# *Superlon Plastics Site: Remedial Investigation Phase V*
## *Work Plan for Characterization of Operational Unit 3 and Property Groundwater*

*The Superlon Plastics Site*
*2116 Taylor Way, Tacoma, WA*

Washington State Department of Ecology Cleanup Site ID 2096

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and

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**March 18, 2022**

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# 1. Introduction

This Work Plan (WP) presents the technical approach for further characterization of soil and perched water within Operable Unit (OU) 3 and groundwater located on the Superlon Plastics Property (Property). The Property is located at 2116 Taylor Way, Tacoma, Washington (see Figure 1). Work to be completed will occur on the Property and on adjacent Taylor Way. This work is necessary to obtain a better understanding of constituent concentrations in soil and perched water in OU 3 and in groundwater along the Property's perimeter which will be used to guide future phases of the groundwater portion of the Remedial Investigation (RI).

This Work Plan has been prepared on behalf of the White Birch Group, LLC (White Birch) and the Chemours Company FC, LLC (Chemours). These companies are hereafter referred to as the "Companies". The Companies or their authorized agent will complete the work described in this Work Plan in accordance with Model Toxics Control Act (MTCA), Chapter 173-340 of the Washington Administrative Code (WAC) under Agreed Order No. DE 5940.

The Agreed Order requires that the Companies submit a Work Plan to Ecology for review and approval whenever work is to be completed at the Superlon Plastics Site (Site) in accordance with WAC 173-340-350(7).

## 1.1. Site Location and Description

The Site is located in a highly industrial area of the Tacoma Tidal Flats between the Blair and Hylebos Waterways (see Figure 1). Definition of the Site boundaries (per MTCA) and an evaluation of data from other off Property media will be presented in a future RI/Feasibility Study (FS) and Cleanup Action Plan (CAP) for the Site. This approach, which has been approved by Ecology, was adopted in order to continue progress toward a final remedy for on-Property media, while continuing to investigate off-Property issues and to define the Site boundary (Ecology 2013a).

The Property is bordered to the northeast by Taylor Way, to the north by a curved rail road right-of-way owned by the City of Tacoma Public Works, to the northwest by Lincoln Avenue and a warehouse operation, and to the southeast by property leased and operated by Gardner-Fields Products, a roofing and waterproofing products manufacturing business (see Figure 2). To the southwest of the Property is a ditch located on the northeast side of a paved trucking yard owned by the Port of Tacoma (see Figure 2).

# 2. Background

A summary of key Site background information is presented in this section.

## 2.1. Site Setting

### 2.1.1. Climate

The marine-influenced climate at the Site is typical of Western Washington and is relatively mild. The average annual precipitation for Tacoma is approximately 40 inches, with most of the precipitation falling between October and April (Western Regional Climate Center 2019).

### 2.1.2. Topography and Drainage

The Site is relatively flat, with exception of a pond located on the eastern central portion of the Property and a drainage ditch located on Port of Tacoma property southwest of the Property (see Figure 2).[1] With the exception of the pond and ditch, topographic elevations generally range between 8 feet and 11 feet above mean sea level (msl). The surface water elevation of the pond fluctuates around 7 feet msl and the elevation of the ditch varies between 2.5 and 4 feet msl (ESM 2021). Stormwater on the Property flows via sheet flow to the pond where it infiltrates.

### 2.1.3. Geology

The underlying regional geology is dominated by Quaternary ice age glacial deposits. In general, regional glacial deposits include sand and gravel aquifers associated with glacial outwash and low permeability glacial till deposits containing clay and silt (Washington Division of Geology and Earth Resources 2015).

The Site is located within the tideflats of the Puyallup River delta. In general, the pre-development tideflats consisted of alternating layers of fluvial lower permeability silt/clay and sandy deposits primarily derived from Mount Rainer lahar deposits. In the early 1900s hydraulic fill from Commencement Bay and its tributaries (e.g., Hylebos and Blair Waterways) was used to raise the Property and surrounding areas above the tideflats. Review of aerial photographs indicates that additional fill was brought onto the Property between 1966 and 1975. This material extends from the land surface to 8 to 10 feet below ground surface (bgs) across the Property and includes fine sands and silts, large wood pilings, construction debris, industrial wastewater treatment sludge (from chlor-alkali manufacturing), manufacturing by-products imported from off-Property sources, and hydrated lime. The known extent of industrial wastewater treatment sludge was removed from the Property during the remedial actions discussed in Section 2.2.

Based on interpretations from the Site's soil boring logs and groundwater monitoring well logs the relevant lithologic units at the Site, from shallowest to deepest, include the following:

- Fill: The fill unit consisting of primarily hydraulic fill (fine sands and silts) with large wood pilings, construction debris, industrial wastewater treatment sludge, manufacturing by-products imported from off-Property sources, and hydrated lime
- Upper Silt: The upper silt unit is interpreted to be the historic tideflat surface and consists primarily of clayey silt to fine sandy silt

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[1] The ditch drains to the northwest along the northeast side of the Port of Tacoma property and then drains to the southwest within the City of Tacoma's right-of-Way along the northwest side of the Port of Tacoma property.

- Shallow Sand: The shallow sand unit consists primarily of a native fine to medium sand with shell fragments and silt interbeds, primarily derived from Mount Rainer lahar deposits.
- Lower Silt: The lower silt unit consists primarily of clayey silt to fine sandy silt.
- Lower Sand: The lower sand unit primarily consists of a fine to medium sand with silt interbeds.

### 2.1.4. Hydrogeology

Based on interpretations from the Site's soil boring logs and groundwater monitoring well logs the relevant hydrostratigraphic units at the Site, correspond to specific lithologic units and include the following from shallowest to deepest:

- Perched Aquifer: The Perched Aquifer is the saturated portion of the fill unit. The thickness of the Perched Aquifer is approximately eight to ten feet. Groundwater within the Perched Aquifer is typically encountered at depths of less than six feet bgs in most portions of the Site, and currently daylights in the pond during the winter months.
- Aquiclude: The Aquiclude is the upper silt unit (i.e., the historic tideflat surface). The thickness of the Aquitard is approximately five to ten feet. Thin and/or leaky portions of the upper silt have been identified in the central portion of the Property.
- Shallow Aquifer: The Shallow Aquifer is the shallow sand unit. The thickness of the Shallow Aquifer is approximately ten to 22 feet.
- Aquitard: The Aquitard is the lower silt unit. The thickness of the Aquitard is approximately five to ten feet.
- Intermediate Aquifer: The Intermediate Aquifer is the lower sand unit. The Intermediate Aquifer appears to be at least 20 feet thick.

The groundwater gradient in the aquifers is tidally influenced and will be evaluated during future phases of the RI process.

### 2.1.5. Property Land Use

The Property is currently owned by the White Birch Group, LLC and operated by Superlon Plastics Company, Incorporated, an extruded plastic pipe manufacturer. The northwestern half of the Property is developed with two industrial buildings (Buildings C and D and asphalt paved lots; see Figure 2). The ongoing Interim Actions (IAs) occupy the southeastern and western sections of the Property (see Section 2.2 for details on the IAs). Following the completion of the IAs the Property will be backfilled to match the grade of the northwestern half of the Property and paved with asphalt.

### 2.1.6. Overview of Ownership History

Historically the Property has had numerous owners and uses since its initial development. A history of Property ownership is listed below (Pacific Environmental and Redevelopment Corporation [PERC]/ PIONEER Technologies Corporation [PIONEER] 2011).

- In 1925, Latimer-Goodwin purchased an approximately 5-acre parcel from Buffelen Lumber & Manufacturing Company. Latimer-Goodwin developed it for the manufacture of lead arsenate pesticides.
- In 1944, Grasselli, a subsidiary of DuPont, purchased Latimer-Goodwin's land parcel and the pesticide manufacturing facilities located there. Grasselli manufactured lead arsenate and calcium

arsenate insecticides until 1946, and performed product mixing and agricultural chemical warehousing operations until 1949.

- In 1951, DuPont sold the Property to V.C. Monahan, who operated the Cabin Creek Lumber Company.
- In 1968, V.C. Monahan in turn sold the Property to Justus Company, Inc., who operated a wood treatment facility there.
- In 1972, Frank B. Lynott, of Justus Cedar Homes and Lindal Cedar Homes sold the Property to Mr. Ragnar M. Nars, to be used for Superlon Plastics Company, Incorporated.
- In 1992, the Property was subdivided evenly into thirds, all of which were re-consolidated and granted through a series of quit claim deeds to White Birch Group, LLC. White Birch continues to own the Property and Superlon Plastics Company continues to occupy the northwestern half of the Property.

## 2.2. Overview of Remedial Actions

Numerous investigation, evaluation, and cleanup activities have been performed at the Site since 2010. The remedial actions are summarized in the following subsections.

### 2.2.1. Remedial Investigation Phase I

The following actions were completed as described in the Phase I RI Work Plan (PERC 2010):

- Collected soil samples
- Collected sediment samples and a surface water sample from the ditch (Figure 2).
- Reviewed and compiled existing data about the Property and surrounding properties;
- Evaluated the nature and extent of fill material on-property;
- Evaluated the potential impacts from on-property surface water and storm water to the ditch;
- Preliminarily assessed the potential impacts from vapor intrusion;
- Used data collected during soil and groundwater sampling to evaluate the potential of utility corridors as preference pathways to contaminant migration; and,
- Determined additional information that would be needed to conduct an FS.

### 2.2.2. Remedial Investigation Phase II

The following actions were completed as described in the Phase II RI Work Plan (PERC/ PIONEER 2011):

- Performed a UST investigation and collected additional sediment samples from the ditch as well as additional soil samples as identified in the Phase II RI work plan. No soil samples were collected on the Gardner-Fields property. Gardner-Fields was not responsive to access requests and access to the Gardner-Fields property was not obtained. This represented the only exception to the scope of work listed in the Phase II RI work plan;
- Compiled all known data about the Property and surrounding properties;
- Assessed the potential impacts from vapor intrusion as new data was developed; and

- Expanded the evaluation of the potential impacts from off-property surface water and storm water to the ditch.

### 2.2.3. Remedial Investigation Phase III

The objective of the Phase III RI was to expand upon the knowledge learned during the Phases I and II of the RI and to thoroughly characterize existing conditions in groundwater throughout the Superlon Property and to complete characterization of soil at the Property. The following actions were completed as described in the Phase III RI Work Plan (PERC 2012a):

- Installed additional groundwater monitoring wells in the Shallow and Intermediate Aquifers (the current and former groundwater monitoring wells [MWs] are presented on Figure 3).
- Collected surface water samples from under former Building A and in the former Building B footprint (Figure 4).
- Re-evaluated COPCs and develop a focused list of Constituents of Concern (COCs) for the Site; and
- Developed a conceptual site exposure model that depicted the understanding of actual and potential exposure pathways to the site COCs that existed at that time.

### 2.2.4. Interim Action Phase I

The Phase I IA included (PERC 2012b):

- Removing surficial vegetation;
- Installing a coffer dam between former Buildings A and B to facilitate surface water management;
- Removing and disposing of a four-inch layer of surface soil across all exposed areas of the Property;
- Contouring the ground surface to direct surface water toward the pond under former Building B (Building B has since been removed and the pond is shown on Figure 2 southeast of Building C);
- Placing a compacted gravel layer over the area to prevent contact with contaminated soils;
- Characterizing Building B materials to determine the proper disposal option after demolition;
- Demolishing Building B and disposing the resulting debris; and,
- Securing the Building B footprint by placing a layer of quarry spalls over this area.

### 2.2.5. Interim Action Phase II

Phase II IA included the following steps and actions:

- Sludge excavation and disposal which included (PERC 2012c):
    - Excavating wastewater treatment sludge;
    - Characterizing excavated materials to determine the proper disposal option; and,
    - Disposing the excavated waste water treatment sludge.
- Building D soil removal and disposal which included (PERC 2014a):
    - Excavating soil exceeding excavation goals underneath the footprint of Building D, prior to construction of the building;

    - Characterizing excavated materials to determine the proper disposal option; and,
    - Disposing the excavated soils.
- Former Building B soil removal and disposal which included (documentation to be provided in the forthcoming Cleanup Action Plan Report for On-Property Soils and Perched Water).
    - Excavating soils exceeding excavation goals within the footprint of former Building B;
    - Characterizing excavated materials to determine the proper disposal option; and,
    - Dewatering and disposing the excavated soils.

### 2.2.6. Remedial Investigation Report for On-Property Soils and Surface Water

The RI for On-Property Soils and Surface Water (OSP) characterized the nature and extent of contamination in the context of past activities on the Property including presentation and evaluation of the analytical data, fill characteristics, and other pieces of information that had been collected on the Property through the completion of Phases I, II and III of the RI (PERC 2013). Specifically, the RI-OSP found that:

- Arsenic and lead are present in soil throughout the Property at concentrations exceeding industrial land use direct contact screening levels.
- Arsenic, cadmium, lead, pentachlorophenol and vinyl chloride in soil may be contributing to the presence of these constituents in the surficial aquifer.
- Total petroleum hydrocarbon (TPH) gasoline fraction, diesel fraction, and heavy oil fraction soil concentrations are greater than the industrial land use direct contact screening levels in a few isolated locations. In all cases these occurrences are co-mingled with arsenic and/or lead exceedances.
- Volatile organic compounds (VOCs; in particular trichloroethylene (TCE) and vinyl chloride) were associated with the wastewater treatment sludge formerly located in the western corner of the Property. An IA removed the VOC-containing wastewater treatment sludge, with the exception of a thin lens of the material at the excavation limits along the southern property boundaries in two directions - toward the Gardner-Fields property and toward the off-Property drainage ditch.
- Arsenic, cadmium, lead, mercury, TPH heavy oil fraction, pentachlorophenol, 1,2-cis-dichloroethylene, and TCE have been detected in perched water above drinking water screening levels.
- In addition, the RI-OSS identified six soil OUs areas (OU 1 through OU6) based upon their fill types. These six areas have distinct characteristics, and have been grouped based on their need for different remedial technologies. This WP includes additional evaluation of OU 3, which is defined by the limits of a hydrated lime layer that is present in the fill unit in the northern corner of the Property.

### 2.2.7. Feasibility Study for On-Property Soils and Perched Water

The FS-OSP presents the technical approach to remediate soils and perched water on the Property only (PERC 2014c). The FS-OSP determined the remedial action objectives (RAOs), Cleanup Levels (CLs), and Remediation Levels (RELs) which set the qualitative and quantitative remediation goals for the remediation of soils and perched water on the Property.

The FS-OSP identified one exposure pathway by which industrial workers could indirectly contact constituents in on-Property perched water. This involves the migration of constituents from perched water to groundwater, with the underlying groundwater used as part of a future process cooling water system. Under this scenario, exposure of industrial workers could occur as a part of maintenance activities on the cooling water system. Based on this pathway, the non-potable groundwater CLs for arsenic, cadmium and lead were calculated to be 0.67, 1.05 and 1.65 mg/l, respectively. However, this pathway is not complete as use of a groundwater-fed process cooling water system does not occur at the Property.

The FS-OSP identified the following two potentially complete exposure pathways for soil: (1) the soil-to-perched water pathway where constituents in soil leach or migrate into perched water; and, (2) direct contact with soils by a future utility worker.

CLs for the soil-to-perched water pathway were developed for arsenic and lead for each of the six OUs depending on the leachability of the material in each OU. The CLs for arsenic and lead in OU 3 were calculated at 114 and 2,121 micrograms per kilogram (mg/kg; see the FS-OSP for CLs for the other OUs).

CLs for the direct soil pathway were developed for arsenic and lead for the Property as a whole. The CLs for arsenic and lead were calculated at 588 and 1,000 mg/kg.

The FS-OSP determined that the CLs are the RELs for arsenic and did not specifically calculate RELs for lead, since arsenic and lead are typically co-located, and remediation of arsenic soils will also remediate lead to below the industrial CL for lead of 1,000 mg/kg.

The FS-OSP selected preferred remedial alternative for on-Property soils and perched water consists of:

- Installing a Slurry or Grout Wall Around the Property Perimeter;
- Treating Perched Water to the Perched Water REL;
- Excavating and Disposing of Soil Greater Than Direct Contact RELs in OUs 4 and 6;
- Excavating and Stabilizing Soils Greater Than Soil-to Perched Water RELs in OUs 1, 2, and 3;
- Covering the Property; and,
- Applying a Deed Restriction to Ensure On-Going Industrial Land Use

After completion of the six cleanup actions, on- and off-Property groundwater will be monitored to determine the progress of natural attenuation.

### 2.2.8. Feasibility Study for On-Property Soils and Perched Water Addendum 1

The FS-OSP Addendum 1 presents a revised remedial alternative that was determined during the remedial design process to implement the FS-OSP selected alternative (PERC 2014c; PERC/PIONEER 2017b). The revised alternative removed installing a slurry or grout wall around the Property perimeter. Ecology agreed to the revised remedial alternative on August 24, 2017, which consists of:

- Treating Perched Water to the Perched Water REL;
- Excavating and Disposing of Soil Greater Than Direct Contact RELs in OUs 4 and 6;
- Excavating and Stabilizing Soils Greater Than Soil-to Perched Water RELs in OUs 1, 2, and 3;
- Covering the Property; and,
- Applying a Deed Restriction to Ensure On-Going Industrial Land Use

After completion of the five cleanup actions, on- and off-Property groundwater will be monitored to determine the progress of natural attenuation.

### 2.2.9. Cleanup Action Plan for On-Property Soils and Perched Water

The CAP-OSP summarizes the technical approach of the preferred remedial alternative that was selected in the FS-OSP (see Section 2.2.7; PERC/PIONEER 2015b). The CAP-OSP includes installing a slurry or grout wall around the Property perimeter as selected in the FS-OSP. However subsequent to Ecology's approval of the CAP-OSP the FS-OSP Addendum 1 was approved by Ecology which removed installing a slurry or grout wall around the Property perimeter from the selected remedy. As such a slurry or grout wall will not be installed around the Property perimeter as part of the CAP-OSP. Remediation of soils and perched water on the Property as described in the CAP-OSP are ongoing, under an interim action approach approved by Ecology in 2017 (PERC/PIONEER 2018a). Following remediation of soils and perched water the Property will be covered with a cap and a deed restriction will be placed on the Property to ensure industrial land use.

### 2.2.10. Remedial Investigation Phase IV Characterization of Drainage Ditch Sediment

Phase IV RI consisted of characterization of the sediment and surface water in the drainage ditch (see Figure 2; PERC/PIONEER 2017a). The RI Phase IV included a sampling event on September 7th and 8th, 2016 to characterize the nature and extent of arsenic and lead as well as TPH in ditch sediment and surface water that remain after remediation of an asphalt tar oil spill (Ecology 2015b). Gardner-Fields Products spilled asphaltic tar oil on their property and approximately 70,000 gallons was released into the ditch on February 8, 2015 (Ecology 2015b). ERM, on behalf of Gardner-Fields Products, conducted remediation in the ditch (including sediment removal) to address the spill. Post-remediation sediment samples were collected and the results indicated that elevated arsenic (up to 330 mg/kg) and lead (up to 350 mg/kg) concentrations remained in the ditch (ERM 2015).

The Phase IV RI used the following sediment screening levels for this evaluation:

- Washington State sediment background concentrations; and
- MTCA Lower Tier Freshwater Sediment Cleanup Objectives (SCOs), Freshwater Sediment Cleanup Levels (SCLs), and Upper Tier Freshwater Sediment Cleanup Screening Levels (SCSLs), as promulgated by Ecology in the Sediment Cleanup User's Manual II (Ecology 2015a).

Based on data collected during the September 2016 sampling event the Phase IV RI determined that the SCSL exceedances for all constituents were primarily located in surface sediment (i.e., 0-0.5 feet bgs). The majority of concentrations collected from 0.5 to 8 feet bgs were non-detect or were detected below background concentrations. Residual contamination above SCLSs/SQOs from the asphalt tar oil spill remained in surface sediment in the ditch.

### 2.2.11. Interim Action Phase III Ditch Remediation

Based on the findings from Phase IV RI, Phase III IA was initiated to remediate the drainage ditch. Phase III IA addresses the arsenic and lead concentrations that are present in the ditch adjacent to the Superlon property that are potentially associated with the Superlon site.

The objectives of Phase III IA are to excavate the:

- Top one foot of the sediment in the ditch in areas where arsenic concentrations exceed the Freshwater SCOs and Freshwater SCSLs promulgated by Ecology in the Sediment Management Standards (Ecology 2013b);

- Eastern berm of the ditch where arsenic and lead concentrations exceed the MTCA industrial cleanup standards for the Port of Tacoma property; and
- Remaining berm soil between the Superlon/Port of Tacoma property line and the western limits of the excavations previously conducted on the Superlon Property to remediate arsenic and lead concentrations exceeding site-specific RELs.

IA Phase III was initiated in 2020 and is expected to be completed by 2022.

### 2.2.12. Groundwater Monitoring

Groundwater monitoring (GWM) has been conducted at the site since 2011. GWM was conducted quarterly from the third quarter of 2011 until the fourth quarter of 2015, when the sampling frequency was reduced to one event per year (Ecology 2015c). The results of the 2015-2021 GWM events were documented in the 2015, 2016, 2017, 2018, 2019, 2020, and 2021 GWM Reports (PERC/PIONEER 2015a, 2016, 2017c, 2018, 2019, 2021a and 2021b). The results from the most recent GWM event indicate that arsenic concentrations in the Shallow Aquifer appear to be fluctuating with a significant decrease in MW-9S and a significant increase in MW-13S[2], while arsenic and lead concentrations in the Intermediate Aquifer and lead concentrations in the Shallow Aquifer are stable (PERC/PIONEER 2021b).

The GWM well network historically consisted of 26 Shallow and Intermediate Aquifer co-located MWs installed at 12 locations on and off of the Property. As of 2021, 10 MWs remained in place, while the other 16 have been decommissioned (see Figure 3). A brief history of MW locations is presented below:

- Seven Shallow Aquifer MWs (MW-1S – MW-7S) were installed during Phase I RI activities in 2011, in accordance with the Phase I RI Work Plan (PERC 2010).
- One Shallow Aquifer MW (MW-8S) and eight Intermediate Aquifer MWs (MW-1I – MW-8I) were installed during Phase III RI activities in 2012, in accordance with the Phase III RI Work Plan (PERC 2012a).
- Four Shallow Aquifer MWs (MW-9S – MW-12S) and four Intermediate Aquifer MWs (MW9I – MW12I) were installed during Phase IV RI activities in 2014, in accordance with the Phase IV RI Work Plan (PERC 2014b).
- Sixteen MWs were decommissioned in 2017 (MW-1I, MW-1S, MW-3I, MW-3S, MW-5I, MW-5S, MW-6I, MW-6S, MW-7I, MW-7S, MW-8I, MW-8S, MW-11I, MW-11S, MW-12I, and MW-12S; PERC/PIONEER 2018b).
- One Shallow Aquifer MW (MW-13S) and one Intermediate Aquifer MW (MW-13I) were installed in November 2019 (PERC/PIONEER 2021a).[3]

## 2.3. Primer on Geochemical Attenuation of Arsenic

Since arsenic does not degrade in the environment and geochemistry plays a critical role in attenuating arsenic, this section presents a brief primer on geochemical attenuation to provide context for the proposed groundwater investigation presented in Section 3. The natural attenuation of arsenic in groundwater in general, and the natural attenuation that is presumably occurring within portions of the arsenic plume, is dependent on three geochemical attenuation mechanisms and several geochemical conditions (Argonne National Laboratory 2003; Savannah River National Laboratory 2011; USEPA 2007a,

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[2] These fluctuations are presumably due to the ongoing soil and perched groundwater interim action (see Section 2.2.8)

[3] MW-13S and MW-13I were installed in the proximate location of MW-3S and MW-3I which were abandoned in 2017 to allow for soil remediation.

2007b, 2015).[4] The three geochemical attenuation mechanisms (in decreasing order of long-term stability) are (1) precipitation or co-precipitation with recalcitrant and highly stable minerals, (2) co-precipitation with metal oxides (e.g., iron oxides), and (3) sorption. The occurrence of these three mechanisms, which involve partitioning of dissolved arsenic from the aqueous phase to the solid phase (i.e., soil or sediment), will be evaluated at the Site by analyzing soil using a sequential extraction procedure. A brief description of each mechanism, along with the geochemical conditions typically associated with the mechanism, is presented in the three following paragraphs.

Arsenic that has precipitated or co-precipitated with highly stable minerals is not environmentally available for transport back to the dissolved phase because the arsenic has been incorporated into the mineral and the mineral will remain intact under a wide range of geochemical conditions (including current and anticipated future geochemical conditions at the Site). Arsenic-containing minerals incorporate arsenic directly as the mineral precipitates. Arsenic can also be incorporated indirectly with non-arsenic minerals as an impurity during mineralization. A preliminary evaluation of the geochemical conditions documented during the sampling of the Site's Shallow and Intermediate Aquifer MWs indicate that a variety of highly stable minerals would be expected to precipitate and incorporate arsenic directly or indirectly during precipitation (PERC/PIONEER 2021b).[5] The presence of arsenic within highly stable minerals at the Site will be confirmed by the results of the sequential extraction procedure discussed in Section 3.

Co-precipitation of arsenic with metal oxides (e.g., iron oxides) is not as favorable in terms of long-term attenuation stability as precipitation/co-precipitation with highly stable minerals because metal oxides can be reduced and dissolved by bacteria as part of their respiration process. However, co-precipitation of arsenic with metal oxides can provide stable attenuation of arsenic as long as oxygen is present. When oxygen is present, bacteria use oxygen instead of metal oxides in respiration, leaving the metal oxides intact. Precipitation of metal oxides, and incorporation of arsenic indirectly in the metal oxide mineral as a co-precipitate, occurs in locations where reduction-oxidation (redox) conditions transition from reducing (e.g., Eh less than 0 V) to oxidizing (e.g., Eh greater than 0 V). Thus, as long as redox conditions remain oxidizing (and favorable for metal oxides), arsenic that has co-precipitated with metal oxides will remain in the solid phase. The presence of arsenic within metal oxide minerals will be confirmed by the results of the sequential extraction procedure discussed in Section 3.

Although sorption of arsenic on the solid phase is an important geochemical attenuation mechanism, sorption is considered the least stable of the three geochemical attenuation mechanisms because arsenic can desorb from the solid phase and mobilize back to the aqueous phase if one or more geochemical conditions change. In particular, sorption of the key arsenic species (arsenate and arsenite) can be affected by changes to pH and/or redox conditions. The ability of arsenic to sorb to the solid phase is better when pH is in a neutral range (e.g., pH between 6 and 8) compared to a basic pH (e.g., pH greater than 9).[6,7] Furthermore, the ability of arsenic to sorb to the solid phase decreases proportionally as the

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[4] The information in this section is based on these references and personal correspondence between Dr. Rebecca Neumann (University of Washington) and Troy Bussey (PIONEER) from November 2016 through June 2019.

[5] The 2011 through 2021 activity of electrons (Eh) values in the Shallow and Intermediate MWs ranged from -0.13 to 0.47 volts (V). The 2011 through 2021 pH results ranged from 6.0 to 9.0, with the exception of three outliers equal or exceeding 11.0.

[6] At a neutral pH, the surface charge of metal oxides (which sorb arsenic in the aquifers) is positive, aqueous arsenate exists as negatively charged oxyanions, and aqueous arsenite exists as a neutrally charged species. Because the charges on the sorption surface and arsenic species are aligned to attract each other, the electrostatic attractions that facilitate sorption are more compatible in a neutral pH range. By contrast, the sorption surface and arsenic species are less attracted to each other at a basic (elevated) pH because the metal oxide surface and both arsenic species are negatively charged.

[7] Arsenate sorption increases and arsenite sorption decreases as pH becomes more acidic (e.g., decreases from pH 6 to pH 1).

pH becomes increasingly basic (elevated).[8] The ability of arsenic to sorb to the solid phase is better in oxidizing conditions (e.g., Eh greater than 0 V) than reducing conditions (e.g., Eh less than 0 V). Oxidizing conditions are better for arsenic sorption primarily because iron oxide minerals are typically present in oxidizing conditions, and iron oxide minerals provide solid-phase sorption surfaces for arsenic.[9] These sorption surfaces can consist of existing iron oxide minerals that have already precipitated or fresh iron oxide minerals that form where redox conditions transition from reducing to oxidizing. Locations in which Eh exceeds 0 V and iron oxide concentrations exceed 1,000 mg/kg are considered favorable for arsenic sorption (Savannah River National Laboratory 2011). Beyond pH and redox conditions, secondary geochemical conditions that can affect sorption include ionic strength and the presence/absence of competitive anions. The ability of arsenic to sorb to the solid phase generally increases as the ionic strength of the aqueous phase increases because sorption surfaces are more positively charged at higher ionic strengths, which facilitates increased sorption of negatively charged arsenic oxyanions.[10] If excessive concentrations of competitive anions such as ortho-phosphate and silicate are present, the ability of arsenic to sorb to the solid phase can decrease because ortho-phosphate and silicate can compete with arsenic oxyanions for sorption surfaces.

In summary, ideal conditions for arsenic attenuation (in general order of importance) include:

- The presence of arsenic within highly stable minerals;
- Oxidizing conditions (e.g., Eh greater than 0 V);
- pH in a neutral range (e.g., pH between 6 and 8);[11]
- Iron oxide concentrations greater than 1,000 mg/kg;
- Elevated ionic strength (e.g., elevated conductivity values); and
- Lower concentrations of competitive anions such as ortho-phosphate and silicate.

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[8] As pH becomes more basic (e.g., increases from pH 9 to pH 11), the sorption surface becomes more negatively charged, which further reduces the attraction of negatively charged arsenic species to the sorption surface.

[9] Manganese and aluminum oxides can also provide sorption surfaces for arsenic.

[10] Conductivity and total dissolved solids are indicators of the ionic strength of the aqueous phase.

[11] Alternatively, ideal attenuation conditions could include an acidic pH if arsenate is the predominant species.

# 3. Phase V Remedial Investigation – Scope of Work

## 3.1. Purpose

The purpose of this section is to present the methodology for collecting and analyzing soil and groundwater samples pursuant to this Work Plan in accordance with WAC 173-340-820 and applicable components of Ecology guidance (Ecology 1995). Specific methods to be used to complete the field investigation are described in the Sampling and Analysis Plan / Quality Assurance Project Plan (SAP/QAPP; PERC/PIONEER 2022).

## 3.2. Sampling Design

This section presents the sampling design of Phase V to determine the following:

- The hydraulic connection between the Perched and Shallow Aquifers.
- The distribution of arsenic and lead in the vadose zone soil and Perched Aquifer soil and groundwater in OU 3.
- The prevalence of arsenic within highly stable minerals and iron oxide concentrations within the Perched Aquifer.
- The distribution of dissolved arsenic and lead in groundwater along the property boundary.

As part of Phase V, the Companies will collect and analyze groundwater and soil samples as summarized in Table 1 (see Figure 4 for sample locations). The SAP/QAPP summarizes the analytical methods, target reporting limits, and holding times for all media and analytes.

### 3.2.1. Connection between the Perched and Shallow Aquifers

Evaluation of the groundwater levels measured in the Shallow Aquifer indicate that the water level pressure in the Shallow Aquifer could extend above the Aquiclude and into the Perched Aquifer. If this occurs this could be the result of two scenarios:

(1) The Aquiclude is a continuous low permeability confining layer that is inhibiting the migration of groundwater from the Shallow Aquifer to the Perched Aquifer making the Shallow Aquifer a confined aquifer[12], or

(2) The Aquiclude is a leaky-discontinuous low permeability layer and the groundwater levels measured in the Shallow Aquifer extend up into the Perched Aquifer.

To determine if this scenario is possible the following analysis will be conducted:

- To determine the vertical intervals of the Perched and Shallow Aquifers and the Aquiclude, a hydraulic profiling tool (HPT) will be advanced to 20 feet bgs using direct push technology at three locations (HPT-01, HPT-02 and HPT-03; see Figure 4).
- Adjacent to each of the three HPT locations, hydropunches will be installed using direct push technology into the Perched and Shallow Aquifers. The hydropunches will be left in place concurrently for 24-hrs in the Perched and Shallow Aquifers to determine the piezometric head for both aquifers (TW-MW-5P/S, TW-MW-6P/S, TW-MW-12P/S; see Figure 4). A groundwater sample will also be collected and analyzed for dissolved arsenic and lead from the Perched and

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[12] A confined aquifer is an aquifer below the land surface that is saturated with water. Layers of low permeability sediments are both above and below the aquifer, causing it to be under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Shallow Aquifers at each HPT location following the procedures and methods presented in Section 3.2.2.2 of the SAP/QAPP.[13]

### 3.2.2. Distribution of Arsenic in the Vadose Zone and Perched Aquifer Soils in OU 3

To more clearly determine the distribution of arsenic and lead in the vadose zone and Perched Aquifer in OU 3 the following analysis will be conducted:

- Seven direct push continuously cored soil borings will be advanced to 10 feet bgs in OU 3 (OU3-SB-1 through OU3-SB-7; see Figure 4).[14] The soil borings will be visually inspected and described in standard geologic terms in the field logbook as defined by the Unified Soil Classification System. The visual inspection will focus on the determination of soil types throughout the length of the core, and will note any waste or other non-native materials occurring within the core.
- Twelve-inch soil samples will be collected from each soil boring at approximately 3 to 4, 6 to 7 and 9 to 10 ft bgs. Each soil sample will be analyzed onsite for arsenic and lead via X-ray fluorescence (XRF). Up to eight of the soil samples will be subsequently analyzed for (1) the RCRA 8 metals and (2) arsenic and lead using the appropriate leachability procedure.[16] To determine if arsenic is prevalent within highly stable minerals and if iron oxide concentrations are prevalent in the phreatic zone, up to seven of the samples collected at 9 ft bgs will be analyzed for arsenic and iron using the sequential extraction procedure (SEP).[17] The SEP samples will be collected by splitting the 9 ft bgs soil samples into two six-inch sections. One six-inch section will be homogenized and analyzed for the non-SEP analysis. The other six-inch section will be used for SEP analysis and will be homogenized and collected under anoxic conditions to prevent arsenic from changing states due to oxidation.[18]
- If groundwater is encountered in any of the seven direct push soil borings, it will be sampled and analyzed for dissolved arsenic and lead following the procedures and methods presented in Section 3.2.2.2 of the SAP/QAPP.

### 3.2.3. Distribution of Dissolved Arsenic and Lead along the Property Boundary

The overall project schedule includes monitoring the on- and off-Property groundwater to determine the progress of natural attenuation following completion of the ongoing OSP clean-up actions (Ecology 2013a). The GWM network will be expanded in phases to delineate and monitor the groundwater plume, in order to determine the progress of natural attenuation. Prior to installing MWs in 2023 a better

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[13] Hydropunches use a stainless screen that is shielded as it is pushed to the desired sample depth, and is then exposed at a discrete depth. After each hydropunch location has been allowed to equilibrate with the aquifer for at least 24 hrs the water level in the hydropunch will be measured and recorded and a groundwater sample will be collected following the procedures and methods in the SAP/QAPP.

[14] OU3-SB-1 is located adjacent to HPT-02 and will be advanced to 20 ft bgs to calibrate the HPT.

[16] The leachability procedure will be determined based on the pH of the soil; If the pH value is less than six TCLP will be used, if the pH value is greater than six SPLP will be used per WAC 173-340-747(7).

[17] SEP analysis will be in accordance with Brooks Analytical Laboratories of Bothell, WA standard procedures using a modified version of the Wenzel et al 2001 methodology (BAL-5913). Analysis includes five-step selective sequential extraction method (i.e., (1) $NH_4H_2PO_4$, (2) $NH_2OH*HCl$, (3)$NH_4$+-oxalate, (4) $HNO_3/H_2O_2$, and (5) $HCl/HF/HNO_3$), for correlation between metals (aluminum [Al], arsenic [As], iron [Fe], manganese [Mn], and silicon [Si]) and different substrate properties. Other analyses include total recoverable arsenic.

[18] Anoxic sampling conditions will be maintained by homogenizing and containerizing the soil samples within a leak proof box without a lid (e.g., cooler) that has dry ice sublimating nitrogen and displacing oxygen from the box. An oxygen meter (e.g, RAE Systems QRAE) will be used to ensure the cooler remains anoxic (i.e., oxygen less than 5%). The soil samples will be delivered to the lab in a cooler with dry ice.

understanding of the Site's hydrostratigraphy and the migration of dissolved arsenic and lead across the Property boundary is needed to guide the location of future MWs. The following analysis will be completed to determine the vertical extent of the Perched, Shallow and Intermediate Aquifers and the dissolved arsenic and lead concentrations in the aquifers along the Property boundary:

- To determine the vertical intervals of the Perched, Shallow and Intermediate Aquifers along the property boundary an HPT will be advanced to 50 feet bgs using direct push technology at eight locations (HPT-GW-01 through HPT-GW-08 see Figure 4). [19, 20]
- Following the determination of the aquifers' vertical intervals using the HPT, groundwater samples will be collected from each of the aquifers at each of the eight locations. The groundwater samples will be collected from hydropunches installed in the Perched, Shallow, Intermediate Aquifers to collect groundwater samples for dissolved arsenic and lead following the procedures and methods presented in Section 3.2.2.2 of the SAP/QAPP.

## 3.3. Pre-Mobilization

Prior to the implementation of this Work Plan, a number of important pre-mobilization coordination tasks will need to be completed. Key pre-mobilization coordination tasks include:

- Coordinate the anticipated field schedule with Ecology.
- Coordinate the scope of work and field schedule with all on-site personnel.
- Coordinate with Chemours, PERC, PIONEER, and on-site contractors, regarding health and safety details specific to this project (e.g., field team organization and communication, potential hazards and associated controls, work zones, decontamination, personal protective equipment, air monitoring).
- Obtain necessary health and safety paperwork from team members (e.g., training records).
- Call the Washington Call Before You Dig phone number for all proposed excavation and drilling locations.
- If necessary, conduct a private utility locate for excavation and drilling locations.
- If necessary, core through asphalt/concrete to facilitate drilling activities.
- Ensure the licensed driller submits the necessary notices of intent and associated fees to the Ecology Water Resources Program for proposed drilling locations.
- Coordinate with the PERC Project Manager, the licensed driller, and XRF Field Screening staff to ensure that sample volume, sample preparation, and sample preservation requirements can be met for the XRF measurements and the laboratory analyses.
- Coordinate with the project laboratories on key elements of the SAP/QAPP (e.g., sample volume, sample preservation, analytical methods and analytes, field quality control samples, target reporting limits).
- Obtain sample containers from the project laboratories.

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[19] This evaluation in not designed to determine the lower extent of the Intermediate Aquifer, which is deeper than 50 feet bgs.

[20] HPT-GW-08 is located on the far side of the Taylor Way from the Property to determine if the dissolved arsenic concentrations detected in MW-2S and MW-2I are migrating onto the Property from offsite.

- Obtain the necessary equipment and supplies (e.g., water level meter, water quality multimeter, dry ice and oxygen meter for anoxic field preservation, soil pH field meter, 0.45-micron filters).
- Coordinate access with the City of Tacoma for boring location HPT-GW-08.

## 3.4. Decontamination

Between boring locations and following the completion of the second boring location the GeoProbe® rod, HPT and hydropunches will be decontaminated using the following three-step process:

1. Each length of pipe will be pressure washed.
2. The exterior and interior surfaces of each rod will be scrubbed using Alconox® soap.
3. The exterior and interior surfaces of each rod will be re-washed using a pressure washer.

Decontamination of personnel and equipment will follow the procedures identified in the Project Health and Safety Plan (PERC/Pioneer 2012).

## 3.5. Boring Completion and Surveying

Following sampling, each boring will be backfilled with bentonite chips or grout in accordance with Chapter 173-160 WAC.[21] Boring locations will be surveyed, establishing horizontal coordinates using a handheld GPS unit.

## 3.6. Reporting

Upon receipt of the qualified laboratory data a Technical Memorandum will be developed that will include:

- A description of the work completed, noting any exceptions to the methodology described in this work plan;
- Figures showing the sampling locations and the observed lithology in those locations;
- HPT and soil boring logs for boring locations;
- The findings of the laboratory analyses; and
- Interpretation of the investigation's findings.

The findings presented in the Technical Memorandum will be used to guide the location of future MWs and will be incorporated into the RI/FS following delineation of the groundwater plume.

## 3.7. Schedule

The preparatory and field work described in this work plan will be completed within the 1st and 2nd Quarters of 2022. The Technical Memorandum will be completed by the 4th quarter of 2022.

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[21] HPT borings will be backfilled with bentonite chips or grout immediately after extraction of the HPT probe from the boring.

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# Figures:

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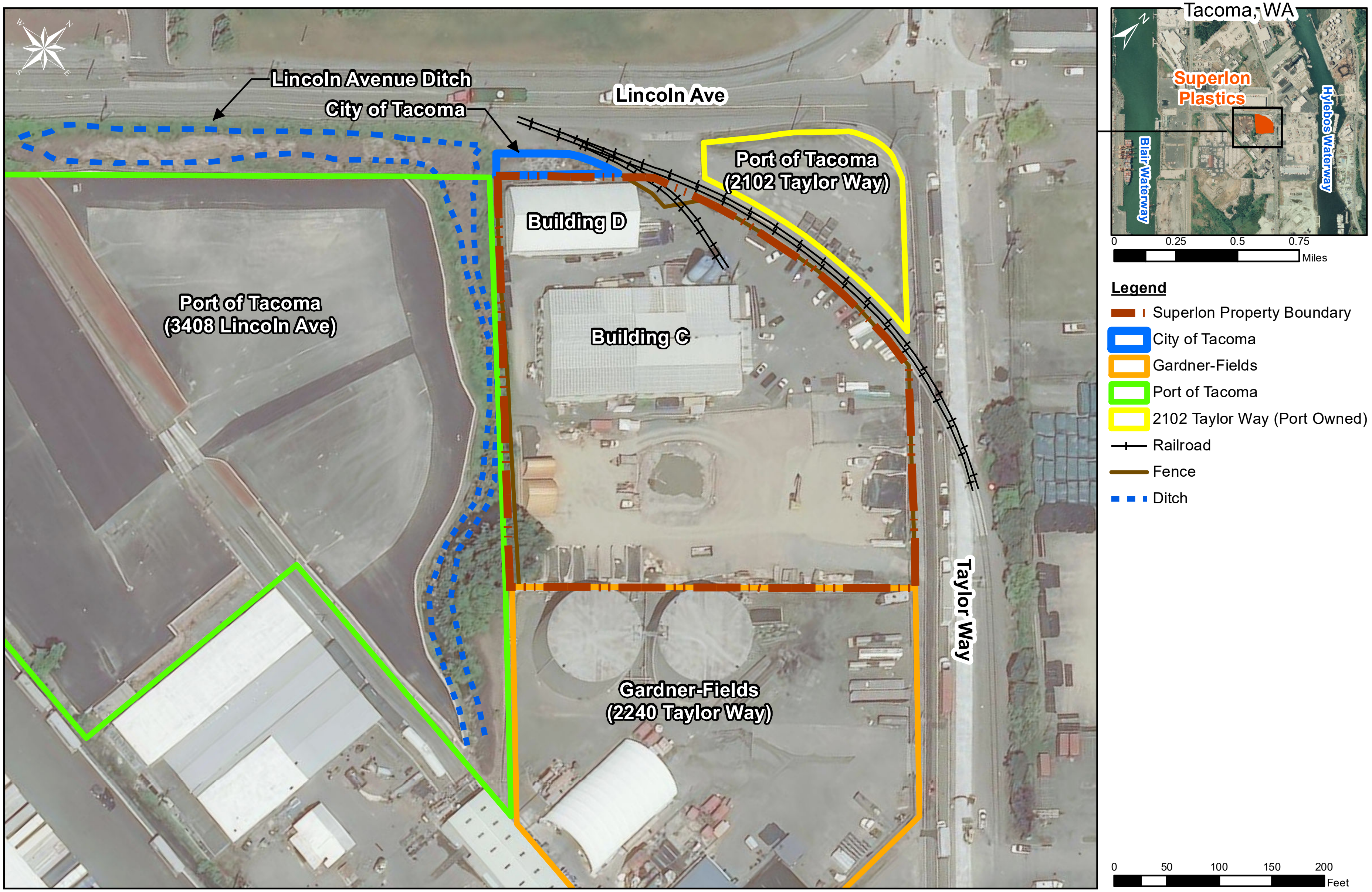
Superlon Property Location
Remedial Investigation Phase V Work Plan
Superlon Plastics Property, Tacoma, Washington

Figure 1

*Document Path: G:\Projects\Superlon\Maps\2022\RI Phase V WP\Figure 1_Superlon Site Location.mxd; Author: SM; Date Saved: 2/3/2022*



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Property Features
Remedial Investigation Phase V Work Plan
Superlon Plastics Property, Tacoma, Washington

Figure 2

PIONEER

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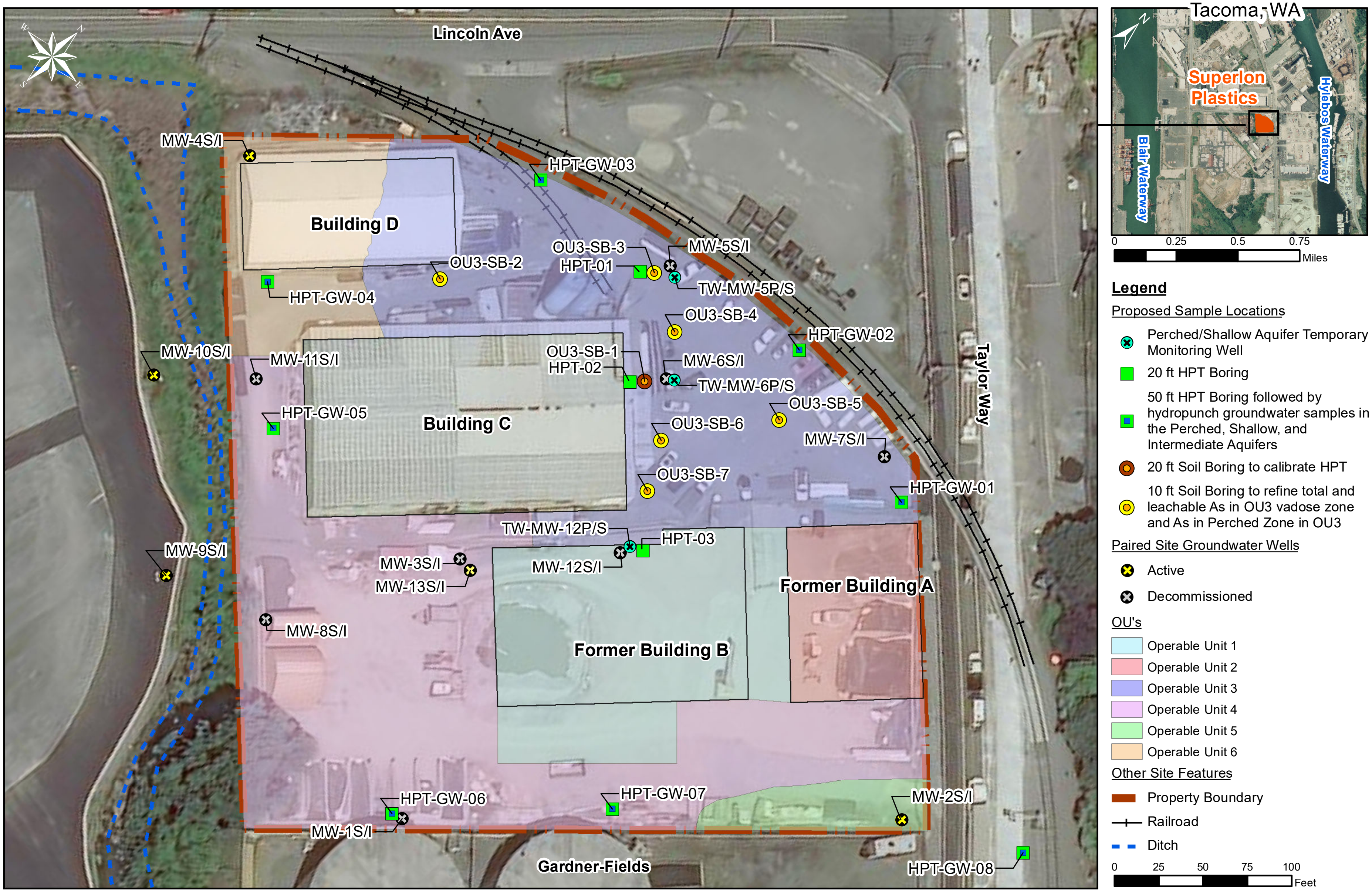
# Monitoring Well Locations
# Remedial Investigation Phase V Work Plan
# Superlon Plastics Site, Tacoma, Washington

Figure 3

Document Path: G:\Projects\Superlon\Maps\2022\RI Phase V WP\Figure 3_Locations of MWs.mxd; Author: MK; Date Saved: 2/3/2022



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Proposed Sample Locations
Remedial Investigation Phase V Work Plan
Superlon Plastics Property, Tacoma, Washington

Figure 4

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# Tables:

## Table 1: Sampling Design for SuperIon RI Phase V - OU 3 and Property Groundwater Investigation

| Boring ID | Boring Location Note[1] | Estimated Boring Depth (in feet bgs) | Media | Potential Sample Interval (in feet bgs) | Sample Purpose | Constituents | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Arsenic and Lead GW[2] | Arsenic and Lead XRF Soil | RCRA 8 Metals Soil | STLC/TCLP Arsenic & Lead | SEP Analysis[3] |
| HPT-01 | HPT locations are designed to determine the intervals of the Perched and Shallow Aquifers and the Tidal Mudflat Aquiclude. | 20 | N/A | N/A | HPT results will guide groundwater sample intervals at TW-MW-5P/S | N/A | N/A | N/A | N/A | N/A |
| HPT-02 | | 20 | N/A | N/A | HPT results will guide groundwater sample intervals at TW-MW-6P/S | N/A | N/A | N/A | N/A | N/A |
| HPT-03 | | 20 | N/A | N/A | HPT results will guide groundwater sample intervals at TW-MW-7P/S | N/A | N/A | N/A | N/A | N/A |
| TW-MW-5P/S | At each location a hydropunch screen will be installed for 24-hrs in the Perched and Shallow Aquifers to determine the piezometric head for both aquifers at each location. A groundwater sample will also be collected from the Perched and Shallow Aquifers at each location. | 9, 20 | GW | 9, 20 | Determine how the Perched and Shallow Aquifers are connected. | 2 | | | | |
| TW-MW-6P/S | | 9, 20 | GW | 9, 20 | Determine how the Perched and Shallow Aquifers are connected. | 2 | | | | |
| TW-MW-7P/S | | 9, 20 | GW | 9, 20 | Determine how the Perched and Shallow Aquifers are connected. | 2 | | | | |
| OU3-SB-01 | Soil Boring locations are designed to determine the distribution and concentrations of arsenic and lead in the vadose zone and Perched Aquifer in OU 3. | 20 | Soil[4] | 3, 6, 9 | Calibrate HPT results and determine arsenic and lead concentrations in OU 3. | | 3 | 1 | 1 | 1 |
| OU3-SB-02 | | 10 | Soil & GW | 3, 6, 9 | Determine the distribution and concentrations of arsenic and lead in the vadose zone and Perched Aquifer in OU 3. | 1 | 3 | 1 | 1 | 1 |
| OU3-SB-03 | | 10 | Soil[4] | 3, 6, 9 | | | 3 | 1 | 1 | 1 |
| OU3-SB-04 | | 10 | Soil & GW | 3, 6, 9 | | 1 | 3 | 1 | 1 | 1 |
| OU3-SB-05 | | 10 | Soil & GW | 3, 6, 9 | | 1 | 3 | 1 | 1 | 1 |
| OU3-SB-06 | | 10 | Soil & GW | 3, 6, 9 | | 1 | 3 | 1 | 1 | 1 |
| OU3-SB-07 | | 10 | Soil & GW | 3, 6, 9 | | 1 | 3 | 1 | 1 | 1 |
| HPT-GW-01 | HPT locations are designed to determine the intervals of the Perched, Shallow and Intermidiate Aquifers. At each location a hydropunch groundwater sample will be collected from the Perched, Shallow, and Intermidiate Aquifers. | 50 | GW | 9, 20, 50 | Determine the distribution and concentrations of arsenic and lead in groundwater along the property boundary. | 3 | | | | |
| HPT-GW-02 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-03 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-04 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-05 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-06 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-07 | | 50 | GW | 9, 20, 50 | | 3 | | | | |
| HPT-GW-08 | | 50 | GW | 9, 20, 50 | Determine if the dissolved arsenic concentrations detected in MW-2S and MW-2I are migrating onto the Property from offsite. | 3 | | | | |
| Field QC Samples | | | Soil & GW | N/A | Field Duplicates | 2 | 2 | 1 | 1 | 1 |
| | | | Soil & GW | N/A | Equipment Blanks | 4 | 2 | 1 | | |
| | | | | | Total Samples per Analysis | 41 | 25 | 9 | 8 | 8 |

**Notes:**

bgs: below ground surface, RCRA 8 Metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver; GW: groundwater, QC: quality control.

[1] Boring locations will be adjusted as necessary in the field based on overhead power lines, underground utilities, etc.

[2] All groundwater samples for metals analyses will be field filtered with a 0.45-micron filter and preserved with HNO3.

[3] SEP analysis includes five-step selective sequential extraction method, based on Wenzel et al., for correlation between metals (aluminum [Al], arsenic [As], iron [Fe], manganese [Mn], and silicon [Si]) and different substrate properties. Other analyses include total recoverable arsenic.

[4] Co-located with groundwater sampling location (e.g., TW-MW-5P/S)