DEPARTMENT OF ECOLOGY
State of Washington

CLEANUP ACTION PLAN
CHLOR-ALKALI REMEDIAL ACTION UNIT

Georgia-Pacific West Site
Bellingham, Washington

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1 Introduction and Background

This Cleanup Action Plan (CAP) defines the cleanup action selected by the Washington State Department of Ecology (Ecology) for the portion of the Georgia-Pacific West Site (Site) referred to as the Chlor-Alkali Remedial Action Unit (RAU). 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).

The Port of Bellingham (Port) acquired the former Georgia-Pacific Mill property located at 300 West Laurel Street in Bellingham, Washington, in January 2005. In August 2009, Ecology and the 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. The Chlorine Plant used a mercury cell technology to produce chlorine and sodium hydroxide for use at the Pulp and Tissue Mill in bleaching and pulping wood fiber, and for off-site commercial sale.

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. Figure 1 shows the RAU boundaries. The 36-acre Chlor-Alkali RAU primarily occupies property owned by the Port. However, as shown on Figure 2, the southeastern[2] portion of the RAU includes a narrow strip of property owned by BNSF Railway Company (BNSF), which is occupied by an operating rail line, including the mainline tracks that connect Seattle, Washington and Vancouver, British Columbia. The rail line also crosses a Port-owned property within the RAU for which BNSF has an easement. In addition, the RAU includes state-owned aquatic lands that have been filled—the portion of the RAU located west of the Inner Harbor Line (Figure 2). Since 1997, the Port has managed the state-owned land under a Port Management Agreement (PMA) signed with Washington State Department of Natural Resources.

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. Cleanup construction for the Pulp/Tissue Mill RAU was completed in 2016, and since then monitoring of groundwater natural attenuation and inspection and maintenance of the environmental cap have been ongoing.

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[1] The terms "Chlor-Alkali Plant" and "Chlorine Plant" have been used interchangeably. The latter is used exclusively in this CAP.

[2] For ease of discussion, and consistency with previous Site reports, this document uses "Mill north" as its directional reference ("Mill north" axis approximately 45 degrees west of true north). In the "Mill north" reference, the Whatcom Waterway is oriented east-west on the north side of the Site (see arrows for true north and Mill north on Figure 2).

The FS for the Chlor-Alkali RAU was finalized in June 2018 (Aspect, 2018b) in accordance with the amended Order. The FS presented a range of cleanup alternatives for the RAU and evaluated them with respect to criteria specified in MTCA (Chapter 173-340 WAC). A "preferred alternative" was identified based on the results of that evaluation, which, following receipt of public comments, will be considered as the final cleanup action to be selected by Ecology.

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

2 Summary of Contaminant Nature and Extent

The RI and FS[3] identify the following contaminants of concern and impacted media within the Chlor-Alkali RAU:

- Mercury in soil, soil gas, and groundwater
- Elevated groundwater pH
- Total petroleum hydrocarbons (TPH) in soil
- Polycyclic aromatic hydrocarbons (PAHs) in soil and groundwater
- The PAH naphthalene in soil gas
- Miscellaneous metals (arsenic, chromium, copper, and nickel) in groundwater

The estimated areal extent of soil and groundwater contamination is shown on Figure 2. Figure 2 also shows specific contaminants associated with specific historical operations and features.

Mercury is the primary contaminant of concern. The RI and FS classify soil mercury in three basic forms:

- Visible elemental mercury
- Mercury contained in wastewater settling basin sludge that was treated by the Chemfix process and placed at the location shown on Figure 2
- All other mercury in soil (e.g., divalent mercury, primarily present as mercury-sulfide and dissolved organic matter complexes)

Mercury concentrations in soil gas are a potential concern wherever visible elemental mercury is present in soil. As shown on Figure 2, visible elemental mercury is found only in the Chlorine Plant Area. In addition to the Chlorine Plant Area, areas impacted by mercury in soil include the Wastewater Settling Basin, Stormwater Swale, and Laurel St. Pipe Rack.

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[3] Hereafter in this CAP, the acronym "FS" refers to the FS for the Chlor-Alkali RAU (Aspect, 2018) unless otherwise specified.

Mercury has impacted groundwater in two hydrogeologic units. Impacts are primarily to the Fill Unit aquifer, which is a shallow water table aquifer that varies in thickness from approximately 10 to 15 feet across the RAU. The Fill Unit water table depth ranges from about 1 to 3 feet below ground surface (bgs) in the south to greater than 9 feet bgs near the Log Pond in the north. The underlying Lower Sand aquifer is hydraulically separated from the Fill Unit aquifer by a naturally occurring silt aquitard that ranges in thickness from a few feet to as much as 10 feet. However, an apparent man-made breach of the aquitard in the northwest corner of the Chlorine Plant Area has resulted in the transport of mercury-impacted groundwater from the Fill Unit downward to the Lower Sand aquifer (refer to Section 4.1 in Aspect, 2018b); Figure 2 depicts the extent of mercury in Lower Sand groundwater emanating from the aquitard breach location. Both aquifers ultimately discharge to the marine environment of Whatcom Waterway (via the Log Pond) to the north or Bellingham Bay to the west.

Historical releases of sodium hydroxide in the Chlorine Plant Area have resulted in elevated (alkaline) pH in Fill Unit groundwater, which enhances mercury mobility. Consequently, the highest dissolved-phase mercury occurs within the area of most alkaline groundwater. The “Caustic Core” called out on Figure 2 is the estimated area where Fill Unit groundwater exceeds pH 10.

Soils impacted by TPH or PAHs are found in the Chlorine Plant, Million Gallon Tanks, and Lignin Warehouse B areas, and PAHs in the Million Gallon Tanks area have leached to Fill Unit groundwater at concentrations of concern. Naphthalene in soil gas is a potential vapor intrusion (VI) concern associated with the Million Gallon Tanks petroleum hydrocarbon releases[4].

Finally, concentrations of metals other than mercury, including arsenic, chromium, copper, and nickel, exceeding groundwater cleanup levels have been detected in Fill Unit groundwater in the Million Gallon Tanks and Lignin Warehouse B areas. These exceedances are attributable to geochemically reducing conditions that enhance the mobility of naturally occurring metals in the Fill Unit aquifer; the RI identified no specific metals source material for the groundwater exceedances. The reducing conditions are typical of developed shorelines of Puget Sound that have been filled with organic-rich dredged material.

Detailed information regarding contaminant nature and extent is presented in the RI (Aspect, 2013) and FS (Aspect, 2018b). Section 7 of the RI and Section 4 of the FS present the conceptual site model for subareas within the Chlor-Alkali RAU, which discusses contaminants of concern and their historical source(s), nature and extent of contamination, contaminant fate and transport, and environmental exposure pathways and receptors. Figure 3 is a graphical depiction of the conceptual site model for the RAU, which is reproduced from the RI. The conceptual site model graphic is not specific to a subarea or historical source of contamination. Rather, it schematically illustrates the presence of contaminated soil, groundwater, and soil vapor, and the pathways by which human receptors (residents or workers) within the RAU, or ecological receptors in

[4] Naphthalene was not detected in any soil gas sample collected from the Million Gallon Tanks subarea, but the samples’ analytical reporting limit exceeded the current MTCA soil gas screening level. Therefore, naphthalene in that subarea remains a potential VI concern (Aspect, 2018b).

Bellingham Bay/Whatcom Waterway, could be exposed to contamination if no remedial action or protective controls are put into place at the RAU.

3 Remedial Action Objectives

Remedial action objectives (RAOs) are specific goals for protecting human health and the environment assuming an unrestricted (non-industrial) land use within the RAU. RAOs for the Chlor-Alkali RAU were developed in the FS, and include the following:

- Prevent direct contact with and erosion of mercury-contaminated soils
- Prevent VI from elemental-mercury-contaminated unsaturated soils or groundwater
- Prevent mercury leaching to groundwater from mercury-contaminated soils and prevent discharge to the Whatcom Waterway of pH- and mercury-contaminated groundwater
- Prevent direct contact with TPH/PAH-contaminated soils
- Prevent discharge to the Whatcom Waterway of cPAH[5]/naphthalene-contaminated groundwater
- Prevent VI from naphthalene-contaminated unsaturated soils or groundwater
- Prevent discharge to the Whatcom Waterway of metals-contaminated groundwater outside of the pH-impacted areas.

4 The Selected Cleanup Action

4.1 Description of Selected Cleanup Action

The selected cleanup action design concept is presented on Figure 4. The cleanup action consists of the following elements:

Prior Cleanup Actions. Prior cleanup actions are described in Section 3 of the FS. The most significant of these were the following:

- 1976-1977 Settling Basin Cleanup, in which mercury-contaminated sludge from the wastewater settling basin was treated by a proprietary solidification process (Chemfix), and the roughly 8,000 cubic yards (CY) of treated material were contained within the RAU.
- 2013-2014 Caustic Plume-Cell Building[6] Interim Action, which included extensive removal of soil containing visible elemental mercury from the Chlorine Plant Area (Aspect, 2014). Removal areas are shown on Figures 2 and 4

[5] The acronym "cPAH" refers to carcinogenic PAH.
[6] The electrolytic mercury cell process was housed in the Cell Building.

Excavated soil was chemically stabilized in an on-site treatment process, and the treated material was disposed of off Site[7].

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 soils with potential visible elemental mercury is estimated at roughly 15,000 CY. Much of this soil is situated within dense arrays of foundation piles that supported 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 soils will be moved as needed to expose the wooden piles down to the aquitard so that they can be cut off at the Fill Unit/aquitard interface (roughly 14-foot depth). Removing the piles in this manner will maintain the integrity of the aquitard to the maximum degree practical.

Soils from the Fill Unit containing visible elemental mercury will then be treated via *in situ*[8] solidification/stabilization (ISS) to reduce mercury leachability and volatilization potential. Portland cement and elemental sulfur were successfully used together to solidify/stabilize soils containing visible elemental mercury (*ex situ*) that were excavated during the Caustic Plume-Cell Building interim action, and these amendments will likely be used for *in situ* treatment as well. Proposed methods for pile removal and *in situ* ISS will be field-tested during the remedy design phase.

Neutralization of Groundwater in the Caustic Core. Fill Unit groundwater within the Caustic Core will be neutralized (i.e., pH reduced to a more neutral level), likely by placing ferrous sulfate heptahydrate ($FeSO_4$*$7H_2O$) below the water table in trenches excavated perpendicular to the groundwater flow direction. Reducing groundwater pH will reduce mercury mobility by decreasing its solubility. Neutralization methods will be further evaluated/optimized during the remedy design phase.

Removal of Wastewater Settling Basin Soils Near the Log Pond with Mercury Concentrations >300 milligrams per kilogram (mg/kg). Nearshore soils with mercury concentrations exceeding 300 mg/kg are of concern with respect to the soil-to-groundwater-to-surface water pathway. An estimated 2,200 CY of these soils will be excavated from the northern portion of the Wastewater Settling Basin area and disposed of off Site.

Removal of TPH-Impacted Soils in Southeast Corner of the Cell Building. An estimated 1,300 CY of shallow TPH-impacted soils in and around the southeast corner of the Cell Building will be excavated and disposed of off Site.

Consolidation and Capping of Residual Soils Exceeding Cleanup Levels. Mercury-impacted soils in the BNSF portion of the Stormwater Swale will be excavated and placed on top of mercury-impacted soils on the Port side of the Stormwater Swale. Hard caps will then be installed in all areas where contaminant concentrations exceed soil

[7] A portion of the excavated soil was stockpiled within the footprint of the former Cell Building and subsequently stabilized and disposed of off Site in 2017 (Aspect, 2018a).

[8] Ecology agrees in principle that 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 a remediation waste under the Resource Conservation and Recovery Act (RCRA).

cleanup levels. The hard caps will limit stormwater infiltration and control the human and terrestrial ecological exposure and soil erosion pathways.

Since the remaining cleanup areas will be contained, the requisite institutional controls will be implemented to ensure that any contaminated soil disturbed during any possible future Site redevelopment or other intrusive activities is properly managed and subject to appropriate worker health and safety protection. As redevelopment of the RAU occurs, the redevelopment project proponent may choose to permanently remove (excavate/properly dispose), instead of cap, residual contaminated soils if such an action is completed in consultation with, and with approval from, Ecology. Excavation of soils undertaken as part of future redevelopment at the Site may require a formal amendment to this Cleanup Action Plan and any associated future Consent Decree, depending on the contaminant levels of the soil to be excavated and the depth or location of the excavation.

Monitored Natural Attenuation (MNA) of Groundwater. MNA will be applied to 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, naphthalene, and cPAH concentrations. Mercury exceedances have also been identified in a localized area of the underlying Lower Sand aquifer. Contaminants in groundwater are expected to continue to naturally attenuate through a combination of sorption, bioattenuation, volatilization, dispersion, and 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[9] 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 determine the causes of failure and, therefore, the most effective and practicable means to remedy it.

Institutional Controls. The Port and Ecology will develop 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:

- Provide notification regarding the presence of residual contaminated materials.
- Require Ecology review and approval of activities involving disturbance/management of residual contaminated materials or the cleanup action components, with particular care taken if conducting subsurface disturbance in areas of treated soils containing elemental mercury (Chlorine Plant Area).
- Provide for long-term monitoring and stewardship of the cleanup action.
- Require that VI potential be evaluated with respect to mercury and/or VI controls constructed beneath future buildings in the immediate vicinity of the Chlorine Plant Area.

[9] Figure 4 shows locations where permeable reactive barriers could be installed for *in situ* treatment of mercury in groundwater in the event that cleanup level exceedances are detected in the sediment bioactive zones of the Log Pond and/or Bellingham Bay.

- Require that VI potential be evaluated with respect to naphthalene and/or VI controls constructed beneath future buildings in the immediate vicinity and downgradient of the Million Gallon Tanks area if groundwater compliance monitoring indicates that naphthalene concentrations have not naturally attenuated to below cleanup levels in that area.

4.2 Contamination Remaining in the RAU

The extent of contaminated soil and groundwater exceeding cleanup levels was estimated in the FS (Aspect, 2018b). As noted above, the selected cleanup action will remove all TPH-contaminated soils from the Chlorine Plant Area and an estimated 2,200 CY of mercury-contaminated soils from the former wastewater settling basin.

Using the FS estimates as a basis, soil contamination exceeding cleanup levels for unrestricted land use (Table 1) will remain in RAU as follows (refer to Figure 2):

- An estimated 74,000 CY of mercury-contaminated soil in the Chorine Plant Area, including an estimated 15,000 CY treated by ISS
- An estimated 8,000 CY of stabilized mercury-contaminated sludge in the Chemfix area
- An estimated 18,000 CY of mercury-contaminated soil in the Wastewater Settling Basin area
- An estimated 1,400 CY of mercury-contaminated soil in the Stormwater Swale area
- An estimated 1,600 CY of mercury-contaminated soil in the Laurel St. Pipe Rack area
- An estimated 6,000 CY of soil contaminated with TPH or PAHs in the Million Gallon Tanks area
- An estimated 2,500 CY of soil contaminated with TPH or PAHs in the Lignin Warehouse B area

With respect to groundwater, plumes exceeding cleanup levels (Table 2) will be present at the beginning of remedy implementation as follows (refer to Figure 2):

- Dissolved mercury in Fill Unit groundwater covering an estimated 12 acres
- Dissolved mercury in Lower Sand groundwater covering an estimated 0.8 acre
- Other dissolved metals in Fill Unit groundwater outside of the Chlorine Plant area covering an estimated 1.0 acre
- Dissolved cPAHs or naphthalene in Fill Unit groundwater covering an estimated 2.4 acres
- Alkaline Fill Unit groundwater ($pH > 8.5$) covering an estimated 6.8 acres

Groundwater monitoring data indicate that natural attenuation is effectively reducing contaminant concentrations in each of the plumes, and that groundwater cleanup levels are currently achieved in the sediment bioactive zone along the shorelines of both the Log Pond and Bellingham Bay.

4.3 Other Remedial Alternatives Evaluated

The FS evaluated eight remedial alternatives (Alternatives 1 through 8), the fourth of which corresponds to the selected cleanup action described above. All eight alternatives include removal of mercury-contaminated soils from the northern portion of the Wastewater Settling Basin area and TPH-contaminated soils from the Chorine Plant Area. Soils containing visible elemental mercury are either treated by ISS[10] (Alternatives 1, 2, 4, and 5) or removed (Alternatives 3, 6, 7, and 8). Groundwater with elevated pH is neutralized with the Caustic Core (pH > 10) in Alternative 4 and within the entire area of cleanup level exceedance (pH > 8.5) in Alternatives 5 through 8. Removal of additional contaminated soils (in lieu of capping) is included in Alternatives 6 through 8. Alternative 8, the most aggressive remedial alternative, also includes *in situ* treatment of residual contamination in Fill Unit groundwater. Institutional controls and groundwater MNA are necessary components, to a greater or lesser degree, in all the alternatives.

Refer to Section 7 of the FS for more detailed descriptions of the eight remedial alternatives.

4.4 Rationale for Selecting Cleanup Action

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

<u>Threshold Criteria</u>

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

<u>Other Criteria</u>

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

It was determined that all eight alternatives would meet the requirements of the "threshold criteria."

A disproportionate cost analysis (DCA) was conducted to assess the extent to which the remedial alternatives would use permanent solutions to the maximum extent practicable.

[10] Soil containing visible elemental mercury could likely be more effectively and less expensively treated *ex situ* (using equipment similar to that used in the 2013-2014 interim action) and then used as backfill for the excavation. However, this was not included in any alternative because placement of soil treated *ex situ* back in the ground would constitute a corrective action management unit (CAMU) under RCRA, and Ecology's Hazardous Waste program determined that a CAMU cannot be used in the cleanup of this RAU.

The DCA quantified the environmental benefits of each alternative, and then compared incremental benefits versus costs between alternatives. Costs are disproportionate to benefits if the incremental cost of a more permanent alternative over that of a lower-cost alternative exceeds the incremental benefits achieved by the more permanent alternative. Based on the results of the DCA, Alternative 4 was determined to be the most cost effective. Therefore, under MTCA, Alternative 4 has been identified as the alternative that is permanent to the maximum extent practicable. Refer to Section 8.3 of the FS for more a detailed description of the DCA for the eight remedial alternatives.

4.5 Compliance with WAC 173-340-360

The selected cleanup action complies with the provisions of WAC 173-340-360. It will be protective of human health and the environment, comply with cleanup standards and applicable state and federal laws, and provide for compliance monitoring.

Soils containing visible elemental mercury, all of which occur within the Chlorine Plant, will be treated by ISS. TPH-contaminated soils in the Chlorine Plant Area and mercury-contaminated soils in the northern portion of the Wastewater Settling Basin area will be removed. Outside of the ISS-treatment and soil-removal areas, soils with hazardous substance concentrations that exceed soil cleanup levels will be contained by capping. Institutional controls in the form of an environmental covenant will provide notification regarding the presence of residual contaminated soils, regulate the disturbance/management of those soils and the cleanup action components, and provide for long-term monitoring and stewardship of the cleanup action. Alkaline groundwater will be actively neutralized in the area where it exceeds pH 10. MNA will address residual contamination in groundwater that exceeds applicable groundwater cleanup levels, and a compliance monitoring plan will specify contingency actions to be considered in the event that potential contaminant migration to adjacent surface water/sediment is indicated.

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

4.6 Compatibility with Whatcom Waterway Cleanup

The Chlor-Alkali RAU is adjacent to the Whatcom Waterway cleanup site, which has a cleanup remedy and schedule defined under a Consent Decree with Ecology. Phase 1 of the Whatcom Waterway cleanup, including remediating the shoreline bordering the Chlor-Alkali RAU, was completed in 2016. Design for Phase 2 of the cleanup action is underway. The selected cleanup action for the Chlor-Alkali RAU has overlap with the Whatcom Waterway cleanup, in terms of integrating an upland soil cap along a portion of the Log Pond shoreline with the completed capping of sediments within the Log Pond. The cleanup action for the Chlor-Alkali RAU is compatible with, and will prevent recontamination of, the Whatcom Waterway cleanup.

5 Cleanup Standards and Remediation Levels

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 Chlor-Alkali RAU are based on an unrestricted land use. The soil and groundwater cleanup standards and remediation levels applicable to the Chlor-Alkali RAU are outlined below.

5.1 Soil

Table 1 lists soil cleanup levels and remediation levels for the soil contaminants identified in the RI. Soil cleanup levels based on groundwater protection are different for soils above the water table (unsaturated) versus soils below the water table (saturated), as presented in Table 1. 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 bgs. However, for this containment (i.e., capping) remedy, compliance with direct-contact soil cleanup standards is determined per WAC 173-340-700(4)(c):

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

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

An environmental covenant for the RAU will specify inspection and maintenance requirements to ensure the long-term integrity of the soil caps. Other requirements for containment specified in WAC 173-340-700 will also be met.

5.2 Groundwater

Table 2 lists groundwater cleanup levels and remediation levels for the groundwater contaminants identified in the RI. As described in Section 5.2 of the RI (Aspect, 2013), the highest beneficial use of Site groundwater is discharge to marine water—not potable use. Under MTCA, however, the standard point of compliance for groundwater cleanup levels is throughout Site groundwater, regardless of whether the groundwater is potable (WAC 173-340-720(8)(b)). When a standard point of compliance is assumed, the FS estimated a restoration time frame of 74 years, where achieving the groundwater cleanup level for mercury (for protection of marine water and sediment) is limiting. Since Ecology does not consider this to be a reasonable restoration time frame, conditional points of compliance were proposed in the FS in accordance with WAC 173-340-720(8)(d)(ii).

Based on the evaluation in Section 9 of the FS (Aspect, 2018b), Ecology is establishing the conditional points of compliance for achieving groundwater cleanup levels in the sediment bioactive zones of the Log Pond (Law-1 area) and Bellingham Bay (Caustic Plume area). This point-of-compliance is appropriate because it applies the groundwater cleanup levels at the location for which they were specifically developed (point of exposure for marine biota). Under this scenario, restoration with respect to mercury concentrations in groundwater would be achieved upon completion of remedy construction (except for VI risk in the immediate vicinity of the Chlorine Plant area, as discussed below). The groundwater remediation levels in Table 2 apply at shoreline monitoring wells[11], located upgradient of the respective conditional points of compliance for the Law-1 and Caustic Plume areas, and may be used during compliance groundwater monitoring for the cleanup action. Derivation of the listed 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).

The shoreline conditional points of compliance would not apply to groundwater cleanup levels that are based on VI risk[12], which are applicable wherever occupied buildings may be located in the future (i.e., standard point of compliance is assumed). With respect to VI risk, the FS estimated a restoration time frame of approximately 34 years for naphthalene in the Million Gallon Tanks area. The corresponding restoration time frame for mercury VI within the Chlorine Plant area was not evaluated. However, it is inferred to be significantly less than 74 years, because the cleanup level for VI protection is more than an order of magnitude higher (less stringent) than the cleanup level for marine protection, and the selected cleanup action will treat elemental mercury within the Chlorine Plant area to greatly reduce its volatilization and thus VI potential. Therefore, 34 years is likely a reasonable estimate for MNA to achieve groundwater cleanup levels (addressing all exposure pathways) throughout the RAU under the selected cleanup action.

A Groundwater MNA Compliance Monitoring Plan (Plan) will be developed and implemented to evaluate the performance of the groundwater MNA remedy. The Plan will present the locations of monitoring wells, monitoring frequency, location-specific monitoring analytes, and analytical methods.

6 Applicable State and Federal Laws

Cleanup standards established for the Chlor-Alkali RAU incorporate applicable state and federal laws and regulations in the form of chemical-specific regulatory criteria for soil

[11] Refer to Sections 4.6.3.2 and 4.7.2.2 of the FS for derivation of groundwater mercury remediation levels for the Law-1 and Caustic Plume areas, respectively.
[12] That is, mercury in the immediate vicinity of the Chlorine Plant area and naphthalene in the immediate vicinity and downgradient of the Million Gallon Tanks area.

and groundwater as described in the FS. In addition, there may be location- and action-specific requirements for completing a cleanup action.

In accordance with MTCA, the Port would be exempt from the procedural requirements of RCW Chapters 70A.15, 70A.205, 70A.300, 77.55, 90.48, and 90.58, and of any laws requiring or authorizing state or local government permits or approvals. However, the Port must still comply with the substantive requirements of such permits or approvals (WAC 173-340-520). The cleanup action must also comply with any applicable federal regulations and obtain any required federal permits.

7 Cleanup Implementation Schedule

The Third Amendment to the Order contains a Schedule of Deliverables for conducting pre-remedial design investigation[13] (PRDI) and for preparing and submitting documents necessary to complete design and permitting of the cleanup action.

At this time, the schedule of deliverables anticipates two pre-remedial design investigations—one for field-scale pilot testing of the ISS elemental mercury cleanup element, and a second for bench-scale testing of the *in situ* groundwater neutralization component of the cleanup. Using that information, an Engineering Design Report would be prepared for the entire cleanup action. However, it is anticipated that the cleanup action will be implemented as four cleanup construction projects given the unique technical requirements for the various cleanup elements. This will allow the Port to tailor project-specific supplemental bidder responsibility criteria to ensure that the best-qualified and most cost-effect contractor is selected to complete each project. The anticipated four cleanup construction projects are:

- Project A: Soil removal from Wastewater Settling Basin, and Consolidation/capping of Stormwater Swale soils
- Project B: *In situ* neutralization of Caustic Core groundwater
- Project C: TPH soil removal from the southeast corner of the Cell Building, and ISS of elemental Hg in Chlorine Plant Area
- Project D: Capping following completion of other cleanup elements.

Accordingly, the Schedule of Deliverables for remedial design includes preparation of construction plans and specifications (CPS) for each of the four construction projects. Construction would proceed for each project upon finalization of its CPS.

This division of the cleanup action into individual construction projects may be further adjusted as agreed to by Ecology and the Port as the project progresses in concert with future land use planning. Any schedule changes agreed to by Ecology and the Port would be formally documented in writing, pursuant to the terms of the current Order's or future amended Order's or Consent Decree's Extension of Schedule sections.

[13] Pre-remedial design investigation will likely include: a) field demonstration of pile removal and ISS of soil containing visible elemental mercury; and b) column testing of groundwater neutralization.

Following completion of the remedial design activities under the Order, a Consent Decree between the Port and Ecology will be prepared for construction of the cleanup action and post-construction activities. Groundwater MNA compliance monitoring and cap inspection and maintenance activities will continue until respective cleanup levels are achieved throughout the Site.

8 References

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Table 1. Soil Cleanup and Remediation Levels

Chlor-Alkali RAU Cleanup Action Plan, GP West Site

Constituent of Concern	Soil Cleanup Level[1] (mg/kg) Unsaturated Soil	Soil Cleanup Level[1] (mg/kg) Saturated Soil	Soil Remediation Level (mg/kg)
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[3]	1	
Chromium (Total)	5,200	260	
Copper	36	36	
Lead	250	81	
Mercury	24[4]	24[4]	300[5] visible elemental mercury[6]
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)[7]	0.19	0.19	
Conventionals			
pH (in Standard pH Units)[8]	>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. Revised post-2013 based on revised groundwater cleanup level (see Table 2).
4. 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.
5. 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).
6. Visible elemental mercury is the remediation level for soils to be treated by *in situ* stabilization/solidification.
7. Child direct contact value from Jan. 2020 revision to Ecology's CLARC, which is determined to be protective of the corresponding groundwater cleanup level (Table 2). The Total cPAHs (TEQ) is calculated from the concentrations of seven cPAHs using the toxicity equivalency factor method described in WAC 173-340-708(e).
8. 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

Chlor-Alkali RAU Cleanup Action Plan, 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[(8)]
Total cPAHs (TEQ)[(9)]	0.02	
Conventionals		
pH (in Standard pH Units)[(10)]	>6.2 and <8.5	<10[(11)]

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, 2020).
3. Based on protection of aquatic life, based on the marine toxicity of weathered diesel (Ecology Implementation Memo No. 23; Ecology, 2020).
4. Based on natural background groundwater quality (Ecology, 2016b).
5. Based on protection of aquatic life (Ecology, 2016a).
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 the listed 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. A mercury concentration of 0.89 µg/L is protective of the vapor intrusion exposure (VI) pathway, which may be a remediation level when assessing need to mitigate VI risks remaining in the Chlorine Plant Area following treatment (refer to Section 4.1 Institutional Controls).
8. Protective of the VI exposure pathway.
9. Total cPAHs (TEQ) is calculated using the toxicity equivalency factor method described in WAC 173-340-708(e). The groundwater cleanup level for Total cPAHs (TEQ) is the practical quantitation limit (PQL), in accordance with MTCA.
10. The pH cleanup level and remediation level are met when the measured pH is within the listed range.
11. The "Caustic Core" is defined as the area where Fill Unit groundwater has a pH greater than 10, which will be actively treated.

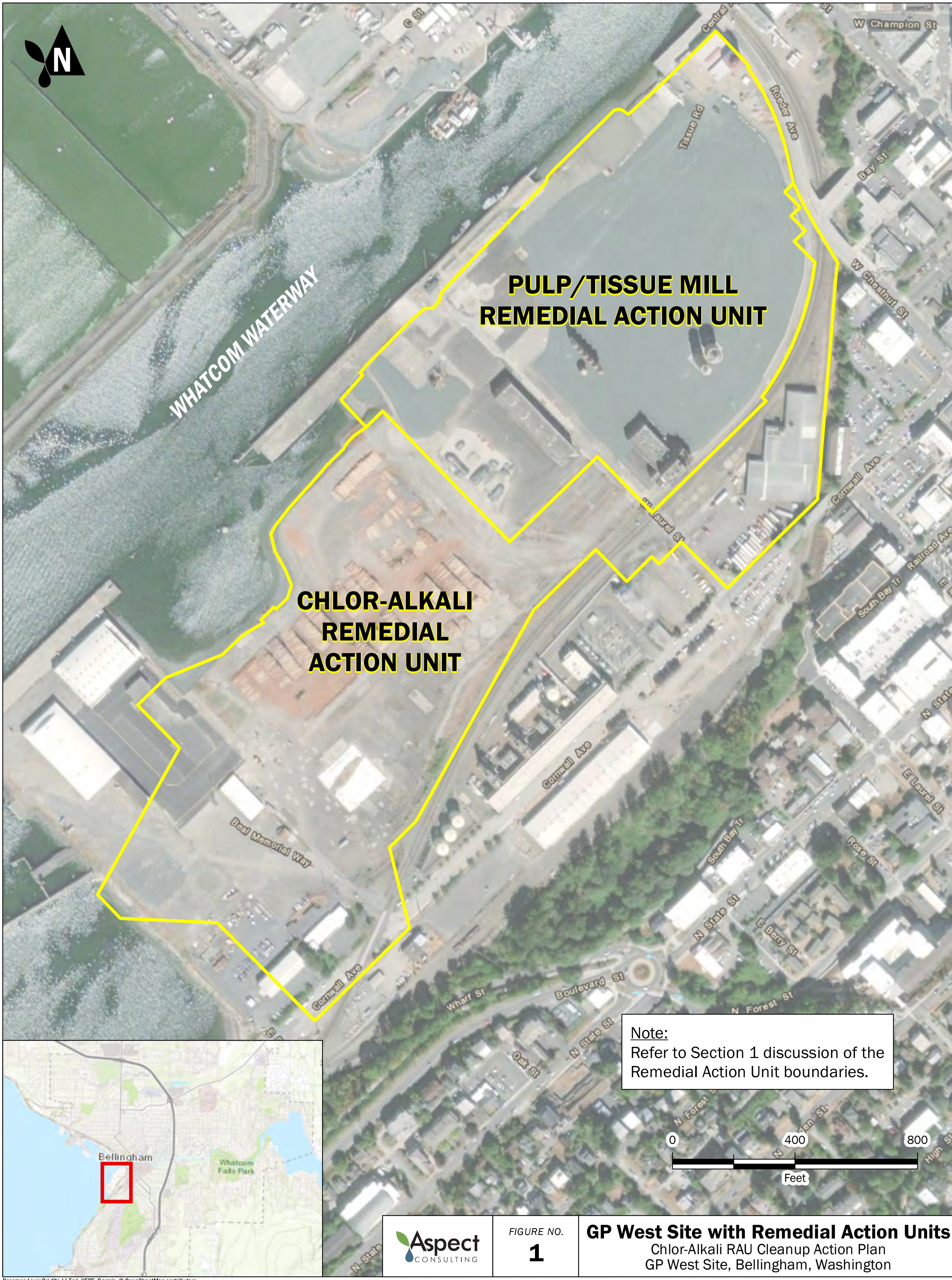

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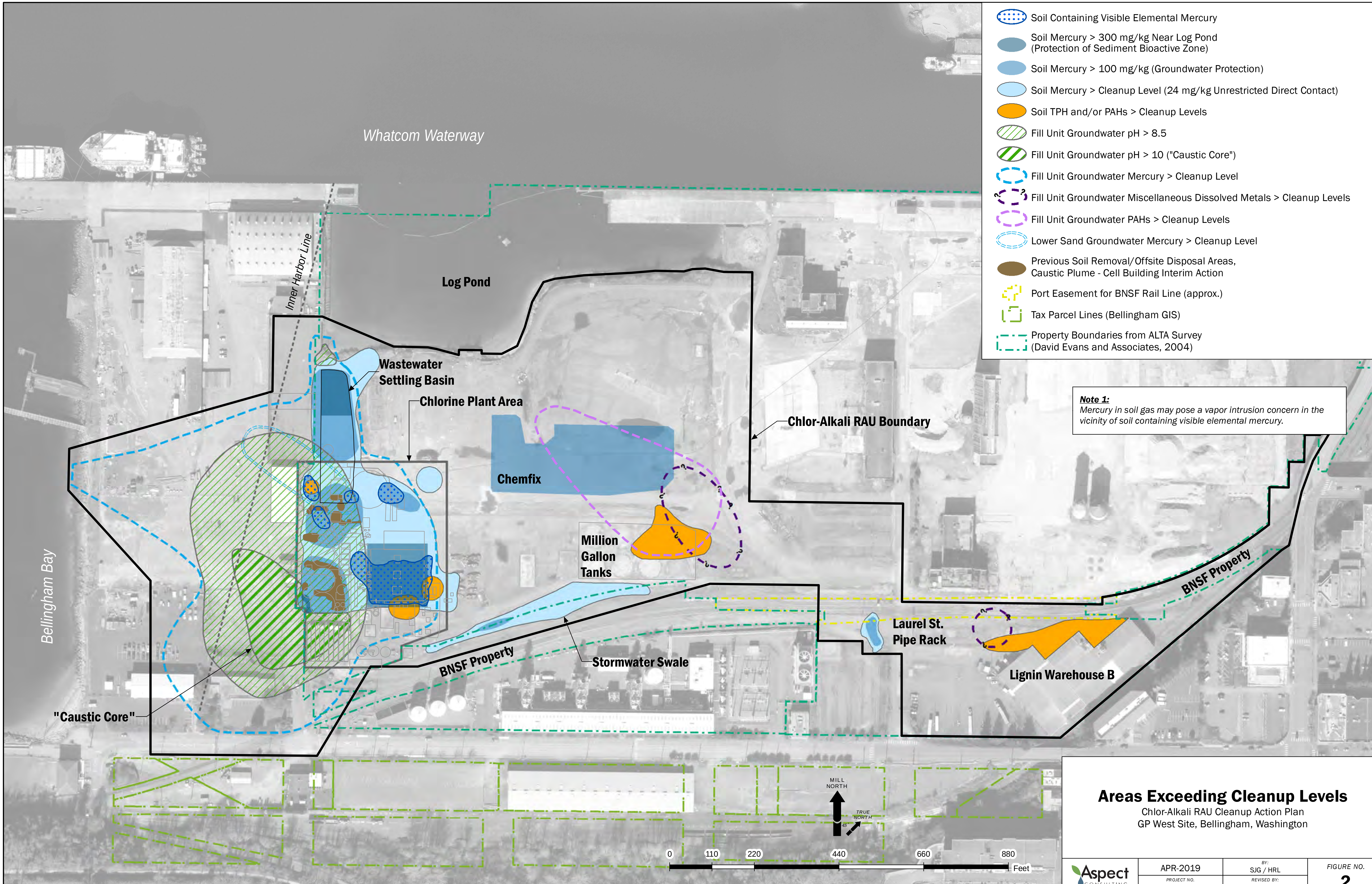
FIGURE NO. 1

GP West Site with Remedial Action Units
Chlor-Alkali RAU Cleanup Action Plan
GP West Site, Bellingham, Washington

GIS Path: T:\projects_8\Port_of_Bellingham\Delivered\Chlor-Alkali RAU Cleanup Action Plan\1 GP West Site with Remedial Action Units.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 4/1/2019 || User: ecrumbaker || Print Date: 4/1/2019

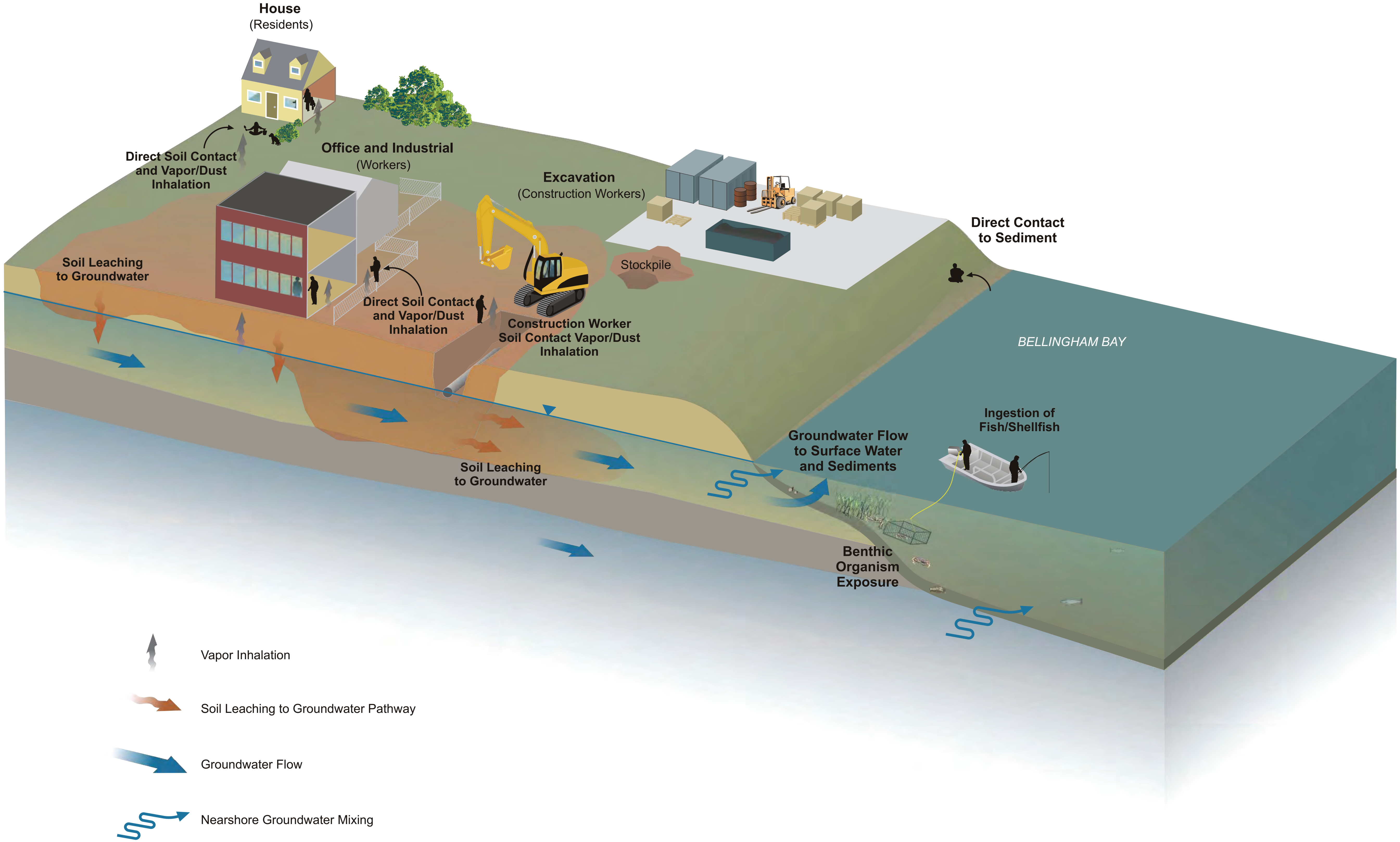
Basemap Layer Credits | | Esri, HERE, Garmin, © OpenStreetMap contributors
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap



Areas Exceeding Cleanup Levels

Chlor-Alkali RAU Cleanup Action Plan
GP West Site, Bellingham, Washington

Aspect CONSULTING	APR-2019 / PROJECT NO. 070188	BY: SJG / HRL / REVISED BY: DAH / RAP / EAC	FIGURE NO. 2

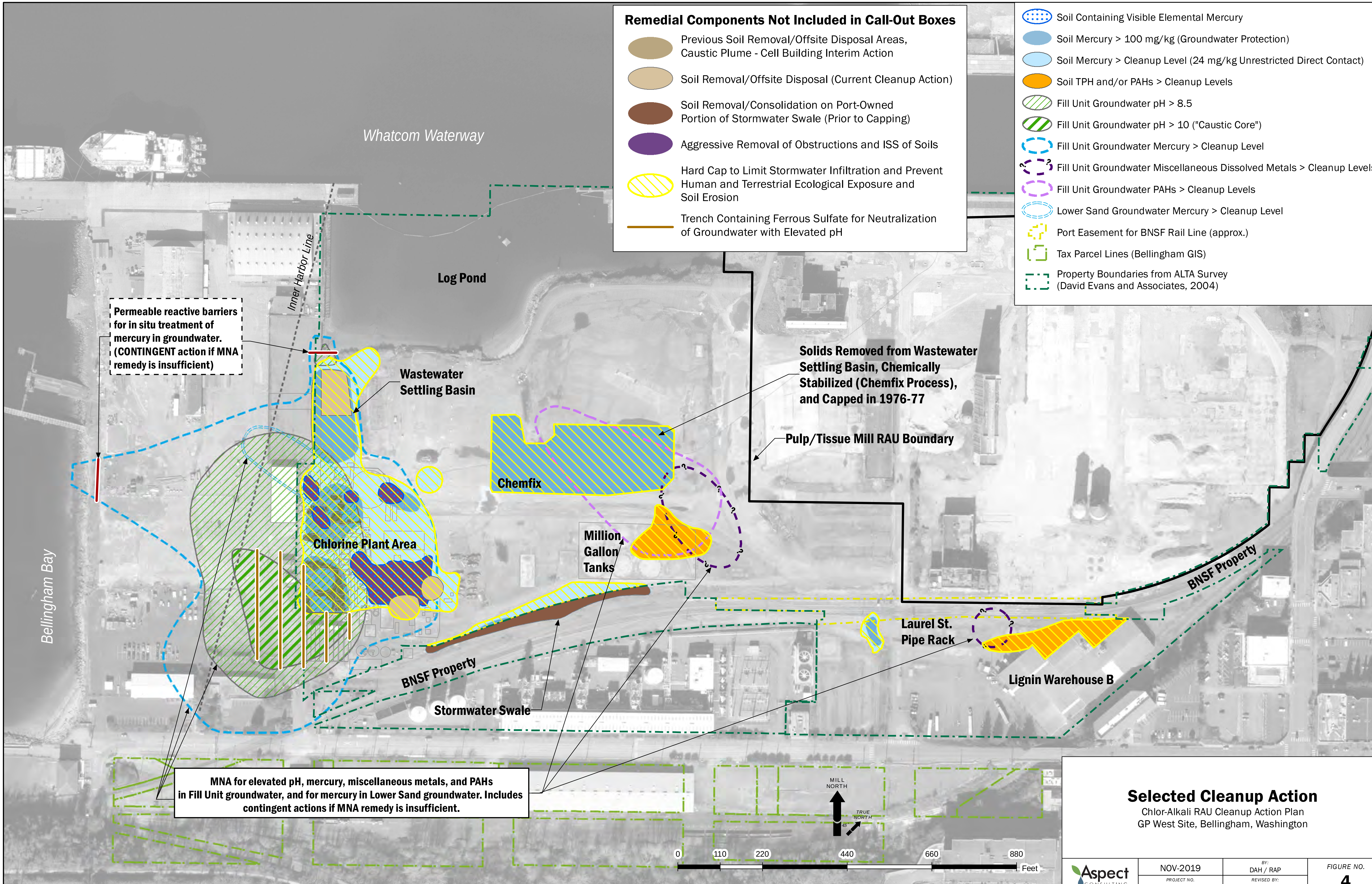


Conceptual Site Model for Potential Contaminant Exposures

Chlor-Alkali RAU Cleanup Action Plan
GP West Site, Bellingham, Washington

Aspect CONSULTING	NOV-2019	BY: SJG / EG	FIGURE NO. 3
	PROJECT NO. 070188	REVISED BY: - - -	

GIS Path: T:\projects_8\Port_of_Bellingham\Delivered\Chlor-Alkali RAU Cleanup Action Plan\3 Conceptual Site Model.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 11/20/2019 || User: ecrumbaker || Print Date: 11/20/2019



Remedial Components Not Included in Call-Out Boxes
Previous Soil Removal/Offsite Disposal Areas, Caustic Plume - Cell Building Interim Action
Soil Removal/Offsite Disposal (Current Cleanup Action)
Soil Removal/Consolidation on Port-Owned Portion of Stormwater Swale (Prior to Capping)
Aggressive Removal of Obstructions and ISS of Soils
Hard Cap to Limit Stormwater Infiltration and Prevent Human and Terrestrial Ecological Exposure and Soil Erosion
Trench Containing Ferrous Sulfate for Neutralization of Groundwater with Elevated pH
Soil Containing Visible Elemental Mercury
Soil Mercury > 100 mg/kg (Groundwater Protection)
Soil Mercury > Cleanup Level (24 mg/kg Unrestricted Direct Contact)
Soil TPH and/or PAHs > Cleanup Levels
Fill Unit Groundwater pH > 8.5
Fill Unit Groundwater pH > 10 ("Caustic Core")
Fill Unit Groundwater Mercury > Cleanup Level
Fill Unit Groundwater Miscellaneous Dissolved Metals > Cleanup Levels
Fill Unit Groundwater PAHs > Cleanup Levels
Lower Sand Groundwater Mercury > Cleanup Level
Port Easement for BNSF Rail Line (approx.)
Tax Parcel Lines (Bellingham GIS)
Property Boundaries from ALTA Survey (David Evans and Associates, 2004)
Whatcom Waterway
Log Pond
Inner Harbor Line
Bellingham Bay
Permeable reactive barriers for in situ treatment of mercury in groundwater. (CONTINGENT action if MNA remedy is insufficient)
Wastewater Settling Basin
Chemfix
Chlorine Plant Area
Million Gallon Tanks
Solids Removed from Wastewater Settling Basin, Chemically Stabilized (Chemfix Process), and Capped in 1976-77
Pulp/Tissue Mill RAU Boundary
BNSF Property
Stormwater Swale
Laurel St. Pipe Rack
Lignin Warehouse B
BNSF Property
MNA for elevated pH, mercury, miscellaneous metals, and PAHs in Fill Unit groundwater, and for mercury in Lower Sand groundwater. Includes contingent actions if MNA remedy is insufficient.
MILL NORTH
TRUE NORTH
0 110 220 440 660 880
Feet
Selected Cleanup Action
Chlor-Alkali RAU Cleanup Action Plan
GP West Site, Bellingham, Washington
Aspect CONSULTING
NOV-2019
PROJECT NO. 070188
BY: DAH / RAP
REVISED BY: SCC / EAC
FIGURE NO. 4
Path: T:\projects_8\Port_of_Bellingham\Delivered\Chlor-Alkali RAU Cleanup Action Plan\4 Selected Cleanup Action.mxd