Draft Final Cleanup Action Plan

BURLINGTON WASHOUGAL SITE
632 South 32nd Street
WASHOUGAL, WASHINGTON

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ACRONYMS AND ABBREVIATIONS

AO....Agreed Order
ARAR....Applicable or relevant and appropriate requirements
bgs....Below ground surface
BTEX....Benzene, toluene, ethylbenzene, and xylenes
CDF....Controlled Density Fill
CFR....Code of Federal Regulation
CLARC....Cleanup Levels and Risk Calculation
COC....Constituent of concern
CPOC....Conditional point of compliant
CSM....Conceptual site model
CUL....Cleanup level
dCAP....Draft Cleanup Action Plan
DOF....Dalton, Olmsted, and Fuglevand
DSM....Deep Soil Mixing
Ecology....Washington State Department of Ecology
EDR....Engineering Design Report
EPA....U.S. Environmental Protection Agency
ERH....Electric Resistance Heating
EVO....Emulsified Vegetable Oil
FS....Feasibility Study
HSWA....Hazardous and Solid Waste Amendments
IC....Institutional control
IPIM....Inhalation Pathway Interim Measure
ISB....In-Situ Bioremediation
ISCO....In-Situ Chemical Oxidation
µg/L....Micrograms per liter
MA....Monitored Attenuation
MFR....Modified Fenton's Reagent
mg/L....Milligrams per liter
MNA....Monitored Natural Attenuation
MTCA....Model Toxics Control Act
NTR....National Toxics Rule
PCB....Polychlorinated Biphenyls
PCE....Tetrachloroethene
POC....Point of compliance
PQL....Practical quantitation limit
RCRA....Resource Conservation and Recovery Act
RI....Remedial investigation
Site....Burlington Environmental Washougal Facility
SPOC....Standard point of compliance
SWMU....Solid Waste Management Unit
1,1,1-TCA....1,1,1-Trichloroethane

TCE……………………………………………………………………………………………………..Trichloroethene
VC……..Vinyl chloride
VOC .... Volatile organic compound
WAC .... Washington Administrative Code
ZVI……………………………………………………………………………………………...………Zero Valent Iron

1.0 Introduction

This draft Cleanup Action Plan (dCAP) describes the cleanup action selected by the Washington State Department of Ecology (Ecology) for the Burlington Environmental, LLC Washougal site (Site) located at 632 South 32nd Street in Washougal, Washington (the Facility or Site) (Figure 1). A CAP is required as part of the site cleanup process under Chapter 173-340 of the Washington Administrative Code (WAC), Model Toxics Control Act (MTCA) Cleanup Regulations.

The facility has a Resource Conservation and Recovery Act (RCRA) (Code of Federal Regulations [CFR] Title 40 Parts 260-299) dangerous waste management facility permit (RCRA Part B Permit WADO92300250). One of the major provisions of the Hazardous and Solid Waste Amendments (HSWA) to RCRA [Section 3004(u)] requires corrective action for releases of hazardous waste or hazardous constituents from Solid Waste Management Units (SWMUs) at hazardous waste treatment, storage, or disposal facilities (TSDFs). Under Section 3004(u), a facility applying for a RCRA hazardous waste management facility permit is subject to the corrective action process. The specific requirements relating to corrective action at the facility are outlined in Part VII of the facility's RCRA Part B permit, revised in September 1999. The Washington State Department of Ecology (Ecology) has been authorized by the U.S. Environmental Protection Agency (EPA) to implement corrective action under the MTCA regulations. The RCRA operating permit was closed in 2000 and since then the property has operated as a transfer facility for hazardous waste only. As a transfer facility, hazardous waste shipments can be held at the property for no more than 10 days. The corrective actions provisions of the RCRA permit are being completed under the direction of Ecology using the Agreed Order.

This dCAP was developed using information presented in the approved Remedial Investigation (RI)/Feasibility Study (FS) for the Site, which was finalized by Dalton, Olmsted, and Fuglevand (DOF) in 2022 (DOF, 2022) on behalf of Burlington Environmental, LLC (referred to as Burlington in this document) in accordance with their RCRA Part B permit No. WADO92300250, which references the Agreed Order (AO) with Ecology Number DE4308. This dCAP was prepared consistent with requirements of the RCRA Permit, the AO, as well as the MTCA Cleanup Regulations.

The purpose of the dCAP is to identify the proposed cleanup action for the Site and to provide an explanatory document for public review. More specifically, this plan:

- Describes the Site;
- Summarizes current Site conditions;
- Summarizes the cleanup action alternatives considered in the remedy selection process;
- Describes the selected cleanup action for the Site and the rational for selecting this alternative;
- Identifies Site-specific cleanup levels (CULs) and points of compliance for each hazardous substance and medium of concern for the proposed cleanup action;
- Identifies applicable state and federal laws for the proposed cleanup action;
- Identifies residual contamination remaining on the Site after cleanup and restrictions on future uses and activities at the Site to ensure continued protection of human health and the environment;
- Discusses compliance monitoring requirements; and
- Presents the schedule for implementing the dCAP.

Ecology has made a preliminary determination that a cleanup conducted in conformance with this CAP will comply with the requirements for selection of a remedy under WAC 173-340-360.

1.1 Previous Studies

The EPA completed a RCRA facility assessment (RFA) in 1988 to identify those areas at the facility where release(s) of hazardous substances may have occurred. In 1991, former owner Chempro submitted a Phase I RCRA Facility Investigation Report to EPA that confirmed the presence of contaminants in soil and groundwater at the facility. Between 1995 and 1997 Burlington conducted an interim action, including removal of concrete containment areas, tanks, and excavation of underlying soil. Burlington conducted additional studies in cooperation with Ecology and ultimately submitted a Final RI Report in 2013 and a Revised FS in 2020 that were approved by Ecology in 2022 after public review.

Previous studies found the primary contaminant source areas at the Site were previously remediated as part of interim actions. The main source area contributing to groundwater impacts is the former tank farm area (Figure 2). This was an area of known releases of chlorinated solvents to the subsurface and has been the focus of considerable investigation and a major soil excavation interim action in 1997.

Data from groundwater directly above, in, and below the Silt Layer at the Site indicate that the Silt Layer beneath the former tank farm is serving as an ongoing secondary source of constituents of concern (COCs) to groundwater.

The selected cleanup alternative for the Site addresses remaining contamination at the Site.

2.0 Site Description and Background

The Burlington property is located at 632 South 32nd Street, Washougal, Clark County, Washington, near the Columbia River (Figure 1). The 5.2-acre property is situated within a diked portion of the Columbia River floodplain in the Camas/Washougal Industrial Park. Prior to development of the industrial park, the area was part of low marshlands in the Columbia River floodplain.

The Burlington property is zoned for industrial land use and is expected to continue to be used for either industrial or commercial use in the foreseeable future; however, the Burlington property is bordered to the east by Stiegerwald Lake National Wildlife Refuge (Figure 3). Land use in the vicinity of the Burlington property is also industrial, with the exception of Steigerwald Marsh to the east (Figure 3).

2.1 Site History

The property sits inside an industrial park developed by the Port of Camas-Washougal. The Port of Camas-Washougal was founded in 1935. The 300-acre industrial park was established in 1966 when the U.S. Army Corps of Engineers created a 5.5-mile levee along the Columbia River, west of the Steigerwald Marsh (https://portcw.com). The property has been used for industrial operations since at least 1978. Operations have included activities related to the paper industry, as well as waste oil and solvent recovery, drum storage, and oil storage and blending. A detailed operational history of the property was presented in the RI.

Mr. Jack McClary operated the McClary Columbia Corporation at the site beginning in 1978. McClary began operations as a maker of phenolic resins for the wood products industry. In 1979, McClary added manufacturing of defoamers and water treatment chemicals for the paper industry to the operations. Commercial recovery of waste oil for use as boiler fuel began in late 1979, and in 1980 the facility began recycling waste solvents. In 1981, the former resin plant was converted to a waste solvent recovery plant. Several buildings were built in the 1980s for drum storage.

In early 1983, former employees of McClary made allegations of illegal discharges of product and waste to the environment. The allegations included pumping of the rainwater/runoff collection sumps and trenches to the ground surface prior to testing for contaminants, dumping of phenolic and solvent resins, and burying formaldehyde resins. These allegations led to requirements for environmental investigation at the facility.

In 1986, tanks were installed for petroleum oil storage and blending. The waste solvent recycling plant and tank farm included tanks for product storage, waste oil storage, and waste solvent storage and processing. The contents stored in the tanks included industrial defoamers, detergents, and a variety of recycled solvents, including mineral spirits, acetone, toluene, isopropyl alcohol, methanol, Freon, methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA). The tank farm was dismantled in 1995.

In August 1999, the fieldwork necessary to close the RCRA Part B operating permit and polychlorinated biphenyls (PCB) permit was completed. The Closure Reports were submitted to Ecology in 1999 and approved in 2000. In 2000, Ecology accepted closure of dangerous waste management units permitted at the Facility and stated Burlington had satisfied the certification of closure requirements in accordance with WAC 173-303-610(6). The RCRA Facility Part B Dangerous Waste Management Permit expired in 2002. Burlington submitted a permit renewal application prior to its expiration to complete corrective action at the Facility. This resulted in the updated Dangerous Waste Management Permit for Corrective Action and associated AO.

The Burlington property currently operates as a hazardous waste transfer facility. Figure 2 shows the current layout of operations. A small portion of the south end of the property is leased for use as a vehicle driveway. Approximately 50% of the Burlington property is an unpaved open gravel area and is not used for Facility operations (Figure 2). The property currently houses five existing buildings, one of which is a temporary office trailer (not slab on grade) constructed in 2006. Land use in the vicinity of the Site is industrial, with the exception of the Steigerwald Marsh, which is part of the Stiegerwald Lake National Wildlife Refuge to the east (downgradient) of the Burlington property.

2.2 Site Geology and Hydrogeology

The Site is located within a diked portion of the Columbia River floodplain at an elevation of approximately 20 feet above mean sea level. The immediate area has little topographic relief but slopes gently downward toward the Steigerwald Marsh complex. The immediate area was constructed by the U.S. Army Corps of Engineers by building up dredge sands on top of native marshy silts in the floodplain surrounding Steigerwald Marsh to elevate the land for development. Surface water bodies nearest the Site are the Steigerwald Marsh complex to the east and the Gibbons Creek remnant channel to the north (Figure 3). The Columbia River flows generally east to west approximately 0.4 mile south-southwest of the Site.

The near-surface geology at the Site is characterized by the following four lithologic units listed in order of increasing depth (Figure 4):

- Sand Fill – The uppermost stratum consists of poorly graded, fine- to coarse-grained sands, with occasional fine gravel that were dredged from the Columbia River and emplaced hydraulically over Columbia River floodplain silts. The Sand Fill extends vertically from the ground surface to as much as 12 feet below ground surface (bgs) and is present across the entire area of the Burlington property.
- Silt Layer – The Silt Layer consists of native floodplain and marsh deposits that were present at the location of the Burlington property and the rest of the Industrial Park prior to site development, which entailed the emplacement of hydraulic dredge fill (the Sand Fill). The Silt Layer consists of dark greenish-grey to black, well-sorted silt and clay, with some sand. The upper surface of the Silt Layer ranges from approximately 3.5 to 12.0 feet bgs and the Silt Layer appears to be continuous in the industrial park. The thickness of the Silt Layer at the Site ranges from approximately 5 feet to 20 feet.
- Gravel – Poorly graded, fine to coarse gravel intermixed with silt and sand (silt decreasing with depth) underlie the Silt Layer. Large gravel and boulders are present within this unit. The upper surface of the Gravel Unit lies at depths of between approximately 14 and 22 feet bgs, and the thickness of this layer has been ranged from 0.5 foot to 24 feet.
- Deeper Silty Sand: Moderately sorted, fine to coarse sand and silt underlie the gravel deposits. The top of the Deeper Silty Sand unit was encountered at depths of between 24 and 36 feet bgs.

Three primary hydrogeologic units have been delineated beneath the Site based on analysis of the geologic and hydrogeologic data collected during previous investigations:

- Sand Fill Shallow Groundwater Zone: This unit includes portions of both the Sand Fill and the underlying Silt Layer. Depth to water ranges from approximately 4 to 6 feet bgs in the dry season to approximately 1 to 4 feet bgs in the wet season. Groundwater within the Shallow Groundwater Zone consistently flows to the east toward Steigerwald Marsh.
- Silt Layer or Upper Confining Unit (Silt Aquitard): The low-permeability Silt Layer underlies the Shallow Groundwater Zone and acts as a confining unit for the Shallow Groundwater Zone above. This layer directly overlies and hydraulically confines the Lower Aquifer. The Upper Confining Unit is laterally continuous, but the thickness of the unit varies across the Site.
- Lower Aquifer: The Lower Aquifer corresponds to the Gravel and Deeper Silty Sand geologic units. Groundwater elevations in the Lower Aquifer are influenced by changes in the tidally influenced surface water stage in the Columbia River, and as a result the flow direction varies greatly and can be to the north/northeast or south/southeast.

The vadose zone exists entirely within the upper Sand Fill Unit. The depth of the vadose zone in the Sand Fill unit varies from 4 to 6 feet bgs during the dry season and from 1 to 4 feet bgs during the wet season. The Silt Layer and the sand/gravel unit are fully saturated and below the water table year-round.

2.2.1 Groundwater Flow

The Hydrogeologic Conceptual Model for the Site places the uppermost groundwater at the Site primarily within the Sand Fill. Shallow Groundwater consistently flows to the east toward Steigerwald Marsh, with downward and upward vertical flow components that vary both spatially and temporally. Near Steigerwald Marsh, the Sand Fill becomes thinner, and the phreatic water table is located within the Silt Layer. This observation suggests that the shallow groundwater within the Sand Fill drains into the Silt Layer at the eastern boundary of the Burlington property and ultimately discharges into the Marsh. Observed horizontal flow gradients suggest that groundwater in the Lower Aquifer generally flows toward the south and east, ultimately discharging to the Columbia River. However, flow direction in the Lower Aquifer can vary significantly based on hydraulic control measures for surface waters in the area, specifically the water elevation in the nearby Columbia River, which varies in response to both seasonal variability in runoff, dam releases, and diurnal tidal cycles.

In general, vertical hydraulic gradients show seasonal variability. Since the water table within the shallow Sand Fill is recharged during the wet winter months, groundwater vertical gradients are primarily downward for most of the Site during the winter and early spring. During the drier months, when the water table in the Sand Fill drops, recharge decreases and the downward vertical gradients tend to weaken or reverse to upward in portions of the Site and/or in especially dry years. The storm sewer utility line located along the west side of South 32nd Street is recognized as a possible preferential groundwater flow pathway that could result in northward contaminant transport.

The observed vertical hydraulic gradients at the Site suggest the Silt Layer acts as a somewhat leaky aquitard. The high organic carbon content in the Silt Layer also adsorbs and retards the migration of organic materials, including many of the COCs at the Site. Decomposition of organic matter in the fill and the Silt Layer produce reducing conditions within the Shallow Groundwater Zone during the drier months.

2.3 Human Health and Environmental Concerns

A conceptual site model (CSM) was prepared as part of the RI/FS based on current and assumed future industrial land use at the Site and continued industrial and commercial land use in the surrounding area (Figure 5).

COCs in groundwater at the Site may migrate and affect groundwater in offsite areas. The anticipated point off-site at which groundwater would be at concentrations below CULs (without treatment) is between 40 and 200 feet away from the Burlington property, well before reaching the Columbia River, based on current concentrations and the extensive monitoring record available for trend analysis at the Site. The CSM recognizes the following complete or potentially complete pathways for human health receptors.

- Office workers, working primarily indoors;
- Industrial workers, working primarily outdoors;
- Temporary workers, working primarily outdoors; and
- Site visitors present at the Burlington property for short durations.

Other future receptor pathways, including well installation for drinking water use and site development for residential use, are considered unlikely since institutional controls will forbid commercial and residential use of the property and forbid the use of groundwater at the Site for drinking water.

Ecological receptors were also considered as part of the RI/FS and screening contaminant levels against criteria protective of those receptors. On the Burlington property itself, soil (where exposed) is considered a potentially complete pathway for small birds, rodents, and rabbits. Concentrations of COCs in soil were compared to MTCA screening levels protective of this exposure pathway. Results showed only barium concentrations in the upper six feet of soil exceeded these screening levels. However, barium concentrations on the Burlington property itself are below state and regional background values.

Based on the CSM the RI/FS defined remedial areas to address complete or potentially complete pathways for Site receptors (see Figure 6).

2.3.1 Soil

The RI and FS identified primary soil COCs including TCE and PCE, and their breakdown component, vinyl chloride (VC); limited areas of benzene, toluene, ethylbenzene, and xylenes (BTEX); and inorganics including arsenic, copper, silver, zinc, and barium. Beyond the former tank farm area, only two other smaller source areas were identified at the Site where soil contamination is the primary concern: the former container storage areas at Building 2 and Building 3, and the area west of the waste oil tank system (see area mapped as capped on Figure 6). Soil immediately underneath Buildings 2 and 3 exceeded the CULs for cyanide, PCE, and TCE, but the absence of exceedances for these COCs in groundwater nearby indicates a limited extent of affected soil.

Most of the soil data at the site are quite old (1985-2011). Recent groundwater data indicate that some COCs have declined over time in groundwater and may similarly have declined in soil, both media that may contribute to concentrations present in soil gas underneath buildings. For remedy design purposes, additional information to inform current concentrations of COCs, particularly volatile organic compounds (VOCs) that have been demonstrated to be naturally degrading at the Site, would be beneficial. To meet this objective, Burlington has agreed to collecting additional soil gas data from beneath Building 1, adjacent to the former tank farm, as part of the Engineering Design Report. Shallow groundwater results from around Building 1 are lower than historical highs detected in this area of the site and should be accounted for as part of remedy design. Soil gas data would aid in evaluation of current risks posed by contaminated soil or groundwater underneath the building.

2.3.2 Groundwater

The RI and FS identified that the primary COCs in groundwater are similar to soil, with the same VOCs consistently present, along with 1,4-dioxane, arsenic, and a few other inorganic COCs. Chlorinated ethenes are the primary VOCs detected above CULs in groundwater.

Current concentrations of COCs in groundwater are typically in the low parts per billion (ppb) range as illustrated in Figures 7 and 8. Maximum recent concentrations don't exceed 1.5 ppb for PCE, 2.5 ppb for TCE, 400 ppb for VC, 280 ppb for 1,4-dioxane, and 49 ppb for arsenic (Figures 7 and 8). Recent concentrations at most wells are below cleanup levels for many COCs and below 1 ppb for most key COCs, indicating there is not a high concentration source in the subsurface. Residual chlorinated and nonchlorinated organic COCs are present in groundwater and adsorbed in the Silt Layer. These COCs adsorbed to the Silt Layer represent a long-term, low concentration continuing secondary source of COCs to groundwater, but appear to no longer be heavily affecting the Shallow Groundwater Zone.

Biodegradation appears to be a very important process affecting the fate and transport of chlorinated organic compounds in groundwater at the Site. Levels of dissolved oxygen in groundwater at the Site are likely suppressed by the biological oxygen demand resulting from the naturally occurring organic matter in aquifer materials associated with the current and former wetland environment. Consequently, anaerobic degradation processes, such as fermentation and reductive dechlorination, are likely to be the most important biodegradation processes occurring at the Site. Patterns observed in both contaminant and geochemical data for groundwater at the Site indicate that microbial degradation of contaminants is likely occurring, but COC concentrations have not yet attained cleanup objectives.

Shallow Groundwater

The 1997 former tank farm area soil excavation removed the bulk of the COC mass above the Silt Layer, but presumably left contamination remaining under Building 1. As a result of this interim action along with naturally occurring microbial degradation, groundwater quality in the Shallow Groundwater Zone has improved dramatically, indicating that residual contamination left beneath Building 1 may have attenuated over time. Groundwater monitoring data in shallow wells around Building 1 indicate predominantly decreasing concentration trends.

Seasonal changes in redox conditions affect subsurface geochemistry and lead to seasonal changes in concentrations of inorganic constituents and chlorinated VOCs. In the winter, recharge with oxygenated rainwater changes redox conditions to a more oxidizing state, causing arsenic concentrations to decrease and chlorinated VOC concentrations to increase (see the RI for further details). Thus, arsenic concentrations in groundwater are generally highest during the summer period when groundwater levels are lowest, dissolved oxygen concentration in groundwater is lowest, and reducing conditions are present within the organic-rich Silt Layer. Conversely arsenic concentrations throughout the Site are generally lowest in the winter months when water levels are highest and fresh rainwater is oxygenating the Shallow Groundwater

Zone. At the same time, chlorinated VOC concentrations increase during winter months when rates of reductive dechlorination are lowest.

VOCs concentrations are generally below CULs or are at low concentrations and trending down, with data indicating ongoing natural attenuation. VC is the main VOC of concern with the highest recent concentration detected at well MC-14 (approximately 0.9 micrograms per liter (µg/L)) (Figure 7).

1,4-dioxane concentrations are highest at well MC-14 (approximately 320 µg/L), and concentrations downgradient of this area (MC-20, MC-123) have declined to levels near or below the CUL (Figure 7). The source appears to be primarily present in the shallow sand fill unit, not in the Silt Layer. Higher concentration wells show concentrations in the Shallow Groundwater Zone go up when the water table is highest, during periods when more of the sandy unit above the Silt Layer is saturated, making it more readily accessible for treatment.

Arsenic concentrations are generally below the CUL, with the highest concentrations at MC-14 and MC-31 and strong seasonal variation. Anaerobic conditions likely existed in the former marsh prior to industrial activities owing to the high organic content of native sediments. Aerobic microbial breakdown of the released organic constituents further depleted the groundwater of dissolved oxygen. The organic Silt Layer is likely to still be creating reducing conditions in groundwater with the strongest reducing conditions occurring during the drier summer season, as is evidenced by the low dissolved oxygen content in wells and correlating higher arsenic levels that do not appear to be related to a release from Facility operations.

Lower Aquifer

The highest concentrations of VOCs are detected at wells in the former tank farm area. Trends in concentrations of chlorinated ethenes over time indicate that the Silt Layer is retaining contamination that continues to leach to groundwater in the shallower portions of the Lower Aquifer. Lower aquifer wells screened immediately below the Silt Layer have higher concentrations than wells screened deeper, indicating the silt is acting as a probable secondary source of COCs.

Additional areas where VOCs have recently been detected above CULs are located along the northern property line, near MC-118D, and southeast of the former tank farm, near well MC-15D (Figure 6). However, the concentrations in these areas are at least an order of magnitude lower than those in the former tank farm area. Shallow wells in these areas do not show elevated concentrations, indicating the source is upgradient.

1,4-dioxane concentrations detected in the Lower Aquifer are much lower than in the Shallow Groundwater Zone, with the highest concentrations (approximately 5 to 15 µg/L) detected in the former tank farm area and along the northern property line (near MC-118D).

3.0 Cleanup Standards

Establishment of cleanup standards requires specification of the CULs (chemical concentrations that are protective of human health and the environment) for each COC in each impacted media and the location on the Site where the CULs must be attained, i.e., the point of compliance (POC). CULs for this dCAP were based on those previously established in the FS.CULs were developed for all COCs identified in the RI report, which used conservative statistical methods to establish a comprehensive list of COCs to evaluate in the RI and FS. The RI described that, in practical terms, the methods used to identify COCs meant if a constituent was ever detected at a concentration above a screening level it was included as a COC.

3.1 Soil Cleanup Levels

The Burlington property is located in an area zoned for heavy industrial use; therefore, MTCA Method C soil CULs are appropriate for use at the Burlington property. In addition, the property meets criteria established in WAC 173-340-200 and 173-340-745 for a site to be defined as an industrial property, as described in the RI. However, portions of the Site that are east of the property, outside the industrial park, do not meet this definition since a national wildlife refuge exists in this area. Areas of the Site outside the industrial park required development of more stringent CULs, which apply in these areas. MTCA Method C industrial soil CULs are based on adult occupational exposures and assume that current and future land use will be restricted to industrial purposes.

CULs for soil on the property are selected by choosing the minimum of the following MTCA CULs:

- MTCA Method C - Industrial CUL based on direct contact/ingestion;
- For those constituents with no available Method C CULs, MTCA Method A Industrial Soil CULs (MTCA Table 745-1);
- Soil CULs protective of the preliminary groundwater CULs described in Section 3.2 [WAC 173-340-747(4)];
- EPA Regional Screening Levels (RSLs); and
- Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals (MTCA Table 749-3).

Additionally, areas outside the Industrial Park (east of the property boundary on 32nd Street adjacent to the Steigerwald Marsh) were considered with regard to MTCA Method A and B – Unrestricted Cleanup Levels and residential EPA Regional Screening Levels, based on direct contact/ingestion. After selecting the minimum value from the levels described above, the cleanup levels were established.

For some constituents, the cleanup levels were revised upward when compared to natural background levels and PQLs in accordance with the MTCA regulations [WAC 173-340-709 and WAC 173-340-705(6)]. Natural background levels for metals were defined by Ecology (1994) for the Clark County area. Cleanup levels that were below the defined Clark County natural background levels were adjusted up to the applicable natural background level in accordance with the limitations set forth in WAC 173-340-706(6).

The soil CULs are presented in Table 1. These values includes modifications made to CULs to update them in 2025 and as discussed below in Section 3.4.

3.2 Groundwater Cleanup Levels

Groundwater CULs are based on analysis of groundwater use and the MTCA methodology for establishing CULs. For groundwater in the Shallow Groundwater Zone (above or in the Silt Layer) as well as for groundwater in the Lower Aquifer (in or below the Silt Layer), the preliminary CUL for each constituent of concern is a MTCA Method B CUL selected by choosing the minimum of the following:

- **MTCA Groundwater Table Values (Ecology, 2025)**
  - MTCA Method A levels for constituents that do not have a Method B level available;
  - MTCA standard Method B levels based on drinking water beneficial use, which include Federal Maximum Contaminant Levels (MCLs);
- **Surface Water ARARs**

  Several surface water criteria have changed since the RI and draft FS due to updates in the Environmental Protection Agency's (EPA's) National Recommended Water Quality Criteria (304[a]), Ecology's Water Quality Standards (WAC 173-201A), and the EPA's "Revision of Certain Federal Water Quality Criteria Applicable to Washington" (40 CFR 131.45; formerly the Washington criteria were in 40 CFR 131.36, referred to as the National Toxics Rule, or NTR). Values were updated in 2025 to reflect recent ARARs.

  - Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A) – Acute and Chronic effects, Aquatic Life, Human Health (water and organism), Human Health (organism only), Freshwater;
  - National Recommended Water Quality Criteria (NRWQC) (Clean Water Act §304) – Freshwater, Acute and Chronic effects, Aquatic Life and for the Protection of Human Health;
  - National Toxics Rule (40 CFR 131) – Freshwater, Human Health, Consumption of Water and Organisms;
- **MTCA Surface Water Table Values (from Ecology)**
  - MTCA Method B Surface Water levels from Ecology's Cleanup Levels and Risk Calculation (CLARC) tables if a federal or local surface water value is not found in the above references (Ecology, 2025); and
- **Values Protective of Indoor Air**
  - For the Shallow Groundwater Zone only, MTCA Method B groundwater CULs protective of vapor intrusion, obtained from CLARC (Ecology, 2025).

The determined values were compared to the laboratory screening levels and were adjusted upward in accordance with WAC 173-340-707 if they were below the PQL.

Both area and natural background were considered in developing CULs for arsenic. Background values were calculated using upgradient Site data outside of contaminated source areas and found to be consistent with Ecology studies that have also found elevated arsenic concentrations present in Clark County. These calculated values are 22.84 µg/L for the Shallow Groundwater Zone and 1.42 µg/L for the Lower Aquifer. Consistent with WAC 173-340-706(1)(a)(i) the CULs for arsenic were set to the MTCA C values because the calculated background values were greater than the MTCA C values.

The groundwater CULs are presented in Table 2.

3.3 Point of Compliance

As defined in the MTCA regulations, the POC is the point or points at which CULs must be attained and may be a standard POC (SPOC) or a conditional POC (CPOC). The SPOC applies to all soil, groundwater, air, or surface water at or adjacent to any location where releases of hazardous substances have occurred or that has been impacted by releases from the location. A CPOC is usually defined only for groundwater, air, or surface water. A CPOC typically applies to a specific location as near as possible to the source of the release. Several requirements are specified in the MTCA regulations for establishing a CPOC, as discussed in more detail below. The most important criterion for approval of a CPOC is the practicality of attaining CULs within a reasonable time frame throughout the plume.

Affected media at the Washougal facility include soil and groundwater. POCs for soil and groundwater are established separately and may be different due to different regulatory requirements and potential exposure pathways associated with the two media.

3.3.1 Soil Point of Compliance

The regulatory requirements for the soil POC are presented in the MTCA regulations, WAC 173-340-740(6). The requirements for the soil POC depend on the relevant exposure pathway. Therefore, MTCA may require different soil POCs for different COCs. The requirements specified by MTCA are as follows.

- For soil COCs whose CUL is based on protection of groundwater, the POC shall be in soils throughout the Site.
- For soil COCs whose CUL is based on the vapor/inhalation pathway, the POC must be the soils throughout the Site (from the ground surface to the uppermost water table).
- For soil COCs whose CUL is based on human exposure, the POC must include the soils throughout the Site from the ground surface to a depth of 15 feet bgs.
- For soil COCs whose CUL is based on ecological exposure, additional specific requirements that must be addressed are presented in WAC 173 370 7490(4).

The soil POCs defined above by MTCA applies to soil at the surface and beneath the surface affected by releases from the historical site operations. However, for cleanup actions that involve containment of contamination, WAC 173-340-740(6)(f) establishes the following provisions for the cleanup to comply with the cleanup standards:

> *For those cleanup actions selected under this chapter that involve containment of hazardous substances, the soil CULs will typically not be met at the points of compliance specified in (b) through (e) of this subsection. In these cases, the cleanup action may be determined to comply with cleanup standards, provided:*
> *(i) The selected remedy is permanent to the maximum extent practicable.*
> *(ii) The cleanup is protective of human health.*
> *(iii) The cleanup action is demonstrated to be protective of terrestrial ecological receptors.*
> *(iv) Institutional controls are put in place … that prohibit or limit activities that could interfere with the long-term integrity of the containment system.*
> *(v) Compliance monitoring and periodic reviews are designed to ensure the long-term integrity of the containment system.*

(vi) The types, levels and amounts of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the cleanup action plan.

Based on the Site conditions presented in the RI and FS, soil CULs would not expect to be met at the SPOC and the provisions of WAC 173-340-740(6)(f) apply. It is not practicable to attain the CULs at the SPOC for soil because buildings on the property limit the accessibility to some portions of the subsurface, and the presence of shallow groundwater limits the practicable depth of many technologies, including excavation. Burlington conducted an interim measure to remove shallow impacted soils from the former tank farm area. This excavation was successful at removing Shallow Groundwater Zone soils that were a significant source of COCs to soil and groundwater. However, it is not practicable to remove the impacted Silt Layer below the water table. In addition, the Silt Layer provides some protection from migration of shallow impacted groundwater to deeper, less impacted water-bearing zones. Therefore, removal of the Silt Layer may not be desirable.

Burlington plans to comply with the requirements of WAC 173-340-740(6)(f) as follows:

(i) Practicable, permanent treatment methods will be used to remove the source area. Treatment methods that may be applicable were described and evaluated as part of the FS and adhere to the requirements specified under WAC 173-340-360.

(ii) CULs have been established to protect human health; in those locations where CULs will not be achieved, the receptor pathways are evaluated and suitable institutional controls (ICs) will be included in the final remedy to protect human health.

(iii, iv) ICs that maintain the integrity of the containment system and protect plants and wildlife from being exposed to any residual contamination are part of the selected final remedy.

(v) Compliance monitoring and long-term controls necessary for the remedy will be defined in the design of the final remedy.

3.3.2 Groundwater Point of Compliance

The groundwater SPOC, as described in WAC 173-340-720(8)(b), would include all groundwater within the saturated zone beneath the Burlington property and in any area affected by releases from the Burlington operations. Under WAC 173-340-720(8)(c), Ecology may approve use of a CPOC if the responsible person demonstrates that it is not practicable to attain the SPOC within a reasonable restoration time frame and that all practicable methods of treatment have been used.

Under MTCA, additional requirements apply for establishing a groundwater CPOC beyond the property boundary for facilities such as the Burlington Washougal facility that are near, but not abutting, surface water are set forth in WAC 173-340-720(8)(d)(ii).

- The CPOC must be located as close as practicable to the source of the release.
- The CPOC must not be located beyond the point or points where groundwater flows into surface water.
- The conditions specified in WAC 173-340-720(8)(d)(i) must be met.

- All affected property owners between the source of contamination and the CPOC agree in writing to the CPOC location.
- The CPOC cannot be located beyond the extent of groundwater contamination exceeding CULs when Ecology approves the CPOC.

A CPOC at the property boundary may be selected for groundwater. The specific regulatory requirements that will apply for establishing a groundwater CPOC for the facility include the following.

- It is not practicable to attain the SPOC within a reasonable restoration time frame [WAC 173-340-720(8)(c)].
- The CPOC shall be as close as practicable to the source of the release [WAC 173 340-720(8)(c)].
- All practicable methods of treatment are used in the Site cleanup [WAC 173 340 720(8)(c)].

The regulatory requirements in the bullet list above must be met in order to specify a groundwater CPOC for the facility.

For groundwater, a standard POC is assumed with a restoration timeframe of 15 years, as established in the FS. If a CPOC is necessary, a CPOC near the property boundary will be evaluated for areas where the effectiveness of the proposed cleanup action is uncertain. As noted above, the CPOC must be located as close to the source area as practicable.

Restoration time frame involves the urgency of achieving remediation objectives and the practicability of attaining a shorter restoration time frame, with consideration given to a number of factors, such as Site risks, Site use and potential use, availability of alternative water supply, effectiveness and reliability of ICs, and toxicity of hazardous substances at the Site. The following criteria, as listed in WAC 173-340-360(4), were considered to determine if each of the alternatives provides a reasonable restoration time frame:

- **Potential risks posed by the Site to human health and the environment.** The proposed cleanup action includes ICs to manage risk and prevent the Site from posing an unacceptable risk.
- **Practicability of achieving a shorter restoration time frame**. The practicability and costs and benefits of different remedies were evaluated in the FS.
- **Current use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site**. The Site is currently an active industrial facility and is largely surrounded by industrial properties. Groundwater beneath the Site is not a source of drinking water. Steigerwald Marsh and the Gibbons Creek Remnant Channel are resources near the Site, but observed concentrations in near or in these locations do not pose an unacceptable risk to human health or ecological receptors.
- **Potential future use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site**.; The Site is currently zoned for industrial use and heavy industrial use is planned at the Site for the foreseeable future. Each alternative is designed to mitigate unacceptable Site risks and no unacceptable risk has been identified in the nearby Steigerwald Marsh and Gibbons Creek Remnant Channel.
- **Availability of alternative water supplies**. Groundwater at the Site is not currently a drinking water source and alternative water supplies are available and in use.
- **Likely effectiveness and reliability of ICs**. Because the property is an active industrial facility,

ICs are very likely to be effective. Regular use of the Site is also likely to result in regular maintenance of controls, thereby increasing their reliability.

- **Ability to control and monitor migration of hazardous substances from the Site.** Groundwater monitoring has been ongoing at the Site both on the property and on adjacent properties, and continued groundwater monitoring is included in proposed remedy.
- **Toxicity of the hazardous substances at the Site**. The toxicity of the hazardous substances was evaluated in the RI report, and a cleanup standard for each COC has been established, including both a CUL and a point of compliance. At the concentrations present in the soil and groundwater, risk from the COCs is low.
- **Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar site conditions.** Natural attenuation of many COCs has been observed and documented at the Site, with most wells showing shrinking plumes in both the Shallow Groundwater Zone and Lower Aquifer.

3.4 Current COC Concentration Evaluation

As part of the dCAP, COCs identified in soil were evaluated to determine if they are also present in groundwater at the Site, and if so, whether concentrations exceed CULs established in this CAP. Several of the COCs were not detected in groundwater at concentrations greater than the CUL in the last five years. Consistent with the empirical demonstration method for deriving soil concentrations for groundwater protection in WAC 173-340-747(3)(f), the soil CULs for these COCs were re-evaluated by removing the groundwater protection-based screening level, and the resultant soil CUL was adjusted upward. In addition, a number of the soil COCs were not tested in the last five years so data from the last 20 years was examined to assess those COCs. If they were not detected above the groundwater CUL, the soil CUL was revised to remove the groundwater protection-based screening level for them as well. The revised CULs for soil are presented in Table 1.

COCs that were not detected above CULs as part of the screening described above were removed from the groundwater COC list, as summarized in Table 3a. These are the only compounds detected in groundwater above the CULs summarized in Table 2. Table 3b lists the soil COCs as identified in the FS.

4.0 Description of Selected Remedy

Figure 6 shows the areas of the site requiring active cleanup to achieve remedial objectives, as determined in the FS. This includes:

- Areas with shallow soil contamination that are currently paved or underneath buildings where surface cover prevents contact with low level contamination (shaded pink and green areas of Figure 6).
- Porous subsurface utility corridors that can be grouted to prevent inadvertent diversion of groundwater downgradient of the site (pink boxes outlined on Figure 6).
- Areas with contamination present in groundwater where contaminant concentrations are either significantly above CULs or show trends over time indicating concentrations are not declining (well locations shaded orange on Figure 6). Recent groundwater concentrations are shown in

Figures 7 and 8. Treatment areas were defined around each of these to design appropriate cleanup actions for the contaminants present and depth where they are detected.

The overall objective of the selected remedy is to reduce the risks to human health and the environment resulting from COCs in soil and groundwater at the Site to acceptable levels that are protective of the environment and exposed receptors identified in the CSM, including consideration of likely vulnerable populations and overburdened communities. All remedial alternatives considered in the FS addressed the CSM and the Site migration and exposure pathways of concern. The remediation considerations and remediation objectives established for the Site provided the framework for development of remedial alternatives.

The MTCA regulations (WAC 173-340-360) present the general requirements for selecting cleanup actions for a contaminated site. The minimum requirements applicable to all cleanup actions include specific threshold requirements and other requirements that must be met by all cleanup actions.

The threshold requirements specify that the cleanup action should:

- Protect human health and the environment, including likely vulnerable populations and overburdened communities;
- Comply with cleanup standards specified in WAC 173-340-700 through WAC 173-340-760;
- Comply with applicable state and federal laws;
- Prevent or minimize present and future releases and migration of hazardous substances in the environment;
- Provide resilience to climate change impacts that have a high likelihood of occurring and severely compromising its long-term effectiveness;
- Provide for compliance monitoring;
- Not rely primarily on institutional controls and monitoring at a site, or portion thereof, if it is technically possible to implement a more permanent cleanup action;Use permanent solutions to the maximum extent practicable, as determined by the requirements of WAC 173-340-360(5);
- Provide for a reasonable restoration time, as determined by the requirements of WAC 173-340-360(4); and
- Consider public concerns.

A variety of remedial technologies were screened as part of the FS. Table 4 summarizes the alternatives screened during that process. These alternatives took into account site conditions and the remedial action objectives described below.

- Prevent direct contact with surface or subsurface soil and inhalation of dust from surface soil affected with COCs at concentrations that exceed industrial CULs (not groundwater protection standards) or reduce the risks associated with these exposure pathways to acceptable levels.
- Reduce subsurface VOC concentrations to levels that will not pose a threat to industrial indoor air quality and reduce risks associated with inhalation of vapors from affected soil or groundwater to acceptable levels established in accordance with MTCA regulations.
- Reduce, as practicable, COC mass.

- Protect human and ecological receptors by reducing COC concentrations in affected soil and by meeting groundwater CULs at the CPOC within a reasonable time frame.
- Support current and future industrial use of the property.
- Attain remedial objectives as soon as possible and cleanup standards within a reasonable time frame.
- Use all practicable methods of treatment in the Site cleanup.
- Consideration of likely vulnerable populations and overburdened communities.

Multiple in situ technologies (biological, chemical oxidation, solidification/stabilization, thermal treatment, caps/covers) and ex situ technologies (excavation/treatment) were considered for remediation of soil. Technologies considered for groundwater included in situ biological treatment, in situ physical/chemical treatment, groundwater extraction, physical containment, and ancillary technologies. See Table 5 for a complete list of technologies reviewed during the FS.

4.1 Description of Cleanup Action

The highest ranking and recommended remedial alternative defined in the FS was “Alternative A-2” which is Capping, In-Situ Bioremediation (ISB), In-Situ Chemical Oxidation (ISCO) and Monitored Attenuation (MA) to address affected site soil and groundwater (Figure 9).

Burlington Environmental considered the MTCA requirements for sites where natural attenuation may be an appropriate aspect of a remedy as part of the FS. These considerations included those specifically cited in WAC 173-340-370(7)(a) through (d), as follows.

a. ***Source control has been conducted to the maximum extent practicable.*** Sources of contamination that remain at the Site are confined to the areas underneath the active portion of the operational facility, and covered by pavement and/or buildings controlling access and risk of contact with this material.
b. ***Leaving contaminants on site during the restoration time frame does not pose an unacceptable threat to human health or the environment.*** ICs will be included in the remedy to prevent risks of contact with contaminated media at the Site and ongoing monitoring will continue to assess risk of offsite migration, which is currently not expected to occur.
c. ***There is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur at a reasonable rate at the site.*** The groundwater data trends presented in the FS showed large reductions in the contaminants of potential concern (COPCs) identified in the RI, and continued degradation of remaining organic COCs at the Site. Inorganic COCs will continue to be monitored for evidence of reduction as geochemical conditions change and the remaining organic COCs attenuate. Current and historical data trends for inorganic COCs support the hypothesis that groundwater concentrations are stable for those compounds, and not increasing, as recommended under Ecology’s natural attenuation related guidance (Ecology, 2005).
d. ***Appropriate monitoring requirements are conducted to ensure that the natural attenuation process is taking place and that human health and the environment are protected.*** The remedy will include ongoing groundwater monitoring.

The full, proposed remedy includes:

- Grouting of the potential groundwater conduit, the utility trench under the stormwater piping to the east of the Burlington property in four locations;
- Continued operation of the existing inhalation pathway interim measure (IPIM) under Building 1;
- Augmenting existing surface cover by paving select areas of the Site with 4-inches of hot mix asphalt pavement;
- Long-term monitoring and maintenance of the pavement cover;
- Treatment near MC-14 - two rounds of ISCO injections to treat 1,4-dioxane and VOCs in the Shallow Groundwater Zone;
- Treatment in the former tank farm area and near the north fence line (near MC-118D) - two rounds of ISB injections utilizing carbohydrates and emulsified ZVI targeting chlorinated VOCs remaining in the Silt Layer and the upper portion of the Lower Aquifer;
- Treatment in the Lower Aquifer upgradient of and near MC-15D - ISB injection of carbohydrates near MC-15D to reduce risk of off-site migration of chlorinated VOCs in the upper portion of the Lower Aquifer;
- Monitored natural attenuation of groundwater downgradient of source areas;
- Groundwater monitoring would be used to evaluate ISB/ISCO effectiveness for the duration of the restoration time frame (15 years based on vendor experience and the extrapolation of groundwater monitoring data trends once source area remediation is complete). Once groundwater monitoring indicates ISB/ISCO and monitored attenuation has permanently destroyed COCs to below CULs, remediation would be considered complete; and
- Institutional controls, including a deed restriction.

The proposed action is the most practicable permanent solution and received the highest total benefit score and cost per benefit ranking amongst the alternatives. It would fully attain remediation objectives provides a permanent solution to the maximum extent practicable, with a reasonable restoration time frame, and considers public concerns. Specifically, the proposed action would:

- Prevent direct contact with soils and inhalation of dust within the Site and be protective of industrial workers;
- Address both chlorinated VOCs and 1,4-dioxane and thereby reduce the restoration time frame to approximately 15 years to meet CULs at the POC;
- Reduce current risks due to inhalation of vapors prior to when CULs are attained by incorporating ICs;
- Require vapor intrusion provisions until soil and groundwater are remediated to eliminate this pathway;
- Protect potential off-site human and ecological receptors in the Steigerwald Marsh by destroying groundwater COCs and limiting the further release of COCs by removal/treatment of Site soils; and
- Support current and future industrial use of the Burlington property.

In addition, the proposed action would provide:

- A reliable remediation approach using proven, robust technologies with low long-term maintenance requirements; and
- An approach that would create moderate short-term risks during construction (drilling, injection, paving) and have reduced potential for causing public concern about exposure to Site constituents during construction.

The proposed action would fully comply with MTCA, the Dangerous Waste Regulations (WAC 173-303), and the RCRA regulations. It would comply with the requirements of the RCRA Permit and AO and achieve the environmental indicator standards for controlling potential exposure to both soil and groundwater for affected media located at and near the Site. Details of the proposed action are described in the following subsections.

4.1.1 Institutional Controls

ICs, as described in WAC 173-340-360(2)(e), are not a remediation technology and do not result in site cleanup; rather, they are commonly used as a component of remedial alternatives to address residual soil and/or groundwater contamination. In addition, ICs may be used to protect human health and the environment during implementation of a remediation program that may require longer time frames to achieve remediation objectives. ICs typically consist of administrative controls, such as deed restrictions, and controls that prohibit actions that may result in the exposure of individuals to soil or groundwater contaminants. They also may include engineering controls that limit exposure to individuals and the environment (e.g., soil cover, hydraulic control, site fencing, etc.).

Given that the Facility is an active industrial site and that several buildings with contamination under them are actively in use, long term institutional controls (primarily for low level soil contamination from inorganic COCs) and temporary institutional controls (for control during the remediation phase) are proposed during cleanup. Temporary institutional controls would be implemented to protect human health and the environment while remedial actions are underway. Once successful completion of remediation is confirmed, temporary institutional controls would be removed.

ICs are included in the proposed cleanup so that the cover is maintained, and to restrict future land use and groundwater use at the Site until CULs have been attained. Since potential exposure to COCs above CULs would remain, a deed restriction limiting the Site to industrial use would be implemented. The deed restriction would also clearly identify the location of known soil and groundwater contamination. Additional ICs to limit recovery and use of groundwater beneath the Site and strict health and safety requirements for conducting subsurface work in impacted areas would also be required. Pavement inspections would be performed during groundwater monitoring events. Facility operators would be expected to repair damage or settling in the pavement.

Deed restrictions protect the health and safety of people who may come in contact with the Site in the future. Such restrictions could include preventing or limiting Site excavation work and assessing potential vapor exposure pathways prior to ground disturbing activities, requirements to notify future construction workers of the presence and location of affected Site soil or groundwater, or precluding future use or redevelopment of the Site for certain uses, such as residential, schools, day care centers, or hospitals. Additional ICs can be established to maintain remediation technologies put in place at a Site.

Administrative controls also can be non-enforceable restrictions that provide information, notification, or site security. These controls may include warning signs that inform users of the potential site hazards and access requirements. On-site security and containment fencing may be employed in addition to warning signs to prevent unauthorized individuals from entering the Site. On an industrial facility operation like this Site, administrative controls can be built into site safety plans and in employee and visitor hazard communications.

4.1.2 Inhalation Pathway Interim Measure

The IPIM was previously implemented to prevent risk of exposure to workers in Building 1 to VOCs. The IPIM system decreases pressure under the building and conveys VOCs through a stack on the roof of the building, preventing VOCs in the soil from entering the building. As part of the proposed cleanup, this system would be operated as long as necessary to protect human health. Sub-slab vapor monitoring is planned as part of design, to better assess the time frame for IPIM operations. If results indicate the system is no longer necessary, shut down of the IPIM and confirmation sampling would be performed to provide verification that shutdown of the IPIM does not adversely impact human health and the environment

4.1.3 Surface Cover

Maintaining surface cover is necessary for both ongoing operations and to prevent worker exposure to subsurface contaminants. Surface cover would be added in areas of the Site that are unpaved to prevent direct contact with or surface water infiltration through soils with elevated concentrations of COCs (Figure 9).

4.1.4 Utility Trench Grouting

While shallow groundwater trends indicate ongoing biodegradation has shrunk the impacted area, there is still a possibility that contaminated groundwater could migrate in the bedding of utility lines when the water table is elevated in the wet season. Grouting of the storm drain utility line is proposed in four locations along the alignment east of the property line. A four-foot cube would be excavated around the pipe within the bedding material and the material would be replaced with cementitious controlled density fill (CDF) to prevent groundwater migration along the utility alignment in the higher permeability pipe bedding material.

4.1.5 In-Situ Chemical Oxidation Groundwater Treatment

ISCO would be utilized to address 1,4-dioxane concentrations in the vicinity of MC-14. Prior to implementation, bench scale studies will be conducted to confirm the appropriate substrate and dosage rates. Injection spacing design will be based on soil types in each area and checked against spacing estimated by injection subcontractors.

Injections within the Shallow Groundwater Zone were assumed in the FS to be completed with a spacing of 15-feet O.C. and a 10-feet depth interval (two to 12 feet bgs). To minimize metals release to the groundwater a Modified Fenton's Reagents (MFR) is proposed to treat the 1,4-dioxane concentrations per an estimate provided by In-Situ Oxidative Technologies, Inc. (ISOTEC). Use of a MFR process reduces the overall pH decrease observed during injections, compared to other in-situ treatment reagents, effectively reducing the potential for metals to migrate into solutions, i.e. groundwater. The bench scale studies conducted prior to implementation will determine the optimal injectates to minimize metals releases. MFR injections would potentially include injections of a proprietary catalyst, sodium persulfate, and hydrogen peroxide. The area is estimated to be completed with nine injection locations.

A second ISCO injection event would be planned within a few months of the first injection to complete treatment of remaining COCs using approximately half the number of injection locations and half the initial treatment volume of hydrogen peroxide and MFR solution.

4.1.5 In-Situ Bioremediation Groundwater Treatment

ISB injections within the former tank farm area, including the MC-118 well cluster area, would utilize an emulsified vegetable oil (EVO) and ZVI substrate to provide a carbon source for the natural bacteria and passively treat chlorinated solvents diffusing from the Silt Layer into the Lower Aquifer. Prior to implementation, bench scale studies will be conducted to confirm the appropriate substrate and dosage rates. Injection spacing design will be based on the soil types in each area and checked against spacing estimated by injection subcontractors.

Injections within the Silt Layer were assumed in the FS to be conducted with a spacing of 15-feet O.C. (approximately 19 injection locations) and injections within the Lower Aquifer were assumed to be completed with a spacing of 25-feet (approximately seven injection locations). Treatment depths for the former tank farm will target the entire silt interval (10 to 18 feet bgs) and the upper 10 feet (18 to 28 feet bgs) of the Lower Aquifer. A second ISB injection event will be planned in the following year to polish treatment of remaining COCs using approximately half the number of injection locations and half the initial treatment volume of EVO and ZVI.

ISB injections within the vicinity of MC-15D will utilize an EVO substrate to provide a carbon source for the natural bacteria to break down chlorinated solvents in the Lower Aquifer. Injections within the Lower Aquifer were assumed in the FS to be completed with a spacing of 25 feet, in the upper 10 feet (18 to 28 feet bgs) of the aquifer. The area is estimated to be completed with four injection locations.

4.1.6 Long-Term Compliance Monitoring

Compliance monitoring required under WAC 173-340-410 consists of the following.

- **Protection Monitoring.** Confirms human health and the environment are adequately protected during construction and operations of cleanup. This will be addressed in a site-specific health and safety plan.
- **Performance Monitoring**. Confirms the cleanup action attains cleanup or other performance standards.
- **Confirmational Monitoring**. Confirms the long-term effectiveness of the cleanup action.

Performance and confirmational monitoring will be addressed by a groundwater monitoring program employing the existing monitoring well network to verify that natural attenuation and degradation of COCs continue to occur, and that COC concentrations are trending toward CULs at the CPOC over time. There are currently 42 wells actively being monitored under the existing monitoring plan. The number of wells is expected to be reduced after active remediation is complete (three to five years), with polishing by monitored attenuation taking an additional five to seven years based on available onsite trend data, with confirmational monitoring taking another five years. Monitoring will consist of regularly scheduled groundwater sampling and analysis for COCs from a network of wells on the Site. These data will be used to document and evaluate remedy effectiveness and progress on anticipated remediation timelines to meet CULs.

4.1.7 Contingent Remedy

The selected remedy is the most likely practicable permanent solution based on the available data on the remedial technologies and the available site-specific data at the time of writing of this report. This determination, while based on sound engineering judgement, may be reassessed as more site-specific information is collected, or as more data becomes available for technologies tested at similar sites in Washington State. In particular, the proposed cleanup action includes bench testing and pilot testing in order to improve performance for ISCO, ISB, and ZVI technologies. The results of the bench and pilot testing could provide valuable site-specific data on effectiveness of those technologies with regards to Site groundwater chemistry and soil characteristics. Based on the available information and engineering judgement, bench and pilot testing is likely to confirm that the selected remedy as the most practicable and permanent solution. However, it is possible that bench or pilot testing could provide different results than anticipated, which may necessitate review of the Cost/Benefit ratio evaluated in the FS or the use of a contingent remedy. For example:

- If bench testing shows ZVI substrate dosing to be significantly more effective in dispersion and treatment than standard EVO substrate, a different ratio of technologies may be used.
- If pilot testing shows distribution of ISB or ISCO substrates is inconsistent and is likely to perform worse than expected in the FS, permeable reactive barrier injection technology may be considered instead.
- If bench and/or pilot testing shows that timelines are longer or treatment effectiveness is worse than anticipated, hydraulic control may need to be revisited.

Retaining contingent remedy technologies is necessary in the event the selected remedy does not meet design goals or CULs within the restoration time frame. The following technologies are retained as potential contingent remedies:

- Permeable Reactive Barrier,
- Full Scale In-Situ Chemical Oxidation, and
- Hydraulic Containment.

4.2 Applicable or Relevant and Appropriate Requirements

Cleanup actions conducted under MTCA must comply with applicable state and federal laws. The term "applicable state and federal laws" includes legally applicable requirements and those requirements that Ecology determines to be relevant and appropriate as described in WAC 173-340- 710, and may be referred to as ARARs. Typical ARARs include location-specific, action-specific, and contaminant-specific ARARs.

The facility RCRA Part B permit specifically required that corrective actions comply with RCW Chapter 70A.300 (Hazardous Waste Management), Chapter 173-303 (Dangerous Waste Regulations), and Chapter 173-340 (MTCA Cleanup Regulations). Additionally, the Site is covered under RCRA for the purpose of corrective action, requiring compliance with federal RCRA regulations (40 Code of Federal Regulations 240-299). Any remedial action taken at the Site must comply with other applicable laws and regulations (42 United States Code Ch. 6901 et seq.). The applicable requirements under the Dangerous Waste Regulations and RCRA pertain primarily to management of remediation wastes and general compliance with the RCRA permit. Corrective action requirements under RCRA and the dangerous waste rules are addressed under the RCRA permit and the MTCA regulations.

Location-specific ARARs include those based on the location of the Site, such as:

- Permits from local municipalities as required for activities at the Site;
- Shoreline, wetlands, and critical areas criteria; and
- Tribal and cultural protections (archaeological resources).

Action-specific ARARs include those based on acceptable management practices. They include:

- Minimum Standards for Construction and Maintenance of Wells;
- General Occupation Health Standards and Safety Standards for Construction Work; and
- State Environmental Policy Act.

Additional ARARs may apply and will be defined as part of the design for implementation. Standard industry practices often address many ARARs, such as construction of wells being performed by a Washington-licensed driller and construction work being conducted under site-specific health and safety plans compliant with federal and local safety regulations.

4.3 Restoration Timeframe

The proposed action would likely result in the attainment of groundwater CULs within approximately 15 years after the action. As noted above, active treatment would lead to destruction of the majority of COCs in the first three to five years, with CULs likely to be attained offsite in the first three to five years, with another five to seven years for polishing groundwater onsite, and five years of confirmational monitoring. Downgradient monitoring already indicates that ongoing biodegradation and attenuation are showing decreasing concentrations in shallow groundwater monitoring wells. Groundwater monitoring well trends in the Lower Aquifer are increasing in some areas onsite, but current trends (without treatment) indicate that Lower Aquifer COCs are unlikely to reach receptors before degrading to below CULs off-site: i.e. before reaching the river or the shallow aquifer. Given the relatively low concentrations of COCs onsite, the ongoing industrial use of the facility, the ICs employed, and the resulting low risk to human and ecological receptors, the restoration time frame of 15 years is considered to be reasonable.

4.4 Public Participation

Ecology will provide public notice and opportunity for public comment on the dCAP before finalizing and proceeding to the Engineering Design Report (EDR). Burlington Environmental will assist Ecology in the preparation of materials to support public participation, as requested, which may include the preparation of mailing lists, fact sheets, and public notices.

5.0 Implementation of the Proposed Cleanup Action

The following sections describe the activities that will be required to implement the cleanup. Specific details of the cleanup action will be provided in the EDR.

5.1 Implementation Tasks

An Engineering Design Report will be prepared once the dCAP is finalized and will include the following:

- Construction Work Plans for:
  - Surface cover inspection and repair;
  - Grouting of utility bedding;
  - ISCO treatment; and
  - ISB treatment.
- Health and Safety Plans
- Draft Long-Term Controls Plan including a draft environmental covenant consistent with the ICs proposed for the Site.

The Engineering Design Report will identify all permits necessary to complete the cleanup. Following implementation, a cleanup action construction report will be prepared, consistent with WAC 173-340-400(b).

5.2 Financial Assurance

Consistent with WAC 173-340-440(11), Burlington Environmental will provide Ecology with proof of financial assurances that Burlington Environmental has sufficient financial resources available and in place to cover all costs associated with the operation and maintenance of the cleanup action, including ICs, compliance monitoring, and corrective measures.

In addition, Burlington Environmental's RCRA Permit (Section III.3) requires that they provide assurances of financial responsibility for corrective action at the facility according to requirements in Agreed Order No. DE 4308.

6.0 References

AMEC Environment & Infrastructure, Inc. (AMEC), 2013, Final Remedial Investigation Report, PSC Washougal Facility, Washougal, Washington: Prepared for Burlington Environmental, LLC, September.

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Ecology, 2019, Cleanup Levels and Risk Calculation (CLARC) resource pages, https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools/CLARC/Data-tables accessed July 2019.

Philip Services Corporation (PSC), 1998, Final Interim Action Report, Washougal Facility, Washougal Washington, September.

Sweet-Edwards EMCOM (SEE), 1991, Chemical Processors Inc, RCRA Facility Investigation Draft Report for the Washougal, Washington Facility, June.

TABLE 1
SOIL CLEANUP LEVELS
Burlington Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Final Cleanup Levels	
		Soils on Burlington Property	Soils Off Burlington Property
Inorganics			
Barium	7440-39-3	102	102
Cadmium	7440-43-9a	14	4
Chromium (total)	7440-47-3	67	42
Copper	7440-50-8	34	34
Cyanide	57-12-5	0.38	0.38
Lead	7439-92-1	118	50
Mercury	7439-97-6	5.5	0.1
Nickel	7440-02-0	21	21
Selenium and compounds	7782-49-2	0.5	0.5
Silver	7440-22-4	5800	2
Thallium, soluble salts	7440-28-0	12	0.78
Vanadium	7440-62-2	1600	2
Zinc	7440-66-6	96	96
PCBs/Pesticides			
Aldrin	309-00-2	0.1	0.039
delta-BHC	319-86-8	0.049	0.005
4,4'-DDD	72-54-8	9.6	2.3
4,4'-DDT	50-29-3	8.5	1.9
Dieldrin	60-57-1	0.07	0.034
Endrin	72-20-8	0.2	0.2
Heptachlor	76-44-8	0.63	0.13
Heptachlor epoxide	1024-57-3	0.33	0.07
Lindane	58-89-9	0.8	0.057
Toxaphene	8001-35-2	2.1	0.49
Polychlorinated biphenyls, total	1336-36-3	0.65	0.23
SVOCs			
Acetophenone	98-86-2	120,000	7,800
Benzidine	92-87-5	0.01	0.0005
Benzo(a)anthracene	56-55-3	21	1.10
Benzo(a)pyrene	50-32-8	0.005	0.005
Benzo(b)fluoranthene	205-99-2	21	1.10
Benzo(k)fluoranthene	207-08-9	210	11
p-Chloroaniline (4-chloroaniline)	106-47-8	11	2.7
bis(2-Chloroethyl) ether	111-44-4	1	0.33
2-Chloronaphthalene	91-58-7	60,000	4,800
2-Chlorophenol	95-57-8	5,800	390

TABLE 1
SOIL CLEANUP LEVELS
Burlington Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Final Cleanup Levels	
		Soils on Burlington Property	Soils Off Burlington Property
Chrysene	218-01-9	2,100	110
3,3'-Dichlorobenzidine	91-94-1	5.1	1.2
2,4-Dichlorophenol	120-83-2	2,500	190
Dibenzo[a,h]anthracene	53-70-3	2.1	0.11
Dibenzofuran	132-64-9	1,200	78
2,4-Dimethylphenol	105-67-9	16,000	1,300
2,4-Dinitrophenol	51-28-5	--	--
2,4-Dinitrotoluene	121-14-2	7.4	1.7
2,6-Dinitrotoluene	606-20-2	1.5	0.36
1,4-Dioxane	123-91-1	0.0018	0.0018
bis(2-Ethylhexyl) phthalate	117-81-7	160	39
Hexachlorobenzene	118-74-1	0.96	0.21
Hexachlorobutadiene	87-68-3	5.3	1.2
Hexachloroethane	67-72-1	8	1.8
Indeno(1,2,3-cd)pyrene	193-39-5	21	1.1
Isophorone	78-59-1	2,400	570
4-Methylphenol	106-44-5	16	16
N-Nitroso-di-n-propylamine	621-64-7	0.33	0.33
N-Nitrosodiphenylamine	86-30-6	470	20
Nitrobenzene	98-95-3	22	5.1
Pentachlorophenol	87-86-5	4.0	1.0
2,4,6-Trichlorophenol	88-06-2	210	10
TPH			
Gasoline Range Organics	86290-81-5	5,000	100
Heavy Oils		2,000	2,000
VOCs			
Acetone	67-64-1	29	29
Acrolein	107-02-8	0.6	0.14
Acrylonitrile	107-13-1	1.1	0.25
Benzene	71-43-2	0.005	0.005
Bromodichloromethane	75-27-4	1.3	0.29
Bromoform	75-25-2	86	19
Bromomethane	74-83-9	30	7
Carbon disulfide	75-15-0	3,500	770
Carbon tetrachloride	56-23-5	2.9	0.65
Chlorobenzene	108-90-7	1300	40
Chloroform	67-66-3	1.4	0.32
Chloromethane	74-87-3	460	110
2-Chlorotoluene	95-49-8	1.9	1.9
1,2-Dibromo-3-chloropropane	96-12-8	0.01	0.01
Dibromochloromethane	124-48-1	39	8.3
1,4-Dichlorobenzene	106-46-7	11	2.6

TABLE 1
SOIL CLEANUP LEVELS
Burlington Washougal Facility
Washougal, Washington

Concentrations are in milligrams per kilogram (mg/kg)

Constituent	CAS Number	Final Cleanup Levels	
		Soils on Burlington Property	Soils Off Burlington Property
Dichlorodifluoromethane	75-71-8	38	38
1,2-Dichloroethane	107-06-2	2	0.46
1,1-Dichloroethene	75-35-4	20	4.8
cis-1,2-Dichloroethene	156-59-2	0.08	0.08
trans-1,2-Dichloroethene	156-60-5	0.52	0.52
Ethyl chloride (chloroethane)	75-00-3	23,000	5,400
Ethylbenzene	100-41-4	0.1	0.1
Ethylene dibromide (EDB)	106-93-4	0.005	0.005
4-Methyl-2-pentanone	108-10-1	140,000	6,400
Methylene Chloride	75-09-2	0.0218	0.0218
Styrene	100-42-5	35,000	300
1,1,2,2-Tetrachloroethane	79-34-5	2.7	0.6
Tetrachloroethene	127-18-4	0.024	0.024
1,1,1-Trichloroethane	71-55-6	36,000	8,100
1,1,2-Trichloroethane	79-00-5	5	1.1
Trichloroethene	79-01-6	0.005	0.005
1,2,3-Trichloropropane	96-18-4	0.02	0.02
1,2,4-Trimethylbenzene	95-63-6	1.3	1.3
1,3,5-Trimethylbenzene	108-67-8	1.3	1.3
Toluene	108-88-3	47,000	200
Vinyl chloride	75-01-4	0.005	0.005
m,p-Xylene	106-42-3	0.51	0.51

Notes

1. Ecology's Cleanup Levels and Risk Calculations (CLARC) tables accessed in June 2025 to update cleanup levels.

Abbreviations

CAS = Chemical Abstracts Service
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 2
GROUNDWATER CLEANUP LEVELS
SHALLOW GROUNDWATER ZONE AND LOWER AQUIFER
Burlington Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Final Cleanup Level	Lower Aquifer Final Cleanup Level
Inorganics			
Ammonia (as nitrogen)	7664-41-7	--	--
Arsenic, inorganic	7440-38-2	22.84	1.42
Barium	7440-39-3	1,000	1,000
Cadmium	7440-43-9	0.42	0.42
Chromium	7440-47-3	50	50
Copper	7440-50-8	1.2	1.2
Cyanide	57-12-5	5	5
Iron	7439-89-6	1,000	1,000
Lead	7439-92-1	2.5	2.5
Manganese	7439-96-5	50	50
Nickel	7440-02-0	11	11
Silver	7440-22-4	0.2	0.2
Vanadium	7440-62-2	80	80
Zinc	7440-66-6	24	24
VOCs			
Benzene	71-43-2	0.44	0.44
Bromodichloromethane	75-27-4	0.71	0.71
Bromoform	75-25-2	4.6	4.6
Bromomethane	74-83-9	11	11
Carbon disulfide	75-15-0	400	800
Carbon tetrachloride	56-23-5	0.2	0.2
Chlorobenzene	108-90-7	100	100
Chloroform	67-66-3	1.2	1.4
Chloromethane	74-87-3	150	--
1,2-Dibromo-3-chloropropane	96-12-8	0.5	0.5
Dibromochloromethane	124-48-1	0.52	0.52
1,4-Dichlorobenzene	106-46-7	4.9	8.1
1,1-Dichloroethane	75-34-3	7.7	7.7
1,2-Dichloroethane	107-06-2	0.48	0.48
1,1-Dichloroethene	75-35-4	7	7
1,2-Dichloroethene (total)	540-59-0	72	72
cis-1,2-Dichloroethene	156-59-2	16	16
trans-1,2-Dichloroethene	156-60-5	100	100

TABLE 2
GROUNDWATER CLEANUP LEVELS
SHALLOW GROUNDWATER ZONE AND LOWER AQUIFER
Burlington Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Final Cleanup Level	Lower Aquifer FInal Cleanup Level
Dichlorodifluoromethane	75-71-8	4.2	1600
1,2-Dichloropropane	78-87-5	0.71	0.71
Ethyl chloride (chloroethane)	75-00-3	--	--
Ethylene dibromide (EDB)	106-93-4	0.2	0.2
Methylene chloride	75-09-2	5	5
Styrene	100-42-5	100	100
1,1,1,2-Tetrachloroethane	630-20-6	1.7	1.7
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.2
Tetrachloroethene	127-18-4	2.4	2.4
Toluene	108-88-3	57	57
1,2,4-Trichlorobenzene	120-82-1	0.5	0.5
1,1,1-Trichloroethane	71-55-6	200	200
1,1,2-Trichloroethane	79-00-5	0.35	0.35
Trichloroethene	79-01-6	0.3	0.3
1,2,3-Trichloropropane	96-18-4	0.5	0.5
Vinyl chloride	75-01-4	0.02	0.02
m,p-Xylene	106-42-3	330	1600
SVOCs			
2,4,6-Trichlorophenol	88-06-2	1	1
2-Chlorophenol	95-57-8	15	15
2-Methylnaphthalene	91-57-6	32	32
Aniline	62-53-3	15	15
Benzo(a)anthracene	56-55-3	0.2	0.2
Benzo(a)pyrene	50-32-8	0.2	0.2
Benzo(b)fluoranthene	205-99-2	0.2	0.2
Benzo(k)fluoranthene	207-08-9	0.2	0.2
bis(2-Chloroethyl) ether	111-44-4	0.2	0.2
bis(2-Ethylhexyl) phthalate	117-81-7	0.2	0.2
Chrysene	218-01-9	0.2	0.2
3,3'-Dichlorobenzidine	91-94-1	1	1
1,4-Dioxane	123-91-1	0.44	0.44
2,4-Dichlorophenol	120-83-2	10	10
2,4-Dinitrophenol	51-28-5	10	10
2,4-Dinitrotoluene	121-14-2	1	1
2,6-Dinitrotoluene	606-20-2	1	1

TABLE 2
GROUNDWATER CLEANUP LEVELS
SHALLOW GROUNDWATER ZONE AND LOWER AQUIFER
Burlington Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Final Cleanup Level	Lower Aquifer FInal Cleanup Level
Dibenzo[a,h]anthracene	53-70-3	0.2	0.2
Dibenzofuran	132-64-9	8	8
Dinoseb	88-85-7	7	7
Hexachlorobenzene	118-74-1	0.2	0.2
Hexachlorobutadiene	87-68-3	0.2	0.2
Hexachlorocyclopentadiene	77-47-4	1	1
Hexachloroethane	67-72-1	0.2	0.2
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	0.2
Isophorone	78-59-1	27	27
N-Nitroso-di-n-propylamine	621-64-7	0.2	0.2
N-Nitrosodiphenylamine	86-30-6	0.62	0.62
Nitrobenzene	98-95-3	10	10
p-Chloroaniline	106-47-8	0.44	0.44
Pentachlorophenol	87-86-5	1	1
TPH			
Gasoline Range Organics	86290-81-5	800	800
Heavy Oils	NA	500	500

Notes

1. Ecology's Cleanup Levels and Risk Calculations (CLARC) tables accessed in June 2025 to update cleanup levels.

Abbreviations

-- = no cleanup level calculated
CAS = Chemical Abstracts Service
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE 3a

CONSTITUENTS OF CONCERN IN GROUNDWATER [1]

Burlington Washougal Facility

Washougal, Washington

Inorganics	SVOCs	TPH
Arsenic	1,4-Dioxane	Gasoline range hydrocarbons
Iron		
Manganese		
Nickel		
VOCs		
1,1,1,2-Tetrachloroethane	1,2-Dichloropropane	Trans-1,2,-Dichloroethene
1,1-Dichloroethane	Benzene	Trichloroethene
1,2-Dibromo-3-chloropropane	cis-1,2-Dichloroethene	Vinyl chloride
1,2-Dibromoethane	Dichlorodifluoromethane	
1,2-Dichloroethene (total)	Tetrachloroethene	

Notes

1. The COC list provided was narrowed from the FS list based on which COCs had been detected recently, as described in Section 3.4.

Abbreviations

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

VOCs = volatile organic compounds

COC = constituent of concern

TABLE 3b

CONSTITUENTS OF CONCERN IN SOIL [1]

Burlington Washougal Facility

Washougal, Washington

Metals		PCBs/Pesticides		TPH
Barium	Nickel	Total PCBs	Endrin	Gasoline
Cadmium	Selenium	4,4'-DDD	Heptachlor	Lube oil range hydrocarbons
Chromium	Silver	4,4'-DDT	Heptachlor epoxide	
Copper	Thallium	Aldrin	Lindane	
Cyanide	Vanadium	delta-BHC	Toxaphene	
Lead	Zinc	Dieldrin		
Mercury				
SVOCs				
1,4-Dioxane	2-Chloronaphthalene	Benzo(a)anthracene	Dibenzo(a,h)anthracene	Nitrobenzene
2,4,6-Trichlorophenol	2-Chlorophenol	Benzo(a)pyrene	Dibenzofuran	N-Nitroso-di-n-propylamine
2,4-Dichlorophenol	3,3'-Dichlorobenzidine	Benzo(b)fluoranthene	Hexachlorobenzene	N-Nitrosodiphenylamine
2,4-Dimethylphenol	4-Chloroaniline (p-chloroaniline)	Benzo(k)fluoranthene	Isophorone	Pentachlorophenol
2,4-Dinitrophenol	4-Methylphenol	bis(2-Chloroethyl) ether	Indeno(1,2,3-cd)pyrene	
2,4-Dinitrotoluene	Acetophenone	bis(2-Ethylhexyl) phthalate	Hexachlorobutadiene	
2,6-Dinitrotoluene	Benzidine	Chrysene	Hexachloroethane	
VOCs				
1,1,1-Trichloroethane	1,2-Dichloroethane	Acrylonitrile	Chloroethane	Methylene chloride
1,1,2,2-Tetrachloroethane	1,2-Dichloropropane	Benzene	Chloroform	Styrene
1,1,2-Trichloroethane	1,3,5-Trimethylbenzene	Bromodichloromethane	Chloromethane	Tetrachloroethene
1,1-Dichloroethene	1,4-Dichlorobenzene	Bromoform	cis-1,2-Dichloroethene	Toluene
1,2,3-Trichloropropane	2-Chlorotoluene (o-chlorotoluene)	Bromomethane	Dibromochloromethane	trans-1,2-Dichloroethene
1,2,4-Trimethylbenzene	4-Methyl-2-pentanone	Carbon disulfide	Dichlorodifluoromethane	Trichloroethene
1,2-Dibromo-3-chloropropane	Acetone	Carbon tetrachloride	Ethylbenzene	Vinyl chloride
1,2-Dibromoethane	Acrolein	Chlorobenzene	m,p-Xylenes	

Note

1. The COC list provided was derived from a conservative screening process as discussed in the 2013 RI, the primary COC detected above cleanup levels are those used for design in the CAP.

Abbreviations

PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
COC = constituent of concern

DOF DALTON OLMSTED FUGLEVAND

TABLE 4
REMEDIAL ALTERNATIVES SUMMARY
Burlington Washougal Facility
Washougal, Washington

General Target Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Common to all alternatives for Soil and GW	Grouting of utility bedding						
	Surface cover over areas with soils with elevated concentrations of COCs						
	Inhalation Pathway Interim Measure under Building 1						
	Verification of GW remediation progress and effectiveness through GW monitoring						
	Long Term or Temporary Institutional Controls						
GW-Shallow Source Areas	MNA in former tank farm area (VOCs, metals)	ISB in former tank farm area primarily targeting silt layer, MA (VOCs, metals)	DSM with ZVI of shallow zone and silt layer, MA (VOCs, 1,4-dioxane, metals)	ERH of shallow zone and silt layer, MA (VOCs, 1,4-dioxane, metals)	PRB with ZVI above and within silt layer, MA (VOCs, metals)	ISB in former tank farm area primarily targeting silt layer, MA (VOCs, metals)	ISCO in former tank farm area primarily targeting silt layer, MA (VOCs, 1,4-dioxane, metals)
	MNA near MC-14 (VOCs, metals)	ISCO near MC-14, MA (VOCs, 1,4-dioxane, metals)	ISCO near MC-14 , MA (VOCs, 1,4-dioxane, metals)	ERH near MC-14, MA (VOCs, 1,4-dioxane, metals)	ISCO near MC-14, MA (VOCs, 1,4-dioxane, metals)	ISCO near MC-14 , MA (VOCs, 1,4-dioxane, metals)	ISCO near MC-14 , MA (VOCs, 1,4-dioxane, metals)
GW-Shallow Downgradient	MNA						
GW-Lower Aquifer Former Tank Farm Area and North Fence line (near MC-118D) Source Area	MNA (VOCs, metals)	ISB in silt/lower aquifer, MA (VOCs, metals)	DSM with ZVI/clay of silt, targeted ISCO in silt/lower aquifer, MA (VOCs, 1,4-dioxane, metals)	ERH in silt/lower aquifer, MA (VOCs, 1,4-dioxane, metals)	PRB with ZVI of silt/lower aquifer, MA (VOCs, metals)	ISB in silt/lower aquifer, hydraulic control, MA (VOCs, 1,4-dioxane, metals)	ISCO in silt/lower aquifer, MA (VOCs, 1,4-dioxane, metals)
GW-Lower Aquifer Downgradient (Including MC-15D Area)	MNA (VOCs, metals)	ISB, MA (VOCs, metals)	ISB, MA (VOCs, metals)	ISB, MA (VOCs, metals)	PRB with ZVI, MA (VOCs, metals)	ISB and hydraulic control, MA (VOCs, 1,4-dioxane, metals)	ISB, MA (VOCs, metals)

Notes

1. Active remediation indicates the expected duration of accelerated degradation rates, except in the case of MNA which has no active component, a passive timeframe was used.
2. Alternatives 2, 5, and 6 assume MNA in the former tank farm area for 1,4-dioxane and active treatment where concentrations are higher.

Abbreviations:

COC= Contaminant of Concern
VOCs = Volitale Organic Compounds
ZVI= Zero Valent Iron
MA= Monitored Attenuation
ISB= In-situ Bioremediation
MNA= Monitored Natural Attenuation
ISCO= In-Situ Chemical Oxidation
DSM= Deep Soil Mixing
ERH= Electrical Resistive Heating
GW= Groundwater

TABLE 5

REMEDIATION TECHNOLOGIES CONSIDERED FOR INCORPORATION IN REMEDIAL ALTERNATIVES

Burlington Washougal Facility

Washougal, Washington

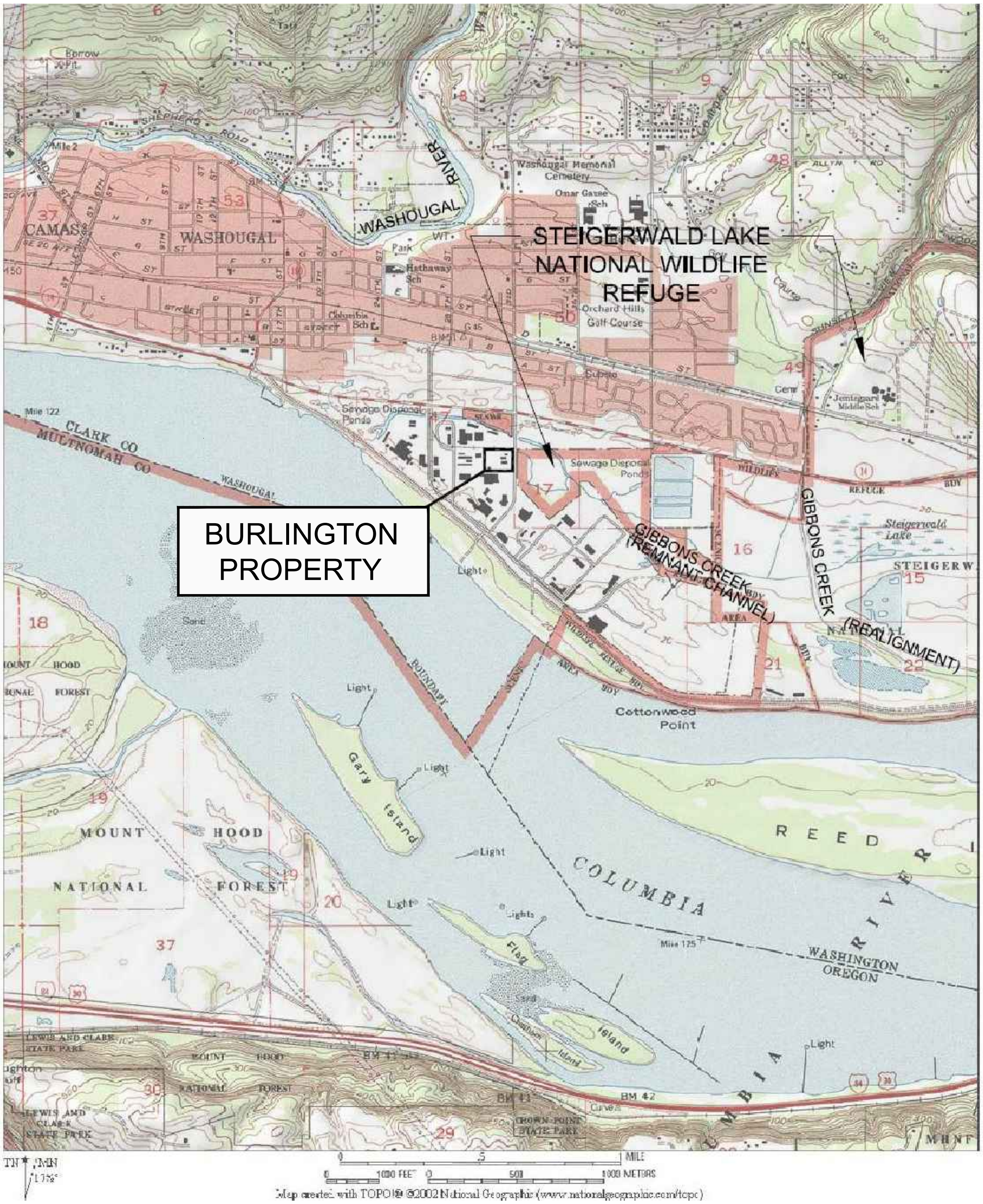
Potentially Applicable Soil Technology	
General Response Actions	**Remediation Technologies**
In Situ Biological Treatment	Phytoremediation
In Situ Physical/Chemical Treatment	Chemical Oxidation
	Solidification/Stabilization
In Situ Thermal Treatment	High-Temperature Volatilization
Containment	Cap/Surface Cover
Excavation and Disposal	Excavation and Off-Site Disposal

Potentially Applicable Groundwater Technology	
General Response Actions	**Remediation Technologies**
In Situ Biological Treatment	Enhanced Biodegradation with Biosparging
	Oxygen Enhancement with Hydrogen Peroxide or ORC
	Biostimulation of Reductive Dechlorination (Anaerobic)
	Bioaugmentation
	Monitored Natural Attenuation
	Phytoremediation
In Situ Physical/Chemical Treatment	Air Sparging
	Chemical Oxidation
	Thermal Treatment
	Passive/Reactive Treatment Walls
	Emulsified Zero-Valent Iron
Groundwater Extraction (Pump and Treat)	Hydraulic Control
Physical Containment	Barrier Wall
Ancillary/Support Technologies	Air stripping
	Oxidation
	Adsorption
	Deep Soil Mixing

Abbreviations

ORC = oxygen-releasing compound

FIGURES



Burlington - Washougal Facility
Washougal, Washington

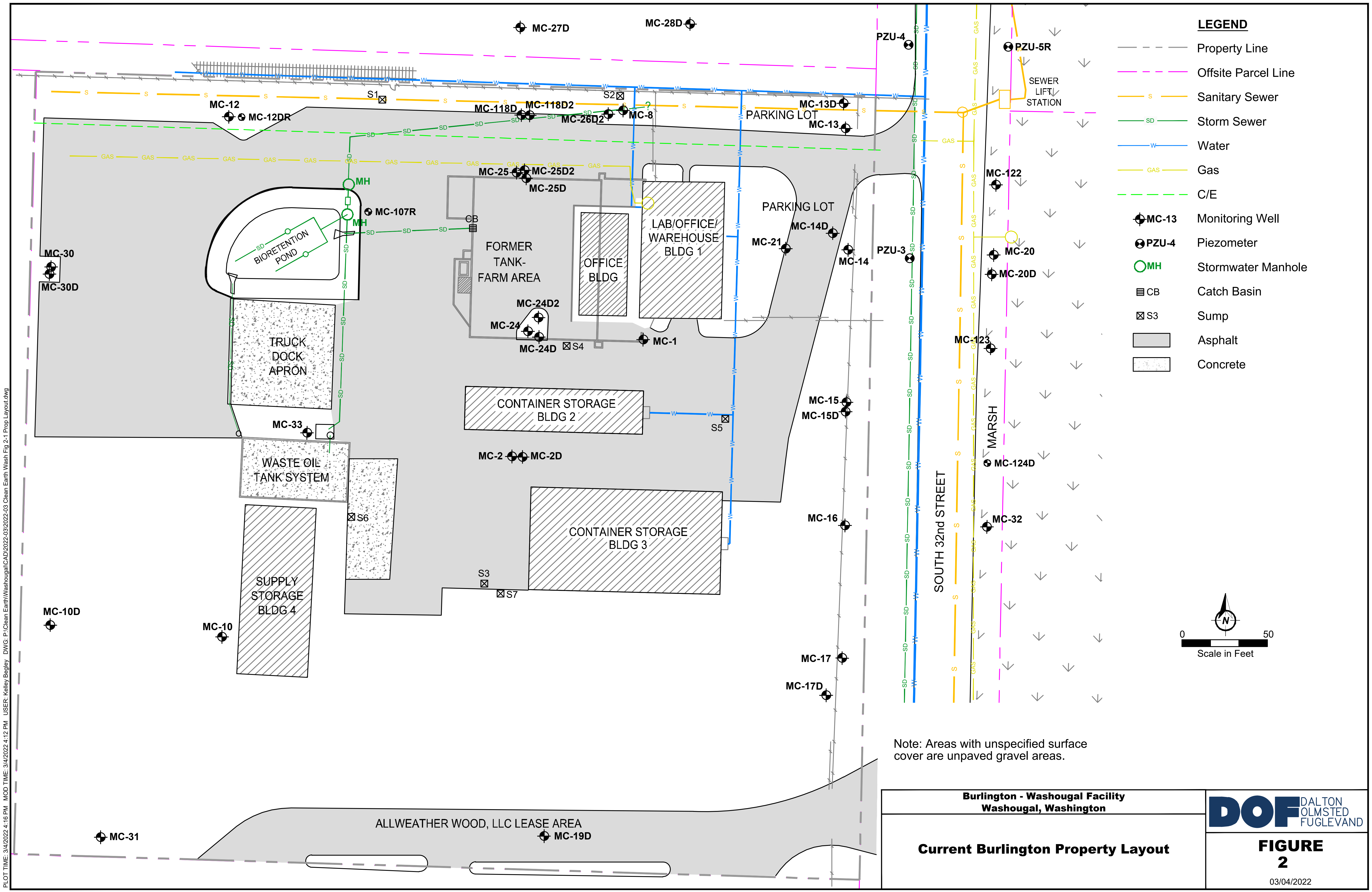
Vicinity Map

DALTON
OLMSTED
FUGLEVAND

FIGURE 1

03/04/2022

PLOT TIME: 3/4/2022 4:15 PM MOD TIME: 3/4/2022 3:56 PM USER: Kelley Begley DWG: P:\Clean Earth\Washougal\CAD\2022-03\2022-03 Clean Earth Wash Fig 1-1 Vic Map.dwg



Burlington - Washougal Facility
Washougal, Washington

Current Burlington Property Layout

FIGURE 2

03/04/2022

Resource: Aerial-Google Earth Pro, 7/16/18.

0 200
Scale in Feet

LEGEND

Property Line

Offsite Parcel Line

Burlington - Washougal Facility
Washougal, Washington

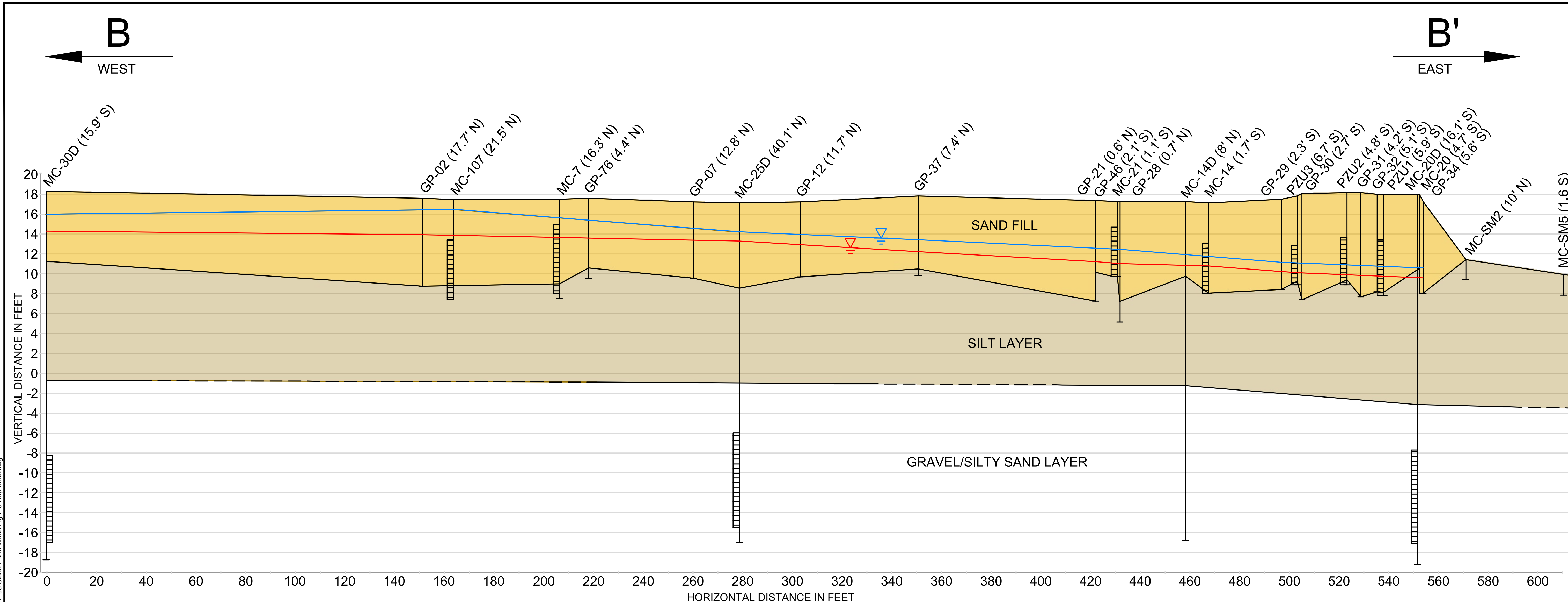
Adjacent Properties

DOF DALTON OLMSTED FUGLEVAND

FIGURE 3

04/19/2022

PLOT TIME: 4/19/2022 1:37 PM MOD TIME: 4/19/2022 1:36 PM USER: Kelley Begley DWG: P:\Clean Earth\Washougal\CAD\2022-03\2022-03 Clean Earth Wash Fig 2-2 Adjac Props.dwg



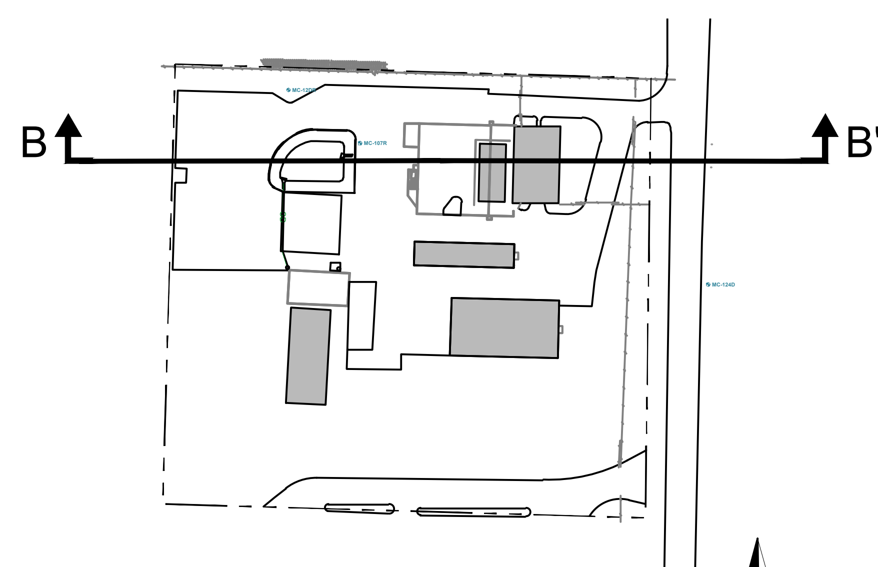
10
5
0
20
40
APPROXIMATE SCALE IN FEET
VERTICAL EXAGGERATION = 4X

LEGEND

MC-107 (21.5' N)	Well/Boring Identification (distance in feet and cardinal direction from cross section plane)
	Poorly Graded Sand
	Organic Soil or Silty Clay
	Screened Interval
	2006-2009 average high water level elevation
	2006-2009 average low water level elevation

NOTES

1. Contact are dashed where inferred.
2. Water levels were calculated using the average of the water level elevations from 2006-2009.
3. Original figure included as Figure 6-5 AMEC 2013 Remedial Investigation.



PLAN VIEW

0
200
Scale in Feet

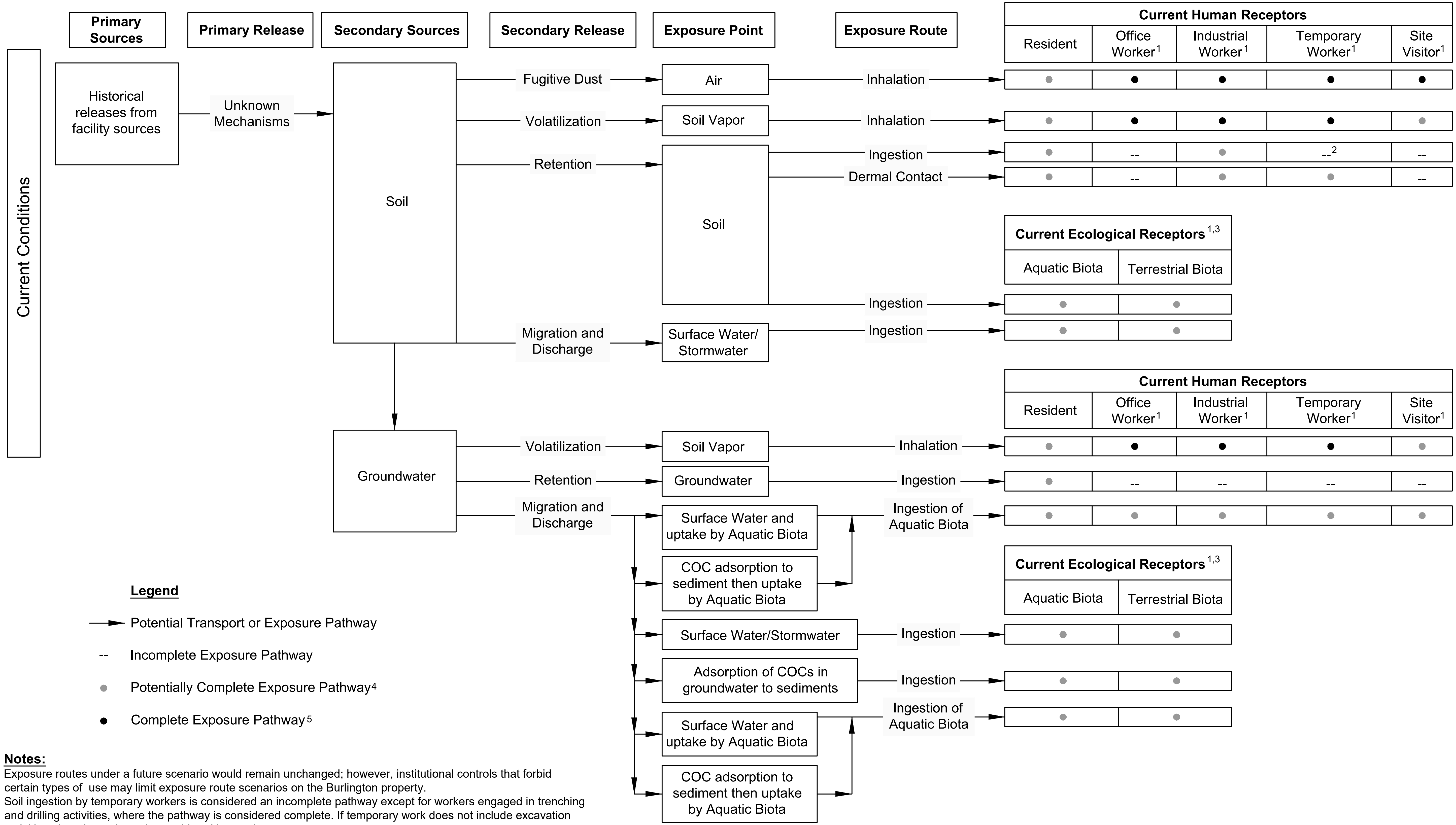
Burlington - Washougal Facility
Washougal, Washington

Representative Cross Section from 2013 Remedial Investigation

FIGURE 4

03/04/2022

PLOT TIME: 3/4/2022 4:16 PM MOD TIME: 3/4/2022 4:12 PM USER: Kelley Begley DWG: P:\Clean Earth\Washougal\CAD\2022-03\2022-03 Clean Earth Wash Fig 2-3 Rep Xsec.dwg



Notes:

1. Exposure routes under a future scenario would remain unchanged; however, institutional controls that forbid certain types of use may limit exposure route scenarios on the Burlington property.
2. Soil ingestion by temporary workers is considered an incomplete pathway except for workers engaged in trenching and drilling activities, where the pathway is considered complete. If temporary work does not include excavation activities, then the pathway is considered incomplete.
3. Dermal contact is not considered a complete pathway for ecological receptors. Note barium concentrations is excess of Ecological Indicator Soil Concentrations for the Protection of Terrestrial Plants and Animals (MTCA Table 749-3) are present on the property, but less than reported background. See Section 8.4 of Remedial Investigation Report (AMEC, 2013) for further detail.
4. A potentially complete exposure pathway exists when potential contamination exposure to an individual or population is considered possible but unlikely.
5. A complete exposure pathway exists when an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from the site.
6. Stormwater could potentially be impacted by soil or groundwater as noted above. There is no un-permitted stormwater discharge by the facility because they are covered by an industrial stormwater general permit.

Burlington - Washougal Facility
Washougal, Washington

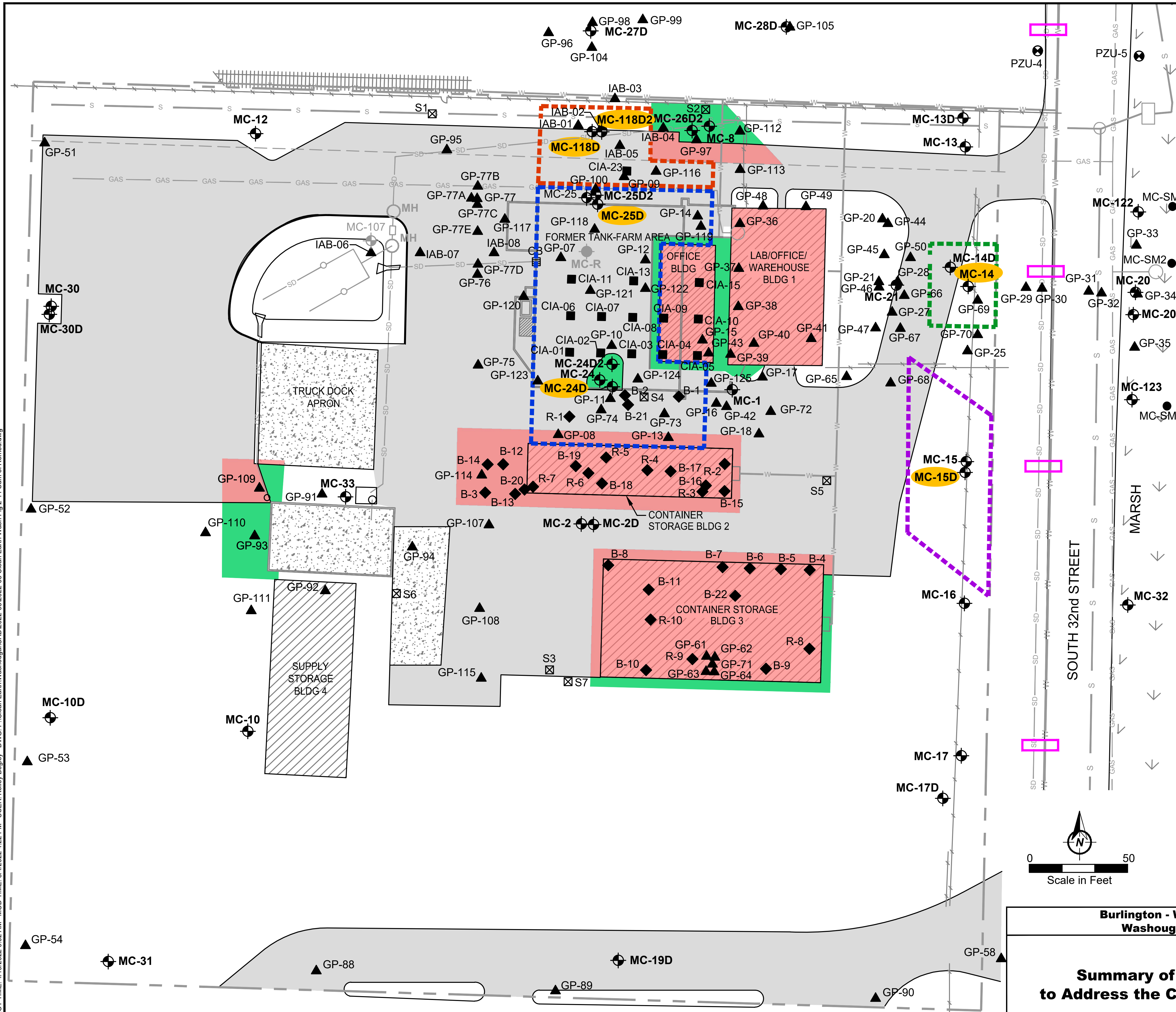
Conceptual Site Model - Receptors

DOF DALTON OLMSTED FUGLEVAND

FIGURE 5

03/04/2022

PLOT TIME: 3/4/2022 4:16 PM MOD TIME: 3/4/2022 4:12 PM USER: Kelley Begley DWG: P:\Clean Earth\Washougal\CAD\2022-03\2022-03 Clean Earth Wash Fig 2-10 Concept Model flow chart.dwg



LEGEND

- Property Line
- Sanitary Sewer
- Storm Sewer
- Water
- Gas
- C/E
- MC-13 Monitoring Well
- MC-107 Monitoring Well, Abandoned
- MC-R Recovery Monitoring Well, Abandoned
- PZU-4 Piezometer
- R-8 RCRA Closure Sample
- CIA-05 Historic Tank Farm Excavation Soil Confirmation Sample
- GP-101 Direct-Push Sample Location
- MH Stormwater Manhole
- CB Catch Basin
- S3 Sump
- Approximate Grout Location to Address Potential Groundwater Conduit (not to scale)
- Existing Capped Area to be maintained
- New Capped Area to be paved
- Downgradient Groundwater Treatment Area (Lower Aquifer)
- MC-14 Treatment Area (Shallow Zone)
- North Groundwater Treatment Area (Shallow Zone, Silt Layer, and Lower Aquifer)
- Former Tank Farm Groundwater Treatment Area (Silt Layer, and Lower Aquifer)
- Groundwater detections significantly above CULs or groundwater detections above CULs with stable or increasing trends.
- Asphalt
- Concrete

0 50
Scale in Feet

NOTE:
The effluent storm drain line was located in the field by others to a location near MC-8. The alignment is unknown beyond this location, but extends to South 32nd Street where it connects to the main line adjacent to the roadway.

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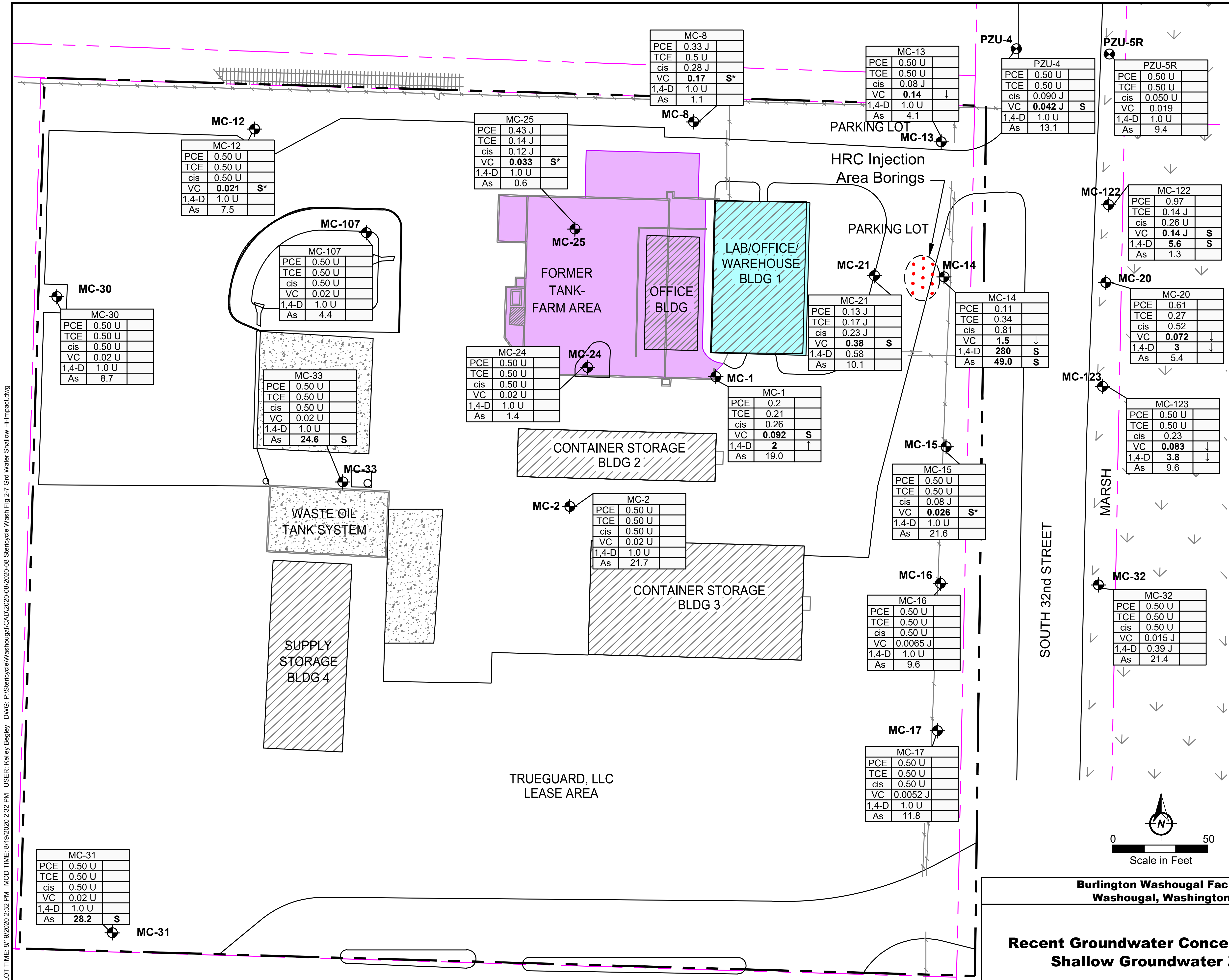
Summary of Remedial Areas to Address the Conceptual Site Model

DOF DALTON OLMSTED FUGLEVAND

FIGURE 6

04/19/2022

PLOT TIME: 4/19/2022 9:02 AM MOD TIME: 3/4/2022 4:22 PM USER: Kelley Begley DWG: P:\Clean Earth\Washougal\CAD\2022-03\2022-03 Clean Earth Wash Fig 2-11 Sum of Remed.dwg



LEGEND

- Property Line
- Offsite Parcel Line
- MC-13 Shallow Groundwater Zone Monitoring Well
- PZU-4 Piezometer
- HRC Injection Area Boring
- Depressurization System-Building 1
- Area of 1997 Excavation

DATABOX KEY

PCE	Tetrachloroethene
TCE	Trichloroethene
cis	cis-1,2-Dichloroethene
VC	Vinyl Chloride
1,4-D	1,4-Dioxane
As	Arsenic

Shallow CUL (ug/L)	
PCE	2.4
TCE	1
cis	16
VC	0.02
1,4-D	1
As	22.8

Location I.D.
Highest detected concentration (ug/L)
Average concentration (ug/L)

DATA QUALIFIERS

U= analyte was not detected at the quantitation limit indicated.
J= analyte was positively identified. Result is an estimated value.
Bold= above cleanup level.
↑= indicates an increasing concentration trend 2003 to 2019
↓= indicates a decreasing concentration
S= indicates a stable concentration
*= indicates a single anomalous detection above the cleanup level between 2Q 2018 and 1Q 2019

NOTES:

Values shown for VOCs and 1,4-Dioxane are highest detected concentrations (or highest detection limit for non-detect analytes) from four quarters of sampling (2Q2018 through 1Q2019). Values shown for arsenic are average total arsenic concentrations over four quarters of sampling.

Concentrations shown in μg/L.

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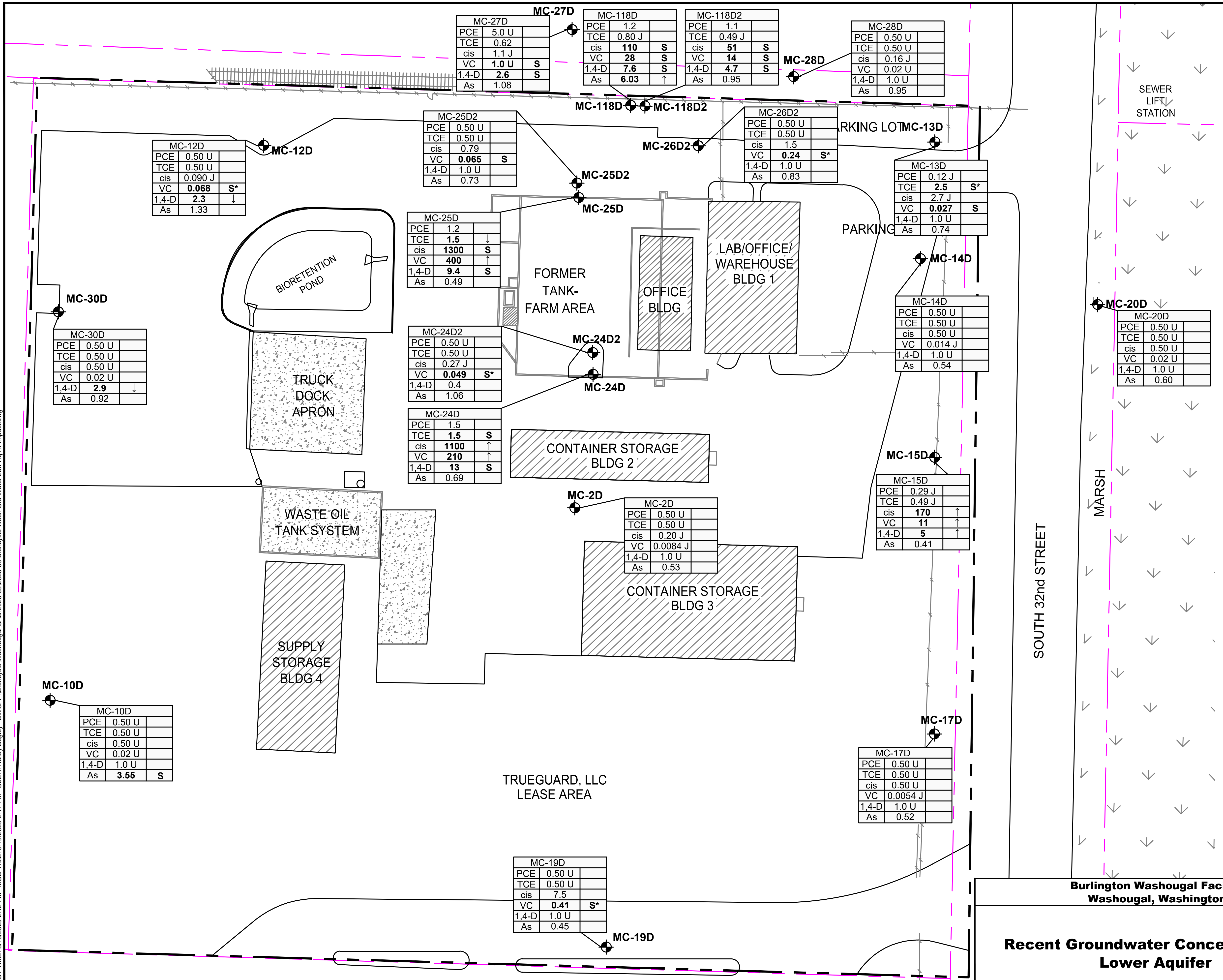
Recent Groundwater Concentrations - Shallow Groundwater Zone

DALTON OLMSTED FUGLEVAND

FIGURE 7

08/19/2020



LEGEND

- Property Line
- Offsite Parcel Line
- MC-13D Deep Groundwater Zone Monitoring Well

DATABOX KEY

PCE	Tetrachloroethene
TCE	Trichloroethene
cis	cis-1,2-Dichloroethene
VC	Vinyl Chloride
1,4-D	1,4-Dioxane
As	Arsenic

Deep CUL (ug/L)		
PCE	2.4	← Location I.D.
TCE	1	Highest detected concentration (ug/L)
cis	16	
VC	0.02	
1,4-D	1	
As	1.42	← Average concentration (ug/L)

DATA QUALIFIERS

U= analyte was not detected at the quantitation limit indicated.
J= analyte was positively identified. Result is an estimated value.
Bold= above cleanup level.
↑= indicates an increasing concentration trend 2003 to 2019
↓= indicates a decreasing concentration
S= indicates a stable concentration
*= indicates a single anomalous detection above the cleanup level between 2Q 2018 and 1Q 2019

NOTES:

Values shown for VOCs and 1,4-Dioxane are highest detected concentrations (or highest detection limit for non-detect analytes) from four quarters of sampling (2Q2018 through 1Q2019). Values shown for arsenic are average total arsenic concentrations over four quarters of sampling.

Concentrations shown in µg/L.

0 50
Scale in Feet

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Washougal, Washington

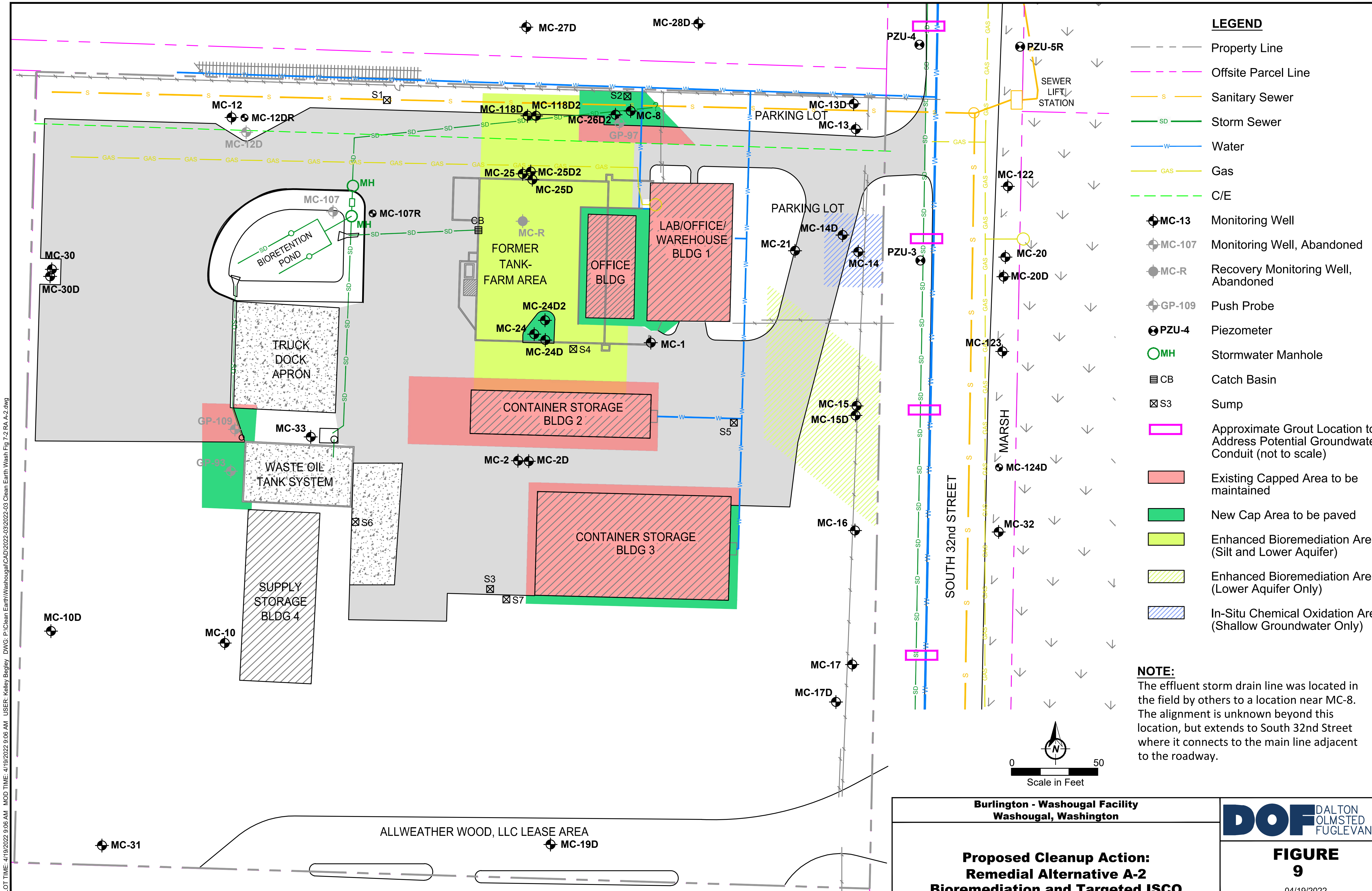
Recent Groundwater Concentrations - Lower Aquifer

DALTON OLMSTED FUGLEVAND

FIGURE 8

08/19/2020

PLOT TIME: 8/19/2020 2:42 PM MOD TIME: 8/19/2020 2:41 PM USER: Kelley Begley DWG: P:\Stericycle\Washougal\CAD\2020-08\2020-08 Stericycle Wash Grd Water Low Aq Hi-Impact.dwg



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Proposed Cleanup Action: Remedial Alternative A-2 Bioremediation and Targeted ISCO

DALTON OLMSTED FUGLEVAND

FIGURE 9

04/19/2022