a direct contact risk under any future land use will remain following the completion of the cleanup action.

The Chlor-Alkali RAU CAP identifies soil cleanup levels based on unrestricted direct contact and protection of groundwater via leaching in near-neutral pH conditions (Ecology 2021). For mercury, the soil cleanup level (target cleanup level) is 24 milligrams per kilogram (mg/kg) in unsaturated and saturated soil. Verification soil samples will be collected from the excavation sidewalls and bottom to confirm that the soils comply with the mercury cleanup level. Figure 2 depicts the planned areas of soil excavation at the stormwater swale to comply with direct-contact cleanup levels. The excavation verification sampling and analysis is described further in Section 4.2.

3. PRE-CONSTRUCTION ACTIVITIES

The sections below describe actions to be taken by the Contractor prior to initiation of the soil cleanup action.

3.1 Contractor Pre-Construction Submittals

The CPS technical specifications are largely "performance-based" in that they specify required outcomes but rely on the Contractor to propose the most efficient means and methods (within specified constraints) of achieving those outcomes. This approach generally works well for "dig-and-haul" cleanups, provided an experienced environmental cleanup Contractor performs the work.

CPS technical specifications take advantage of the Contractor's previous experience with similar projects and places the Contractor in more of an "ownership" role with respect to the construction means and methods to be employed. The Port's contract documents include supplemental bidder criteria, requiring demonstration of the Contractor's qualifications and experience relevant to this cleanup action. The Port can also eliminate Contractors that do not meet the minimum requirements from consideration.

As described in the Specifications, prior to mobilization, the Contractor will prepare and submit the following two pre-construction submittals for Engineer approval:

- **A Stormwater Pollution Prevention Plan (SWPPP)** describing erosion, sedimentation, and stormwater control Best Management Practices (BMPs) to be installed to manage and prevent stormwater and fugitive dust emissions from leaving the construction site. The SWPPP and BMPs will be implemented by the Contractor and comply with City of Bellingham requirements throughout completion of the soil removal action.
- **An Excavation and Water Management Plan** detailing the Contractor's means and methods for soil excavation, materials handling and stockpiling on-site, loading and off-site transportation of excavated materials, excavation backfill, and compaction to meet specified criteria. The plan will also detail excavation water management, collection of runoff within the stockpile area, and treatment and discharge of water generated from excavation dewatering and from the stockpile area to comply with applicable permit requirements. The plan will also identify the Contractor's selected permitted off-site facilities for disposal of materials generated during the soil removal action.

Geosyntec, on the Port's behalf, will review and provide comments on the pre-construction submittals; the Contractor will then address Geosyntec's comments and submit a revised plan(s) as required. No work at the project site, with the exception of site inspections and surveys, may be performed until the pre-construction submittals are approved by Geosyntec, on the Port's behalf.

3.2 Excavation Area Preparation

Prior to the start of soil removal, the Contractor will temporarily remove the chain link fence that runs approximately 610 linear feet along the Port-BNSF property boundary within the planned work area. The Contractor will install a temporary construction fence on the southern side of the excavation at the BNSF regulatory foulage (25 feet from the nearest track), preventing any track fouling during this project. The Contractor will install temporary erosion and sediment control measures and locate and protect the stormwater line. The Contractor will also survey and stake out the limits of the excavation using the control points in the CPS. The Contractor will also locate utilities to be protected during construction.

4. CONSTRUCTION OVERSIGHT AND MONITORING

During the soil removal, Geosyntec will conduct the following construction oversight and monitoring activities in the role of Engineer:

- Oversight of mobilization and site preparation, including establishment of perimeter fencing; temporary erosion and sedimentation controls including a stabilized construction entrance, the stockpile areas for contaminated soil and for inert debris; and the water treatment equipment.
- Oversight of soil excavation to meet required design depths/elevations, and, if conducted prior to off-site transportation, temporary stockpiling of excavated soils.
- Oversight of excavation water management, if necessary, and disposal of the water generated in accordance with applicable discharge permit requirements.
- Soil sampling and analysis within the excavation to verify that the soil target cleanup level is achieved (cleanup goal achieved).
- Oversight of loading contaminated soils for landfill disposal.
- Oversight of excavation backfill and compaction.
- Compilation of documentation for all materials disposed of off-site, including certificates of disposal for contaminated soils.

4.1 Soil Excavation and Segregation for Disposal

The planned soil excavation area shown in Figure 2 is based on the locations and depths of soils with mercury concentrations exceeding 24 mg/kg. The planned soil excavations to remove mercury concentrations exceeding the target cleanup level will extend to depths ranging from 1 to 2.5 feet below current grade on both the BNSF and Port properties. Approximately 1,500 bank cubic yards (BCY) of soil (or 2,300 tons assuming a unit weight of 1.5 tons per BCY) contaminated with mercury is anticipated to be excavated from the BNSF and Port properties, respectively. The excavated contaminated soils will be transported for off-site disposal at a permitted Subtitle D landfill.

4.2 Excavation Performance Monitoring and Over-Excavation

Excavation compliance verification soil samples will be collected from the excavation sidewalls and base to confirm that the residual soils comply with the 24 mg/kg soil mercury cleanup level for unrestricted land use.

The excavation verification soil samples will be collected on a systematic 50-foot grid across the excavation bottom as illustrated on Figure 2. On the excavation bottom, one three-point composite sample will be collected within each 50-foot by 50-foot square to document that the cleanup level is met at depth—vertically bounded. In addition, one discrete sample will be collected along the shallow excavation sidewalls within the same grid (every 50 linear feet) to document that the lateral extents of soil exceeding the cleanup level have been removed. Given the shallow depth of excavation, the verification soil samples will be collected by hand using a decontaminated stainless-steel spoon or disposable spoon. Composite samples will be homogenized and sampled

using a stainless steel bowl. The excavation verification soil samples will be submitted to an Ecology-accredited analytical laboratory for analysis of mercury (U.S. Environmental Protection Agency [EPA] Method 7471). Typically, a 24- or 48-hour turnaround will be requested for the verification sample analyses so as not to delay the field decision making and overall progress for the soil removal action.

Where the detected concentration of mercury in an excavation sidewall soil sample exceeds the 24 mg/kg cleanup level, the length of sidewall represented by the sample will be overexcavated a minimum 1 foot laterally and a new sidewall-verification sample will be collected. Likewise, where the mercury concentration in an excavation-bottom sample exceeds the cleanup level, the excavation area represented by the sample will be deepened by a minimum 0.5 feet, followed by collection of a new bottom-verification sample.

As the excavation progresses, and samples representing contaminated soils are removed and replaced by new verification sample data, the residual in-place soils' compliance with the target cleanup levels will be evaluated applying the MTCA 3-part compliance criteria (WAC 173-340-740(7)(d) and (e)), where compliance is defined as follows

- the 95% upper confidence limit (95% UCL) on the mean concentration is less than the target cleanup level;
- all residual soil concentrations are less than or equal to two times the target cleanup level; and
- the frequency of soil sample exceedance is less than 10%.

Excavation will proceed until the data set representing in-place soils complies with the 24 mg/kg cleanup level applying the MTCA 3-part criteria. Geosyntec will review and evaluate the data in consultation with Ecology in order to obtain Ecology concurrence that the soil removal action has achieved the RAO.

4.3 Monitoring for Archaeological Resources

The cleanup excavation work will be completed in accordance with the Inadvertent Discovery Plan (IDP) included as Appendix A to this CMP. The IDP defines the stop-work and notification procedures to perform in the event of discovering potential archaeological materials while completing the excavation.

The cleanup action excavation work will occur in non-native fill soils and will be shallow (up to 2.5 feet below ground surface). The native soil horizon is estimated to occur at 15 feet below ground surface, therefore, there is a low likelihood for encountering archaeological materials.

If the Engineer observes potential archaeological materials in the excavation, the Engineer will stop the excavation work and mobilize a professional archaeologist to the excavation location to observe and assess the materials encountered and determine the appropriate path forward in accordance with applicable laws and regulations. Cleanup-related work may proceed in locations away from that excavation location unless such work would interfere with the evaluation of potential archaeological materials encountered.

4.4 Monitoring of Water Management

Groundwater infiltration and stormwater may accumulate within the stormwater swale excavation footprint. Any accumulated water will be conveyed to the Contractor's temporary on-site water treatment system where it will be treated as needed to meet all permit requirements for discharge. The cleanup Contractor will have the option to discharge the treated water by one of two methods

1. discharge treated water to surface water via the City of Bellingham storm drain in accordance with a National Pollution Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSWGP) with project-specific Administrative Order issued by Ecology; or
2. pump the treated water into water truck(s) for conveyance to the Port's pump station for the Aeration and Settlement Basin (ASB) in accordance with the Port's NPDES permit for the facility.

The Port intends to obtain the CSWGP with Administrative Order but then transfer it to the Contractor. If the Contractor chooses to discharge to surface water under the CSWGP, they will be required and responsible to comply with all of its provisions, including, but not limited to, initial treatment batch testing to demonstrate achievement of permit indicator levels prior to any discharge, obtaining Ecology approval for flow-through operation and discharge based on the batch testing results, and conducting monitoring and reporting to Ecology throughout the duration of treatment and discharge. In this case, treated water would be discharged to the City of Bellingham storm drain line[2] along Laurel Street.

If the Contractor chooses to discharge to the Port's ASB, Geosyntec will monitor the quality of water discharged to the pump station to ensure compliance with specified water quality performance standards for discharge (turbidity less than 100 nephelometric turbidity units [NTUs] and no visible sheen).

Geosyntec will also monitor performance of the Contractor's erosion control measures throughout the project to ensure that no stormwater, visible dust, or soil track-out leave the project site. If any of those conditions are observed, the Contractor will be required to immediately adjust their erosion control BMPs to rectify the situation. The truck route for the cleanup project will not use residential streets. Trucks hauling contaminated materials will remain covered from the time they leave the Site until they off-load at the designated facility. The Contractor will also be required to remove any deposits that may accumulate on the roadway surface outside of the project site.

4.5 Documentation of Material Disposal or Recycling

Prior to the start of construction, Geosyntec will use existing analytical data to profile the mercury-contaminated soil and obtain pre-approval for proper off-site disposal as a non-hazardous waste at a permitted Subtitle D disposal facility. The Contractor will be responsible for selecting and contracting the Subtitle D disposal facility permitted to accept the waste generated during the

[2] The City storm drain line is located under Laurel Street and discharges to the Whatcom Waterway via an outfall beneath the historical Georgia-Pacific pier, approximately 1,000 feet north of the northern edge of the stormwater swale.

cleanup action. The Contractor will provide Geosyntec with copies of the certificates of disposal for contaminated material disposed of off-site. Geosyntec will include the disposal records in the As-Built Cleanup Report documenting the soil removal cleanup action (refer to Section 5).

4.6 Excavation Backfill

Once the excavation verification sampling demonstrates that direct contact cleanup levels have been achieved for the stormwater swale area, the cleanup excavation areas on both BNSF and Port properties will be backfilled using imported permeable ballast as defined in Washington State Department of Transportation (WSDOT) Standard Specifications Section 4-05.3(12).

5. REPORTING

In accordance with the CAP (Ecology 2021), an As-Built Report will be prepared after the soil removal action is completed to provide documentation of the activities for Ecology review in accordance with the Consent Decree Amendment. At a minimum, the report will include the following

- a description of cleanup activities conducted, including deviations from the construction specifications;
- maps illustrating the as-built excavation areas and other pertinent information;
- detailed soil confirmation monitoring information, including sample locations, analytical methods, data quality review, and results with respect to achieving the RAO;
- data validation (Stage 2A) results for the analytical data collected during the soil removal action;
- documentation of water management during construction;
- documentation of contaminated soil disposal, including quantities of soil removed;
- documentation of excavation backfill quantities by source; and
- documentation of final grading and surface stabilization.

The data collected during the cleanup will be uploaded to Ecology's Environmental Information Management (EIM) database in accordance with the Consent Decree Amendment. The As-Built Report for the Stormwater Swale Cleanup Action will be submitted to Ecology as a draft for review. Ecology comments will be incorporated into the Final As-Built Report.

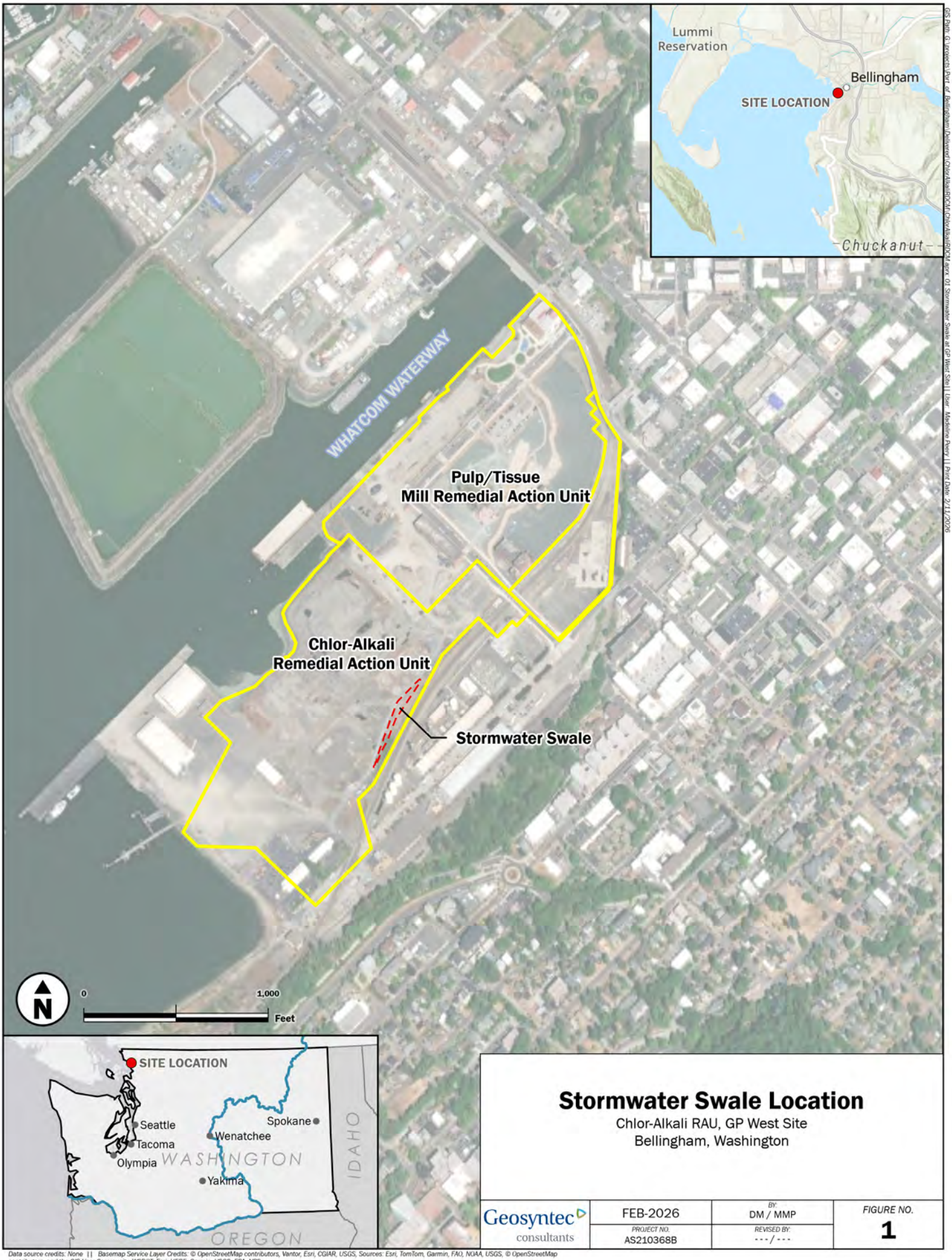
6. REFERENCES

Aspect Consulting, LLC (Aspect). 2013. Remedial Investigation, Georgia-Pacific West Site. Bellingham, Washington. Volume 1 of RI/FS. August 5, 2013.

Geosyntec Consultants (Geosyntec). 2026. 60 percent Construction Plans and Specifications (CPS). April 2026.

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FIGURES



Stormwater Swale Location

Chlor-Alkali RAU, GP West Site
Bellingham, Washington

Geosyntec consultants	FEB-2026	BY: DM / MMP	FIGURE NO. 1
	PROJECT NO. AS210368B	REVISED BY: ---/---	

Data source credits: None || Basemap Service Layer Credits: © OpenStreetMap contributors, Vantor, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, WSDOT, Esri, HERE, Garmin, USGS, EPA, NPS

GIS Path: G:\projects\Port of Bellingham\Delivered\ChlorAlkali\RDCM\ChlorAlkaliRDCM.aprx, 01 Stormwater Swale at GP West Site | User: Madeline Powell | Print Date: 2/11/2026



N
Project North

N
True North

0 60
SCALE IN FEET

GENERAL NOTE:

ALL SOIL SAMPLING WILL BE CONDUCTED BY THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDE ACCESS TO THE EXCAVATION, CONDUCTING ANY ADDITIONAL EXCAVATION BASED ON THE SAMPLING RESULTS, AND AWAITING THE ENGINEERS APPROVAL TO BACKFILL.

LEGEND

50' x 50' SOIL SAMPLING GRID

xx ENVIRONMENTAL BORING LOCATION

TEMPORARY CONSTRUCTION FENCE & PROJECT LIMITS

EXCAVATION LIMITS

Planned Soil Removal Area with Excavation Verification Sampling Grid
Chlor-Alkali RAU, GP West Site
Bellingham, Washington

Geosyntec consultants

FIGURE 2

PROJECT NO:AS210368B | June 2026

Q:\PORT OF BELLINGHAM\210368-B GP WEST CLEANUP\FIGURE 2 - PLANNED SOIL REMOVAL AREA - Last Saved by: nathan.althauser on 6/23/26

APPENDIX A
Inadvertent Discovery Plan for Stormwater Swale Soil Removal

DEPARTMENT OF ECOLOGY
State of Washington

PLAN AND PROCEDURES FOR THE UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS[1]

PROJECT TITLE: Chlor-Alkali RAU Cleanup Excavations

COUNTY WASHINGTON: Whatcom

Section, Township, Range: Section 30 T38N R3E

1. INTRODUCTION

The following Inadvertent Discovery Plan (IDP) outlines procedures to perform in the event of discovering archaeological materials or human remains, in accordance with state and federal laws.

2. RECOGNIZING CULTURAL RESOURCES

A cultural resource discovery could be prehistorical or historical. Examples include:

a. An accumulation of shell, burned rocks, or other food-related materials
b. Bones or small pieces of bone
c. An area of charcoal or very dark stained soil with artifacts
d. Stone tools or waste flakes (e.g., an arrowhead. or stone chips)
e. Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years
f. Buried railroad tracks, decking, or other industrial materials

When in doubt, assume the material is a cultural resource.

3. ON-SITE RESPONSIBILITIES

STEP 1: *Stop Work*. If any employee, contractor, or subcontractor believes that he or she has uncovered a cultural resource at any point in the project, all work must stop immediately. Notify the appropriate party(s). Leave the surrounding area untouched, and provide a demarcation adequate to provide the total security, protection, and integrity of the discovery. The discovery location must be secured at all times by a temporary fence or other on-site security.

STEP 2: *Notify Archaeological Monitor or Licensed Archaeologist*. If there is an Archaeological Monitor for the project, notify that person. If there is a monitoring plan in place, the monitor will follow the outlined procedure.

[1] If you need this document in a format for the visually impaired, call Water Quality Reception at Ecology, (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

STEP 3: *Notify the Project Manager* of this project and contact the Ecology Staff Project Manager, or other applicable contacts:

Environmental Project Manager Name: Ben Howard Phone: 360.676.2500 Email: Benh@portofbellingham.com	Ecology Staff Project Manager Name: John Rapp Phone: 360.407.6265 Email: john.rapp@ECY.WA.GOV

Assigned Alternates:

Assigned Project Manager Alternate: Name: Gina Stark Phone: 360.676.2500 Email: GinaS@portofbellingham.com	Ecology Cultural Resource Specialist (Alternate): Name: Phone: Email:

The Project Manager or applicable staff will make all calls and necessary notifications. **If human remains are encountered**, treat them with dignity and respect at all times. Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed. **Do not call 911 or speak with the media. Do not take pictures unless directed to do so by Washington Department of Archaeology and Historic Preservation (DAHP). See Section 5.**

4. FURTHER CONTACTS AND CONSULTATION

A. **Project Manager's Responsibilities**:

- *Protect Find*: The Project Manager is responsible for taking appropriate steps to protect the discovery site. All work will stop immediately in a surrounding area adequate to provide for the complete security of location, protection, and integrity of the resource. Vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site. Work in the immediate area will not resume until treatment of the discovery has been completed following provisions for treating archaeological/cultural material as set forth in this document.

- *Direct Construction Elsewhere on-site*: The Project Manager may direct construction away from cultural resources to work in other areas prior to contacting the concerned parties.

- *Contact Senior Staff*: If the Senior Staff has not yet been contacted, the Project Manager must do so.

B. **Senior Staff Responsibilities**:

- *Identify Find*: The Senior Staff (or a delegated Cultural Resource Specialist), will ensure that a qualified professional archaeologist examines the area to determine if there is an archaeological find.

- If it is determined not to be of archaeological, historical, or human remains, work may proceed with no further delay.

- If it is determined to be an archaeological find, the Senior Staff or Cultural Resource Specialist will continue with all notifications.

- If the find may be human remains or funerary objects, the Senior Staff or Cultural Resource Specialist will ensure that a qualified physical anthropologist examines the find. **If it is determined to be human remains, the procedure described in Section 5 will be followed.**

- *Notify DAHP*: The Senior Staff (or a delegated Cultural Resource Specialist) will contact the involved federal agencies (if any) and the DAHP.

- *Notify Tribes*: If the discovery may be of interest to Native American Tribes, the DAHP and Ecology Supervisor or Coordinator will coordinate with the interested and/or affected tribes.

General Contacts

Federal Agencies: **State Agencies**:

Agency: Name: Title: Number: Email:	Agency: Name: Title: Number: Email:

Department of Archaeology and Historic Preservation:

Dr. Allyson Brooks State Historic Preservation Officer 360.586.3066 Assigned Alternate:	Rob Whitlam, Ph.D. Staff Archaeologist 360.586.3050 Assigned Alternate:

The DAHP or appropriate Ecology Staff will contact the interested and affected tribes for a specific project.

Tribes consulted on this project are:

Tribe: Lummi Nation	Tribe: Upper Skagit Tribe
Name: Lena Tso	Name: Scott Schuyler
Title: THPO	Title: Cultural Resources
Phone: 360.312.2257	Phone: 360.854.7009
Email: lenat@lummi-nsn.gov	Email: sschuyler@upperskagit.com

Tribe: Swinomish Tribal Community	Tribe: Nooksack Tribe
Name: Larry Campbell	Name: Trevor Delgado
Title: THPO	Title: THPO
Phone: 360.466.7314	Phone: 360.592.5176, ext. 32234
Email: lcampbell@swinomish.nsn.us	Email: tdelgado@nooksack-nsn.gov

Further Activities

- Archaeological discoveries will be documented, as described in Section 6.
- Construction in the discovery area may resume, as described in Section 7.

5. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Do not take photographs by any means, unless you are preapproved to do so.

If the project occurs on federal lands or receives federal funding (e.g., national forest or park, military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 apply, and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on nonfederal lands, the Project Manager will comply with applicable state and federal laws, and the following procedure:

A. In all cases you must notify a law enforcement agency or Medical Examiner/Coroner's Office:

- In addition to the actions described in Sections 3 and 4, the Project Manager will immediately notify the local law enforcement agency or medical examiner/coroner's office.

- The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human, whether the discovery site constitutes a crime scene, and will then notify DAHP.

- Enter contact information below:

    - City of Bellingham Police Department
      360.778.8800

B. Participate in Consultation:

- Per Revised Code of Washington (RCW) 27.44.055, RCW 68.50, and RCW 68.60, DAHP will have jurisdiction over nonforensic human remains. Ecology staff will participate in consultation.

C. Further Activities:

- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in RCW 27.44.055, RCW 68.50, and RCW 68.60.

- When consultation and documentation activities are complete, construction in the discovery area may resume, as described in Section 7.

6. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS

Archaeological deposits discovered during construction will be assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

Project staff will ensure the proper documentation and field assessment will be made of any discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and a contracted consultant (if any).

All prehistorical and historical cultural material discovered during project construction will be recorded by a professional archaeologist on a cultural resource site or isolate form using standard and approved techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for minimal subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require further evaluation using hand-dug test units. Units may be dug in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Test units will be used only, when necessary, to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. Excavations will be conducted using state-of-the-art techniques for controlling provenience, and the chronology of ownership, custody, and location recorded with precision.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of cultural resources investigation will be screened through 0.125-inch mesh, unless soil conditions warrant 0.25-inch mesh.

All prehistorical and historical artifacts collected from the surface and from probes and excavation units will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribes.

Within 90 days of concluding fieldwork, a technical report describing any and all monitoring and resultant archaeological excavations will be provided to the Project Manager, who will forward the report for review and delivery to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s).

If assessment activity exposes human remains (burials, isolated teeth, or bones), the process described in Section 5 will be followed.

7. PROCEEDING WITH WORK

Work outside the discovery location may continue while documentation and assessment of the cultural resources proceed. A professional archaeologist must determine the boundaries of the discovery location. In consultation with Ecology, DAHP, and any affected tribes, the Project Manager will determine the appropriate level of documentation and treatment of the resource. If there is a federal nexus, Section 106 consultation and associated federal laws will make the final determinations about treatment and documentation.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Manager, DAHP, any affected tribes, Ecology (and the federal agencies, if any) determine that compliance with state and federal law is complete.

8. RECIPIENT/PROJECT PARTNER RESPONSIBILITY

The Project Recipient/Project Partner is responsible for developing an IDP. The IDP must be immediately available onsite, be implemented to address any discovery, and be available by request by any party. The Project Manager and staff will review the IDP during a project kickoff or preconstruction meeting.

We recommend that you print images in color for accuracy.

Implement the IDP if …

You see chipped stone artifacts.



- Glass-like material
- Angular
- “Unusual” material for area
- “Unusual” shape
- Regularity of flaking
- Variability of size



Implement the IDP if …

You see ground or pecked stone artifacts.









- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

Implement the IDP if …

You see bone or shell artifacts.



- Often smooth
- Unusual shape
- Carved
- Often pointed if used as a tool
- Often wedge shaped like a "shoehorn"



Bone Awls from Oregon and Bone Wedge from California

Implement the IDP if …

You see bone or shell artifacts.



- Often smooth
- Unusual shape
- Perforated
- Variability of size



Implement the IDP if …

You see fiber or wood artifacts.



- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare



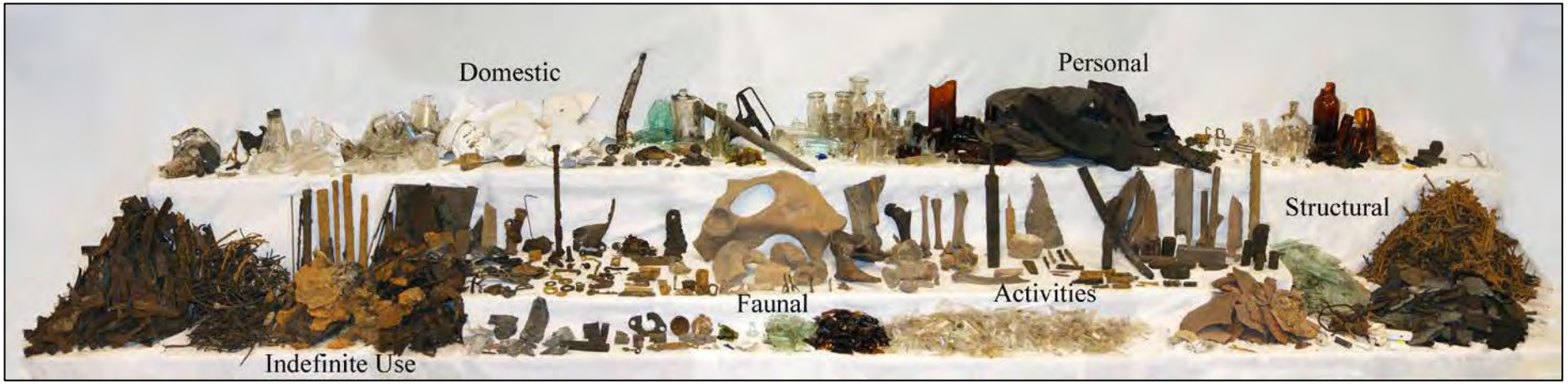
Artifacts from Mud Bay, Olympia, Washington

Implement the IDP if …

You see historical period artifacts.







Artifacts from Downtown Seattle, Alaskan Way Viaduct (Upper Left and Lower) and Unknown Site (Upper Right)

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- Human activities leave traces in the ground that may or may not have artifacts associated with them
- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burnt-looking soils
- Accumulations of shell
- Accumulations of bones or artifacts
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Site on Muckleshoot Indian Reservation, near WSDOT ROW along SR 164

Implement the IDP if …

You see strange, different, or interesting looking dirt, rocks, or shells.



- Often have a layered or "layer cake" appearance
- Often associated with black or blackish soil
- Often have very crushed and compacted shells



Implement the IDP if …

You see historical foundations or buried structures.



APPENDIX C

Caustic Core Groundwater Neutralization Design Calculations

Geosyntec consultants

engineers | scientists | innovators

CAUSTIC CORE GROUNDWATER NEUTRALIZATION DESIGN CALCULATIONS

Chlor-Alkali RAU, GP West Site

Bellingham, Washington

Prepared for

Port of Bellingham

Prepared by

Geosyntec Consultants, Inc.
801 5th Ave., Suite 2200
Seattle, WA 98104
(206) 328-7443

Project: 26002616

September 23, 2026

Caustic Core Groundwater Neutralization Design Calculations

Chlor-Alkali RAU, GP West Site, Bellingham, Washington

Prepared for

Port of Bellingham



9/23/2026

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Project Number: 26002616

September 23, 2026

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C.1 INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Caustic Core Groundwater Neutralization Design Calculations Report as an appendix to the *Engineering Design Report* (EDR) on behalf of the Port of Bellingham to summarize elements of the horizontal well injection design and carbon dioxide injection system design for neutralization of Caustic Core groundwater at the Chlor-Alkali Remedial Action Unit within the Georgia Pacific West site in Bellingham, Washington (Site).

The cleanup implementation of Caustic Core groundwater neutralization will consist of two construction elements: installation of three horizontal injection wells (HIWs) and installation of a carbon dioxide (CO_2) delivery system. This EDR appendix presents engineering design criteria and calculations for the HIW screens and CO_2 demand design for the CO_2 injection system.

C.2 HORIZONTAL INJECTION WELL DESIGN

C.2.1 Horizontal Well Screen Design

Geosyntec will subcontract a third-party professional to design the screen for three HIWs to target relatively uniform airflow distribution across the entire length of screen for each well. The well screens will be fabricated locally in Washington, following the design drawings. The HIW wells will be constructed using 3-inch-diameter, DR11 HDPE with an open slot design. The screens will be slotted longitudinally to create a single slot zone, with slots uniformly distributed around the circumference of the pipe.

The screen slot placement will be designed based on the air flow rate per foot of screen. The variance in design air flow rate is to be less than 20% of the design air flow rate. The nominal/average depth to water would be assumed to be approximately 1.5-5 feet below ground surface. Variation in the water table and gradient in water along the well screen will be considered during the screen design. The hydraulic conductivity of the formation will be assumed to be uniform.

During the screen design, the formation in the subsurface will be assumed to be homogeneous with uniformly varying fluid head along the length of the well screen—the well screen will be assumed to be a constant elevation with the water table gradient changing along the well length. It will be assumed that the size distribution of the soil particles would prevent significant plugging of the 0.012-inch-wide slots during system operation.

A mathematical model will be used to calculate the pressure profile along the inside of the well screen and will use the pressure differential inside the well screen to develop the pressure profile for the well screen. The model will then adjust the slot open area profile to compensate for the change in fluid head along the length of the well due to the gradient in the water table along the well length. The model will be run for each HIW using DR11 HDPE with a nominal 3-inch-diameter well screen. Various slot sizes, slot density patterns, and zone configurations will be tested to identify a suitable slot pattern for each well screen. Each well screen design will be limited to a maximum of two different zones of open slot areas.

Hydraulic Gradients

The groundwater horizontal hydraulic gradient in the HIW installation area was estimated using historical water levels from 12 groundwater monitoring events from 2023 through 2024. Horizontal hydraulic gradients were calculated using the EPA Online Tool for Hydraulic Gradient Magnitude and Direction[1], which uses a least-squares fitting of the data to a plane. A hydraulic gradient was calculated for three monitoring events using upgradient wells AMW-02, EMW-19S, and CP-MWA1, and downgradient wells CP-MW103, CP-MW01, and CP-MW102 as shown in Table C-1 below.

[1] EPA Online Tool for Site Assessment Calculation, updated on May 1, 2026, https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/gradient4plus-ns.html.

Table C-1. Horizontal Hydraulic Gradient (2023-2024)

Sample Date	Horizontal i (feet per foot)	Flow direction as degrees from North [1]
9/19/2023	0.009	24.28
3/6/2024	0.014	21.75
6/12/2024	0.013	18.38
Average i	0.006	

Notes:

1. Assuming west is zero degrees, positive values are clockwise, and negative values are counterclockwise.

C.3 CO_2 INJECTION SYSTEM DESIGN

Carbon Demand

The total CO_2 demand for the Caustic Core was estimated to determine the amount of CO_2 required to achieve the remediation level (REL) of pH 10 in groundwater. These CO_2 demand calculations were based on the 2013 Mutch Associates, LLC (Mutch) report (Mutch 2013) which presented the proof of concept test for CO_2 sparging to neutralize a subsurface caustic brine pool.

A numerical titration was performed to calculate the CO_2 demand of the Caustic Core groundwater. The first step in the titration is to determine the total carbonate (C_T) of representative water. Site data from three wells (AMW-03, CP-MWA1, EMW-19S) were used as inputs for the total carbonate calculations, as these wells have the highest groundwater pH and are most representative of conditions in the Caustic Core area. The groundwater monitoring data collected during the Pre-Remedial Design Investigation 3 (PRDI 3) in September 2023 was selected as "worst-case" conditions (highest pH) and is shown below in Table C-2 (Aspect 2024).

Table C-2. Site Data

Analyte	Unit	AMW-03 09/20/2023	CP-MWA1 09/20/2023	EMW-19S 09/20/2023
Dissolved Metals				
Mercury	µg/L	**0.072**	**0.024**	**8.4**
Geochemical Parameters				
Alkalinity, Total	mol/L	**0.039**	**0.110**	**0.007**
Alkalinity, Total	mg/L	**3900**	**11000**	**740**
Aluminum (Dissolved)	mg/L	**0.32**	**0.35**	**1.1**
Calcium (Dissolved)	mg/L	**8.5**	**6.4**	**10**
Chloride	mg/L	**230**	**2100**	**55**
Iron (Dissolved)	mg/L	**3.7**	**11**	**6.5**
Magnesium (Dissolved)	mg/L	**0.15**	**0.27**	**0.95**
Manganese (Dissolved)	mg/L	**0.04**	**0.019**	**0.12**
Nitrate as Nitrogen	mg/L	0.15 UJ	0.76 UJ	0.15 UJ
Nitrite as Nitrogen	mg/L	0.14 UJ	0.71 UJ	0.14 UJ
Potassium (Dissolved)	mg/L	**13**	**65**	**4.5**
Sodium (Dissolved)	mg/L	**2100**	**6600**	**510**
Sulfate	mg/L	**15**	**46**	**180**
Sulfide (Total)	mg/L	**69**	**130**	**1.9**
Total Organic Carbon	mg/L	**350**	**690**	**22**

Analyte	Unit	AMW-03 09/20/2023	CP-MWA1 09/20/2023	EMW-19S 09/20/2023
Field Parameters				
Temperature	deg C	**18.72**	**22.1**	**19.1**
Specific Conductance	µS/cm	**6675.6**	**18586**	**1841**
Total Dissolved Solids (TDS)		**5340**	**14869**	**1473**
Dissolved Oxygen	mg/L	**0.03**	**0.08**	**0.06**
pH	Std units	**12.34**	**10.84**	**10.55**
$[H^+]$	M	**4.57E-13**	**1.45E-11**	**2.82E-11**
$p[OH^-]$	Std Units	**1.66**	**3.16**	**3.45**
$[OH^-]$	M	**2.2E-02**	**6.9E-04**	**3.5E-04**
Oxidation Reduction Potential	mV	**-543.2**	**-414.8**	**-392**
Turbidity	NTU	**20.9**	**11**	**11.2**

Notes:
Blue highlighted fields are calculated.
deg C: degrees Celsius
M: mole
mg/L: milligrams per liter
mol/L: moles per liter
µg/L: micrograms per liter
µS/cm: microsiemens per centimeter
mV: millivolts
NTU: Nephelometric Turbidity Unit
UJ: Analyte not detected and the Reporting Limit (RL) is an estimate

The equation used below, which was derived by Mutch, relates the alkalinity, C_T, and hydrogen ion concentration ($[H^+]$). Where ${}^cK_{a1}$ and ${}^cK_{a2}$ are concentration-based acidity constants (${}^cK_{a1} = 10^{-6.532}$, ${}^cK_{a2} = 10^{-10.329}$), K_w is the equilibrium constant for water ($K_w = 10^{-14}$), [H+] and alkalinity are based on recent water quality data, and C_T = total carbonate.

$$Alkalinity = C_T \left(\frac{K_{a1}[H^+] + 2K_{a1}K_{a2}}{[H^+]^2 + K_{a1}[H^+] + K_{a1}K_{a2}} \right) + \frac{K_W}{[H^+]} - [H^+]$$

The numerical titration was performed by calculating the C_T for the current site conditions, assuming a constant alkalinity, and calculating the C_T for the target REL pH of 10. The difference between these C_T values is the total amount of CO_2 that is needed to satisfy the demand of the system. The results of the numerical titration and carbon demand calculation are shown in Table C-3 below. A 25 percent safety factor was added to the CO_2 demand calculation to provide some contingency.

Table C-3. Calculated Carbon Demand

Total Carbonate	Units	AMW-03	CP-MWA1	EMW-19S
Current Conditions, pH>10	mol/L	0.0086	0.0620	0.0043
Target REL, pH = 10	mol/L	0.0295	0.0833	0.0055
CO_2 Demand = Target - Current	mol/L	0.0209	0.0214	0.0012
CO_2 Demand (25% safety factor)	mol/L	0.0261	0.0267	0.0015

Notes: CO_2: carbon dioxide; mol/L: moles per liter

The calculated CO_2 demand was highest at CP-MWA1 (0.0267 moles per liter). To be conservative, this worst-case CO_2 demand was carried forward into calculations to determine the total mass of CO_2 needed to treat the Caustic Core. The total treatment volume was estimated using the area between the injection wells in the Caustic Core as of September 2023, and a total saturated thickness of 15 feet was assumed based on depth to water and depth to aquitard. The calculated total CO_2 demand for the Caustic Core including an assumption of 75% efficiency is approximately 80,000 pounds.

Table C-4. Total CO_2 Required to Treat Caustic Core

Injection Well	Area (ft^2)	Depth (ft)	Volume (ft^3)	Volume (L)	CO_2 (g/mol)	CO_2 Demand (g/L)	CO_2 Demand (kg)	CO_2 Demand (lbs)
A	14,202	15	213,033	6,032,436	44	1.17556	7,092	15,601
B	20,745	15	311,178	8,811,567	44	1.17556	10,359	22,789
C	19,659	15	294,883	8,350,167	44	1.17556	9,816	21,596
						Total CO_2 Demand (lbs)		**59,986**
						75% efficiency CO_2 (lbs)		**79,981**
						Number of CO_2 tanks (15,000 lbs)		**5.33**

Notes:
CO_2: carbon dioxide
ft: foot
ft^2: square foot
ft^3: cubic foot
g/L: grams per liter
g/mol: grams per mole
kg: kilograms
L: liter
lbs: pounds

C.4 REFERENCES

Aspect Consulting, LLC. 2024. *Pre-Remedial Design Investigation 3 Data Report, Chlor-Alkali RAU, GP West Site, Bellingham, Washington*. September 16.

Mutch. 2013. *CO_2 Sparging Proof of Concept Test, LCP Chemical Site, Brunswick, Georgia*. Mutch Associates, LLC. April 1, 2013.

APPENDIX D

In Situ Solidification (ISS) Design Calculations

Geosyntec consultants

engineers | scientists | innovators

IN SITU SOLIDIFICATION (ISS) DESIGN CALCULATIONS

Chlor-Alkali RAU, GP West Site

Bellingham, Washington

Prepared for

Port of Bellingham

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September 23, 2026

In Situ Solidification (ISS) Design Calculations

Chlor-Alkali RAU, GP West Site, Bellingham, Washington

Prepared for

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D.1 INTRODUCTION

Geosyntec Consultants, Inc. has prepared this In Situ Solidification (ISS) Design Calculations Report as an appendix to the *Engineering Design Report* (EDR) on behalf of the Port of Bellingham to summarize the volume estimates and conceptual design of the additional excavation areas associated with the ISS treatment areas at the Chlor-Alkali Remedial Action Unit within the Georgia Pacific West site in Bellingham, Washington (Site). This EDR appendix presents the engineering design basis and calculations developed to confirm that sufficient in situ volume exists to accommodate the treated soil volume while maintaining a final ISS monolith elevation at or below 14 feet North American Vertical Datum of 1988 (NAVD88).

The purpose of the additional excavation areas is to accommodate material generated from volumetric expansion of soil during ISS (i.e., "swell"); provide flexibility associated with obstruction removal, ISS treatment, and final grading requirements; and reduce mercury emissions.

D.2 ISS VOLUME BALANCE AND ADDITIONAL EXCAVATION AREA

Design Basis and Assumptions

The engineering design basis and assumptions used in the ISS volume balance and additional excavation area calculations are shown in Table D-1 below.

Table D-1. Design Basis and Assumptions

Parameter	Assumption / Basis
ISS Swell	30 percent volume increase
ISS Swell Basis	Based on project experience and addition of approximately 15 percent reagent by weight
Final ISS Monolith Elevation	At or below elevation 14 feet NAVD88
Existing Ground Surface	Representative elevations based on project topographic survey
Treatment Areas	Based on planned ISS treatment areas shown on EDR Figure 13
Treatment Depth	Determined from existing grade to the estimated top of the underlying aquitard
ISS Area A Adjustment	Treatment depth reduced by 5 feet where applicable to account for overlap with the total petroleum hydrocarbon-contaminated soils excavation area that will lower the existing grade prior to ISS treatment
Obstruction Volumes	Developed from available Site records, historical drawings, and ISS limits
Obstruction Types	Cell Building foundation elements, pile caps, grade beams, stem walls, timber piles, tank foundations, brine sludge pits, stormwater structures, utilities, and other anticipated subsurface features
Additional Excavation Areas	Sized to accommodate ISS swell below elevation 14 feet NAVD88
Construction Flexibility	Final additional excavation area dimensions may be adjusted during final design and construction based on actual obstruction quantities, excavation conditions, and the amount of observed ISS swell generation

Volume Balance Methodology

The estimated obstruction volumes were subtracted from the undisturbed treatment volume to determine the anticipated pre-ISS treatment volume. A 30 percent volume increase was then applied to the pre-ISS treatment volume to account for ISS swell associated with soil mixing and reagent addition.

The final ISS monolith elevation is required to be at or below elevation 14 feet NAVD88. Therefore, the available in situ volume within each treatment area was evaluated based on the

volume available below the required final ISS monolith elevation. The difference between the estimated post-treatment volume and the available in situ volume below elevation 14 feet NAVD88 was used to determine the additional volume to be created within the adjacent excavation areas.

Soils temporarily excavated to facilitate obstruction removal will be returned to the treatment footprint prior to ISS implementation. Following grading and soil redistribution, the original ISS treatment areas and the adjacent excavation areas will be treated to create a continuous ISS monolith.

ISS Volume Summary

The results of the ISS treatment volume calculations are shown in Table D-2 below.

Table D-2. ISS Volume Balance Summary

ISS Area	ISS Area (sf)	Treatment Depth (feet)	Pre-ISS Treatment Volume (LCY)	Post-ISS Volume (LCY)	Estimated Excess Volume (LCY)[1]
A	24,190	17.0	12,410	16,130	3,580
B	2,110	17.5	1,180	1,530	240
C	3,390	17.0	1,980	2,570	570
D	1,380	16.5	770	1,000	210
E	2,470	15.0	1,320	1,720	440
Total	33,540	—	17,660	22,950	5,040

Notes:
1. The estimated excess volume for ISS Area A accounts for the volume of total petroleum hydrocarbon-contaminated soils that will be excavated from the area that overlaps ISS Area A.

LCY: loose cubic yards
sf: square feet

Additional Excavation Areas

The locations of the additional excavation areas adjacent to the ISS treatment areas were selected based on anticipated low mercury soil concentrations, anticipated low obstruction density, existing Site constraints, and the ability to efficiently increase the capacity for treated soil volume below the required maximum monolith elevation of 14 feet NAVD88. The conceptual additional excavation area, typical excavation depth, and estimated available capacity associated with each ISS treatment area are summarized in Table D-3 below.

Table D-3. Conceptual Additional Excavation Areas

ISS Area	Conceptual Additional Excavation Area (sf)[1]	Typical Excavation Depth (feet)	Estimated Available Capacity (BCY)[1, 2]
A	12,160	10	3,580
B/C	3,180	10	810
D	980	10	210
E	1,900	10	440
Total	18,220	—	5,040

Notes:

1. Conceptual additional excavation areas shown herein represent the total excavation footprint, including flat-bottom areas and side slopes. Estimated available capacity is not equal to excavation area multiplied by excavation depth because (1) excavation side slopes are incorporated into the conceptual excavation geometry and, (2) only the volume created below the maximum final monolith elevation of 14 feet NAVD88 contributes usable capacity for accommodating ISS-treated material. As a result, the available capacity is less than the total excavation volume.
2. Estimated available capacity represents the conceptual in situ volume created below elevation 14 feet NAVD88 and is used for planning-level evaluation of the ISS volume balance.

BCY: bank cubic yards
sf: square foot

Engineering Judgement and Construction Flexibility

The volume balance calculations presented herein are estimates for the remedial design. Actual obstruction volumes, excavation geometries, existing grades, and amount of ISS swell generation may differ from the assumptions used in these calculations. In addition, the final excavation surfaces following obstruction removal will not be fully known until construction activities are underway. Accordingly, the additional excavation areas shown on Figure 13 of the EDR may be modified during final design or construction to accommodate actual field conditions.

The intent of the additional excavation area design is to accommodate ISS swell; provide flexibility associated with obstruction removal, ISS treatment, and final grading requirements; and reduce mercury emissions.