PERIODIC REVIEW

Burlington Environmental
("PSC-Georgetown")
Ecology/EPA Facility Permit# WAD 00081 2909

"East of 4th" portion of the Site

734 South Lucile Street
Seattle, WA 98108

Northwest Regional Office

HAZARDOUS WASTE AND TOXICS REDUCTION PROGRAM

[5/27/15 DRAFT]

Periodic Review Executive Summary and Summary Form

The "PSC-Georgetown" (or, "Burlington Environmental-Georgetown") facility is located at 734 South Lucile Street in Seattle.[1] The PSC-Georgetown Site is defined as the area where hazardous substances associated with the facility have been deposited, stored, disposed of, placed, or otherwise come to be located. This includes areas of groundwater contamination on the facility, immediately east and north of the property, and extending west and southwest to areas west of 4th Ave. S., approaching the Duwamish Waterway. The Site was administratively divided into two parts in 2010. The cleanup of areas of contamination located in the eastern part of the Site, east of 4th Avenue South, is governed by Agreed Order DE# 7347 and its attached Cleanup Action Plan (CAP). WAC 173-340-420 (2) requires that Ecology conduct a periodic review for certain categories of sites every five years. The PSC-Georgetown Site meets these criteria. This Periodic Review only applies to the eastern part of the Site and those required cleanup actions established in the May 28, 2010, Agreed Order DE# 7347 and its attached CAP.

In August 1991, EPA and Ecology jointly issued Permit No. WAD 000812909 to Chemical Processors, Inc. (Chempro) to treat and store hazardous and dangerous wastes. The permit also contained requirements for performing RCRA corrective action (cleanup). In January 1992, Chempro formally changed its corporate name to "Burlington Environmental Inc." Following several corporate mergers and acquisitions at the parent company level, in March 2003, Burlington Environmental Inc. became a wholly owned subsidiary of PSC Environmental Services, Inc. The facility and site became known as the *PSC-Georgetown facility*.

On December 1, 2002, PSC notified EPA and Ecology of its intent to close all permitted dangerous waste operations at its Georgetown facility. In August 2003 Ecology conditionally accepted certification for final clean closure of permitted dangerous waste management units at the facility. Today, the (non-operating) PSC dangerous waste facility consists of two adjacent and contiguous parcels of property: the original permitted parcel consisting of approximately two acres located at 734 Lucile Street, Seattle, Washington; and, an unpermitted parcel of approximately four acres (the former Amalgamated Sugar Company or "TASCO" property, purchased by PSC in 2003) located at 5400 Denver Ave. S.[2]

In the late 1990s PSC investigated groundwater contamination to the west and southwest of its property (in the direction of groundwater flow). In 2000, more groundwater samples were collected as part of a "step-out" study that continued to proceed farther west/southwest and deeper if shallower groundwater samples collected closer to the facility contained contamination. As a result of "stepping out" in this fashion, PSC discovered that groundwater was contaminated in certain locations, and at particular depths, as far west/southwest as the Duwamish Waterway (about 0.8 miles from the facility). Subsequently, PSC installed new groundwater monitoring wells throughout this area and began sampling those wells on a quarterly basis in 2003.

[1] Burlington Environmental, LLC is a wholly-owned subsidiary of PSC Environmental Services, LLC, which is a wholly-owned subsidiary of Stericycle Environmental Solutions, Inc.
[2] PSC purchased the Amalgamated Sugar parcel on December 2, 2002.

In 2003 the lead agency for overseeing cleanup at the PSC-Georgetown facility changed from EPA Region 10 to Ecology. Later that year PSC submitted a Remedial Investigation (RI) Report to Ecology, which we approved in December 2004. In 2004 PSC constructed a subsurface barrier wall that surrounds their properties at 734 S. Lucile St. and 5400 Denver Ave. S. The purpose of the barrier wall is to contain the groundwater contamination located below those properties, preventing it from migrating any farther to the west and southwest.

In 2010 Ecology issued an Agreed Order (DE #7347) to PSC that contained a Cleanup Action Plan. The Cleanup Action Plan sets out the final remedy for the eastern portion of the Site. This includes excavation, soil vapor extraction, and capping/covering in areas of soil contamination. Groundwater cleanup levels protective of surface water and indoor air are to be met via monitored natural attenuation, with a restoration timeframe of 22 years.

Hazardous substances in soils and groundwater at the Site include a number of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, and toxic inorganics (such as metals). The primary contaminants of concern in Site groundwater today are: trichloroethene (TCE), vinyl chloride (a breakdown product of TCE), 1,4-dioxane (an SVOC), and petroleum-related compounds (limited to the far eastern portion of the Site).

The purpose of a Periodic Review is to examine current Site conditions every five years and: a) determine how well the cleanup action has performed, b) assess whether human health and the environment are being adequately protected, and c) identify any actions that should be implemented to improve remedy performance and/or better protect human health and the environment. Based on our Review, Ecology concludes that human health and the environment are currently protected at the Site. However, we recommend several actions that should be carried out in the near future. These include: finalizing Environmental Covenants on the PSC and Union Pacific Railroad Argo Yard properties; implementing a new action to hasten attainment of 1,4-dioxane cleanup levels; and, initiating the groundwater bioremediation action behind the barrier wall.

SITE IDENTIFICATION		
Site Name: **PSC-Georgetown** (Facility) Address: **734 South Lucile Street, Seattle**		
PLP Name: **Burlington Environmental, LLC** (a wholly-owned subsidiary of **PSC Environmental Services, LLC**, which is a wholly-owned subsidiary of **Stericycle Environmental Solutions, Inc.**)		
Facility ID: **47779679**		
Site ID: **2622**		
Permit ID# **WAD 00081 2909**		
State MTCA Agreed Order # **DE7347**		
Region: **NWRO**	State: **WA**	City/County: **Seattle/King**

SITE STATUS	
	Has the site achieved construction completion? **No**

REVIEW STATUS
Author name (State Project Manager): **Ed Jones** **Washington State Department of Ecology, Northwest Regional Office** **3190 160th Ave. SE** **Bellevue, WA 98008** **(425) 649-4449; ejon461@ecy.wa.gov**
Review period: **May 29, 2010 to May 28, 2015**
Date of site inspection: **April 9, 2015**

Conclusions/Recommendations

Affects Future Protectiveness and/or remedy performance	Implementing Party	Oversight Party	Milestone Date
Finalize two Environmental Covenants	Stericycle, Ecology, and (for Argo Yard) Union Pacific Railroad	Ecology	Argo Yard EC: end of CY 2015 EC for PSC properties: early 2016
Finalize AO Amendment and implement actions to reduce 1,4-dioxane levels in groundwater	Stericycle	Ecology	Early summer 2015 (finalize AO Amendment)
Implement bioremediation action to reduce degradable COC levels in groundwater behind the barrier wall	Stericycle	Ecology	Immediately, or following site surface redevelopment

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1.0 INTRODUCTION

This document is a review by the Washington State Department of Ecology (Ecology) of Site conditions and monitoring data to ensure that human health and the environment are being protected within the eastern portion of the Burlington Environmental ("PSC") Georgetown site (hereafter referred to as the Site).[3] Cleanup at the Site has been implemented under the Model Toxics Control Act (MTCA) regulations, Chapter 173-340 Washington Administrative Code (WAC).

Required cleanup activities at this part of the Site were established in a 2010 Agreed Order (AO) DE# 7347 and Cleanup Action Plan (CAP). Some of these activities have been implemented, while others have not. The cleanup actions established in the AO and CAP have and will reduce contamination at the Site. However, they will also result in concentrations of hazardous substances (such as organic compounds associated with chlorinated solvent releases, petroleum hydrocarbons, PCBs, and metals) remaining at the Site which exceed standard MTCA cleanup levels.[4]

WAC 173-340-420 (2) requires that Ecology conduct a periodic review of a Site every five years under the following conditions:

(a) whenever Ecology conducts a cleanup action,

(b) whenever Ecology approves a cleanup action under an Agreed Order or Consent Decree, or, as resources permit, and

(c) whenever Ecology issues a no further action opinion, and one of the following conditions exists:
- institutional controls or financial assurance are required as part of the cleanup;
- a cleanup level is based on a practical quantitation limit; or
- in Ecology's judgment, modifications to the default equations or assumptions using Site-specific information would significantly increase the concentration of hazardous substances remaining at the Site after cleanup. Or, the uncertainty in the ecological evaluation or the reliability of the cleanup action is such that additional review is necessary to assure long-term protection of human health and the environment.

When evaluating whether human health and the environment are being protected, the factors Ecology considers during its Periodic Review include [per WAC 173-340-420(4)]:

a) the effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the Site;

[3] Burlington Environmental, LLC is a wholly-owned subsidiary of PSC Environmental Services, LLC, which is now a wholly-owned subsidiary of Stericycle Environmental Solutions, Inc.
[4] MTCA cleanup levels for soil are generally established under WAC 173-340-740 and -745. The MTCA cleanup levels for groundwater are generally established under WAC 173-340-720.

b) new scientific information for individual hazardous substances or mixtures present at the Site;

c) new applicable state and federal laws for hazardous substances present at the Site;

d) current and projected Site use;

e) the availability and practicability of higher preference technologies; and,

f) the availability of improved analytical techniques to evaluate compliance with cleanup levels.

Ecology publishes a notice of all periodic reviews in the Site Register and provides an opportunity for public comment.

The following sections of this Review discuss:

- Site conditions, currently and historically [Section 2]
- the effectiveness and protectiveness of cleanup actions implemented to date under AO #7347 [Section 3]
- conclusions reached during this periodic review [Section 4]

In addition, pursuant to requirements established in the 2010 AO and CAP, PSC submitted:

a) "Five-Year Review Assessment of the Effectiveness of Institutional and Other Controls as Part of Cleanup," received December 31, 2014;

b) "Potability Determination: Five-year review," received December 31, 2014;

c) "Cleanup Level Attainment: Five-year Review," received January 15, 2015; and,

d) "Five-Year Review Assessment of the Vapor Intrusion Mitigation System," received February 27, 2015.

These four reports have been appended to Ecology's Periodic Review (Appendices 6.4 through 6.7).

2.0 SUMMARY OF SITE CONDITIONS

2.1 Site Description and History

Burlington Environmental, LLC is a wholly-owned subsidiary of PSC Environmental Services, LLC, which is now a wholly-owned subsidiary of Stericycle Environmental Solutions, Inc. Stericycle's "PSC-Georgetown" (or, "Burlington Environmental-Georgetown") facility is located at 734 South Lucile Street, east of 4th Avenue South. Because the public has become familiar with the facility and site under the name "PSC-Georgetown," Ecology uses this terminology below to minimize confusion. Likewise, references to the company who owns the 734 South Lucile Street property and is conducting the site cleanup use "PSC" instead of Stericycle Environmental Solutions.

The PSC-Georgetown Site was administratively divided into two parts in 2010. The cleanup of contamination in the eastern part, east of 4th Avenue South, is governed by AO DE# 7347 and its attached CAP. In this eastern part of the Site PSC is the sole potentially liable person (PLP). The western part of the Site, located west of 4th Avenue South, includes contamination caused by multiple PLPs. PSC is one of four PLPs currently conducting a Feasibility Study in the western part of the Site. Requirements for performing the Feasibility Study and drafting a CAP in this "West of 4th" area are set out in AO DE#10402. The Periodic Review contained herein only applies to the eastern part of the Site and those required cleanup actions established in AO DE# 7347 and its CAP.

FACILITY HISTORY

Chemical Processors, Inc. (Chempro) was incorporated in August 1970 and began solvent distillation and recycling operations at the 734 S. Lucile St. property initially on behalf of the Preservative Paint Company. Chempro filed a Part B RCRA hazardous waste management permit application, and in 1988 negotiated a Section 3008(h) agreed order with the United States Environmental Protection Agency (EPA) to perform RCRA correction action at the Georgetown Facility.[5] In August 1991, EPA and Ecology jointly issued Permit No. WAD 000812909 to Chempro to treat and store hazardous and dangerous wastes. In January 1992, Chempro formally changed its corporate name to "Burlington Environmental Inc." Following several corporate mergers and acquisitions at the parent company level, in March 2003, Burlington Environmental Inc. became a wholly owned subsidiary of PSC Environmental Services, Inc. While Burlington Environmental was the owner and operator of the Georgetown facility, most documents related to the facility starting in the later 1990s referred to Philip Services Corp., or PSC Environmental Services, as the responsible party. The facility and site became generally known as the *PSC-Georgetown facility*.

PSC's Georgetown dangerous waste facility permit expired in August 2001. Rather than seek a new operating permit, the company chose to close the facility. In 2003 PSC completed closure of operations and the facility has not operated as a RCRA hazardous/dangerous waste treatment

[5] RCRA stands for the federal Resource Conservation and Recovery Act.

and storage facility since that time.[6] Today, the (non-operating) PSC dangerous waste facility consists of two adjacent and contiguous parcels of property: the original permitted parcel consisting of approximately two acres located at 734 Lucile Street, Seattle, Washington; and, an unpermitted parcel of approximately four acres (the former Amalgamated Sugar Company or "TASCO" property) located at 5400 Denver Ave. S.[7]

In the 1990s PSC installed a number of groundwater monitoring wells on or nearby their own property. Samples collected from these wells confirmed that groundwater was contaminated with a host of hazardous substances. Substances included chlorinated solvent constituents such as trichloroethene (TCE), as well as the breakdown products of those constituents (such as vinyl chloride). Petroleum-related substances were also detected, such as benzene. A number of both organic and inorganic substances were detected above federal and state drinking water standards.

In the later 1990s PSC additionally began to investigate groundwater contamination to the west and southwest of its property (in the direction of groundwater flow). In 2000, more groundwater samples were collected as part of a "step-out" study that continued to proceed farther west/southwest and deeper if shallower groundwater samples collected closer to the facility contained contamination. As a result of "stepping out" in this fashion, PSC discovered that groundwater was contaminated in certain locations, and at particular depths, as far west/southwest as the Duwamish Waterway (about 0.8 miles from the facility). Subsequently, PSC installed new groundwater monitoring wells across this area and began sampling those wells on a quarterly basis in 2003.

In late 2003 PSC submitted a Remedial Investigation (RI) Report to Ecology. The RI Report, as amended, was approved by Ecology in December 2004. The RI Report describes the soil, soil gas, and groundwater sampling PSC performed on and in the vicinity of their property and the extent of groundwater contamination known in 2004. Concentrations of hazardous substances detected at that time in groundwater and soils exceeded State cleanup levels established for the protection of human health and the environment.

In 2004 PSC constructed a subsurface barrier wall that surrounds their properties at 734 S. Lucile St. and 5400 Denver Ave. S. This action was taken as an interim measure. The purpose of the barrier wall is to contain the groundwater contamination located below those properties, preventing it from migrating any farther to the west and southwest.

In 2010 Ecology issued an AO (DE #7347) and CAP to PSC. The CAP sets out the final remedy for the eastern portion of the Site. Later, PSC prepared Design documents for the specific actions described in the CAP, and once those documents were approved by Ecology, began to implement the actions. As of today, the company has completed several actions, including the

[6] On December 1, 2002, PSC notified Ecology of its intent to close all permitted dangerous waste operations at its Georgetown facility. In August 2003 Ecology conditionally accepted certification for final clean closure of permitted dangerous waste management units at the facility. PSC closed the operating portion of the facility effective December 2003.
[7] PSC purchased the Amalgamated Sugar parcel on December 2, 2002.

excavation and removal of PCB-contaminated soils, and soil vapor extraction. Other actions have been initiated.

Hazardous substances in groundwater at the Site migrate in the direction of regional groundwater flow, which is generally westerly-to-southwesterly. As a result, contaminated groundwater has come to be located west and southwest of the PSC-Georgetown facility. East of 4th Ave. S. groundwater contamination is present in some areas as far north as S. Brandon St. and as far south as S. Fidalgo St. Contamination has also migrated west of 4th Ave. S.

WEST OF 4TH AVE. S.

Releases from the PSC-Georgetown facility have led to the migration of contaminated groundwater west of 4th Ave. S. In this western part of the Site, releases from properties owned by Art Brass Plating, Inc. (ABP), Blaser Die Casting Co., and Capital Industries, Inc., have also contributed to the groundwater contamination.[8] At certain locations and at certain depths the groundwater contamination is commingled (i.e., due to multiple sources). The four companies are PLPs under State law and are collectively referred to as the "West of 4th Group." AO DE #10402 was issued to the West of 4th Group in April 2014. The AO governs the performance of a Feasibility Study, which evaluates cleanup action options prior to proposing a preferred action, or actions, to the public. PSC's future cleanup obligations are therefore contained in two documents: (1) their 2010 east-of-4th AO, the subject of this Periodic Review; and, (2) the West of 4th AO (which also contains cleanup requirements for three other PLPs).

The West of 4th site consists of contaminated soils and groundwater located between 4th Ave. S. and the Duwamish Waterway. The primary contaminants of concern in this area are chlorinated solvent compounds such as TCE, their breakdown products (e.g., vinyl chloride), and toxic metals (copper, nickel, and zinc). The latter were released during plating operations at the ABP Facility. More specific information regarding the findings of each facility's remedial investigations and the interim actions performed to date may be found at the facilities' on-line information repositories.

2.2 Site Investigations and Sample Results

As noted above, the PSC-Georgetown RI Report was approved by Ecology in December 2004. Following approval of that Report, PSC prepared additional investigation reports for an area of contamination east of their facility (on Union Pacific Railroad property) and several Feasibility Study documents focused on the eastern portion of the Site. In 2010 a CAP was finalized, which set out the cleanup actions the company was required to take east of 4th Ave. S. In 2011 an Engineering Design Report was approved by Ecology that described how these various cleanup actions would be constructed and implemented. As discussed in Section 2.3 below, many of these actions have been subsequently taken.

GROUNDWATER

[8] None of these three facilities treat, store, or dispose of hazardous or dangerous wastes.

Groundwater and soils have been, and remain, contaminated at the PSC-Georgetown Site. Groundwater contamination extends west and southwest of PSC's properties into areas west of 4th Ave. S. Groundwater is also contaminated due to historic releases from facility operations to the north, south, and east of the 734 S. Lucile St. property. The 2010 CAP specifically addresses the eastern part of the PSC-Georgetown site, which includes groundwater contamination:

a) west and southwest of the PSC properties into areas as far west as 4th Ave. S.;

b) below the 734 S. Lucile St. and 5400 Denver Ave. S. properties owned by PSC; and,

c) north, south, and east of the 734 S. Lucile St. property, including areas on Union Pacific Railroad's Argo Yard.

Within these three general areas, certain contaminants have exceeded, and continue to exceed, groundwater cleanup levels established in the 2010 CAP. Please see the figures provided in Appendices 6.1, 6.2, and 6.3.

In Site cleanup documents, groundwater "zones" are primarily differentiated by their depths below ground surface (bgs). The Water Table zone extends from the top of the seasonal high water table (approximately 10 feet bgs) to 20 feet bgs. The Shallow zone extends from 20 to 40 feet bgs. The Intermediate zone extends from 40 feet bgs to deeper depths. Below the PSC facility and to an unknown distance west and southwest, the Intermediate zone is underlain by a silt unit referred to as the Silt Aquitard. Where this aquitard is present, groundwater below it is referred to as the Deep Aquifer. Below PSC's properties the Silt Aquitard slopes downward towards the west; if present more than a block west of Denver Ave., the aquitard is located at a depth of more than 100 feet bgs.

The 2010 CAP contains groundwater cleanup levels for some 67 contaminants, including chlorinated ethenes, petroleum hydrocarbons, other volatile organic compounds (VOCs), some semi-volatile organic compounds, metals, and PCBs. The greatest number of groundwater contaminants exceeding State cleanup levels, and the highest concentrations of most contaminants, are present below the two PSC properties. Most of this groundwater, at depths above the Silt Aquitard, is contained by the subsurface barrier wall installed in 2004.

The barrier wall is continuous and "encloses" groundwater at depths above the Aquitard. The Point of Compliance for attaining Site groundwater cleanup levels at depths above the Silt Aquitard was therefore established as the point immediately downgradient ("outside") of the wall. Under MTCA this is considered a "conditional" Point of Compliance.

Following construction of the barrier wall, and because of natural processes that act to reduce chemical concentrations (like the microbial de-chlorination of substances like TCE), levels of contaminants in groundwater today are generally lower in areas between Denver Ave. S. and 6th Ave. S. The primary contaminants of concern in Site groundwater downgradient of the barrier wall are currently TCE, vinyl chloride, and 1,4-dioxane. TCE, vinyl chloride, PCBs, and petroleum-related contaminants are also present in upgradient groundwater, immediately north

and east of PSC's facility property. Quarterly/semi-annual Progress Reports are prepared by PSC that document the latest groundwater monitoring results; the most recent such Report was submitted in December 2014. Figures from this Report showing recently measured concentrations of TCE, cis-1,2-dichlorethene, vinyl chloride, and 1,4-dioxane are provided in Appendix 6.3.

Potential exposure pathways associated with contaminated groundwater in the eastern portion of the Site include:

- direct contact (ingestion and dermal contact) with any contaminated groundwater brought to the ground surface for use as drinking water, or irrigation, or other purposes unrelated to cleanup;
- indoor inhalation of contaminants that have volatilized from the water table, contaminated soil gas in the vadose zone, and then migrated into overlying buildings (i.e., via vapor intrusion);
- inhalation of contaminants that have volatilized from the water table and contaminated soil gas. The receptors of concern include those individuals digging below ground surface during construction activities or utility line maintenance/repair;
- direct contact (ingestion and dermal contact) with contaminated groundwater as a result of digging several feet below ground surface as part of construction activities or utility line maintenance/repair;[9] and,
- migration of groundwater to the west and the potential human and ecological exposure pathways associated with contaminated groundwater discharging to the Duwamish Waterway.

Direct contact (ingestion and dermal contact) with contaminated groundwater brought to the ground surface:

Site groundwater in certain locations and at particular depths contains contaminant concentrations that exceed Safe Drinking Water Act levels and standard MTCA Method B (drinking water-based) groundwater cleanup levels. Site groundwater is not used for drinking water purposes, however, and is not expected to be used for such purposes in the foreseeable future. The 2010 CAP designated the Site's Water Table, Shallow, and Intermediate groundwater zones "non-potable," in accordance with WAC 173-340-720(2). The basis for this designation was essentially that natural levels of inorganic and other contamination in groundwater exceeded Safe Drinking Water Act levels. Should the groundwater be pumped to the ground surface for drinking or other domestic uses, then, it would need to be treated. The costs of performing this treatment, compared to the costs of obtaining drinking water from other sources, were deemed disproportionately expensive.[10]

[9] Depth to the water table, as distance from ground surface, varies seasonally and with location. In most parts of the Site it is generally located at about 10 feet below ground surface.
[10] PSC's initial potability analysis was included in their 2003/2004 RI Report.

Although groundwater below the Silt Aquitard, in the "Deep Aquifer," is not used for drinking water purposes, and is not expected to be used for this purpose in the foreseeable future, the 2010 CAP considers it "potable." Drinking water cleanup standards therefore apply to this minimally-contaminated zone.

Indoor inhalation of contaminants that have migrated into overlying buildings via vapor intrusion:

Because site groundwater contamination was detected at the water table, and because some of the contaminants detected were volatile compounds (like TCE), 15 years ago EPA, Ecology, the Washington State Department of Health, and PSC recognized it was possible that this contamination could potentially affect indoor air quality.[11] Therefore, starting in 2000 and continuing through 2004, PSC implemented a vapor intrusion (VI) program known as the Inhalation Pathway Interim Measure (or, IPIM) program. The program utilized groundwater (water table) measurements and indoor air measurements to assess the potential for VI in homes and commercial buildings overlying contaminated Site groundwater. This resulted in the installation of a number of VI mitigation systems east and west of 4th Ave. S. After 2004 PSC continued the IPIM program, but it was modified to include mitigation inspection and monitoring, as well as ongoing checks on shallow groundwater contaminant levels (to ensure that concentrations are not increasing and that "clean" areas remain clean).

As part of PSC's VI program, measured Water Table Zone contaminant concentrations are routinely compared to groundwater levels deemed protective of indoor air quality. In areas where these groundwater levels are exceeded, the indoor air in buildings within those areas is sampled to determine if VI is causing unacceptable levels of indoor air contamination.[12] If it is, actions are taken to mitigate the VI impacts.[13]

Exposures to receptors digging below ground surface:

Should someone dig deep enough in those Site areas where shallow groundwater is contaminated, they could encounter and be exposed to the contaminated groundwater itself. Shallower digging could expose the person to contaminated soil gas in those places where groundwater is contaminated with volatile substances. The CAP does not contain groundwater cleanup levels specifically calculated to be protective of such receptors. The 2010 cleanup action assumed the exposures associated with digging in areas downgradient of the PSC properties would be infrequent (episodic) and of fairly short duration. However, it also included

[11] Groundwater contamination can volatilize and contaminate the "soil gas" above the water table. The contamination in this soil gas can then potentially enter buildings by moving across their foundations. When soil gas enters a building and contaminates indoor air this is referred to as *vapor intrusion*.
[12] There are areas east of 4th Ave. where Water Table zone groundwater concentrations still exceed levels protective of indoor air. For most buildings in these areas indoor air sampling has already been completed and decisions made about the need for mitigation.
[13] Mitigation systems used for this purpose are similar to systems utilized to prevent radon from contaminating indoor air. They are typically installed at the Site if indoor inhalation risk, due to vapor intrusion, exceeds 1 in 100,000 or a Hazard Index of 1.

institutional controls to notify those digging below ground surface about the types of groundwater contamination likely to be present. These notifications are needed until cleanup levels (based on the protection of indoor air and surface water) have been achieved.[14]

Potential exposures to humans and ecological receptors at the Duwamish Waterway:

Exposure pathways associated with contaminated groundwater discharging to the Duwamish Waterway are a concern at the Site. Surface water-based groundwater cleanup levels have been established for all groundwater contaminants in the eastern part of the Site that may potentially reach the Waterway. These cleanup levels were selected in 2010 to protect the river's ecological receptors as well as humans eating fish and shellfish harvested from the river. With respect to the latter: standard Method B surface water cleanup concentrations, calculated per Equations 730-1 and 730-2, were reduced (by approximately one half) to better protect Asian Pacific Islander receptors.[15]

Areas of groundwater contamination east of 4th Ave. S. continue to exceed particular surface water-based groundwater cleanup levels in specific locations and at certain depths. It should be recognized, however, that the groundwater contamination located east of 4th Ave. S. is about 0.4 to 0.8 miles east of the Waterway.

SOILS

Contaminated soils within the eastern portion of the Site are located on PSC's properties east of Denver Ave. S., and to the immediate north and east on property owned by Union Pacific Railroad (which PSC leased in the past in order to conduct certain hazardous waste management operations). These properties meet the MTCA definition of "industrial" property. Smaller areas of soil contamination likely remain to the immediate west of PSC's 734 S. Lucile St. property. The CAP contains soil cleanup levels for some 73 contaminants, including volatile and semi-volatile organic compounds, metals, petroleum-based chemicals, and PCBs.

The primary exposure pathways of potential concern include:

- direct contact with contaminated soils;
- inhalation of contaminated soil particles ("dust") in outdoor air;

[14]For construction or utility workers digging below ground surface in contaminated Site areas, the CAP's Method C direct contact soil cleanup levels are protective when exposures are limited to ingesting soils or having soils come into contact with their skin. And, the CAP's groundwater cleanup levels are protective of digging-related exposures due to contacting groundwater or inhaling contaminants vaporizing from the water table. However, the Method C direct contact soil cleanup levels may not adequately protect digging-receptors breathing vapors associated with contaminated soils, and in any case, there are large Site areas where groundwater cleanup levels are exceeded. The 2010 cleanup action's goal, therefore, is to ensure protection of these receptors via a combination of: reducing contaminant concentrations over time; notifications; and – on the PSC and Union Pacific Railroad properties – imposing land use controls.

[15] Equation 730-1 inputs for "API" consumption of fish and shellfish harvested from the Waterway: ABW = 63 kg; FCR = 57 g/d; FDF = 1; AT = 30 years; ED = 30 years. Equation 730-2 inputs are the same as for Equation 730-1, except that AT is 75 years.

- indoor inhalation of air contaminated by the volatilization of contaminated soils ("vapor intrusion"); and,
- inhalation of a mixture of contaminated soil gas and outdoor air by construction or utility workers digging below ground surface.

In addition, the hazardous substances in contaminated soils can leach into underlying groundwater. Once in groundwater, contaminants can potentially threaten human health and the environment via the exposure pathways discussed in the GROUNDWATER section above.

Direct contact with contaminated soils:

Prior to implementation of the 2010 CAP's remedial actions, soil contamination exceeding standard Method C soil cleanup levels was present on PSC's 734 S. Lucile St. property and covered, for the most part, with a thick concrete cap. There were also limited areas of soil contamination exceeding standard Method C soil cleanup levels on Union Pacific Railroad property, and un-capped areas on the PSC property.

Inhalation of contaminated soil particles:

The CAP does not contain soil cleanup levels specifically calculated to be protective of outdoor receptors exposed to contaminated "dust" (i.e., contaminated surficial soils that become airborne). The 2010 cleanup action included actions to cover areas containing surficial soil contamination with clean soil or pavement.

Indoor inhalation of air contaminated by the volatilization of contaminated soils:

Prior to implementation of the 2010 CAP's remedial actions, two buildings were located in areas where soil contamination could potentially result in unacceptable indoor air contamination.[16] One of these buildings was located on PSC's property. The other building was located at 710 S. Lucile St. This latter building had been "mitigated" to minimize the intrusion of contaminated soil gases and thereby protect indoor air quality. The building located on PSC's property was primarily used for storage; the 2010 CAP assumed indoor exposures in the building, though routine, were of relatively short duration.

Exposure to contamination by construction or utility workers digging below ground surface:

The CAP does not contain soil cleanup levels specifically calculated to be protective of outdoor receptors digging below ground surface. Such digging could directly expose the person to contaminated soils as well as contaminated soil gas. The 2010 cleanup action assumes the exposures associated with digging in soil-contaminated areas would be infrequent and of fairly short duration. However, it also required institutional controls to ensure that workers digging below ground surface on the properties noted above were adequately notified and protected.

[16] A third building, located in Union Pacific's Argo Yard, was and remains "open" to outdoor air. For this reason its indoor air was judged unlikely to be unacceptably impacted by vapor intrusion.

Exposure to contaminated surface water due to the leaching of soil contaminants to groundwater, and the eventual discharge of this contaminated groundwater to surface water:

Exposure pathways associated with contaminated groundwater discharging to the Duwamish Waterway are a concern at the Site. Surface water-based groundwater cleanup levels have been established for all groundwater contaminants in the eastern part of the Site that may potentially reach the Waterway. The 2010 CAP also included soil cleanup levels that would be "protective" of these groundwater cleanup levels. These soil levels are very low and a large number of Site soil contaminants were, and remain, present at concentrations exceeding the levels. The 2010 cleanup action included excavation of significantly contaminated soil on the Union Pacific Railroad property and in one smaller area on PSC's property. Following excavation and before back-filling with clean soils, materials were added in selected locations to help biodegrade remaining groundwater and soil contaminate below the depths of excavation. Afterwards, soil vapor extraction was implemented. These actions will reduce the potential for contaminated soils to further contaminate Site groundwater. However, the CAP's primary means of protecting groundwater quality from the leaching of soil contamination on PSC's property is to minimize infiltration by maintaining the existing cap and other forms of cover.

2015 CONTAMINATION IN SOILS AND GROUNDWATER

Today, as noted above, concentrations of hazardous substances exceeding State environmental-media cleanup levels remain in the eastern portion of the Site. This was anticipated by the 2010 CAP. In some cases and at particular locations this is because the goals of the cleanup actions established in the CAP, and later implemented by PSC, were to attain cleanup levels over time and not enough time has yet elapsed to achieve these levels.[17] In other cases it is because the goals of the cleanup actions were to contain and/or prevent exposures to the contamination, or to reduce contaminant mass, not to attain cleanup levels.

The Site cleanup action described in the 2010 CAP is discussed in further detail in Section 2.3 below. Contamination as it now exists at the Site is further discussed in Section 3.1.

2.3 Cleanup Actions

The 2010 CAP required the following cleanup actions and controls:

1. Removal of PCB-contaminated soils on PSC's facility property and on portions of the adjoining Union Pacific Railroad Argo Yard property. While PCBs were the targeted contaminants for removal, the actions also opportunistically removed other co-located hazardous substances. Excavated soils were disposed of off-site at a landfill. This action has been completed.
2. Addition of emulsified vegetable oil (EVO) and sodium lactate "substrate" in the part of Union Pacific Railroad's Argo Yard where soils were excavated. Prior to backfilling

[17] Nor have all the cleanup actions required by the 2010 CAP been implemented yet.

with clean soils, substrate was added to the excavation pits to enhance the bioremediation of degradable contaminants below excavation depth. This action has been completed.

3. Implementation of soil vapor extraction (SVE) on PSC's property and on a portion of the adjoining Union Pacific Railroad Argo Yard property. Target contaminants included VOCs and the more volatile SVOCs. This action has been completed (SVE was conducted between August 2012 and October 2014).

4. Implementation of enhanced in situ bioremediation to reduce degradable contaminants in groundwater behind the subsurface barrier wall. Targeted zones of contamination include the Water Table and Shallow zones. This action has not begun yet.

5. Placement of additional or new covering/capping material and continued reliance on covering/capping materials already in place. Cover and capping are needed to protect human health, comply with TSCA (Toxics Substances Control Act) regulatory requirements for PCB-contaminated soils, and, in some areas, minimize the leaching of soil contaminants into groundwater. This action has been completed.

6. Continued reliance on the subsurface barrier wall installed in 2004.

7. Continued reliance on Monitored Natural Attenuation (MNA) for groundwater contamination west and southwest of the PSC properties and north, south, and east of the 734 S. Lucile St. property, including areas on Union Pacific Railroad's Argo Yard.

8. Continued reliance on the Vapor Intrusion (VI) program. The 2010 CAP established groundwater cleanup levels for VOCs in the Water Table Zone that were intended to protect indoor air quality. These Water Table Zone cleanup levels were known, or assumed, to be exceeded in certain Site areas where occupied buildings were currently located.

   The VI program is a continuation of the vapor intrusion assessment, mitigation, monitoring, and mitigation-inspection program initiated over ten years ago.[18] The program will remain in effect until the cleanup action has effectively reduced Water Table Zone VOC concentrations to levels too low to pose a vapor intrusion threat.

9. Imposition of new controls and continued reliance on controls put in place prior to CAP finalization. The 2010 CAP required that controls be utilized to limit or prohibit activities that may interfere with the integrity of the cleanup action or that may result in unacceptable exposures to hazardous substances at the Site. These controls utilize restrictions on the uses of particular Site properties and also include:

   a) maintenance requirements for engineered controls such as the inspection and repair of monitoring wells, PSC's groundwater extraction treatment system,

[18] PSC's post-CAP VI program is essentially a continuation of the procedures and actions begun as an interim action during the RI/FS.

capping/covering implemented or relied upon as part of the cleanup action, and the subsurface barrier wall barrier; and,

b) "educational programs," such as signs, public notices, mailings, and other measures that educate the public (and/or employees working on the PSC and Argo Yard properties) about site contamination and ways to limit exposures.

Prior to 2010, Consent Decrees were issued to the property owner located immediately west of PSC's facility property and to the property owner located immediately north of PSC's 5400 Denver Ave. S. property. These Decrees were primarily issued to allow the construction, monitoring, and future maintenance of the barrier wall. However, they also included some property use restrictions (e.g., continued operation of a VI mitigation system within the building of one of the properties).

As discussed in Section 2.5 below, the CAP additionally required Environmental (Restrictive) Covenants for PSC's properties and for the portion of Union Pacific Railroad's Argo Yard subject to cleanup actions under PSC's Agreed Order. In accordance with WAC 173-340-440, these Covenants are required:

a) because hazardous substances remain at the Site at concentrations that exceed applicable cleanup levels;
b) because industrial soil cleanup levels have been established using Method C;
c) because some groundwater cleanup levels exceeding potable groundwater cleanup levels were established for the Site;
d) because a conditional groundwater Point of Compliance was established for the Site; and,
e) to assure the continued protection of human health and the environment, and the integrity the of cleanup action.

Please see PSC's "Five-Year Review Assessment of the Effectiveness of Institutional and Other Controls as Part of Cleanup," in Appendix 6.4.

10. Five-year requirements for PSC to ensure, over time, that contaminated Site groundwater is not being used for drinking water purposes, is not expected to be used for such purposes, and cannot be "practicably" used for such purposes. Please see PSC's submittal, responding to this requirement, in Appendix 6.5.

11. Requirements for PSC to demonstrate and maintain Financial Assurance for Site cleanup.

2.4 Cleanup Levels

The 2010 CAP includes tables (Tables 4 through 8) of Site media cleanup levels. A large number of Site contaminants exceed one or more cleanup levels, though the exceedances may be limited to relatively small areas and specific depths belowground. Cleanup levels are briefly described below, per medium:

SOILS

Soil cleanup levels in the 2010 CAP were based on three pathways/receptors and migration routes:

(1) Direct worker contact with contaminated soils: These cleanup levels apply to soil contamination on the PSC properties and to the portion of Union Pacific Railroad's Argo Yard included within the 2010 CAP.

(2) Protection of groundwater that discharges to surface water: These cleanup levels are soil concentrations low enough to ensure that underlying groundwater contaminant levels do not exceed surface water-based cleanup levels at and downgradient of the groundwater Point of Compliance. They apply to soil contamination on the PSC properties and the portion of Union Pacific's Argo Yard included within the 2010 CAP.

(3) Protection of shallow groundwater that could be a vapor intrusion (VI) source: These are soil concentrations low enough to ensure that underlying shallow groundwater VOC levels do not exceed concentrations posing a potential VI threat.[19]

The cleanup levels were calculated as follows:

1. Direct worker contact with contaminated soils: by calculation of Method C risk-based (ingestion and dermal exposure) concentrations using Equations 745-1 and 745-2 [WAC 173-340-745].

2. Protection of groundwater that discharges to surface water: by calculation of surface water-based groundwater cleanup levels (see below), and then use of Equations in WAC 173-340-747 to determine Method B soil cleanup levels protective of these groundwater cleanup levels. The Method B soil concentrations derived in this manner only apply to those contaminants which may "reach" the Waterway.

3. Protection of groundwater that could be a VI source: by a) calculation of Method B air cleanup levels per Equations 750-1 and 750-2, b) use of an attenuation factor to determine shallow groundwater cleanup levels protective of the indoor air cleanup levels, and then c) use of Equations in WAC 173-340-747 to determine Method B soil cleanup levels protective of these shallow groundwater cleanup levels. Method B soil concentrations derived in this manner are limited to those Site contaminants volatile enough to possibly pose a VI threat.

GROUNDWATER

[19] Soil cleanup levels protective of indoor air – due to the volatilization of soil contamination which could then result in vapor intrusion – were not explicitly identified in the 2010 CAP (please see Section 3.2 below). As discussed in Section 2.2, the Site areas where soils are contaminated with VOCs are limited to PSC's properties and the Union Pacific Railroad property immediately north and east. Controls for protecting future indoor receptors will be included in the Environmental Covenants for those properties.

Groundwater cleanup levels at all depths, at and beyond the Point of Compliance, are MTCA Method B cleanup levels.[20] These cleanup levels apply to contamination throughout the eastern portion of the Site. Groundwater cleanup levels in the 2010 CAP were based on the following pathways/receptors and migration routes:

NOTE: cleanup levels for groundwater at depths above the Silt Aquitard are not based on direct contact (ingestion) exposure pathways. Site groundwater is not a current source of drinking water and is not expected to be in the foreseeable future.

(1) Water Table Zone
- Groundwater that could be a VI source.
- Protection of surface water that groundwater discharges to. These cleanup levels only directly apply to those groundwater contaminants that may "reach" the Duwamish Waterway.[21]

(2) Shallow and Intermediate Zones
- Protection of surface water that GW discharges to.

(3) Deep Aquifer
- Protection of surface water that GW discharges to.
- Protection of groundwater used in the future as drinking water. 2010 cleanup levels for groundwater at depths below the Silt Aquitard (within the "Deep Aquifer") are based on direct contact exposure pathways, including use of the groundwater as a drinking water source.
  NOTE: the Deep Aquifer has not been encountered in Site borings west of Denver Ave. S.

The cleanup levels were calculated as follows:

1. Water Table Zone groundwater that could be a potential VI source: by calculation of Method B air cleanup levels per Equations 750-1 and 750-2, and then use of an attenuation factor to determine Method B groundwater cleanup levels protective of indoor air quality. These Method B groundwater cleanup concentrations apply to volatile contaminants of concern in the Water Table Zone throughout the eastern portion of the Site.

2. Protection of surface water that groundwater (in all zones) discharges to: by calculation of surface water-based groundwater cleanup levels (see paragraph below). These Method B groundwater cleanup concentrations only apply to those contaminants in the Water Table zone which may "reach" the Waterway.

[20] As described in CAP, the groundwater "point of compliance" is all contaminated Site groundwater located outside of the subsurface barrier wall.
[21] Alternative cleanup levels for groundwater contaminants not expected to "reach" the Waterway are site-specific concentrations calculated to be protective of Waterway receptors, based on fate and transport expectations.

3. Protection of Deep Aquifer groundwater for use in the future as drinking water: by a) calculation of Method B groundwater cleanup levels using human health Equations 720-1 and 720-2; and, (2) use of human health drinking water Applicable or Relevant and Appropriate Requirement (ARAR) values, such MCLs.

The SURFACE WATER cleanup levels used to establish the groundwater (and soil) cleanup levels described above were calculated as follows:

1. Protection of Duwamish Waterway ecological receptors: by use of ecological ARAR or "To Be Considered" (TBC) values, such as Ambient Water Quality Criteria (AWQC) or National Toxics Rule (NTR) concentrations.

2. Protection of human receptors eating fish and shellfish harvested from the Duwamish Waterway: by a) calculation of Method B surface water cleanup levels using WAC 173-340 human health Equations 730-1 and 730-2, with adjustment of specific exposure factors to protect "API" receptors; and, (2) use of human health ARAR values, such as AWQC or NTR concentrations.

CLEANUP LEVEL ADJUSTMENTS[22]

2010 media cleanup levels, calculated as described above, were adjusted as follows:

- Any media cleanup levels lower than Practical Quantitation Limits (PQLs, as defined by MTCA) were revised upwards to the contaminant-specific PQL for that medium.
- Any inorganic media cleanup levels lower than natural background were revised upwards to the contaminant-specific natural background concentration for that medium.
- Any groundwater cleanup levels for contaminants that do not, and will not, "reach" surface water were revised. For these contaminants and for their groundwater cleanup levels based on surface water cleanup levels, alternative surface water-protective groundwater cleanup levels were established (called "Site-specific cleanup levels").
- A number of non-carcinogenic human health-based Method B and C media cleanup levels, calculated as described above, were revised downwards by dividing by 10. This was done because of the large number of contaminants and the possibility that once the cleanup levels for individual substances were attained, the Hazard Index per exposure pathway could be greater than 1.0.

2.5 Restrictive Covenant

[22] These were, for the most part, adjustments made after media cleanup levels had been calculated per Method B (or C) and chemical-specific ARARs had been identified.

Based on the 2010 CAP's use of "industrial" soil cleanup levels, establishment of a conditional groundwater Point of Compliance, construction of the barrier wall, and the continued presence of soil and groundwater contaminant levels posing a potentially unacceptable threat to human health in the future, an Environmental (Restrictive) Covenant was required in the Agreed Order for the two PSC properties. A Restrictive Covenant was also required for the part of Union Pacific Railroad's Argo Yard property included in the CAP. These Covenants are needed to:

a) maintain the cap and cover on the PSC properties, thereby protecting aboveground receptors from directly contacting contaminated soils or inhaling contaminated soil particles;
b) maintain the barrier wall below the PSC properties, thereby protecting downgradient groundwater quality;
c) ensure that the indoor air in any occupiable buildings constructed on the PSC properties is not unacceptably impacted by vapor intrusion;
d) ensure that the land use on the PSC properties remains "industrial;"
e) ensure that groundwater below the PSC properties is not used for drinking water;
f) maintain covering on the Union Pacific Railroad property, thereby protecting aboveground receptors from directly contacting contaminated soils or inhaling contaminated soil particles;
g) ensure that the indoor air in any occupiable buildings constructed on the Union Pacific Railroad property is not unacceptably impacted by vapor intrusion;
h) ensure that the land use on the Union Pacific Railroad property remains "industrial;"
i) ensure that groundwater below the Union Pacific Railroad property is not used for drinking water until that time when contamination diminishes to levels consistent with that use;
j) ensure that any cleanup actions, such as continued groundwater monitoring, on the Union Pacific Railroad property are not compromised by future actions or use of that property; and,
k) comply with TSCA regulatory requirements for residual levels of PCBs in soils.

Neither Covenant has yet been finalized or recorded with the King County Auditor. The primary reason for this is a decision Ecology made during our review and approval of PSC's 2011 Engineering Design Report. At that time Ecology decided that finalizing and recording the two Covenants should await: a) completion of the excavation and soil vapor extraction cleanup actions (for the Union Pacific property covenant), and b) initiation of the groundwater bioremediation cleanup action targeting groundwater contamination behind the barrier wall (for the PSC properties' covenant).

Completion of the excavation and soil vapor extraction cleanup actions occurred by October 2014. The groundwater bioremediation cleanup action is scheduled to be initiated later this year. Ecology therefore expects the two Covenants to be finalized shortly, and to then be recorded with the Auditor.

PERIODIC REVIEW

3.1 Effectiveness of completed cleanup actions

Today, concentrations of hazardous substances exceeding State soil and groundwater cleanup levels remain in the eastern portion of the Site. In some locations this belowground contamination has also contaminated soil gas and air. This scenario was anticipated by the 2010 CAP. In some cases and at particular locations this is because the goals of the cleanup actions established in the CAP, and later implemented by PSC, were to attain groundwater cleanup levels over time and not enough time has yet elapsed to achieve these levels. In other cases it is because the goals of the cleanup actions chosen for the Site were to contain and/or prevent exposures to the soil and groundwater contamination, or to reduce contaminant mass, not to attain cleanup levels.

To determine the effectiveness of cleanup actions implemented since 2010, the discussion below is organized by "action" (i.e., by those cleanup action elements required by the 2010 CAP).

1. Removal of PCB-contaminated soils on PSC's facility property and on portions of the adjoining Union Pacific Railroad Argo Yard property:

   These actions have been completed and are documented in PSC's January 2013 *PSC Area Cleanup Implementation Report* and July 2013 *Argo Yard Area Cleanup Implementation Report*. According to the Reports, 297 tons of soil from PSC's property and 767 tons of contaminated soil (i.e., soil defined as hazardous/dangerous/TSCA "regulated" waste) from Union Pacific Railroad's Argo Yard were removed and disposed of in an off-site landfill, permitted to receive such materials. During the excavation process measures were appropriately taken to protect outdoor receptors from inhaling potentially unacceptable levels of Site-related contaminants, including contaminated airborne soil particles. The actions were successful in significantly reducing the mass of PCBs and other hazardous substances in Union Pacific Railroad's Argo Yard and one location on PSC's facility property. Residual soil contamination remains in these areas, however, beyond the extent of the excavations. This contamination is described in PSC's 2013 Reports and in their 2015 *Cleanup Level Attainment: Five-year Review* document (Appendix 6.6). The contamination is "capped" with cover material specified in PSC's September 2011 final *Engineering Design Report*.

2. Addition of bioremediation-enhancing substrate in the part of Union Pacific Railroad's Argo Yard where soils were excavated:

   This action was completed following the excavations in Argo Yard. It was conducted in accordance with the 2011 *Engineering Design Report* and is documented in PSC's 2013 *Argo Yard Area Cleanup Implementation Report*. The purpose of adding this material was to improve the biodegradation of residual subsurface contamination and thereby hasten the attainment of groundwater cleanup levels. It will take time – and continued groundwater monitoring – to determine how effective this action has likely been.

3. Implementation of soil vapor extraction (SVE) on PSC's property and on a portion of the adjoining Union Pacific Railroad Argo Yard property:

   This "source control" action was completed following the excavations of contaminated soils discussed above and after increased pumping of groundwater "behind" the barrier wall lowered water levels in that area. 15 extraction wells were installed on the PSC and Union Pacific Railroad properties and operated between August 2012 and October 2014.[23] As noted in PSC's December 1, 2014, *Soil Vapor Extraction Completion Report*, collected soil gases were initially treated with a combination of carbon adsorption and zeolitic/potassium permanganate treatment. Later, due to the collection of elevated concentrations of petroleum-related contamination in soil gases removed from Argo Yard, a portion of the system's extracted soil gas was routed to a catalytic oxidation treatment system. These forms of treatment were needed to reduce the mass of VOCs in recovered soil gas prior to its discharge to the atmosphere. Monitoring was conducted to ensure the treatment system was effective and that exhausted emissions were below health-based limits established in the final Engineering Design Report.

   The SVE action's objective was not to directly achieve any specific soil cleanup levels. Instead, the goal was to remove a significant amount of volatile contaminant mass and, in Argo Yard, to thereby diminish vadose zone contamination and hasten the attainment of groundwater cleanup levels. The action was successful in removing contaminant mass. Approximately 3,500 lbs of total VOCs were removed over the two-year period. Ecology assumes that residual soil contamination remains in the areas subjected to SVE; however, in most of these areas the contamination is covered with pavement or other capping material (as discussed below).

4. Placement of additional or new covering/capping material and continued reliance on covering/capping materials already in place:

   As documented in PSC's January 2013 *PSC Area Cleanup Implementation* and July 2013 *Final Argo Yard Area Cleanup Implementation* Reports, covering materials were placed in targeted areas identified in the Engineering Design Report. These included areas where contaminated soils were excavated on the PSC and Union Pacific Railroad properties. A previously uncovered area in the southeast corner of PSC's facility property was also paved.

   The action was successful. Based upon the Site visit conducted on April 9, 2015, the buildings, asphalt cover, and concrete cap on the PSC properties continue to eliminate exposure to contaminated soils by ingestion and dermal contact.[24] The cover and cap appear to be in satisfactory condition and no repair, maintenance, or contingency actions seem to be currently required. The portion of Argo Yard included in the 2010 CAP was not visited as part of the April 9 inspection. However, based on observations made that

[23] Certain parts of the system experienced significant downtime over this two-year interval, due to repeated efforts to optimize off-gas treatment.
[24] A photo log of the inspection is provided in Appendix 6.5.

day from PSC's property, and review of PSC's *Argo Yard Area Cleanup Implementation Report*, the covering appears to be in good shape.

Soils with a range of contaminant concentrations higher than MTCA cleanup levels are still present at the Site. The Restrictive Covenants for the PSC and Union Pacific properties – once finalized – will ensure that, in the future, the remaining contamination will continue to be contained and controlled.

5. Continued reliance on the subsurface barrier wall installed in 2004:

   The barrier wall itself is a subsurface structure that extends from ground surface to the Silt Aquitard. It is constructed of a material impermeable to groundwater and is supplemented with a hydraulic system that pumps water from behind the wall, creating an "inward"-directed (i.e., outside to inside) pressure gradient. This gradient serves to direct any leakage of water through the wall inward, towards the contained area.

   Groundwater that is pumped from behind the wall is routed to a treatment system prior to discharge to the sewer. The treatment system includes an air stripper and air-phase carbon adsorption treatment. Monitoring is conducted to ensure that water discharged to the sewer meets permit requirements and that air emissions from the treatment system are below applicable health-based limits.

   The barrier wall, together with its related extraction wells and treatment system, continues to serve an important function and has been well-maintained. Annual barrier wall ("Hydraulic Control") reports have been submitted since the action was implemented in 2004 and document the wall's performance.

6. Continued reliance on Monitored Natural Attenuation (MNA) for groundwater contamination "outside of" (i.e., up and downgradient of) the barrier wall:

   The cleanup action's objective, for areas of groundwater contamination at and downgradient of the Point of Compliance (including groundwater upgradient of the barrier wall in Argo Yard), is to attain all Method B groundwater cleanup levels protective of Waterway receptors within a reasonable timeframe.[25] This is to be achieved via a combination of actions, and ultimately by MNA.

   While the concentrations of many groundwater contaminants have significantly decreased since 2010 in the eastern part of the Site, others – in particular areas and depths – have not. PSC's *Cleanup Level Attainment: Five-year Review* document notes that based on monitoring trends it appears that some contaminants will, or may not, attain 2010 groundwater cleanup levels by 2032. From our review of PSC's document and groundwater monitoring data submitted in Progress Reports, it is uncertain if the following contaminants will be reduced to cleanup levels over the next 17 years:

   a) Tetrachloroethene (PCE) at:

[25] The 2010 CAP's "reasonable restoration timeframe" for contaminated Site groundwater is 22 years, or 2032. This applies to all contaminants but 1,4-dioxane. The CAP's restoration timeframe for 1,4-dioxane was 2015.

- monitoring well CG-5-S1. NOTE: current concentrations are very low (0.3 to 0.6 µg/l)
- monitoring well CG-103-S1
- monitoring well CG-124-WT. NOTE: current concentrations are low (approximately 3 µg/l)

b) Vinyl chloride at:
- monitoring well CG-102-S2
- monitoring well CG-119-40
- monitoring well CG-131-40
- monitoring well CG-134-40
- monitoring well CG-149-WT, possibly
- monitoring well CG-104-I, possibly

c) Trichloroethene (TCE) at:
- monitoring well CG-126-WT
- monitoring well CG-127-WT
- monitoring well CG-131-WT
- monitoring well CG-132-WT
- monitoring well CG-157-WT, possibly
- monitoring well CG-103-S1, possibly
- monitoring well CG-124-WT, possibly

d) Petroleum-related contaminants, such as ethylbenzene, trimethylbenzenes, and xylenes, at monitoring well CG-154-WT[26]

e) Cyanide at:
- monitoring well CG-158-WT, possibly
- monitoring well CG-121-70, possibly

f) PCBs at:
- monitoring well CG-154-WT, possibly
- monitoring well CG-155-WT, possibly
- monitoring well CG-156-WT, possibly

In addition, 1,4-dioxane concentrations continue to exceed the CAP's 2010 cleanup level at a number of locations and depths (at, e.g., wells CG-127-40, 131-40, 134-40, and 122-60). Although groundwater sampling results from monitored areas approaching the Waterway indicate that 1,4-dioxane is not present at concentrations exceeding its surface water-based cleanup level this far west, the CAP's 1,4-dioxane restoration timeframe (2015) has not been met. On June 19, 2014, Ecology therefore directed PSC to identify a new cleanup action that would hasten the attainment of 1,4-dioxane cleanup levels. PSC has done this and the conceptual design of a new action has been agreed to. The preferred cleanup action and a draft amendment of the 2010 Agreed Order and CAP will

[26] Fuel-related light non-aqueous phase liquid has been observed in this part of the Site.

be proposed to the public for comment later this year. Since this preferred action, followed by MNA, will not achieve 1,4-dioxane groundwater cleanup levels site-wide for a number of years, the draft Agreed Order amendment and revised CAP propose 2032 as the restoration timeframe.

MNA has not reduced Water Table Zone VOC concentrations to levels protective of indoor air quality, or Water Table, Shallow, and Intermediate zone groundwater levels protective of surface water, in all parts of the eastern portion of the Site. Nor was it expected to by 2015. Concentrations this low are unlikely to be attained throughout the areas west and southwest of the PSC properties and north, south, and east of the 734 S. Lucile St. property, for a number of years. It is also true that the cleanup actions implemented in Union Pacific's Argo Yard were completed fairly recently. It will take some time to judge how beneficial these actions were in reducing the elevated groundwater contaminant concentrations measured at water table monitoring wells 154 through 158, located east of Denver Ave. S.

Still, predictions that several contaminants within the eastern part of the Site are unlikely to achieve their groundwater cleanup levels by 2032 are troubling. This is especially the case for those contaminants migrating at elevated levels towards and west of 4th Ave. S. (such as 1,4-dioxane, cis-1,2-dichloroethene, and vinyl chloride), and volatile contaminants present at the water table. If similar trends continue over the next five year period, PSC will need to consider additional cost-effective actions for improving remedy performance and assuring cleanup attainment by 2032.

7. Continued reliance on the Vapor Intrusion (VI) program:

   Until VOC concentrations in Site Water Table Zone groundwater decrease to levels protective of indoor air quality, a VI program is needed to ensure the protection of indoor receptors. Over the past five years PSC's VI program has effectively protected these receptors from VI-related health risks (please see Appendix 6.7, PSC's *Five-Year Review Assessment of the Vapor Intrusion Mitigation System*). However, the program's effectiveness has limitations. These are briefly discussed below:

   a) The program, from the building owner's and tenant's perspective, is voluntary. Buildings identified as needing investigations are only investigated if the property owner and tenant grant access for this purpose. In the past, some property owners and/or tenants have not provided this access. As a result, it is unknown if vapor intrusion has been, or is, causing unacceptable indoor air quality within these buildings. Likewise, if an investigation concludes vapor intrusion is causing unacceptable indoor air quality, a mitigation system is only installed investigated if the property owner and tenant agree and grant access for the installation. In the past, some property owners and/or tenants have not opted for mitigation, despite Ecology's encouragement.

      In addition, once a building is mitigated, it is only inspected or monitored if the owner/tenant allows PSC's representatives access to perform these activities. Despite signing access agreements giving PSC such rights, some property owners

have either not responded or have not consistently agreed to scheduled visits for annual inspections or particular monitoring activities. Furthermore, neither PSC nor Ecology can be certain that building occupants: (1) operate their mitigation systems,[27] or (2) have not remodeled the building in some fashion that compromises mitigation goals – except at those times when access is granted and an inspection performed.

b) The program relies upon groundwater monitoring to identify buildings located in areas where Water Table Zone VOC concentrations pose a potentially unacceptable vapor intrusion threat. While this is, in general, a reasonable system for targeting buildings of concern, it is possible that:

- some buildings, especially vulnerable to vapor intrusion (e.g., with indoor sumps or other large entry-openings between the subsurface and the building's interior), may not be properly assessed if they are located in areas where shallow groundwater is contaminated, but VOC concentrations are below the groundwater VI action levels. The groundwater VI action levels may not be protective of such scenarios/buildings; and,

- new buildings may be constructed in areas where Water Table Zone VOC concentrations are elevated sufficiently to pose a threat to indoor air quality. These may be areas where buildings are replaced or where no structures have previously existed. Some time may elapse before either PSC or Ecology realizes that such a building exists.

c) The program relies primarily upon indoor air investigations to determine if vapor intrusion is causing unacceptable indoor air VOC levels. This is standard practice nationally, and once it has been determined that vapor intrusion is not contaminating indoor air, the conclusion should hold over time as long as VOC levels in the subsurface source do not increase. However,

- following an indoor air investigation, changes in the building itself (remodeling, e.g.) or changes in the manner in which it is ventilated may act to make it more vulnerable to vapor intrusion. Neither PSC nor Ecology would realize these changes had occurred if we were not notified by the building's owner or tenant (who may not understand that the changes affect susceptibility to higher levels of indoor air contamination); and,

- Site investigations began as far back as 2000, and many investigations that concluded with a "no further action" determination (i.e., did not recommend mitigation) were performed as long as 10 years ago. Most, if not all, of the investigations collected air samples in 6-liter canisters for eight or 24-hour periods and then used the resulting data to estimate long-term vapor intrusion impacts on indoor air quality. More recent findings from researchers

[27] Effective system operation depends on continued depressurization utilizing a fan. The fan may be turned off without PSC's or Ecology's knowledge.

evaluating vapor intrusion effects, however, show that the impacts on indoor air can vary significantly over time, and over short time periods. A sample of indoor air collected over one eight or 24-hour interval may not conservatively represent vapor intrusion impacts on indoor air quality during other eight or 24-hour intervals, or average impacts on air quality over a year or multi-year time period.

Ecology agrees that PSC's VI program is effective and the company has conscientiously carried out its assessment, monitoring, and mitigation-related obligations. The program's limitations should be acknowledged, however, and efforts continually made to minimize the probability that receptors living and working above the shallow VOC groundwater plume could be exposed to VI-caused indoor air contamination.

8. Continued reliance on controls put in place prior to CAP finalization:

   Prior to 2010, Consent Decrees were issued to the property owner located immediately west of PSC's facility property and to the property owner located immediately north of PSC's 5900 Denver Ave. S. property. The controls embodied in the Decrees remain in effect and have been successful in protecting human health on the two properties.

9. Five-year requirements for PSC to ensure, over time, that contaminated Site groundwater is not being used for drinking water purposes, is not expected to be used for such purposes, and cannot be "practicably" used for such purposes:

   PSC's December 30, 2014, submittal, included in Appendix 6.5, documents the company's efforts to comply with this CAP requirement. As it discusses, properties within the boundaries of a water system (such as supplied by Seattle Public Utilities) are required to hook-up to that water system rather than having a private drinking water well. Should a property qualify for an exemption to these requirements, the well installed must meet state construction standards (WAC 173-160) and state and county setback (WAC 173-160-171) and other requirements. This significantly limits the possibility of a new well being installed in the Site area, even if a property owner in the area should desire such a well and legally qualify for an alternative to City-supplied water. According to the Ecology well log "viewer" (https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx), no water (production) wells are currently known to exist in the Site area.

   The City and County do not appear to have any future drinking-water resource plans that include the possible use of groundwater within the Site area.

10. Requirements for PSC to demonstrate and maintain Financial Assurance for Site cleanup:

    Financial assurance was established and has been maintained.

11. Implementation of enhanced in situ bioremediation to reduce degradable contaminants in groundwater behind the subsurface barrier wall:

    Enhanced in situ bioremediation for groundwater contamination behind the barrier wall has not yet been implemented. This cleanup action element was scheduled last, among

the "active" cleanup actions mandated by the 2010 CAP. It is anticipated to begin later in 2015. The action could not be implemented sooner, since it had to await completion of SVE operations and restoration of pre-SVE water levels behind the barrier wall.

12. Imposition of controls:

    As discussed in Sections 2.3 and 2.5 above, the 2010 CAP required Environmental (Restrictive) Covenants for PSC's properties and for the portion of Union Pacific Railroad's Argo Yard subject to cleanup actions under PSC's Agreed Order. The Covenants have a number of specific purposes, but are generally required to protect human health and ensure the continued effectiveness of the cleanup action.

    Neither Covenant has yet been finalized. With respect to PSC's properties, this is because Ecology agreed that a Covenant need not be finalized until the CAP's "active" cleanup actions had been completed. Therefore, we did not expect that a Covenant would be finalized any earlier than completion of the first phase of the in situ enhanced bioremediation groundwater action described in "11" above. Until that time requirements contained in the company's Agreed Order, CAP, and associated documents were, in our opinion, adequate to the purpose of protecting human health and ensuring cleanup action effectiveness on PSC's properties.

    Likewise, we agreed that a Covenant on Union Pacific Railroad's Argo Yard property need not be finalized until the "active" cleanup actions on that property had been completed. We therefore did not expect that the Covenant would be finalized any earlier than completion of the SVE action. Since 2010 Ecology has relied upon Union Pacific Railroad's "voluntary" controls and PSC inspections of the contaminated Argo Yard property, to ensure protection of worker health and limit or prohibit activities that may interfere with the integrity of the cleanup action.

    Ecology expects the Argo Yard Environmental Covenant to be finalized shortly, and to then be recorded with the Auditor by the end of the year. Finalization of PSC's Covenant is likely to occur later. We hope to have it recorded with the Auditor by early 2016.

    PSC has implemented other "controls" that are intended to protect human health in areas downgradient of the Site where groundwater remains contaminated. These include annual notifications to property addresses within the Site area, east and west of 4th Ave. S. The notifications update the local community on Site progress and summarize information related to groundwater contamination. They remind property owners that groundwater contaminants in certain areas of the Site continue to exceed drinking water standards and should not be pumped to the surface for domestic or other purposes. PSC has also provided Site contamination information to Utility entities with conveyances in the affected area.

3.2 New scientific information and/or new applicable state and federal laws for hazardous substances present at the Site

The cleanup at the Site is governed by MTCA regulations in Chapter 173-340 WAC. WAC 173-340-702(12) (c) provides that,

> "A release cleaned up under the cleanup levels determined in (a) or (b) of this subsection shall not be subject to further cleanup action due solely to subsequent amendments to the provision in this chapter on cleanup levels, unless the department determines, on a case-by-case basis, that the previous cleanup action is no longer sufficiently protective of human health and the environment."

As noted in Section 2.4, the 2010 CAP included tables (Tables 4 through 8) of Site media cleanup levels. For soil contamination, the 2010 cleanup levels were based on:

- MTCA Method C cleanup levels for direct contact and other industrial exposure pathways.
- MTCA Method B cleanup levels for protection of groundwater quality.

For groundwater contamination, the 2010 cleanup levels were based on:

- MTCA Method B surface water cleanup levels for the protection of Duwamish Waterway exposure pathways (all groundwater zones).
- MTCA Method B cleanup levels for the protection of indoor air quality. These cleanup levels were based on Method B air levels, and were limited to volatile contaminants in the Water table Zone.
- MTCA Method B drinking water-based cleanup levels for the Deep Aquifer.

2010 cleanup levels can potentially be no longer protective or MTCA-compliant for several reasons:

- Site receptors (or receptor behavior) have changed.
- Determinations regarding the inability of a groundwater contaminant to "reach" the Waterway have changed.
- The Practical Quantitation Limits (PQLs) values for certain contaminants and media have changed, and the 2010 cleanup levels were based on these PQLs.
- The 2010 cleanup levels were not sensitive to a particular, or new, pathway or migration route.
- The 2010 cleanup levels were calculated or established incorrectly.
- The understanding of contaminant toxicity has changed for a particular exposure route/pathway.
- Contaminant-specific inputs (such as bio-concentration factors) to the cleanup level Equations in WAC 173-340-720, -730, -740, or -750 have changed.
- ARAR values have changed.

The 2010 media cleanup levels must therefore be examined to determine if:

a) *Site receptors (or receptor behavior) have changed.*

The types of Site receptors identified in the RI/FS and 2010 CAP have not changed. However, groundwater cleanup levels are based on surface water cleanup levels, and in

2010 the surface water cleanup levels used for this purpose were calculated assuming that an Asian/Pacific Islander (API) consumer of fish and shellfish was the "reasonably maximally-exposed" receptor. Although it was recognized at that time that Native Americans also consumed fish and shellfish harvested from the Waterway, no Native American-specific exposure factors were available for calculating cleanup levels protective of these receptors. Such exposure factors are now available and use of these factors in Equations 730-1 and 730-2 generally results in surface water cleanup levels about one third lower than the 2010 risk-based levels calculated to be protective of API receptors.[28]

b) *2010 judgments concerning those groundwater contaminants unable to "reach" the Waterway are still valid.*

Several cleanup levels for soils or one or more groundwater zones are not as low as the contaminants' surface water ARAR or risk-based values. These include a number of polycyclic aromatic hydrocarbons (PAHs), various petroleum hydrocarbons, and, in the Intermediate Zone, vinyl chloride. The 2010 CAP's cleanup level tables do not explicitly identify those groundwater contaminants that will not "reach" the Duwamish Waterway. These contaminants were identified during the feasibility study (FS Technical Memorandum 1, July 2006), per groundwater zone, and alternative surface water-protective cleanup levels were subsequently established for them.

For the purposes of the Periodic Review, it is important to determine if contaminants previously deemed incapable of reaching the Waterway appear now, in 2015, capable of migrating this far. With two exceptions, Ecology believes the FS's fate and transport conclusions regarding potential contaminant movement to the Waterway remain valid. The first exception was discussed with PSC as long ago as 2006 and related to the compound bis(2-ethylhexyl) phthalate. As we noted nine years ago, bis(2-ethylhexyl) phthalate was present over a large area in Shallow and Intermediate Zone groundwater. We are not confident that groundwater discharging to the Waterway has not, does not, and will not in the future, contain detectable levels of this compound. More protective groundwater cleanup levels would account for this uncertainty by being lowered to the applicable surface water cleanup level.

The second exception is vinyl chloride in the Intermediate Zone. Based on conservative modeling performed in 2006, a concentration of vinyl chloride of 4390 µg/l in the Intermediate Zone immediately downgradient of the PSC facility was not predicted to result in a future detectable level of the compound at the point where groundwater discharges to the Waterway. Ecology believes there are good reasons to think this was a valid prediction. In 2006, levels of vinyl chloride this high (4390 µg/l) were present in the Intermediate Zone at one monitoring well location immediately downgradient of PSC's barrier wall. Since that time concentrations have drastically diminished (to as low

[28] Equation 730-1 inputs: ABW = 81.8 kg; FCR = 97.5 g/d; FDF = 1; AT = 64 years; ED = 64 years. Equation 730-2 inputs are the same as for Equation 730-1, but AT is 70 years. See Boeing Plant 2 "Target Media Cleanup Levels" technical memorandum, dated May 26, 2011.

as 2 µg/l in 2014) and concentrations downgradient of that point remain very low. So, there is good reason to believe that the vinyl chloride at this "hot-spot source area" will not, eventually, result in future detectable levels of the compound at the river's eastern edge. Nevertheless, since 2008 the investigations of groundwater and surface water/sediment contamination west of 4th Ave. S. have indicated that elevated levels of vinyl chloride are present in Intermediate Zone groundwater in areas approaching the Waterway. Ecology believes detectable levels of vinyl chloride do, or could, reach the Waterway due to contamination in this Zone. Therefore, while PSC's contribution to this West of 4th contamination is uncertain, Ecology is not confident that historic releases from the PSC facility, which have contaminated Intermediate Zone groundwater with vinyl chloride, are incapable of potentially reaching surface water.

c) *The PQLs used in 2010 for certain cleanup levels have changed.*

The analytical methods used to quantify contaminant concentrations in media samples at the Site are capable of detecting very low concentrations. However, certain risk-based concentrations are even lower and as a result, some cleanup levels in the 2010 CAP have been adjusted upwards to be no lower than PQLs. For these particular contaminants, such as PCBs, the cleanup levels are higher than the lowest Method B risk-based concentrations and ARARs. Improved analytical techniques since 2010, with lower analytical Reporting Limits, could potentially allow Ecology to adjust these cleanup levels to values approaching, or as low as, the appropriate risk/ARAR-based Method B cleanup levels.

Based on Ecology's review, there do not appear to be 2010 soil or groundwater contaminant cleanup levels based on PQLs: (1) that can be significantly lowered due to improved analytical techniques, and (2) where such adjustments would be likely to affect decisions or recommendations made for the Site.

d) *The 2010 cleanup levels were not sensitive to certain pathways or migration routes.*

Ecology believes this is not the case. As noted in Section 2.4, the 2010 CAP's tables do not contain soil cleanup levels that are explicitly identified as being protective of indoor air quality (via the direct volatilization of soil contamination). It is possible, however, that Table 8's "industrial cleanup levels" may embody consideration of this pathway. Even though protection of the pathway is assured in any case through land use controls, the particular exposure pathways protected by Table 8's "industrial cleanup levels" need to be clarified (please see recommendations in Section 4).

e) *The 2010 cleanup levels were calculated or established incorrectly.*

This is unlikely to be the case, with the possible exception of certain cleanup levels discussed in the two tables below.

f) *The understanding of contaminant toxicity has changed for a particular exposure route/pathway; contaminant-specific inputs for the WAC 173-340 cleanup level Equations have changed; or, contaminant-specific ARAR values have changed.*

Since 2010 the State's standard Method B and C cleanup levels for certain contaminants have changed due to the results of EPA's periodic reviews of contaminant toxicology. Therefore, to determine whether the 2010 media cleanup levels remain protective, they must be compared to the most recent and applicable ARAR values and Ecology's most up-to-date:

(1) Method C soil cleanup levels for direct contact exposures;
(2) Method B surface water cleanup levels (which soil and groundwater cleanup levels protective of the Waterway are based upon);
(3) Method B air cleanup levels (which groundwater cleanup levels protective of indoor air are based upon); and,
(4) Method B groundwater cleanup levels assuming groundwater is a drinking water source (for the Deep Aquifer).

The Soil and Groundwater cleanup tables below represent the results of Ecology's evaluation of the 2010 CAP's cleanup levels. Our evaluation compared 2010 industrial soil cleanup levels to 2015 CLARC Method C values (calculated in accordance with WAC 173-340 Equations 745-1 and 745-2). It also compared 2010 groundwater-protective soil cleanup levels to updated levels. These updated levels correspond to updates in the groundwater cleanup levels, as discussed below. The only contaminants listed in the Soil table are those for which the soil cleanup level appears to be significantly lower now than the level established in the 2010 CAP.

Ecology's groundwater evaluation compared 2010 cleanup levels protective of indoor air to updated Method B values. The updated concentrations are based on 2015 CLARC air cleanup levels (calculated in accordance with WAC 173-340 air cleanup level Equations 750-1 and 750-2). Our evaluation also compared 2010 surface water-protective groundwater cleanup levels to the most recent Method B values. These Method B levels are consistent with 2015 CLARC Method B surface water cleanup levels (calculated in accordance with WAC 173-340 Equations 730-1 and 730-2, and current human health and ecological ARARs). Similar to the Soil table, the Groundwater table only contains contaminants for which the groundwater cleanup level appears to be lower now than the level established in the 2010 CAP.

Following each table, the cleanup levels noted in the table are briefly discussed, per contaminant.

SOIL

contaminant	**2010 CAP Method B Soil Cleanup level (mg/kg) based on the protection of groundwater quality**	**2015 REVIEW Method B Soil Cleanup level (mg/kg) based on the protection of groundwater quality**
1,1-dichlorothene	0.192	≈ 0.025
PCBs [Aroclors 1016, 1232, 1242, 1248, 1254, 1260]	No groundwater-protection soil concentrations are provided for PCBs. Cleanup levels of 1.46 mg/kg are identified for Aroclors 1016, 1242, 1248, 1254, and 260	2015 EPA Regional Screening Level (not Method B) risk-based soil concentrations, protective of groundwater, are: Aroclor 1016: 1.1E-1 mg/kg Aroclor 1232: 7.9E-5 mg/kg Aroclor 1242: 6.1E-3 mg/kg Aroclor 1248: 6E-3 mg/kg Aroclor 1254: 1E-2 mg/kg Aroclor 1260: 2.7E-2 mg/kg "PCBs (low risk)": 3E-2 to 7.8E-2 mg/kg
benzo(a) pyrene	11	≈ 0.34
bis(2-ethylhexyl) phthalate	55	≈ 4.8
chromium	200	< 200
naphthalene	1.48	≈ 0.9

1,1-dichloroethene (DCE): the groundwater-protection soil concentration for 1,1-DCE in Table 8 of the 2010 CAP is listed as 0.192 mg/kg. As noted below, the groundwater cleanup level for 1,1-DCE should be 3.2 µg/l, the surface water ARAR concentration. To protect groundwater to this concentration the soil CUL should be a little less than one order of magnitude lower than the CAP's level (i.e., ≈ 0.025 mg/kg).

PCBs: the CAP does not contain risk-based groundwater-protection soil concentrations for PCBs. However, on-site soils are contaminated with these compounds and in some locations east of Denver Ave. S., PCBs have been detected in Site groundwater. The EPA risk-based concentrations referred to above are based on different "target" groundwater concentrations than apply at the PSC-Georgetown Site, and do not factor-in cleanup level adjustments such as PQLs. They are therefore not the Method B soil cleanup levels applicable to the Site. They have been provided here to draw attention to the significant difference between the CAP's soil cleanup levels (1.46 mg/kg) and the much lower levels likely to be needed to protect underlying groundwater from contamination.

Benzo(a)pyrene: the CAP's groundwater-protection soil concentration for benzo(a) pyrene is listed as 11 mg/kg. The groundwater cleanup level for this compound, however, should be 1.8E-2 µg/l, the surface water ARAR. To protect groundwater to this

concentration, the soil cleanup level should be ≈ 0.34 mg/kg. This assumes the compound can reach surface water, which may not be the case.

Bis(2-ethylhexyl)phthalate [BEHP]: the groundwater-protection soil concentration for BEHP in Table 8 of the CAP is 55 mg/kg. However, the groundwater cleanup level for this compound should be 2.2 µg/l, the surface water ARAR. To protect groundwater to this concentration the soil cleanup level should be ≈ 4.8 mg/kg. This assumes the compound can reach surface water, which – as discussed above – is debatable.

Chromium: The CAP's groundwater-protection soil concentration for chromium is 200 mg/kg. Separate soil cleanup levels do not appear to be listed for Cr+3 and Cr+6. Groundwater-protection soil concentrations for Cr+6 would need to be less than 200 mg/kg. If the 2010 CAP made an assumption about the ionic composition of the chromium in Site soil (or its composition upon leaching to groundwater), it is not obvious. This should be clarified.

Naphthalene: the CAP's groundwater-protection soil concentration for naphthalene is listed as 1.48 mg/kg. PSC's surface water concentration protective of ecological receptors is 12 µg/l. 1.48 mg/kg is not necessarily low enough to protect groundwater to this level (12 µg/l); a soil concentration about 5 times lower would likely be needed. However, it is assumed that naphthalene will not reach the Waterway, and for this reason a cleanup level of 1.48 mg/kg has been deemed adequate.

Nevertheless, the Method B air cleanup level for naphthalene is lower now than in 2010. The corresponding soil cleanup level protective of shallow groundwater as a VI source should be ≈ 0.9 mg/kg.

GROUNDWATER

contaminant	**2010 CAP Groundwater Cleanup level (µg/l) based on indoor air protection**	**2015 REVIEW Method B Groundwater Cleanup level (µg/l) based on indoor air protection**	**2010 CAP Groundwater Cleanup level (µg/l) based on the surface water cleanup level)**	**2015 REVIEW Method B Surface Water Cleanup Level or ARAR (µg/l)**
1,1-dichlorothene			25	3.3
PCBs			5E-3 (the 2010 PQL)	6.45E-5 (if analytically attainable)
Bis(2-ethylhexyl) phthalate			7.1 to 25, depending on zone (depth)	2.2
naphthalene	59 (water table zone)	~31 (water table zone)		
styrene			0.5 (the 2010 PQL) in deeper groundwater; 15 µg/l in the Water Table Zone.	6E-2 (in shallow and intermediate zones, if analytically attainable)
Vinyl chloride			4390 (intermediate zone)	< 4390 (intermediate zone)
1,4-dioxane			78.5	~ 23
Penta-chlorophenol			2.1 to 2.5 µg/l, depending on zone (depth)	~ 2
cyanide			3.8 to 11.8 µg/l, depending on zone (depth)	1 (water table zone)
xylenes			116	81 (in shallow and intermediate zones)
1,4-DCB	3505 (water table zone)	< 3505 (water table zone)		.

As discussed above, 2010 groundwater (and soil) cleanup levels were <u>not</u> based on protection of Native American Duwamish receptors who consume more fish/shellfish than "API" receptors. That is, since surface water cleanup levels were not calculated or established with Native American-specific exposure factors, nor were groundwater

cleanup levels established that would necessarily be this low. Nevertheless, the 2010 cleanup level concentrations were intentionally selected to be conservative and for this reason the vast majority are protective of Native American Duwamish receptors (potential risk less than 1 in 100,000).

1,1-DCE: the 2010 CAP's groundwater cleanup level is 25 µg/l, based on surface water ecological protection. However, the surface water human-health ARAR (NTR Rule) concentration is 3.3 µg/l. It appears, then, that the CAP's groundwater CUL is not currently ARAR-compliant.

PCBs: the surface water human-health ARAR for PCBs is very low, 6.45E-5 µg/l (total PCBs). The CAP's surface water-protective PCB groundwater cleanup levels (0.005 µg/l) are 2 orders of magnitude higher and based on 2010 PQLs. Although the lowest standard MRLs for Aroclors 1016, 1232, 1242, 1254, and 1260 may continue be 0.005 µg/l, and PCBs at the Site are unlikely to migrate as far as the Waterway, PSC should re-look at PCB quantification methods (including Method 1668 Rev A and associated reporting limits) to ensure continued compliance with the PQL adjustment allowed by WAC 173-340-707. As we noted in the PQL discussion above, Ecology does not believe adjustments based on a lower quantitation limit are likely to affect Site decisions or recommendations.

BEHP: the CAP's groundwater cleanup levels range from 7.1 to 25 µg/l, depending on zone (depth). These cleanup levels are higher than both the surface water ARAR concentration (2.2 µg/l) and risk-based concentrations (protective of API and native American fish consumption). The human health ARAR concentration of 2.2 µg/l should be the groundwater cleanup level if BEHP can reach surface water, which in Ecology's opinion is debatable for the shallow and intermediate zones.

Naphthalene: the VI-protective groundwater cleanup level for naphthalene in Table 4 of the CAP is 59 µg/l, corresponding to a non-carcinogenic air cleanup level of 0.14 µg/m3. However, naphthalene's carcinogenic Method B air CUL is now 7.4E-2 µg/m3 and the 1E-6 VI-protective groundwater cleanup level corresponding to this indoor air concentration should be approximately 31 µg/l.

Styrene: the CAP's groundwater cleanup levels range from 0.5 ug/l (the PQL) in deeper groundwater to 15 µg/l in the Water Table zone. However, the ecologically-protective surface water concentration is 6E-2 µg/l. Styrene in the Water Table zone will not reach surface water, but for the Shallow and Intermediate Zones PSC should look at the Reporting Levels associated with current quantification methods to ensure continued compliance with the PQL adjustment allowed by WAC 173-340-707 and -720(7)(c).

Vinyl chloride: please see the discussion above (in this section), regarding the Intermediate Zone and vinyl chloride's ability to migrate downgradient to the Waterway. The current (human health) surface water ARAR concentration for vinyl chloride is 2.4 µg/l.

1,4-dioxane: The 2010 CAP's groundwater cleanup level is 78.5 µg/l, based on API fish consumption. Since 2010 this surface water-based concentration has decreased to 69 µg/l due to changes in 1,4-dioxane's perceived toxicity (and perhaps Bioconcentration Factor changes). To be protective of Native American (Waterway) fish ingestion – to the 1E-6 risk level – the surface water-protective groundwater cleanup level should be about three times lower (approximately 23 µg/l).

Pentachlorophenol: The CAP's groundwater cleanup levels are 2.1 to 2.5 µg/l, depending on zone (depth). These cleanup levels s are lower than surface water ARARs (minimum value of 3 µg/l). Nevertheless, the lowest human-health ARAR concentration for pentachlorophenol, and the CAP's Water Table Zone groundwater cleanup level of 2.5 µg/l correspond to a Native American fish consumption risk greater than 1E-5. The surface water-protective groundwater cleanup level should therefore be approximately 2 µg/l.

Cyanide: the CAP's groundwater cleanup levels range from 3.8 to 11.8 µg/l, depending on zone (depth). This is based on a prediction that cyanide in the Shallow and Intermediate zones will not reach the Waterway. However, the ARAR concentration protective of surface water ecological receptors is 1 µg/l. This should be the surface water-protective groundwater cleanup level for the Water Table Zone.

Xylenes: the CAP's groundwater cleanup level of 116 µg/l is higher than the surface water ARAR concentration (protective of ecological receptors) of 81 µg/l. For the Water Table Zone the CAP's cleanup level is appropriate, because xylenes in that zone will not reach surface water. However, 81 µg/l should be the surface water-protective groundwater cleanup level for the Shallow and Intermediate Zones.

1,4-dichlorobenzene: the carcinogenic Method B air cleanup level for this compound is now 0.23 µg/m3. The CAP's Water Table zone groundwater cleanup level, protective of indoor air, is 3505 µg/l. This concentration appears to be as much as two orders of magnitude higher than a suitably protective level.

Trichloroethene (TCE) is not listed above in either the Soil or Groundwater Tables. However, the 2010 CAP does not acknowledge its potential short-term inhalation health effects for pregnant women.[29] This should be factored into vapor intrusion-related decisions at the Site. The reasons TCE has not been included in Ecology's tables above is that the CAP's soil and groundwater cleanup levels, protective of indoor air that receptors are chronically exposed to, are lower than cleanup levels based on short-term exposures.

It is important to consider the groundwater cleanup level discussion above in its proper context. The eastern portion of the PSC-Georgetown Site includes no surface water bodies. The nearest

[29] The West of 4th Site's *Vapor Intrusion Assessment Monitoring and Mitigation memorandum*, approved on February 5, 2015, contains TCE action levels for these receptors.

surface water body, the Duwamish Waterway, is over 1800 feet west of this portion of the Site. Changes to surface water-protective groundwater cleanup levels, then, while pertinent to the eventual attainment of Site groundwater quality restoration, do not directly affect the degree of protectiveness afforded by the cleanup action. Moreover, most of the compounds discussed above (such as PCBs, naphthalene, styrene, pentachlorophenol, cyanide, and xylenes), whose 2010 groundwater cleanup levels may now be outdated, are not present in Site groundwater – outside of the area contained by the barrier wall – except in limited areas and at particular depths. Few of them are being currently detected at significant levels within half of mile of the Waterway.

3.3 Current and projected Site use

The portion of the PSC-Georgetown Site located east of 4th Ave. S. is currently used for residential, commercial, and industrial purposes. Ecology expects this mixed use to continue into the foreseeable future.

3.4 Availability and practicability of higher preference technologies

The remedy implemented included containment of hazardous substances, and it continues to be protective of human health and the environment (please see Sections 4.0, 4.1, and 4.2) . While higher preference cleanup technologies may be available, they are still not practicable at this Site.

4.0 CONCLUSIONS

The following conclusions are a result of this periodic review:

- The cleanup actions completed so far at the Site appear to be currently protective of human health and the environment.

- Soil cleanup levels have not been met at the standard point of compliance for the Site; however, achieving all such cleanup levels was not a remedial action objective. The cleanup action has been determined to comply with cleanup standards by "containing" and covering/capping contaminated soils and requirements related to these technologies are currently being met. The long-term integrity of the containment and cover/cap will be ensured once the Restrictive (Environmental) Covenants on PSC and Union Pacific Railroad properties have been finalized and recorded (see discussions in the 4th bullet below and in Sections 2.5 and 3.1 above).

- Groundwater cleanup levels have not been met at the point of compliance (areas of Site groundwater "outside" the barrier wall); however, achieving all such cleanup levels by 2015 was not a Site remedial action objective. For many groundwater contaminants and areas and depths of contamination cleanup levels have been attained or on the way to attainment by, or before, 2032. The most problematic areas of groundwater contamination at the Site (i.e., east of 4th Ave. S.) include:

    a) those areas between Maynard Ave. S. and 4th Ave. S. where 1,4-dioxane remains elevated above cleanup levels;
    b) areas in Argo Yard where petroleum-related contamination and PCBs remain elevated above cleanup levels; and,
    c) several areas between the PSC property and 4th Ave. S. where the Water Table zone contains volatile contaminants exceeding levels protective of indoor air quality.

- The Restrictive Covenants for the PSC and Union Pacific Railroad properties are not in place. These Covenants are needed to ensure the protection of public health and the integrity of the cleanup action. They should be finalized over the following six to eight months.

- As discussed in Section 3.2, media cleanup levels have changed for a number of contaminants since 2010. In some cases the cleanup levels that would be calculated for the Site today are lower than those established in the 2010 CAP. This is due – depending on the contaminant, environmental medium, and manner in which the 2010 cleanup level was calculated – to:
    a) recent studies suggesting that the contaminant is more toxic (per a given exposure route) than previously understood;
    b) the availability of a lower ARAR concentration; or,

c) the availability of Native American Duwamish Waterway exposure factors, which include a higher assumed fish consumption rate than the cleanup levels established in the 2010 CAP.

Contaminated soils at the Site are covered/capped. Changes in soil cleanup levels, then, are of primary interest in terms of whether these changes signify a need to re-evaluate the likely effect of continued leaching on groundwater quality. That is, if soil cleanup levels should now be lower to be protective of lower (since 2010) groundwater cleanup levels, the cleanup actions performed to date, and the reliance on the covering/capping of residual soil contamination, the barrier wall, and the natural attenuation of groundwater contamination may be inadequate. Based on our first 5-year review, Ecology does not believe this is the case.

The 2010 CAP expects the Site remedy to achieve groundwater cleanup levels within and throughout the eastern portion of the Site by 2032. New and lower groundwater cleanup levels, then, are of primary interest in three respects: (1) is the natural attenuation component of the cleanup action likely to attain these new and lower surface water-protective groundwater cleanup levels? (2) is the natural attenuation component of the cleanup action likely to attain new and lower Water Table Zone cleanup levels, protective of indoor air quality? and, (3) do any of the new and lower Water Table Zone cleanup levels based on updated air cleanup levels indicate that additional Site buildings are potentially threatened by VI?

Based on our first 5-year review, Ecology believes that the 2010 cleanup action's ability to achieve groundwater cleanup levels by 2032 is unlikely to be significantly affected by revising cleanup levels to the more-protective concentrations identified in Section 3.2's groundwater table. 2032 is more than a decade and a half away. Attainment of cleanup levels within that timeframe is more likely to be influenced by factors other than modest (less than one order of magnitude) changes to our target levels. This assumes that the 1,4-dioxane cleanup action is expeditiously implemented, as planned.

- The cleanup level tables in the 2010 CAP are basically summary tables. They provide the cleanup levels themselves, but little of the rationale for their selection. As discussed in Section 4.2 below, Ecology does not suggest that these tables be formally revised through an amendment to the 2010 Agreed Order. However, some of the concentrations included in those tables were calculated long ago during the RI/FS. It can be difficult – without researching documents submitted as long as 9 to 12 years ago – to piece together how the values presented in the CAP's summary tables were derived, what RfDs and CPFs were used, which pathways were and were not considered, why certain substances in groundwater are unlikely to reach the Waterway and how their "site-specific cleanup levels" were established, etc. The answers to these questions should be both transparent and obtainable – without having to refer to the tables and text of multiple historic documents.

  Ecology therefore recommends the following:

a) PSC should re-calculate Method C direct contact[30] and Method B groundwater-protection soil cleanup levels based on the most recent toxicity information and consistent with the analysis provided in Section 3.2. The spreadsheets used to calculate these cleanup levels, as well as the tables generated, should be available to the two Project Coordinators;

b) PSC should re-calculate Method B surface water-protection groundwater cleanup levels based on the most recent toxicity information, ARARs, and PQLs. These levels should be based on Duwamish tribal fish and shellfish consumption, and consistent with the analysis provided in Section 3.2.[31] The spreadsheets used to calculate the cleanup levels, and the tables generated, should be available to the two Project Coordinators;

c) PSC should re-calculate Method B indoor air-protection Water Table Zone cleanup levels based on the most recent toxicity information, and consistent with the analysis provided in Section 3.2. The spreadsheets used to calculate the cleanup levels, and the tables generated, should be available to the two Project Coordinators; and,

d) PSC should re-calculate indoor air and VI-protective Water Table Zone *action levels* based on the most recent toxicity information, and update and re-submit Pioneer's November 2012 "Indoor Air and Groundwater IPIMALs/VIRLs…" (Table 1).[32]

The cleanup levels produced in the tables described in "a" through "c" above do not replace the CAP's cleanup levels. As discussed in Section 4.2, Ecology does not recommend formally revising the 2010 levels at this time. But, it should be more obvious how the CAP's cleanup levels were generated. It should also be clear to the Project Coordinators which levels would be different if calculated today, why, and how much higher or lower these new levels are than those established in 2010.

4.1 Protectiveness

Based on this periodic review, the Department of Ecology has determined that the cleanup action, once completed and as amended by the new 1,4-dioxane action, "will be protective."

[30] These are not the same as the cleanup levels listed under Table 8's "Minimum Industrial Risk-based Soil Cleanup Levels." Ecology is unsure what the Table 8 levels are based on. It is possible that they are concentrations calculated to be protective of industrial direct contact exposures as well as industrial inhalation exposures.

[31] In addition, this Periodic Review has not discussed how cleanup levels are established for three special contaminant groups. The spreadsheets and tables recommended in this section must also contain Site cleanup levels that comply with:

- Petroleum hydrocarbon cleanup level requirements, described in 173-340-720(4)(b)(iii)(C);
- Carcinogenic PAH cleanup level requirements, described in 173-340-708(8)(e); and,
- PCB mixtures cleanup level requirements, described in 173-340-708(f)

[32] This revised table should include "short-term" TCE action levels, protective of pregnant women breathing indoor air.

By this we mean that although certain cleanup construction and implementation activities have yet be completed, and Environmental Covenants must still be finalized and recorded, health risks to human and ecological receptors are currently *under control* and the remedy is anticipated to be protective upon completion. The basis for this determination is discussed in Sections 2.2, 2.4, 3.1, 3.2, and 4.0 above.

As discussed in Section 3.2, some of the 2010 cleanup levels are different, and less protective, than levels that would be calculated and established today. The differences, however, do not, by themselves, suggest that the Site's cleanup action should be supplemented or otherwise changed. Therefore, Ecology believes the 2010 Order and CAP should not be amended at this time to incorporate new, more protective cleanup levels.[33] It is likely that this will eventually need to be done, prior to the time at which PSC is demonstrating compliance with all groundwater cleanup standards (per WAC 173-340-720(9)).[34] But that compliance demonstration is a number of years away and additional changes to the State's soil, air, and groundwater cleanup levels are expected over this timeframe. It therefore seems reasonable at this juncture to acknowledge the changes, and use them in determinations of protectiveness, but hold off on amending the Order and CAP for simply this purpose.

4.2 Remedy Performance

Cleanup actions implemented since 2010 were constructed and implemented as designed. They have reduced the mass of hazardous substances in Site soils. Containment of residual soil contamination by capping/covering and associated controls appears, so far, to be effective. Containment of groundwater contamination by the barrier wall also appears to be effective. Continuation of the VI program protects indoor receptors living and working in areas where Water Table Zone VOC concentrations remain elevated.

Ecology is therefore generally satisfied with the effectiveness of the actions taken to date. MNA, however, did not effectively reduce 1,4-dioxane groundwater concentrations to cleanup levels by 2015. It will need to be supplemented by a new action, targeting those areas and depths with the most elevated dioxane concentrations.

Although MNA has effectively reduced the concentrations of most other Site groundwater contaminants, as noted above in Sections 3.1 and 4.0, it is unclear whether natural attenuation will be able to achieve cleanup levels by 2032 for several compounds at particular locations and depths. At a minimum, groundwater monitoring and trend-tracking will need to be continued throughout the next 5-year period.

[33] This also applies to 2010 cleanup levels that are now too low. Ecology's Periodic Review focused primarily on the *protectiveness* of 2010 cleanup levels. We did not identify those 2010 cleanup levels that now appear to be lower than they need be. Based solely on changes to the reference doses and/or cancer potency factors of some chemicals, however, the cleanup levels established in 2010 may now be considered overly-protective.
[34] I.e., revisions of those 2010 cleanup levels which are no longer deemed adequately protective.

Environmental Covenants for the PSC and Union Pacific Railroad properties have not been finalized. These documents should be completed and recorded over the following six to eight months.

In addition, since 2010 EPA Regions 9 and 10 have identified short-term action levels for the protection of pregnant women exposed, via inhalation, to TCE. It is important that these action levels be recognized in PSC's VI Program. It is also important that utility companies performing work in areas where the Water Table zone is contaminated with TCE be notified of these short-term action levels. While the action levels were developed for the protection of pregnant women breathing indoor air, these receptors could also be exposed to TCE outside, should they be involved in subsurface work that exposes them to contaminated soil gas. Likewise, as part of PSC's annual notifications, the information regarding TCE exposures should also be provided to property addresses within the Site's affected area. Residents and business owners contemplating significant subsurface work should be aware of the potential health risks.

In situ bioremediation of groundwater contained by the barrier wall has not been implemented. Mobilization for the action was scheduled for the spring of this year. Last month, however, PSC notified Ecology that the company and Union Pacific Railroad were currently discussing the possibility of a leasing agreement for the two PSC properties (734 S. Lucile St. and 5900 Denver Ave. S.). Should the companies enter into this agreement, Union Pacific would use the PSC properties for parking. This would require demolition of the large "White Satin Sugar" building on the 5400 Denver Ave. property, relocation of the groundwater treatment building, and extensive re-paving. To carry out this work, many of the extraction and monitoring wells currently in place on PSC's properties would need to be abandoned and then re-installed following the completion of surface re-paving.

The in situ groundwater bioremediation project requires the installation of approximately 40 new wells on PSC's property. It operates in phases over a four-year period. Should the wells associated with this project be installed now, they will need to be abandoned if Union Pacific leases the PSC properties and carries out the redevelopment plans they have been discussing with PSC. They will then need to be re-installed following the completion of the paving work.

Ecology prefers that the bioremediation wells not be abandoned after several months and then re-installed, <u>if</u> the two companies are close to reaching a leasing agreement and property redevelopment is imminent. For that reason we approved a request by PSC to hold-off mobilization for the bioremediation action until at least mid-July 2015. At that time we will determine the most likely near-future use of the PSC properties and re-visit the question of the appropriate start date for in situ groundwater bioremediation.

4.3 Next Review

The next review for the Site will be scheduled five years from the date of this periodic review. In the event that additional cleanup actions or institutional controls are required, the next periodic review will be scheduled five years from the completion of those activities.

5.0 REFERENCES

PSC/Stericycle. 2011. Final Engineering Design Report, September.

PSC/Stericycle. 2013. PSC Area Cleanup Implementation Report, January.

PSC/Stericycle. 2013. Final Argo Yard Area Cleanup Implementation Report, July.

PSC/Stericycle. 2014. 1,4-Dioxane Remediation Approach Technical Memorandum, September.

PSC/Stericycle. 2014. Soil Vapor Extraction Completion Report, December.

PSC/Stericycle. 2014. Potability Determination: Five-year review, December.

PSC/Stericycle. 2014. Five-Year Review Assessment of the Effectiveness of Institutional and Other Controls as Part of Cleanup, December.

PSC/Stericycle. 2015. 1,4-Dioxane Remediation Approach Focused Feasibility Study, January.

PSC/Stericycle. 2015. Cleanup Level Attainment: Five-year Review, January.

PSC/Stericycle. 2015. Five-Year Review Assessment of the Vapor Intrusion Mitigation System, February.

PSC/Stericycle. 2015. 1,4-Dioxane Remediation Approach Focused Feasibility Study, Response to Comments, March.

US EPA. 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007; OSWER 9355.7-03B-P.

US EPA. 2012. Memorandum "Clarifying the Use of Protectiveness Determinations for Comprehensive environmental Response, Compensation, and Liability Act Five-Tear Reviews." OSWER 9200.2-111.

WDOE. 2010. Agreed Order (DE 7347) and Cleanup Action Plan, May.

WDOE. 2013. PSC Area Cleanup Implementation Report approval letter, April.

WDOE. 2013. Final Argo Yard Area Cleanup Implementation Report letter, September.

WDOE. 2014. Letter requiring PSC to submit a schedule and feasibility study/conceptual design information related to choosing and implementing a new cleanup action for 1,4-dioxane, June.

WDOE. 2015. Ecology letter, responding to the Soil Vapor Extraction Completion Report, January.

WDOE. 2015. Ecology letter, responding to the 1,4-Dioxane Remediation Approach Focused Feasibility Study, February.

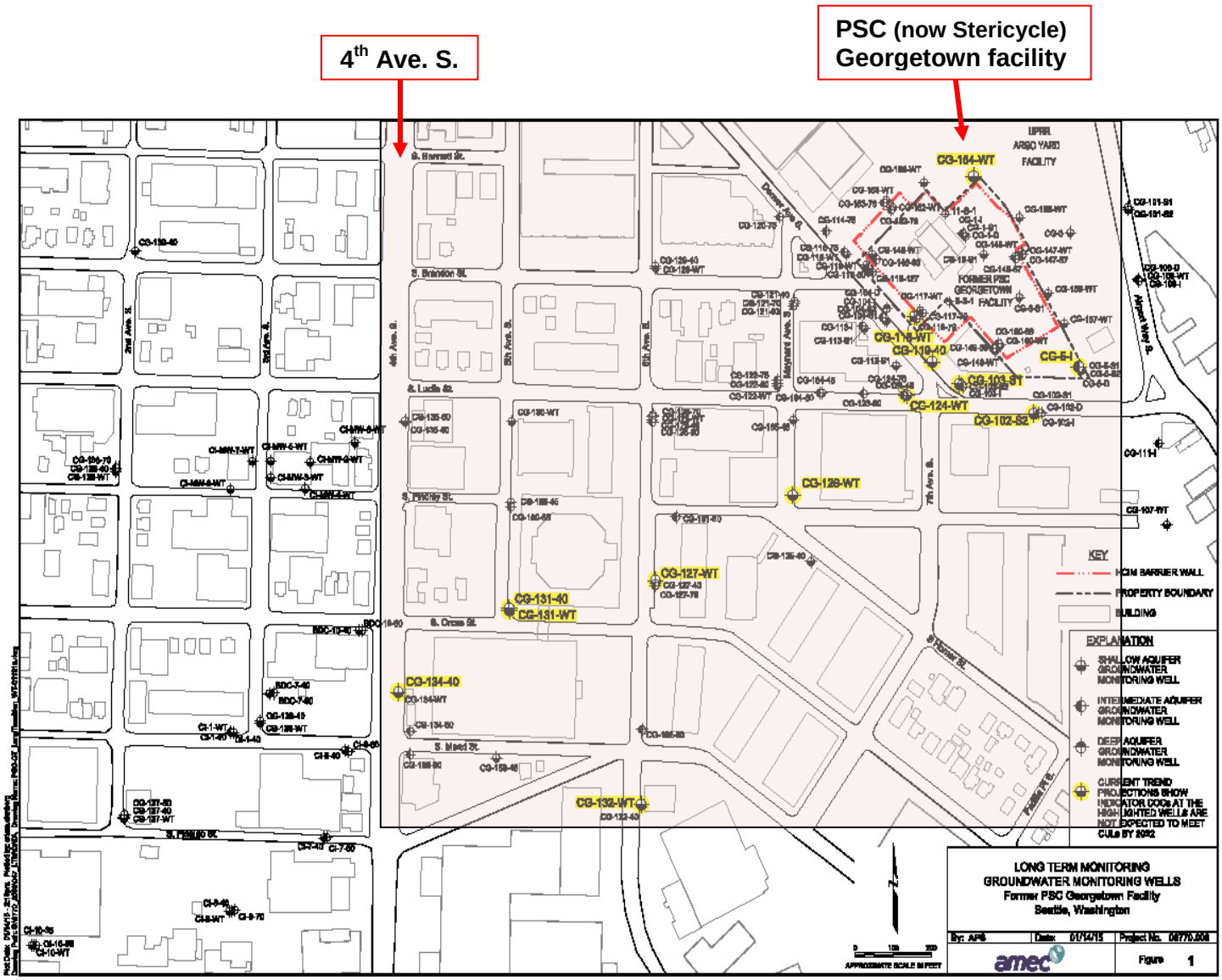
WDOE. 2015. CLARC database Method B air cleanup levels; Method B risk-based surface water cleanup levels and ARARs; Method B drinking water-based cleanup levels and ARARs; Method C soil cleanup levels.

6.0 APPENDICES

6.1 Vicinity Map

6.2 Site Plan (East of 4th portion of the Site)

NOTE: shaded area is the part of the Site east of 4th Avenue South



6.3 Groundwater COC Concentration Figures

Groundwater sample concentrations of trichloroethene (TCE), cis-1,2-dichlorethene (DCE), vinyl chloride, and 1,4-dioxane, measured at Site monitoring wells in August2014 [see file: "PSC-GT 3rd qtr 2014 figures 13-20"]

6.4 "Five-Year Review Assessment of the Effectiveness of Institutional and Other Controls as Part of Cleanup," received December 31, 2014

[see file: "2014_12-30_Effectiveness of ICs Argo Yard_ Sx"]

6.5 "Potability Determination: Five-year review," received December 31, 2014

[see file: "2014_12-30_Potability Determination_ Sx"]

6.6 "Cleanup Level Attainment: Five-year Review," received January 15, 2015

[This document is available from Ecology via hardcopy or CD. To request, please refer to the title above or file "2015_01-14_Cleanup Level Attainment_Sx" (25.2 MB)]

6.7 "Five-Year Review Assessment of the Vapor Intrusion Mitigation System," received February 27, 2015

[see file: "Five Year Review Assessment" (10 MB)]

6.8 Inspection Checklist and Photo Log

5-year Review Inspection Checklist

5-year review site inspection

- Observe and document current use of the property. Is it consistent with any Covenants? Is it consistent with assumptions/expectations in the CAP?

- Observe and document state of Institutional or other Controls. Document capping and "cover" conditions, extent, and any settlement/erosion. Document changes (new structures; presence/absence of wells) since the CAP was issued.

- Document wells and their apparent condition.

- Interview key O&M personnel and inspect key O&M documents (O&M Manual, maintenance logs, training records, etc.). Ensure a H&SP is available and being followed. Ensure all needed permits and service agreements have been obtained and documented.

- Document site security measures (fencing, signs, other), how measures are enforced, and any breaches of security (vandalism, trespassing, etc.) over the past 5 years.

- Document how access is obtained to adjoining properties in order to carry out ongoing cleanup actions and O&M (and protect HH&E). Any problems?

- Observe and document state of all cleanup-related treatment systems and associated aboveground piping, tanks, etc., that continue to operate. Any problems?

- Document (i.e., record) those cleanup actions required by the CAP and EDR that have yet to be implemented or have been implemented but not completed. Document those cleanup actions that have been completed, but were not conducted in a manner consistent with the EDR or did not achieve all performance goals (and for any such actions, record why this was).

- Document (i.e., record) how primary potential exposure pathways at the facility property are being addressed. These include: a) use of contaminated GW as a drinking water source; b) aboveground receptor DC with contaminated soils; c) aboveground receptor inhalation of contaminated soil particles; d) aboveground receptor inhalation of contaminated soil gas, either indoors or outdoors; e) aboveground receptor inhalation of contaminated air associated with treatment systems; f) exposures to receptors working below ground/cap surface.

[photos: see file: “PSC 5 yr review photos 5-19-15” (12.8 MB)]