South Park Landfill

Cleanup Action Plan

Draft for Public Review

Issued by

Washington State Department of Ecology
Toxics Cleanup Program
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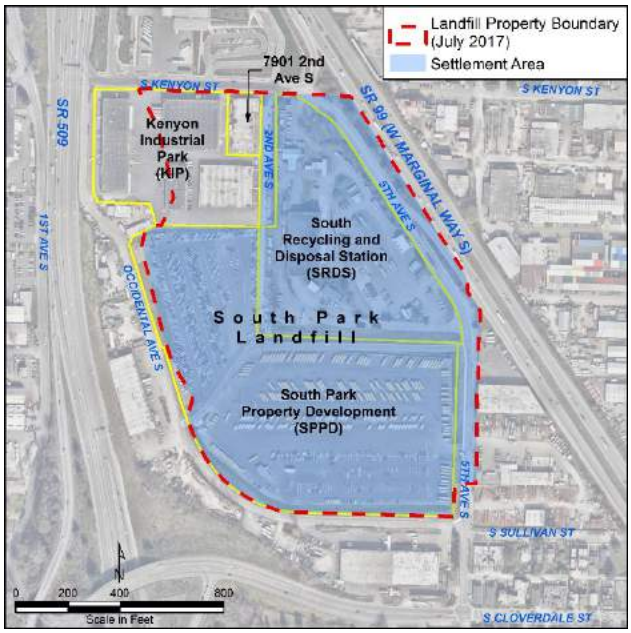
Executive Summary



The South Park Landfill Site (Site) includes property that is a closed solid waste landfill in the South Park neighborhood of Seattle, Washington. It is located in the Lower Duwamish Valley near the western valley wall between State Routes 509 and 99.

The landfill operated from the 1930s until 1966 when it was closed. By 1970, the South Recycling and Disposal Station, Kenyon Industrial Park, and several other facilities had been built on top of the landfill portion of the Site and were operating industrial facilities.

In February 2007, the Site was added to Washington State's Hazardous Sites List. Soil, groundwater, surface water, and landfill gas monitoring began in the late 1980s and have continued periodically to the present day. Today, landfill gas (methane) is still being produced at low levels and will require remedial controls, but no methane was detected in buildings on or near the landfill based on investigations conducted over four quarters in 2011. Vinyl chloride is still present at low levels in groundwater greater than Washington State's groundwater cleanup level. Vinyl chloride data will continue to be collected during groundwater monitoring to confirm that concentrations remain low and continue to decrease over time. Drinking water for the South Park community is provided by the Seattle Municipal Water Supply system, and the source of the water is protected watersheds in the Cascade Mountains.

A preliminary draft Cleanup Action Plan (CAP) for the Site was prepared by the potentially liable persons, as required by Washington State Model Toxics Control Act (MTCA) Agreed Order No. 6706. The Washington State Department of Ecology (Ecology) reviewed the preliminary draft CAP and used it to develop this Public Review Draft CAP.

This CAP describes the proposed remedial alternative and specifies cleanup standards and other requirements for the cleanup of the "Settlement Area," which is a portion of the Site. The Settlement Area consists of the two largest parcels within the "Landfill Property" (defined below) and certain adjacent City of Seattle and Washington State right-of-ways. The Landfill Property is a portion of the Site where wastes were placed as part of South Park Landfill operations. The proposed cleanup action is based on information and technical analyses documented in the 2017 Remedial Investigation/Feasibility Study (RI/FS) for the Site and consideration of public comments and community concerns.

Ecology will hold a public comment period on this CAP. During the comment period, the public will be provided an opportunity to review the CAP and submit comments to Ecology. Once the

comment period closes, Ecology will consider all comments received before finalizing the CAP. The final CAP will be implemented under a Consent Decree.

PROPOSED CLEANUP ACTION

Under MTCA, closed solid waste landfills are expected to prevent the spread of (or contain) hazardous substances. To meet the requirements of MTCA, the selected containment remedy must protect human health and the environment, and provisions must be made for long-term monitoring and maintenance.

The environmental investigation and analyses conducted as part of the RI/FS have guided the selection of a cleanup action that protects human health and the environment into the future. This proposed cleanup action for a portion of the Site consists of the following elements:

- A **landfill cap/cover** to protect people and animals from direct contact with the landfill contents.
- **Landfill gas controls** to prevent or mitigate subsurface migration of landfill gas into on-site and nearby buildings and structures.
- **Stormwater controls** to (1) prevent stormwater from coming into contact with solid waste, (2) maintain the landfill cap/cover, and (3) meet regulatory requirements.
- **Long-term monitoring of groundwater** to confirm that the residual vinyl chloride in the groundwater system remains at low concentrations and continues to degrade over time. Iron, manganese, and arsenic will also be monitored to demonstrate reduction in concentrations over time to background or pre-impairment levels.
- **Long-term monitoring of the cap/cover, the landfill gas controls, and groundwater** to ensure that the cleanup remedy is effective and provides long-term protection of human health and the environment.
- **Environmental Covenants** to ensure long-term compliance with regulations and maintenance of the cleanup remedy.

Completing the cleanup action detailed in this CAP will ensure that the Settlement Area meets the regulatory requirements for the protection of human health and the environment.

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
7901	7901 2nd Avenue S., LLC
ARAR	Applicable or relevant and appropriate requirement
CAP	Cleanup Action Plan
City	City of Seattle
COC	Chemical of concern
CPOC	Conditional point of compliance
County	King County
CUL	Cleanup level
DCE	Dichloroethene (three isomers: 1,1-DCE, *cis*-1,2-DCE, and *trans*-1,2-DCE)
Ecology	Washington State Department of Ecology
IA	Interim Action
IAWP	Interim Action Work Plan
IB	Industrial Buffer, a City zoning designation
IG2	General Industrial 2, a City zoning designation
KIP	Kenyon Industrial Park
L3	Lowrise 3, a City zoning designation
LEL	Lower explosive limit
Lenci	Lenci Frank Corporation
LFG	Landfill gas
µg/L	Micrograms per liter
µS/cm	Microsiemens per centimeter
MFS	Minimal Functional Standards
mg/L	Milligrams per liter
MTCA	Model Toxics Control Act
NAVD 88	North American Vertical Datum of 1988
OMM	Operations, maintenance, and monitoring
OMMP	Operations, Maintenance, and Monitoring Plan
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PLP	Potentially liable person
POC	Point of compliance

Acronym/ Abbreviation	Definition
ppmv	Parts per million by volume
redox	Oxidation-reduction (potential)
RI/FS	Remedial Investigation/Feasibility Study
ROW	Right-of-way
SF 5000	Single Family 5000
SPPD	South Park Property Development, LLC
SR	State Route
SRDS	South Recycling and Disposal Station
STS	South Transfer Station
STSII	South Transfer Station Phase II
TCE	Trichloroethene
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Introduction

This Public Review Draft Cleanup Action Plan (CAP) describes the cleanup action selected by the Washington State Department of Ecology (Ecology) for the "Settlement Area," a portion of the Site, which is comprised of the two largest parcels within the "Landfill Property" (defined below) and certain adjacent City of Seattle and Washington State right-of-ways (ROWs). The Site consists of a former municipal solid waste landfill located in the South Park neighborhood of Seattle, Washington; the Site includes the Settlement Area, the Landfill Property, plus any adjacent areas where contamination has come to be present. The Landfill Property is defined as that area of the Site where wastes were placed as part of South Park Landfill operations. The landfill received solid waste from the 1930s until 1966, when it was closed under the existing landfill closure laws. In February 2007, the Site was added to Ecology's Hazardous Sites List, based on concerns related to groundwater contamination and the presence of potentially flammable or explosive landfill gas (LFG). Investigations of groundwater, surface water, soil, and LFG began in the late 1980s and have continued to the present day. The selected cleanup action described in this CAP fulfills the requirements of the Model Toxics Control Act (MTCA), Chapter 70.105D of the Revised Code of Washington, administered by Ecology under the MTCA Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC), for a portion of the Site. In 2009, the City of Seattle (City) and South Park Property Development, LLC (SPPD) entered into Agreed Order No. 6706 to conduct a Remedial Investigation/Feasibility Study (RI/FS) and to complete a preliminary draft CAP. Agreed Order No. 6706 was amended in 2013 to include an Interim Action (IA) to be conducted primarily on the portion of the Site owned by SPPD and was amended again in 2015 to include an IA to be conducted primarily on the portion of the Site owned by the City.

This CAP was developed using information presented in the RI/FS (Floyd|Snider et al. 2017) for the Site, which was prepared by the Floyd|Snider Team (Floyd|Snider, Aspect Consulting, Herrera Environmental Consultants, and BHC Consultants) on behalf of the City, King County (County), and SPPD, and reviewed and approved for public comment by Ecology. Ecology will hold a single unified public comment period on the RI/FS, CAP, and Consent Decree. During the comment period, the public will be provided an opportunity to review the RI/FS, CAP, and Consent Decree, and submit comments to Ecology. Once the comment period closes, Ecology will consider all comments received before the documents are finalized and the final Consent Decree is implemented.

The objective of this CAP is to satisfy the MTCA requirements for cleanup action plans set forth in WAC 173-340-380(1). Consistent with the requirement of that section, this CAP provides the following information:

- Site description, background, and characterization
- Cleanup standards and remediation levels for each hazardous substance in each medium of concern
- Description of the selected remedial action, including justification for the selection
- Brief summary of the remedial action alternatives considered in the RI/FS

- Implementation schedule and restoration timeframe
- Institutional controls
- Applicable state and federal laws

2.0 Site Description and History

2.1 SITE, LANDFILL PROPERTY, AND SETTLEMENT AREA DESCRIPTIONS

The Site is situated in the South Park neighborhood, located in Section 32 of Township 24 North, Range 4 East (Figure 2.1). The Site includes the Landfill Property, which refers to that section of the Site where landfill operations occurred historically and solid waste was placed, and the Settlement Area. Remedial actions required by this CAP address the Settlement Area, which is composed of the largest two parcels within the Landfill Property and certain adjacent City of Seattle and Washington State ROWs. The Landfill Property and Settlement Area are shown in Figure 2.2.

The Landfill Property consists primarily of several parcels that were initially added to the County tax rolls via foreclosure in the 1920s and were later purchased by the City and the County in the 1950s. Until it was closed in 1966, the landfill was operated by the City, and operation included disposal and burning of municipal, commercial, and industrial refuse (SPU 1997; Ecology and Environment, Inc. 1988). Since that time, the Landfill Property has undergone filling and grading activities and has been redeveloped. Nearly half of the Landfill Property is currently covered with structures and the rest is paved with limited areas of landscaping. A detailed description of the history of the Landfill Property and its owners is provided in Section 2.0 of the RI/FS.

The Landfill Property covers approximately 39 acres and is roughly bounded to the north by South Kenyon Street, to the east by State Route (SR) 99 and 5th Avenue South, to the south by South Sullivan Street, and to the west by Occidental Avenue South (Figure 2.2). The edge-of-refuse shown in Figure 2.2, which is used to define the Landfill Property, was established by review of aerial photographs from 1936 to 1970, logs from dozens of soil borings, and other information. Details are presented in Section 4.0 of the RI.

The following sections describe the Settlement Area.

2.1.1 South Park Property Development Parcel

The SPPD property includes 21.0 acres of land purchased from the County in 2006. The County had purchased the parcel out of tax title in 1957 prior to leasing it to the City from 1958 through 1978. After disposal operations at the landfill ended in 1966, additional unclassified fill was added, and the parcel was graded. The County later leased portions of the property to a variety of tenants from the mid-1980s through the late 1990s, primarily for truck and equipment storage. In 2008, the property was largely cleared of vegetation and, in some areas, a layer of crushed concrete was added as ballast and the parcel was regraded.

In 2014 and 2015, SPPD performed an IA for cleanup at the parcel per the 2013 Ecology-approved Interim Action Work Plan (IAWP) under Amendment No. 1 of Agreed Order No. DE 6706 for the Site (Farallon 2013). The IA was performed simultaneously with the redevelopment of the property. The property redevelopment includes a modular building for employees and paved parking for employees and visitors. The IA work included regrading and capping the landfill surface, installing and operating a LFG control system, implementing institutional controls, and

conducting monitoring. Ecology has reviewed the IA and associated design reports, and determined that the IA at this portion of the Site is consistent with requirements for the final cleanup detailed this CAP. Under the terms of this CAP, there will be ongoing obligations performed at this property as detailed in the Landfill Post-Closure Operations, Maintenance, and Monitoring Plan (OMMP; Appendix A).

2.1.2 South Recycling and Disposal Station Parcel

The South Recycling and Disposal Station (SRDS) property[1] is defined by County tax parcel 7328400005, encompassing 10.55 acres, and was purchased out of tax title by the City in 1951. Two additional strips of land, 60 feet on the west of the SRDS parcel and 30 feet on the south, were incorporated into the property in 2003 by City Ordinance 121306. This additional land is in the process of being recorded by the County and brings the site area to approximately 11 acres.

The SRDS parcel operated from 1966-2013 as a transfer station for municipal solid waste and other recyclable materials. In spring 2013, the City opened a new solid waste transfer station across the street on South Kenyon Street. The City will redevelop the SRDS as a support arm of the new South Transfer Station (STS). Under Amendment No. 2 of Agreed Order No. DE 6706, an IA will take place on this property as detailed in the 2015 Ecology-approved IAWP (Herrera and Aspect 2015). The IA includes installation of asphalt, concrete, or membrane caps, and LFG and surface water controls; implementation of institutional controls; and compliance monitoring. The LFG collection system will include horizontal (trench) collectors, conveyance piping, and vents to address areas covered by cap materials as well as new buildings planned for construction. Both LFG and groundwater will be monitored to assess the effectiveness of the IA on the SRDS portion of the Landfill. Under the terms of this CAP, there will be ongoing obligations performed at this property as detailed in the OMMP (Appendix A).

Ecology has reviewed the IAWP and determined that the IA will meet the final cleanup action elements of this CAP.

2.1.3 Transportation Corridors

The landfill is surrounded by City streets and State highways, as shown in Figure 2.2. The Landfill Property extends beneath sections of the following roads and/or ROWs, as shown in Figure 2.2:

- 5th Avenue South where the landfill is present has complex ownership as shown on Figure 2.2.
    - The section adjacent to the City's SRDS parcel is deeded by quitclaim deed (King County Record No. 9012260159 dated 12/14/90, Blocks 6, 7, 17 & 18 of plat – 1st Add to River Park, Vol. 8, p. 65) to the City from the State, as turn back ROW of SR 99. The quitclaim deed conveys all right, title, and interest for road purposes only.

[1] The City's landfill parcel is known as the SRDS in this CAP, to be consistent with other landfill-related documents. It is called the South Transfer Station Phase II (STSII) in other City documents, as it is being redeveloped to provide services that complement the new STS across the street.

  - On the section adjacent to the SPPD parcel, the western 20-foot-wide strip is held by the City through accepted deeds from the County, for street and general corporate purposes under Ordinance 96099; while the western 30-foot-wide strip is held as easement by the City (through the original platting).
- South Sullivan Street where the landfill is present was accepted under ord. 96099, for street and general corporate purposes by the City.
- Southbound lanes of SR 99 (West Marginal Way S.) were originally part of US Route 99 (1926-1972) and part of Primary State Highway 1 (1937-1964), then became SR 99 in 1972. The landfill extends to the near edge of pavement of the southbound lanes (i.e., under the right shoulder of the southbound lanes).

Information on Seattle Department of Transportation ownership was supplied by Mr. Larry Huggins, Real Property and Environmental Manager, City of Seattle Department of Transportation. Information on Washington State Department of Transportation ownership of SR 99 was inferred from a City of Seattle City Engineer's Department drawing created in 1934 and revised through 1989; a copy of the drawing is contained in Appendix A of the RI.

2.2 ZONING AND LAND USE

The majority of the Landfill Property portion of the Site, with the exception of the southeastern corner in the vicinity of the intersection of 5th Avenue South and South Sullivan Street, is zoned by the City as General Industrial 2 (IG2; Figure 2.3). This zoning designation includes general and heavy manufacturing, commercial uses subject to certain limitations, transportation and utility services, and salvage and recycling uses. The areas west, north, and northeast of the Site are also designated as IG2. The southeastern corner of the Site is designated as Industrial Buffer (IB), which is intended to provide buffering between industrial areas and adjacent residential areas. Farther east, southeast, and south of the Site, the South Park area is designated as either Lowrise 3 (L3) or Residential Single Family 5000 (SF 5000). The residential property closest to the Landfill is an L3 apartment building located at the southeastern corner of 5th Avenue South and South Sullivan Street, which is approximately 100 feet southeast of the Site. The nearest single-family home is located approximately 200 feet southeast of the Site (Figure 2.3).

Major roadways surrounding the Site (Figure 2.2) include the following:

- SR 99, adjacent to the northeastern portion of the Site
- SR 509, approximately 200 feet west of the Site

Based on the zoning characteristics and a review of the available aerial photographs, both the IG2- and IB-zoned areas of the Site can be reasonably designated as industrial properties.

2.3 SITE HISTORY

Historical operations at the landfill are based primarily on information available in the City and County files, as well as aerial photographs taken from 1936 to 2004. A detailed description of the historical operations and accompanying aerial photographs are provided in Section 2.0 the RI/FS.

The original disposal location documented in the records became active sometime before 1936, when most of the surrounding area was still farmland. Materials disposed of in the landfill primarily consisted of municipal, commercial, and industrial waste (SPU 1997; Ecology and Environment, Inc. 1988) from south and west Seattle. Waste from some parts of nearby unincorporated King County may also have been disposed of, as allowed under the County's 1958 lease with the City. By 1946, active disposal in the northwestern corner of the landfill had expanded to the southeast into the parcel occupied by the present-day SRDS. At that time, solid waste was burned at the landfill prior to final disposal, and that practice would continue until 1961.

After the landfill was closed in 1966, South Sullivan Street was moved approximately 150 feet north to its present location. Between 1967 and 1974 (more than 40 years ago), the Kenyon Industrial Park (KIP), 7901 2nd Avenue S., LLC (7901), and SRDS parcels were established facilities, closely resembling their current configuration and use today. After the landfill was closed, the SPPD property was used for truck storage and other purposes from the early 1970s until the mid-1990s. In 2008, the SPPD parcel was cleared of vegetation and partially regraded using crushed concrete as fill. The parcel then continued as a leased equipment and truck storage yard.

3.0 Conceptual Site Model

3.1 PHYSICAL CONCEPTUAL SITE MODEL

The Site is located within the Lower Duwamish Valley, near the western valley wall, as shown in Figure 2.1. The Duwamish Valley consists of a relatively thick sequence of alluvial deposits overlain by a relatively extensive layer of imported fill. The alluvial deposits range from 30 to 50 feet thick near the edge of the valley to more than 100 feet thick in the center of the valley (Hart Crowser 1998). Groundwater first occurs in the upper deposits within the alluvial Duwamish Valley Aquifer. More details on the hydrogeology can be found in Figures 3.1 and 3.2 of the RI/FS.

The Duwamish Valley Aquifer is a relatively young hydrogeological feature. Approximately 7,000 years ago, an arm of Elliott Bay extended up the valley for several miles past where the Site is today, to the city of Auburn. At that time, marine waters from Puget Sound filled the valley. A series of volcanic events and mudflows, and subsequent erosion of the mudflows, slowly filled the marine embayment and led to the formation of the valley and its aquifer. Today, the Duwamish Valley has an average elevation of 21 feet above mean sea level (based on the North American Vertical Datum of 1988 [NAVD 88]), and the former marine embayment contains sediment/soils comprising the subsurface alluvial aquifer. The sides of the valley are bounded by glacial materials (mostly glacial till) with isolated areas of bedrock.

Deeper groundwater below the B-Zone (greater than -40 feet NAVD 88) within the Duwamish Valley Aquifer is saline in most locations and often old, with little opportunity for recharge and/or discharge. Shallow groundwater is fresh due to recharge from the uplands near the edge of the valley walls and precipitation falling in the valley. At the Site, the Duwamish Valley Aquifer is subdivided into three zones (Perched Zone, A-Zone, and B-Zone) to assist in the classification and investigation of the aquifer conditions and chemical contamination.

Shallow groundwater flow (fresh water) flows from the Duwamish Valley walls, joins with precipitation that infiltrates the Duwamish Valley Aquifer, and discharges into the Lower Duwamish Waterway, which flows north to discharge into Elliott Bay (refer to Figure 2.1). Because groundwater flows from the higher topographic elevations of the uplands toward the lower topographic elevations of the Duwamish Waterway, the groundwater typically has a slight upward vertical gradient from the B-Zone to the A-Zone of the Duwamish Valley Aquifer. Within the A-Zone of the Duwamish Valley Aquifer, there is a Silt Overbank Deposit, which, due to its fairly consistent thickness and extent, acts as a low-permeability leaky aquitard across much of the valley. The Silt Overbank Deposit is generally located at an elevation between 0 and +10 feet, based on the NAVD 88, and represents an alluvial flood deposit surface likely from the 1800s. The Silt Overbank Deposit creates perched groundwater conditions because it limits downward groundwater migration.

The Duwamish Waterway is a channelized tidal waterway directly connected to Elliott Bay. As the groundwater in the Duwamish Valley Aquifer approaches the Duwamish Waterway, it enters a zone that is influenced by tidal action in Puget Sound, which can cause temporary groundwater

flow reversals near the waterway. These flow reversals introduce oxygen-rich, saline water into the Duwamish Valley Aquifer adjacent to the Duwamish Waterway.

As mentioned above, groundwater at the landfill has been investigated in three zones:

- **The Perched Zone:** A shallow zone of groundwater and infiltrating stormwater, typically less than 1 foot in thickness perched on top of the Silt Overbank Deposit where it is present. This zone reflects very localized conditions.
- **A-Zone groundwater:** The groundwater in the Duwamish Valley Aquifer beneath the Silt Overbank Deposit is generally the upper 15 feet of the aquifer, extending down to approximately -15 feet NAVD 88.
- **B-Zone groundwater:** Groundwater deeper in the Duwamish Valley Aquifer is generally located below -15 feet NAVD 88 but above the estuarine/marine deposits. This zone does not exist along the upgradient edge of the landfill near the valley wall because the Duwamish Valley Aquifer becomes thinner and only the A-Zone is present. Along the downgradient edge of the landfill, estuarine deposits are generally encountered around -40 feet NAVD 88.

Groundwater migration through the Duwamish Valley Aquifer is through both the A-Zone and the B-Zone.

3.2 LANDFILL "STAGE" CONCEPTUAL SITE MODEL

Solid waste landfills have been extensively studied across the country and are well understood by today's solid waste engineers. As part of engineers' modern training, they are taught the concept that municipal solid waste landfills undergo well-defined stages as they age and that understanding these stages allows the engineer to predict the characteristics of LFG and leachate production. This section describes the five stages of solid waste landfills and discusses where the landfill portion of the Site is within this scheme and what that means for future LFG and leachate production.

3.2.1 The Five Stage Model

Municipal solid waste landfills contain a large proportion of organic material that can be degraded by the range of microorganisms found in landfills, including food and garden waste, paper and board, and wood and some textiles (Williams 2005). The processes of degradation of organic bioreactive wastes in landfills involve not only biological processes but also interrelated physical and chemical processes. Five main stages of degradation of biodegradable wastes have been identified and are routinely used by landfill engineers to understand performance and improve designs. These five stages are addressed in detail in the RI/FS (Floyd|Snider et al. 2017).

As shown in Figure 3.1, the stage of a landfill controls the composition of the LFG, the rate of LFG production, and the composition of the leachate coming from the landfill. The South Park Landfill is in late Stage 4 and early Stage 5 (refer to Section 3.2.2). Stage 4 conditions typically last the

longest and involve the most pronounced changes. During Stage 4, LFG is dominated by methane and carbon dioxide, with little to no oxygen present. The leachate becomes anaerobic. Initially it is acidic due to the formation of organic acids from food decomposition, but later the pH returns to neutral, and the carbon dioxide acts to buffer the pH. The anaerobic conditions within the landfill favor the reductive dechlorination of the solvents, such as trichloroethene (TCE) to vinyl chloride, and then further reduction to the nontoxic ethene occurs. If the anaerobic leachate enters groundwater, the groundwater will also become anaerobic, and this will cause the dissolution of iron and manganese from the native soils. It is during this time that many unlined solid waste landfills develop groundwater contamination from iron, manganese, and vinyl chloride.

During late Stage 4, methane concentrations decline to less than 20 percent by volume and, most importantly, the rate of methane production decreases sufficiently enough that there is little or no buildup of pressure. Without a buildup of pressure, there is no mechanism to "push" LFG migration; instead, the gas is emitted slowly from the landfill by a combination of diffusion and barometric pumping.[2] At Stage 5, methane production is so low that the gas within the landfill begins to resemble atmospheric conditions, and both oxygen and nitrogen concentrations rise. The leachate has a neutral pH and only a slightly elevated concentration of salts. The underlying groundwater system also starts to recover during this period. As the groundwater starts to become aerobic, iron and manganese are redeposited on the native soils (from which they came). Vinyl chloride, if still present, will continue to degrade but will use different biological pathways, as discussed in Section 5.8 of the RI/FS.

3.2.2 South Park Landfill Current Stage

The landfill was opened in the 1930s and closed in 1966. It primarily accepted solid waste, and much of the waste was burned to reduce volume. Today, the landfill is in late Stage 4 (where methane is still present but with no pressure accumulation) to early Stage 5 (where oxygen is present), depending on the location within the landfill. LFG data since 1997 indicate that the concentrations in many of the probes are stable and range from 0 to 40 percent methane by volume. The production of methane is too low to produce a measureable increase in pressure. In areas where the methane production is now less than 20 percent, the landfill is transitioning to Stage 5; when it is less than 5 percent methane, it is in Stage 5.

Specific conductivity in wells in and downgradient of the landfill, at concentrations between 170 and 1,500 microsiemens per centimeter (µS/cm), is now consistent with upgradient concentrations of 400 to 1,300 µS/cm. The pH at the landfill has also returned to neutral conditions, with most wells between 6.6 and 6.9.

Another aspect of the anaerobic conditions that develop at a landfill during Stage 4 is the development of an iron and manganese zone downgradient. The anaerobic conditions that

[2] Barometric pumping refers to the natural airflow in the unsaturated zone included in landfills without active gas control systems, in response to natural variations in atmospheric pressure.

develop in groundwater beneath a landfill leach naturally occurring iron and manganese from the soils in the aquifer. As soon as the conditions become less anaerobic, the iron and manganese concentrations return to background conditions in the aquifer. At the Landfill, iron and manganese concentrations are approaching background conditions as defined by the conditions at upgradient wells. The iron and manganese concentrations in many of the wells are already equal to their respective background concentrations; MW-18 has the greatest concentrations, with manganese at the background concentration and iron at less than 2 times the background concentration. These concentrations are consistent with the landfill transitioning to Stage 5.

Chemicals of concern (COCs) are discussed in Section 4.0, along with their nature and extent and cleanup levels (CULs). As discussed there, their extent and concentrations are also consistent with an aged municipal landfill transitioning into Stage 5. Section 6.0 presents remedial action components to bring the COCs and LFG into compliance with CULs.

3.3 EXPOSURE PATHWAYS AND RECEPTORS

3.3.1 Human Health Exposure Pathways and Receptors

The Settlement Area is primarily composed of a closed solid waste landfill that has been redeveloped as industrial-zoned properties and public streets. The Settlement Area encompasses buildings, hard-packed surfaces, and paved areas. Streets within and adjacent to the Settlement Area are asphalt-covered and contain utility ROWs. Other utilities also run through the Settlement Area.

The areas around the landfill where vinyl chloride is present in groundwater and LFG is present in unsaturated soil, and those areas of the Site beyond the landfill are also industrial areas.

Table 3.1 lists potential exposure pathways and human receptors that are being considered at the Settlement Area and for downgradient groundwater.

Table 3.1
Potential Exposure Pathways and Human Receptors

Medium	Location	Exposure Route	Receptor
Ambient air	Buildings throughout the Settlement Area	Inhalation of VOCs	Industrial worker
Ambient air	Buildings throughout the Settlement Area	Explosive hazard from methane	
Confined air	Utility vaults at or adjacent to the Settlement Area	Inhalation of VOCs	Industrial maintenance worker
Confined air	Utility vaults at or adjacent to the Settlement Area	Explosive hazard from methane	
Surface soil	Soils that are not covered by the existing pavement/ buildings or future landfill cap at the Settlement Area	Direct contact, including dermal	Industrial worker
Groundwater	Groundwater downgradient of the edge-of-refuse	Potential drinking water use	No current or potential future receptors
	Groundwater that discharges into the Lower Duwamish Waterway	Use of surface water by aquatic species	Aquatic species (because the Lower Duwamish Waterway is saline; there is no drinking water use)

Abbreviation:
VOC Volatile organic compound

3.3.2 Ecological Receptors

The Settlement Area is exempt from the requirement for a terrestrial ecological evaluation consistent with WAC 173-340-7491(1)(b) because all contaminated soil "will be below existing buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to soil contamination." To qualify for this exemption, an institutional control is required under WAC 173-340-440. This institutional control is also required as part of the landfill closure. Filing an environmental (restrictive) covenant on each property within the Settlement Area is a remedial action required by this CAP and is also a requirement in the Consent Decree (refer to Section 16.0 of the RI/FS).

3.4 REMEDIAL INVESTIGATION CONCLUSIONS

Based on the findings of the RI and the conceptual site model discussed in Section 3.1, the following historical information, findings, and determinations were considered during development of the FS to identify effective remedial actions for the Settlement Area within the Landfill Property:

3.4.1 Age, Extent, and Condition of the Landfill

- Solid waste was disposed of in the landfill portion of the Site from the 1930s through the mid-1960s; much of the waste was burned to reduce the volume. The landfill was closed in 1966. The extent of the Landfill Property is shown in Figure 2.2 and is based on review of aerial photographs, available records from the City and County, and soil test pit and boring logs.
- The landfill is unlined, and the bottom of the waste is in direct contact with groundwater, either a thin layer of Perched Zone groundwater resting on the Silt Overbank Deposit, or the upper few feet of the A-Zone of the Duwamish Valley Aquifer when the silt layer is not present.
- Between landfill closure in 1966 and 2015, the SPPD parcel and sections of the SRDS parcel, as well as the shoulders of the ROWs, were unpaved and allowed rainwater falling on the site to infiltrate. During this time, infiltration occurred on over 60 percent of the landfill.
- The contents of the landfill include municipal solid waste, burned waste and ash, and interbedded soil and general-purpose fill used as cover during operations and as fill during closure and post-closure activities. Because of the heterogeneous nature of the waste/fill and its presence within a closed landfill, limited characterization was performed during the RI. Based on 30 years of state and national experience with similar landfills, the waste/fill is presumed to contain one or more hazardous substances, some of which may be at concentrations greater than MTCA CULs. Some of these hazardous substances have been released to groundwater and soil vapor as discussed above.
- The former West Ditch is part of the Landfill Property due to historical operations, but the ditch is not part of the "contained landfill;" rather, it historically served as part of the stormwater system for the SPPD parcel. Soil in the ditch was investigated as part of the RI. It was found to contain polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), metals, petroleum hydrocarbons, and very low concentrations of two common pesticides. All concentrations are less than MTCA CULs for soil at industrial sites.

3.4.2 Landfill Gas Findings

- Ongoing LFG (methane) monitoring confirms that the landfill is in late Stage 4 or early Stage 5, depending on the location. Specifically, the landfill is still producing methane in some areas but with no measureable pressure buildup on either the paved or unpaved parcels.[3] Methane concentrations measured in the subsurface within the landfill range from non-detect to approximately 20 percent. Typical concentrations are below 10 percent and many areas are below 1 percent. Similar conditions have been observed at the landfill since the 1990s.
- During the RI, methane was also detected in an adjacent feature on the KIP parcel—a historical swale that was filled in the late 1960s with structural fill and cement kiln dust. Methane is produced in the bottom of the historical KIP swale; potentially from decaying plant matter (as seen in the soil logs) that was in the swale before it was filled or residual petroleum contamination within the swale. Perimeter probes installed to monitor the LFG associated with the landfill encountered the methane coming from the swale. However, the swale area in the KIP parcel is not within the Settlement Area.
- Perimeter LFG probes were not in compliance for LFG during the RI in the following locations:
  - The historical KIP swale.
  - The area along 5th Avenue South adjacent to the SPPD parcel. An SPPD IA was performed that included installation of a LFG control system on the SPPD parcel. The LFG control system brought this area into compliance (as discussed in the RI/FS); however, the system will need to maintain control sufficient to keep the area in compliance.
- Methane intrusion into buildings at or adjacent to the Landfill is not occurring:
  - Buildings at the SRDS parcel were either built with methane mitigation or undergo routine monitoring by Seattle Public Utility (SPU) staff with no detected methane.
  - Screening of buildings at the KIP parcel and the 7901 parcel for methane and explosive gases occurred quarterly for four quarters in 2011. No methane was detected.
  - Screening of buildings along 5th Avenue South across from the Landfill occurred quarterly for four quarters in 2011. No methane was detected.
  - No buildings existed on the SPPD parcel at the time of the RI. The new building on the parcel is equipped with methane mitigation and an alarm.
- Concentrations of volatile organic compounds (VOCs) in subsurface soil vapor at the Landfill are less than Ecology's screening levels except for benzene and vinyl chloride:

[3] Although no pressure has been detected at the landfill in years, under the terms of this CAP, for any change in site conditions, such as changes in pavement, the Subject potentially liable persons (PLPs; defined in Section 6.2) must demonstrate to Ecology that either the change will not cause LFG to build up beneath the surface or that the LFG will be controlled by an active or passive LFG system with monitoring to prevent the buildup of LFG pressure.

- Benzene was detected in soil vapor in the historical KIP swale outside the Landfill Property boundary at concentrations greater than the screening level, but is less than the screening level at all other locations.
- Vinyl chloride was detected at low concentrations in soil vapor at the Landfill. Only one sample exceeds its screening level: the vinyl chloride concentration in GP-27 located along 5th Avenue South is approximately 1.5 times its screening level. The nearest building is more than 50 feet away and that area is now under control of the SPPD LFG system.

3.4.3 Groundwater Findings

- Vinyl chloride, iron, and manganese are groundwater COCs that exceed CULs at the conditional point of compliance (CPOC) for the Settlement Area.
- Vinyl chloride exceeds its CUL at the northeast corner of the Site. Its CUL is 0.29 micrograms per liter (µg/L) and is based on consumption of drinking water. Concentrations at the Landfill near the downgradient edge-of-refuse (the CPOC) range from non-detect at 0.02 µg/L to detections ranging from 0.051 µg/L to 1.4 µg/L. The source of vinyl chloride at the Landfill is believed to have been small amounts of the degreasing solvent TCE that were likely disposed of at the landfill and have since degraded to vinyl chloride. Vinyl chloride is still present today because residual contamination is likely trapped in the fine-grained Silt Overbank Deposit; this residual contamination would slowly diffuse into the A-Zone of the Duwamish Valley Aquifer. Concentrations in groundwater downgradient of the landfill at monitoring wells across SR 99 are between non-detect at 0.02 and 0.31 µg/L (MW-08, MW-24, MW-26, and MW-27), except at MW-31 where a second non-landfill source is also contributing contamination.
- Iron and manganese concentrations are naturally high in the Alluvial Aquifer; therefore, a CUL based on background was calculated using the procedures in MTCA 173-340-709. Details are presented in Section 5.6.4 of the RI/FS. Iron is periodically (but not consistently) elevated at concentrations greater than background in MW-10, MW-18, MW-25, and MW-32; the other wells are in compliance. Manganese is periodically (but not consistently) elevated at concentrations greater than background in MW-08, MW-10, MW-18, MW-24, MW-25, and MW-32; the remaining wells are in compliance. Based on the trend plots presented in Appendix J of the RI/FS, all wells are expected to be in compliance for iron and manganese within the next 10 years.
- Three other COCs are present in groundwater although their concentrations are less than their respective CULs at the CPOC:
    - Benzene concentrations are greater than its CUL in upgradient well KMW-05 and it is detected in MW-25; it will be monitored in KMW-05, KMW-03A, and CPOC well MW-25.

  - Arsenic concentrations are greater than its CUL in upgradient well KMW-05 and interior well KMW-03A, and it will be monitored in wells MW-12, MW-08, MW-10, MW-18, MW-24, MW-25, MW-26, MW-27, MW-32, and MW-33. Note that MW-27 is not a CPOC well for arsenic.
  - *cis*-1,2-dichloroethene (DCE) is in compliance in all wells, but is the precursor of vinyl chloride and will be monitored in all wells in which vinyl chloride is monitored.

- Groundwater has been monitored at the landfill since the late 1980s, with additional wells added along the downgradient edge during the RI. Today, the leachate/perched groundwater has neutral pH (6 to 8) and salinities that are typically between background concentration and 3 times the background concentration, but less than the natural salinity of deeper groundwater in the Duwamish Valley Aquifer. Wells screened within refuse show moderately anaerobic groundwater with concentrations of dissolved oxygen at 0.37 to 0.56 milligrams per liter (mg/L; versus 9.0 mg/L for fully aerobic groundwater) and corresponding oxidation-reduction (redox) potential at -20.8 to -145.9 millivolts (mV). By the edge-of-refuse, the groundwater is already becoming less anaerobic than that beneath the landfill, with slightly greater concentrations of dissolved oxygen between 0.45 and 0.78 mg/L and redox potential at -6 to -123.6. These dissolved oxygen, specific conductivity, and pH conditions are consistent with the transition from late Stage 4 to Stage 5. Comparing upgradient and downgradient A-Zone groundwater concentrations for conventional indicators of leachate such as pH (average 6.6 to 6.7), specific conductance (average 703 to 733 µS/cm), alkalinity (average 240 versus 292 mg/L as calcium carbonate [$CaCO_3$]), and dissolved iron (average 11 versus 14 mg/L) showed very little difference consistent with minimal impact for leachate today. This is discussed in Section 5.6.6 of the RI/FS.
- The historical KIP swale outside the Landfill Property also had a unique groundwater signature due to the presence of the cement kiln dust fill. Groundwater from KMW-05 is highly alkaline, with a pH of approximately 13 between January 2011 and March 2014 and high concentrations of arsenic. Groundwater monitoring wells completed downgradient of this area have pH values between 7.4 and 7.8. The landfill compliance wells farther downgradient have returned to neutral pH, indicating that the alkalinity has been neutralized before the groundwater leaves the downgradient edge of the Landfill Property. Likewise, arsenic concentrations have decreased to less than natural background (5 µg/L as discussed in Section 5.6.2 and Table 5.9 of the RI/FS) by the downgradient edge of the Landfill Property.

These findings were used to develop the final CULs for a portion of the Site and to identify the preferred remedy for the Landfill Property and the Settlement Area (discussed in Sections 8.0 through 16.0 of the RI/FS).

4.0 Contaminated Media, Chemicals of Concern, and Cleanup Standards

The landfill has been investigated since the late 1990s because of the ongoing presence of low concentrations of LFG and groundwater contamination. For the 2014 Draft Final RI/FS, data from the various investigations at the Site were compiled to develop the list of contaminated media and COCs. This section provides a summary of these data.

4.1 SOIL CLEANUP LEVELS, POINT OF COMPLIANCE, AND COMPLIANCE REQUIREMENTS

4.1.1 Waste and Soil within the Landfill

The waste/fill at the site is presumed to be contaminated with one or more hazardous substances. Due to the heterogeneous nature of waste at municipal landfills and its planned containment within a closed landfill, the landfill contents were not fully characterized for specific hazardous substances during the RI, although leachate and groundwater were. Soil used as daily cover during operations and as fill during closure and post-closure activities is also considered part of the landfill contents and was not fully characterized. As with the refuse, the soil fill is presumed to contain one or more hazardous substances. The presence of the Landfill requires the placement of an environmental (restrictive) covenant on each parcel within the Settlement Area stating that the Landfill is present and incurring other obligations discussed in the FS.

In some areas within the Settlement Area, landscaping soils exist above the capped landfill contents; these areas include landscaped areas and ROWs. Landscaping soil within the Settlement Area above the landfill cap was tested and identified hazardous substances at concentrations typical for urban soils, below the MTCA Method C Industrial CULs.[4] The Environmental (Restrictive) Covenants will also state that the site is limited to Industrial uses.

Per MTCA requirements, a plan that relies on containment of landfill wastes and use of industrial soil CULs also requires that an Environmental Covenant (discussed in Section 6.2.7) be recorded against each of the Settlement Area's parcels.

4.1.2 Soil in the Former West Ditch

As discussed in Section 3.4, soils in the former West Ditch are part of the Settlement Area but are not contained within the landfill itself. Soils in the former West Ditch were sampled and characterized and were found to contain PAHs, PCBs, metals, petroleum hydrocarbons, and very low concentrations of two common pesticides. All concentrations were less than the MTCA Method C CULs for soil at industrial sites. Because none of the concentrations in soils currently exceed the MTCA Method C CULs for industrial sites, no remedial action is required for those soils under this CAP; however, the soils were solidified as part of the SPPD IA.

[4] MTCA Method A industrial CULs are being used for lead, total petroleum hydrocarbons, and PCBs, according to customary practice in Washington State.

4.2 GROUNDWATER CLEANUP LEVELS AND POINT OF COMPLIANCE

For groundwater, the point of compliance (POC) is the point or points where the groundwater CULs must be attained for the Site to be in compliance with the cleanup standards. The standard POC for groundwater under MTCA is throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest most depth, which could potentially be affected by the Site. Where it is not practicable to meet the CUL throughout the Site within a reasonable restoration timeframe, Ecology may approve a CPOC. The CPOC will be as close as practicable to the source of hazardous substances, not to exceed the property boundary. Ecology has approved a CPOC for the Settlement Area at the downgradient edge of refuse.

Also, for landfills closed prior to modern landfill standards, MTCA (WAC 173-340-710(7)(c)) considers Minimal Functional Standards (MFS) to be relevant and appropriate requirements, and MFS (at WAC 173-304-100(58)) defines the groundwater POC as "that part of ground water that lies beneath the perimeter of a solid waste facilities' active area as that active area would exist at closure of the facility." This is commonly referred to as "edge-of-refuse." Groundwater beyond the MFS POC at the edge-of-refuse would also need to meet the CULs with respect to releases (current or historical) from the landfill. A MTCA CPOC for groundwater for the Landfill Property is in the same location as a MFS POC. For this CAP, it will be referred to as a groundwater CPOC.

For the Settlement Area, the groundwater CPOC is the downgradient edge-of-refuse shown as the red dashed line in Figure 2.2. Compliance is monitored by a series of monitoring wells located as close as practical to this boundary. Unfortunately, SR 99 (West Marginal Way S.) was constructed in the 1960s over the downgradient edge of the landfill. This has limited the location of CPOC monitoring wells. In consultation with Ecology over the last decade, a series of compliance wells have been installed on the far and near sides of SR 99. These locations were deemed to be practical monitoring locations from which compliance at the CPOC (beneath the southbound lanes of SR 99) can be inferred.

Ecology has determined that maximum beneficial use of groundwater beneath and immediately downgradient of the Site is drinking water; therefore, the groundwater CULs are based on CULs for potable groundwater. MTCA Method B CULs were developed for all contaminants detected in groundwater; CULs for iron, manganese, and arsenic are based on background consistent with procedures in Section 709 of MTCA regulations.

Currently only vinyl chloride, iron, and manganese exceed their CULs at the CPOC. The chemical precursor of vinyl chloride, *cis*-1,2-DCE, will be monitored in all CPOC wells to aid in understanding future vinyl chloride concentrations, but has been in compliance for years and is not a COC.

Arsenic and benzene are elevated at the Site, upgradient of the Landfill Property on the KIP parcel, decrease as they move across the KIP parcel, and are currently in compliance at the CPOC wells for the Settlement Area. Benzene will be monitored in MW-25 (CPOC well), which is downgradient of where benzene is elevated. Arsenic will be monitored in wells MW-12, MW-08,

MW-10, MW-18, MW-24, MW-25, MW-26, MW-27, MW-32, and MW-33. Note that MW-27 is not a CPOC well for arsenic.

Iron and manganese exceed the A-Zone background concentrations determined for the Settlement Area (27 mg/L and 2.1 mg/L, respectively). Manganese also exceeds the B-Zone background concentration determined for the Settlement Area (1.1 mg/L). Therefore, iron and manganese are also groundwater COCs that will be monitored at the CPOC. For the A-Zone background concentrations, site-specific data from upgradient wells were used. For the B-Zone background concentrations, data from other MTCA sites within the valley were used to estimate a background concentration. If more and/or better data become available in the future, the B-Zone background estimate may be updated.

Table 4.1 presents the site COCs, the CULs set for the Settlement Area, and their concentration range in the CPOC monitoring wells during the most recent monitoring event in March 2014.

Table 4.1
Chemicals and Their Groundwater Cleanup Levels

Chemical	Cleanup Level	Compliance Status in CPOC Monitoring Wells	Range in CPOC Monitoring Wells (March 2014)
Vinyl chloride	0.29 µg/L	Out of compliance	<0.02 to 0.99 µg/L
Iron (Total)	27 mg/L (A-Zone) 31 mg/L (B-Zone)	Out of compliance	A-Zone: 4 to 29 mg/L B-Zone: 21 to 33 mg/L
Manganese (Total)	2.2 mg/L (A-Zone) 2.2 mg/L (B-Zone)	Out of compliance	A-Zone: 0.15 to 2.9 mg/L B-Zone: 1.1 to 1.5 mg/L
cis-1,2-DCE	16 µg/L	No exceedances	<0.2 to 1.9 µg/L
Benzene	5.0 µg/L	No exceedances	<0.2 µg/L
Arsenic	5.0 µg/L (background)	No exceedances[1]	Dissolved: 0.2 to 0.9 µg/L Total: 0.3 to 0.7 µg/L

Note:

1 MW-27, a downgradient A-Zone well across SR 99 consistently has arsenic at concentrations greater than the CUL due to a cement kiln dust deposit that is across the street from the Settlement Area; this well is not a CPOC for arsenic. Arsenic concentrations at the CPOC upgradient of MW-27 are in compliance, as shown in Figure 5.13 of the RI. All other CPOC wells are in compliance for arsenic.

Abbreviations:

µg/L Micrograms per liter
mg/L Milligrams per liter

Vinyl chloride concentrations in the compliance wells range from not detected (at a detection limit of 0.02 µg/L) to 0.99 µg/L. In some locations the concentrations are greater than the MTCA Modified Method C CUL of 0.29 µg/L.[5]

Figure 4.1 shows the vinyl chloride concentrations at the Settlement Area for the most recent round of sampling. Green symbols for the wells indicate concentrations less than the CUL. Yellow symbols indicate concentrations greater than the CUL but less than the drinking water standard, and red symbols indicate concentrations greater than both. For those wells that have exceedances, trend plots are showing the trends over time for the wells.[6]

4.3 AIR CLEANUP LEVELS AND POINT OF COMPLIANCE

The facilities located within the Settlement Area boundary are industrial facilities. The appropriate CULs for air at the Settlement Area are the MTCA Method C industrial standards. The standard POC is ambient air throughout the Settlement Area. Application of these standards is complicated because ambient air measurements cannot distinguish between chemicals released from the landfill (for example as vapor intrusion facilitated by LFG migration) and chemicals being actively used at the operational facilities within the Settlement Area boundary. Therefore, soil vapor samples were collected. Based on a vapor intrusion analysis performed in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2016; originally published as a draft in 2009 and updated in 2016 to include toxicity factors.), as discussed in Section 6.5.3 of the RI/FS, vapor intrusion is not a pathway of concern for this Site.

4.4 LANDFILL GAS REQUIREMENTS

Methane, the primary constituent of LFG, is regulated under MTCA. Methane is also regulated as LFG in the regulations pertaining to landfills, and these regulations are relevant and appropriate requirements. LFG mitigation criteria under the MFS are defined in WAC 173-304-460 and King County Board of Health Title 10 regulations. The principal criteria relevant to the Settlement Area are the following:

- Methane concentrations in soil at the facility boundary (the edge-of-refuse, not the MTCA Site boundary) must not exceed 5 percent by volume, the lower explosive limit (LEL) for methane. This is traditionally measured in a network of LFG perimeter probes along the edge-of-refuse. Currently, methane concentrations in all of the LFG perimeter probes on the Settlement Area comply with this criterion, except for periodic concentrations in one of the LFG perimeter probes along 5th Avenue South.[7]

[5] Because vinyl chloride has a state and federal drinking water number, the MTCA Method B value is modified per Ecology's guidance (Ecology 2005).

[6] Trend plots begin when data for a well were first available; wells were installed at different times.

[7] The LFG along 5th Avenue South is believed to be coming from the Settlement Area, and the SPPD LFG system is being optimized to control it. The LFG concentrations in the bioswale are greater than the measurements within the landfill and are believed to be due in part to the degradation of residual petroleum contamination and decaying plant matter unrelated to the landfill within the bioswale itself. The LFG exceedances in the bioswale are localized and bounded, as discussed in the RI.

- Methane concentrations inside buildings and structures within the Settlement Area must not exceed 1.25 percent by volume, or 25 percent of the LEL. These measurements are collected within the buildings. During the RI, all buildings at the landfill were in compliance based on the extent of monitoring done for the various properties; however, ongoing monitoring of buildings that overlie the Landfill is included as part of long-term compliance monitoring for LFG (refer to Section 6.0).
- Methane concentrations inside buildings and structures located beyond the Settlement Area must not exceed 100 parts per million by volume (ppmv). During the RI, all buildings within 100 feet of the landfill were inspected and found to be free of methane. However, ongoing monitoring of off-Landfill Property buildings is still required as part of long-term compliance monitoring (refer to Section 6.0) for any building that is within 100 feet of a perimeter LFG probe that exceeds 5 percent methane (by volume).

Figure 4.2 shows the most recent data for each of the perimeter probes. Extensive monitoring of the buildings occurred during the RI, and no methane was detected.

4.5 FINAL CHEMICALS OF CONCERN AND CLEANUP LEVELS

The final COCs exceeding a CUL at their CPOC and their associated CULs are summarized in Table 4.2.

Table 4.2
Contaminated Media, Chemicals of Concern, and Their Cleanup Requirements

Medium	Chemical of Concern Exceeding Cleanup Level	Cleanup Level (or Equivalent)	Point of Compliance	Restoration Timeframe
Waste and soil within the Settlement Area	Multiple hazardous substances based on heterogeneity of landfill refuse	MTCA Method A and C Industrial cleanup levels	Wastes and soil that are contained within the Landfill	In compliance as long as containment remedy meets requirements of this CAP
Landscaping soil above the contained area	None remaining after SPPD IA	MTCA Method C Industrial Cleanup Level	Soil, to 15 feet below ground surface, that is above the contained Landfill	In compliance
Groundwater	Vinyl chloride (refer to Table 4.1 for other COCs that are in compliance at the CPOC)	0.29 µg/L	Groundwater throughout the aquifer at and beyond the CPOC (edge-of-refuse)	Approximately 10 years based on existing trend data
Groundwater	Iron	27 mg/L (A-Zone) 31 mg/L (B-Zone)	Groundwater throughout the aquifer at and beyond the CPOC (edge-of-refuse)	Approximately 10 years based on landfill stage model
Groundwater	Manganese	2.1 mg/L (A-Zone) 1.1 mg/L (B-Zone)	Groundwater throughout the aquifer at and beyond the CPOC (edge-of-refuse)	Approximately 10 years based on landfill stage model
Groundwater	Arsenic	5 µg/L	Groundwater throughout the aquifer at and beyond the CPOC (edge-of-refuse)	Approximately 10 years based on existing trend data
Soil vapor	LFG (methane)	5 percent by volume	Vadose zone at and beyond the CPOC (edge-of-refuse)	Within 1 year after the completion of construction of the individual LFG systems
Indoor air	LFG (methane)	1.25 percent by volume	Throughout the buildings located above refuse (landfill footprint)	In compliance

Abbreviations:
µg/L Micrograms per liter
mg/L Milligrams per liter

5.0 Applicable or Relevant and Appropriate Requirements

According to WAC 173-340-360(2) and WAC 173-340-710, all cleanup actions under MTCA must comply with applicable state and federal laws and Ecology-identified relevant and appropriate requirements. "Applicable state and federal laws" include legally applicable requirements including those cleanup standards, standards of control and other environmental protection requirements, criteria or limitations adopted under state or federal law that specifically address a hazardous substance, cleanup action, location, or other circumstance at the Site. "Relevant and appropriate requirements" include those cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that, while not legally applicable to the hazardous substance, cleanup action, location or other circumstance at the Site, are considered by Ecology to address problems or situations similar enough to those encountered at the Site that their use would make common sense. These two types are referred to collectively as "applicable or relevant and appropriate requirements" or "ARARs." The remedial action must meet all Ecology-approved ARARs.

Table 5.1 lists the known ARARs for this cleanup action separated into three categories that apply to establishing CULs or conducting cleanup actions:

- Chemical-specific requirements are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. These were used during the RI/FS to establish the CULs presented in Section 4.0.
- Location-specific requirements are restrictions placed on the concentration of hazardous substances or on activities solely because they occur in special locations.
- Action-specific requirements are usually technology-based requirements or limitations on actions taken with respect to hazardous substances.

5.1 MINIMUM FUNCTIONAL STANDARDS FOR SOLID WASTE HANDLING

Because of the size of this particular landfill, the development that has already occurred on areas where waste is in place, and the apparent effectiveness of the current containment system, it was concluded that treatment or removal of the landfill is not practicable, and this option was eliminated early in the feasibility process. Because that is the case, as a starting point MTCA uses the closure requirements in in the MFS for Solid Waste Handling (WAC 173-304) as an ARAR for the selected cleanup action and then modifies them as needed to meet the MTCA cleanup requirements (WAC 173-340-710(7)(c), solid waste landfill closure requirements):

> *"For solid waste landfills, the solid waste closure requirements in WAC 173-304 shall be minimum requirements for cleanup actions conducted under this chapter. In addition, when the department determines that the closure requirements in WAC 173-351 or WAC 173-303 are legally applicable or relevant and appropriate*

requirements, the more stringent closure requirements under those laws shall also apply to cleanup actions conducted under this chapter."[8]

The requirements described in the MFS are designed to ensure that a landfill is closed in a manner that accomplishes the following:

- Minimizes the need for further maintenance.
- Controls, minimizes, or eliminates threats to human health and the environment from post-closure escape of municipal solid waste constituents, leachate, LFGs, and contaminated rainfall or waste decomposition products to the ground, groundwater, surface water, and the atmosphere.
- Prepares the site for the post-closure period, which must allow for continued facility maintenance and monitoring of air, land, and water as long as necessary for the facility to stabilize and protect human health and the environment.
- Implements LFG collection and treatment.
- Establishes institutional controls to supplement engineering controls.

5.2 OTHER LOCATION- AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Additional ARARs for the Site are identified in Table 5.1.

[8] Solid waste landfills operating after October 1991 are required to meet landfill requirements in WAC 173-351. Because the landfill within the Site was closed in 1966, none of the closure requirements in WAC 173-301, 173-304, or 173-351 are applicable requirements. However, as allowed by WAC 173-340-710(7)(c), Ecology used the soil waste closure requirements in WAC 173-304 as minimum requirements for the cleanup action.

6.0 Implementation of the Cleanup Action

This section describes the cleanup action for the Settlement Area developed in accordance with WAC 173-340-360 through 173-340-390. The cleanup action is based on the presumptive remedy for solid waste landfills, which is containment, and monitoring with possible contingent action for contaminated groundwater. It also includes provisions for inspection and maintenance of the landfill cover (cap), long-term monitoring at the Settlement Area, and institutional controls, including Environmental Covenants, and meets the MTCA cleanup action requirements for the Settlement Area portion of the Site.

6.1 USE OF THE PRESUMPTIVE REMEDY FOR LANDFILLS

Under MTCA, closed landfills are considered to be sites that have used "containment of hazardous substances" as the preferred remedy for meeting soil cleanup standards. Under WAC 173-340-740(6)(f), MTCA defines the expectation for containment sites as follows:

> *"WAC 173-340-740(6)(f) The department recognizes that, for those cleanup actions selected under this chapter that involve containment of hazardous substances, the soil cleanup levels will typically not be met at the points of compliance specified in (b) through (e) of this subsection. In these cases, the cleanup action may be determined to comply with cleanup standards, provided:*
>
> > *(i) The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;*
> >
> > *(ii) The cleanup action is protective of human health. The department may require a site-specific human health risk assessment conforming to the requirements of this chapter to demonstrate that the cleanup action is protective of human health;*
> >
> > *(iii) The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;*
> >
> > *(iv) Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;*
> >
> > *(v) Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system; and*
> >
> > *(vi) The types, levels, and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the draft cleanup action plan."*

As noted above, it has been concluded that treatment or removal of the landfill are not practicable alternatives. Therefore, it is not necessary to conduct a disproportionate analysis under WAC 173-340-360 for these alternatives. However, the specific remedy selected for the Settlement Area must demonstrate that the other elements of containment are met as defined

by sections (ii) through (iv) above. The RI/FS focuses on screening alternative approaches consistent with the landfill closure ARAR that would meet the requirements of containment under MTCA as described above—for example, determining site-specific alternatives for LFG controls that would comply with WAC 173-340-740(6)(f).

The basic requirements for landfill closure under MFS are as follows:

- Installation of a landfill cap, with associated grading and stormwater controls to eliminate direct contact with refuse, decrease leachate formation, and avoid contamination of stormwater by refuse.
- Installation of LFG controls as needed to control migration of LFG at unacceptable levels from the area of refuse.
- Installation of leachate controls as needed to prevent groundwater contamination from the refuse.
- Institutional controls to supplement engineering controls.
- Long-term monitoring of remedial systems for as long as the system is needed to meet CULs and containment goals.

The preferred alternative was developed as part of the FS, with consideration of multiple technologies and/or alternatives for each of the components required as part of landfill closure.

6.2 REQUIRED CLEANUP ACTION

MTCA defines specific requirements that must be met for a selected remedy to be protective of human health and the environment and identifies criteria that must be met by each alternative. In addition, the selection of other requirements that must be met to protect human health and the environment is guided by the MFS. The regulations also ensure that a landfill must continue with operation and maintenance of the selected remedy and the appropriate long-term monitoring to ensure that the remedy is effective.

This section states the components of the cleanup action for the Settlement Area. Additional rationale can be found in Sections 10.0 through 16.0 of the RI/FS.

6.2.1 Landfill Cap

The cleanup action requires a landfill cap covering all areas at the Settlement Area that contain solid waste. The primary goal of the landfill cap is to block access or exposure to the solid waste and soil; secondary goals are to limit stormwater infiltration and to facilitate the performance of the LFG systems. Minimum standards for the landfill cap and requirements for continued monitoring and maintenance of the cap are discussed below.

6.2.1.1 Minimum Standards for Landfill Cap

All areas of the Settlement Area must be covered by a landfill cap, which meets the minimum standards set out below. These requirements do not apply in areas that are covered by a structure. However, if redevelopment results in removal of a structure, then a landfill cap

meeting these minimum standards must be installed unless another structure covers the same footprint.

The minimum standards for a landfill cap are as follows:

- A minimum thickness of 12 inches of fill material will be placed over the solid waste. This fill material does not need to meet a low-permeability standard. Existing fill that meets this depth requirement will be considered acceptable. Imported fill must not introduce new contaminants and must be naturally occurring soil or rock (i.e., virgin material) from an established quarry. This material will not require testing prior to use at the Landfill; however, the quarry must provide testing results for the fill material that are current (i.e., within 2 years). If an alternative to these fill specifications is requested by a Subject PLP or a property owner, a variance request and justification must be submitted to Ecology for approval.
- Additional fill or fill of specific geotechnical specification must be placed in order to meet the structural section requirements of road and foundation base as required by the geotechnical engineer responsible for the pavement design.
- A 3-inch minimum thickness for asphaltic concrete or a 4-inch minimum thickness for cement concrete will cover the fill.
- Pavement sections that fail to meet the primary and secondary goals of a landfill cap must be replaced. For example, a pavement section that fails and develops large cracks, potholes, or settlement issues due to insufficient or incorrect pavement design (as opposed to routine maintenance needed due to age), must be replaced with an appropriate pavement section.
- Areas, such as landscaped buffers and slopes, planter islands, or gravel road shoulders, that will not be paved or receive hardscape (i.e., concrete), will require a soil layer with a minimum thickness of 24 inches and a distinct visible barrier between the new improvements and the top of the solid waste. The soil used as fill must not introduce new contaminants or contain contaminant concentrations exceeding MTCA industrial CULs.
- Stormwater conveyance and treatment facilities located above solid waste such as swales, ditches, or ponds on the Settlement Area are required to have cover, as prescribed by WAC 173-304-460, consisting of a low-permeability layer with a minimum 24-inch thickness of soil and permeability of 10^{-6} centimeters per second or less, or an impermeable geomembrane that is at least 50 millimeters thick.
- There are also requirements for construction practices that will provide protection for the workers and ensure that construction at the Settlement Area is conducted in a manner that will minimize potential exposure or release of contaminants to the environment. These practices are described in Section 9.4 of the RI/FS.

On the SRDS parcel, there is an existing area with large, established trees. The landfill cap requirements specified above are not intended to require removal of the trees. The requirement associated with the trees is to ensure that the landscaping at the base of the trees blocks direct contact with refuse.

If a variance to the minimum standard requirements for a landfill cap is requested by a Subject PLP, then a variance request and justification must be submitted to Ecology for approval. Each proposed variance will be reviewed by Ecology to determine if the proposal will meet the goals of the landfill cap and MTCA regulations. As an example, the following variances have been approved for the SPPD parcel within the Settlement Area:

- The Seattle Department of Transportation's standard sidewalk section of 2 inches instead of 3 inches is acceptable in areas where the sidewalk will not be driven over. The sidewalks must be maintained to prevent direct contact with refuse.
- In areas with steep slopes, the use of a multilayer cap with a geomembrane instead of asphalt must be used. The designed and built layer must be stable and resistant to erosion; if erosion occurs, the area affected must be repaired.

6.2.1.2 Relationship with Requirements in Minimum Functional Standards

Although the minimum landfill cap requirements discussed above are protective of human health and the environment and meet the MTCA requirements, they are a variance to the specific cap design listed in the MFS. The proposed landfill cap does not consist of either 2 feet of low-permeability soil or a geomembrane layer and does not include a 6-inch-thick vegetative layer. As part of this CAP, Ecology is approving the variance from the closure methods set forth in WAC 173-304-460. This is allowed by MTCA in WAC 173-340-710(5), which allows for variances, or waivers, of provisions that are included in other applicable regulations. Allowing the asphaltic concrete cap to vary from the provisions of the MFS is appropriate at this Settlement Area for the following reasons:

- A low-permeability cap is not needed because the landfill is already in late Stage 4/early Stage 5, and infiltration of stormwater has been occurring for decades.
- The landfill is unlined and in direct contact with groundwater; therefore, blocking stormwater infiltration has no measureable impact on groundwater quality.
- The proposed landfill cap, supported by the OMMP and institutional controls that limit the uses of the landfill, will effectively prevent direct contact with wastes, improve the effectiveness of the LFG system, and reduce the amount of stormwater infiltration.

A more detailed rationale for the variance, or waiver, of provisions in the MFS for the landfill cap was approved by Ecology in October 2012 and is available in Appendix B of the IAWP for the SPPD parcel (Farallon 2013).

6.2.1.3 Allowance for Reinterment during Cleanup

Regrading, including excavation and reinternment of the solid waste, is allowed during the implementation of the cleanup action, as long as the final configuration does not expand the footprint of the Landfill and all solid waste and contaminated soil remains contained beneath the landfill cap.

6.2.1.4 Implementation Schedule

Landfill cap requirements by parcel are presented in Figure 6.1. At present, the SPPD parcel is in compliance with the landfill cap requirements described above following its IA conducted in 2015. The SRDS is undergoing an IA that will bring the landfill cap into compliance with these requirements in the next 3 to 5 years.

6.2.2 Landfill Gas Controls

LFG controls at the Settlement Area must be sufficient to eliminate explosion hazards due to methane buildup and to demonstrate that LFG is not migrating off the Settlement Area in unacceptable concentrations (refer to Section 4.4 for LFG criteria). Section 6.0 of the RI/FS presents the nature and extent of LFG, including methane and VOCs. Measurements were collected in soil vapor probes and in ambient air in buildings. Monitoring of perimeter gas probes has shown that LFG is still present in some locations at concentrations greater than 5 percent methane but with no measurable pressure. Buildings were measured for methane in four events as part of the RI, and no methane was detected with a detection limit of 0.5 ppmv and an action level of 100 ppmv. Although documented conditions are protective in aboveground buildings, the continued slow generation of LFG requires ongoing monitoring and controls.

Indoor air in buildings that are closest to the LFG probes that had the greatest methane concentrations was monitored several times during the course of the RI, and no LFG intrusion was found.

LFG mitigation criteria under the MFS are defined in WAC 173-304-460 and King County Board of Health Title 10 regulations. The principal criteria relevant to the Settlement Area are the following:

- Methane concentrations in soil within the Settlement Area boundary must not exceed 5 percent by volume, the LEL for methane.
- Methane concentrations inside buildings and structures within the Settlement Area boundary must not exceed 1.25 percent by volume, or 25 percent of the LEL.
- Methane concentrations inside buildings and structures beyond the Settlement Area boundary must not exceed 100 ppmv.

Routine perimeter probe monitoring and building monitoring will be conducted in accordance with the OMMP to ensure the above criteria are met Settlement Area (perimeter probe network is shown in Figure 6.2). All occupied buildings within the Settlement Area will be required to have continuous methane detectors with alarms (i.e., operate 24 hours per day, 7 days per week); meters will be set to alarm at the 1.25 percent level.

The cleanup action for the Settlement Area is presented in the following sections by parcel.

6.2.2.1 SPPD Parcel and Adjacent 5th Avenue South

As part of the redevelopment and IA, SPPD installed an active LFG control system in 2014 and 2015. The system was designed and installed in conjunction with the landfill cap and cover requirements described above, and new buildings and utilities on the parcel will be constructed to be compatible with the LFG system. LFG had been detected along 5th Avenue South adjacent to the SPPD parcel. The LFG system at the SPPD parcel was designed to control LFG along the section of 5th Avenue South adjacent to the parcel. Since the system became fully operational in late 2015, the probes along 5th Avenue South have been in compliance. The system at SPPD will continue to be responsible for compliance along the adjacent section of 5th Avenue South. Continued operation of the LFG system is required under this CAP.

6.2.2.2 SRDS Parcel

The buildings that are currently on the parcel are either naturally ventilated or are elevated and skirted with porous siding; both are appropriate methods of LFG mitigation. As part of the IAWP, SRDS will install a LFG control system, intended to be operated as passive with an option to convert to active if necessary. The final design for the SRDS system was described in the Ecology-approved IAWP, dated July 2015. The system has been designed in conjunction with the landfill cap and cover requirements described in Section 6.2.1, and new buildings and utilities on the parcel will be constructed to be compatible with the proposed system. This system also influences the ROW associated with 5th Avenue South adjacent to this parcel. Continued operation of the LFG system is required under this CAP.

6.2.2.3 Public Roads and Right-of-Ways

LFG has not been identified at concentrations of concern in public roads and ROWs anywhere except for along 5th Avenue South in LFG probes GP-27 and GP-29. The LFG system installed at the SPPD parcel during its IA was designed to control LFG leaving the Landfill Property and migrating into 5th Avenue South. Post-construction results of the IA indicate that both probes are now in compliance. The probes will continue to be monitored as part of long-term monitoring of LFG under this CAP. If exceedances occur in the future at these probes, the operation of the LFG system at the SPPD parcel will be adjusted to bring the probes back into compliance. If they occur, the out-of-compliance results and the adjustment of the LFG system would be reported to Ecology as part of the long-term compliance monitoring program discussed in Section 6.2.5 and presented in Appendix A, Attachment A.2.

6.2.3 Stormwater Controls

The stormwater controls at the Settlement Area are designed to capture the bulk of the stormwater before it can make contact with solid waste. Because the landfill extends into the water table, stormwater controls for the Settlement Area are not intended to limit infiltration; rather, stormwater controls for the Settlement Area are intended to prevent solid waste constituents from contaminating stormwater runoff. The stormwater controls are also intended to minimize the potential for disturbances, erosion, scouring, or otherwise disturbing the landfill

cap. The parcels within the Settlement Area are paved and have stormwater infrastructures that are consistent with the goal stated above. As part of the cleanup action detailed in this CAP, the systems described below will be operated and maintained:

- **SRDS Parcel.** This parcel is undergoing redevelopment and plans are not yet final. Final plans will be approved by Ecology before implementation and will take into account the goal of stormwater controls for the Settlement Area and will be designed not to interfere with the cleanup action. Currently, the redevelopment plans indicate that stormwater drainage will be collected across the SRDS parcel and will require flow and quality mitigation using a subsurface stormwater vault, anticipated to be located on the northern portion of the SRDS parcel under a parking area where the site is more open (i.e., not under buildings). Discharge from the stormwater vault is anticipated to drain to the northwest to the 30-inch-diameter storm pipe located in 2nd Avenue South. This system ties in to the storm drain system on SR 509 that flows into the wetlands on the west side of SR 509.

- **SPPD Parcel.** Stormwater capture on the SPPD parcel is achieved with a system of paved surfaces and catch basins, and conveyance via overland flow on paved surfaces and piping to detention and treatment in one of two SPPD property bioswales. A small proportion of SPPD parcel stormwater runoff (e.g., from the access driveway off 5th Avenue South) is outside the capture area of the bioswales and flows to catch basins in ROWs.

  The North and West bioswales discharge to a new 36-inch-diameter concrete storm drain line installed in the Occidental Avenue South ROW. The new storm drain line bypasses the private KIP storm drain line formerly used to convey stormwater flows from the SPPD property to a City drain line in South Kenyon Street. The new Occidental Avenue South storm drain line connects to the same City drain line in South Kenyon Street downstream of the inflow from KIP. The City drain line discharges into the wetland system west of SR 509, ultimately discharging to the Lower Duwamish Waterway.

  Past surface water control included construction of two bioswales: one in the northern portion of the SPPD parcel (North Bioswale), and the other in the northern portion of the former West Ditch (West Bioswale). As part of the construction of the West Bioswale and preparation of the subgrade for the bioswale and other redevelopment purposes, former West Ditch sediments were solidified by mixing in a Portland cement mixture. The low-permeability membrane cap system was installed along the eastern slope of the former West Ditch and keyed into the solidified material, effectively capping exposed solid waste in this area. Soil on the western side of the former West Ditch was covered with a distinct visible barrier that was overlain with a minimum of 18 inches of clean fill material or top soil. To minimize the effects to shallow groundwater flow from the solidified material, notches were cut into the top of the solidified mass and filled with drain rock, providing drainage to convey shallow groundwater from west to east across the top of the solidified mass. The design and the basis for the design of the former West Ditch sediment solidification aspect of the surface water control component of the IA are presented in the IAWP.

6.2.4 Downgradient Groundwater Controls

The remedial action for groundwater is long-term groundwater monitoring with contingent action if triggers are met related to concentrations rising at the Settlement Area boundary in the future. The groundwater cleanup action uses monitoring and statistical analysis of well-by-well trend plots, as further described in the Groundwater Monitoring and Contingency Plan (Appendix A, Attachment A.3). This plan also contains the triggers for the contingent action. Long-term monitoring will confirm whether concentration trends remain stable or decrease further once cleanup actions are implemented (landfill cap and LFG extraction). Finally, measured concentrations in MW-30, a shallow, perched well, are less than Ecology's screening levels for vapor intrusion concerns, and so will not be addressed as part of the remedial action.

The only COCs greater than CULs for groundwater at the CPOC are vinyl chloride, iron, and manganese. Monitoring wells have been installed along the downgradient perimeter of the Settlement Area to monitor compliance at the CPOC for groundwater. There is no drinking water or water supply well downgradient of the Settlement Area, and the nearest point of exposure is 1,600 feet downgradient, where groundwater discharges to the Lower Duwamish Waterway.

Based on data collected from the RI/FS, residual vinyl chloride appears to be releasing very slowly from a silt lens in the upper sections of the aquifer. Based on existing trend plots, these concentrations are expected to come into compliance within 10 years of the completion of construction of cleanup elements at the Settlement Area.

Long-term groundwater monitoring will include vinyl chloride, iron and manganese, *cis*-1,2-DCE (the precursor for vinyl chloride) in wells where vinyl chloride is measured. Benzene will be monitored in well MW-25 to track a localized plume that appears to originate upgradient of the Settlement Area, and arsenic in wells MW-12, MW-08, MW-10, MW-18, MW-24, MW-25, MW-26, MW-27, MW-32, and MW-33. Note that MW-27 is not a CPOC well for arsenic. The perimeter groundwater monitoring well network is shown in Figure 6.2.

6.2.4.1 Contingent Triggers and Actions Based on Vinyl Chloride

Two conditions that will trigger contingent actions will be monitored in the existing compliance monitoring well network:

- **Condition 1.** Condition 1 (the concentration trigger) is based on groundwater concentrations. In about half of the downgradient wells, the vinyl chloride concentrations exceed the CUL of 0.29 µg/L, with concentrations in one well (MW-25) fairly consistently between 0.7 and 1.4 µg/L. If concentrations in any downgradient well exceed 1.45 µg/L (5 times the CUL) for two consecutive sampling events, this constitutes Condition 1, and a contingent response is triggered. This trigger is not applied to MW-30 and MW-31, whose concentrations are affected by a non-Landfill Property source in addition to the Landfill Property.

- **Condition 2.** Condition 2 (the trend trigger) is based on the trend of groundwater concentrations over time in the monitoring wells. Condition 2 is reported using trend plots supported with simple statistical tools in ProUCL.[9] Condition 2 is designed to capture statistically meaningful increases in groundwater concentrations. The trend identification will use a well-established, non-parametric statistical method for trend analysis available in ProUCL called the Mann-Kendall method and will be applied to downgradient wells where the concentration of vinyl chloride is greater than the CUL. The trend analysis will include MW-31 (which is screened in the alluvial aquifer), but not MW-30 (which is screened in the Silt Overbank Deposit). The trend test will be performed at a 95 percent confidence interval.

If either or both of the trigger conditions occur, the following actions will be implemented:

1. Ecology will be notified within 30 days of data validation to report that a trigger condition has occurred.
2. Within 90 days of the notification, the Subject PLPs will submit a written evaluation that considers the following:
    a. Is the cause of the trigger event (source of the contamination) known?
    b. Does it likely represent a transient condition or a new condition?
    c. Do the data indicate that the most likely source is the Landfill?
    d. Does a focused exposure assessment indicate an exposure threat to human health or the environment?
    e. If the source is likely a parcel within the Settlement Area, what actions are appropriate at this time? Actions may include, but are not limited to, one or more of the following:
        i. Continued monitoring to confirm that it is a transitory effect. For example, construction that disturbs the Silt Overbank Deposit may cause a short-term increase that may be acceptable to Ecology as part of the construction project.
        ii. Modified sampling to understand the cause or source.
        iii. Changes in operations of LFG systems.
        iv. Changes in some site-related activity, if practicable.
        v. Additional investigation at the Site.
        vi. Confirmation that natural attenuation conditions are stable and favorable and possible implementation of in situ modification (such as the addition of a reducing agent or microbial enhancement), if needed.
        vii. Pump and/or treat if determined to be appropriate and effective.
        viii. Other technologies that are appropriate to the situation.

[9] ProUCL is currently approved by Ecology for use for this test. Other software may be used in the future but will require approval by Ecology.

f. If additional remedial action beyond the above actions is considered, it will be evaluated in a manner consistent with a focused FS under MTCA, leading to a proposed corrective action.

Ecology will review the evaluation and determine what action(s) the Subject PLPs will take based on the written evaluation. Following implementation of the contingent actions, Ecology will determine if the actions have addressed the risks or hazards precipitated by the trigger. If Ecology determines that the action(s) do not address them, Ecology may decide if the conditions constitute remedy failure such that Ecology may use a reopener to require more remedial action.

If an increasing trend is observed for MW-31, the following actions would be appropriate:

1. Ecology will be notified within 30 days of data validation to report that a trigger condition has occurred.
2. Because monitoring wells MW-25, MW-32, and MW-33 are between the Landfill Property and MW-31, if an increasing trend is observed in MW-31, the concentrations at these wells will be evaluated to determine if the source could be the Landfill Property or if it is another location. If concentrations at the Landfill Property indicate that the probable source is the Landfill Property, the Subject PLPs will proceed with the action in 2e above. If Ecology determines the data at the Landfill Property indicate that the Landfill Property is not the cause of the increasing trend, it is Ecology's expectation that no additional action is required under this Consent Decree.

6.2.4.2 Contingent Triggers and Actions for Iron and Manganese

Iron and manganese are elevated to concentrations greater than background in several downgradient CPOC wells, as discussed in Section 4.2. Trend plots shown in Appendix J of the RI/FS indicate that concentrations are slowly decreasing and are expected to come into compliance within 10 years. As long as the concentrations are stable or decreasing, no further action is required beyond monitoring. Once a dataset of eight quarterly events has been collected for iron and manganese during long-term monitoring (Section 2.4 of the Groundwater Monitoring and Contingency Plan, Appendix A, Attachment A.3), Ecology may approve a decreased frequency of monitoring for iron and manganese. If the concentrations are increasing, the Subject PLPs will meet with Ecology to discuss next actions. Ecology will determine if further active remediation is needed and if this will require reopening the consent decree due to remedy failure.

6.2.4.3 Contingent Triggers and Actions for Arsenic

There are known cement kiln dust deposits upgradient of the Landfill Property on the KIP parcel, and downgradient of the Landfill Property east of 5th Avenue S. As long as the arsenic concentrations are stable or decreasing in the downgradient wells MW-08, MW-10, MW-18, MW-24, MW-25, MW-26, MW-32, and MW-33, no further action is required beyond monitoring. If arsenic remains in compliance for 2 years (eight additional quarters), arsenic analysis for the Settlement Area would be terminated. If the concentrations are increasing, the Subject PLPs will

meet with Ecology to discuss next actions. Ecology will determine if further active remediation is needed and if this will require reopening the consent decree due to remedy failure.

6.2.5 Operations, Maintenance, and Monitoring

To ensure that the selected components of the cleanup action are implemented efficiently and are operating properly, long-term operations, maintenance, and monitoring (OMM) of the various components must be implemented. An OMMP that outlines these specific requirements for long-term monitoring is included in Appendix A. The following is a summary of the OMM requirements for the affected media at the Settlement Area:

- **Landfill cap.** The landfill cap, consisting of pavement, buildings, and geomembrane/soil layers, as described in Section 6.2.1, must be maintained in such a manner as to prevent contact with the solid waste/soil beneath the cap, prevent "short-circuiting" of the LFG controls, and support the stormwater controls that avoid solid waste contamination of runoff. The landfill cap is not required to entirely block the infiltration of stormwater. The cap must be inspected annually, and these records must be maintained for Ecology inspection. If the cap is damaged or becomes worn, it must be repaired and the repairs must be reported in accordance with the Landfill Cap Inspection and Maintenance Plan (Appendix A, Attachment A.1).
- **Landfill gas.** Monitoring LFG collection systems serves two purposes: (1) performance monitoring within the system guides its operation, and (2) post-construction compliance monitoring (confirmational monitoring under MTCA) confirms that the system is controlling LFG emissions as required by the cleanup action. The long-term LFG monitoring requirements are described in the Landfill Gas Monitoring and Contingency Plan (Appendix A, Attachment A.2). Additional monitoring will be performed on a parcel-by-parcel basis because the LFG controls are parcel-dependent. The specifics for each parcel will be described in a parcel-specific LFG OMMP.
- **Groundwater.** Long-term groundwater monitoring is a fundamental component of both landfill closure requirements and MTCA. The long-term groundwater monitoring requirements are site-wide (not parcel-specific) and are described in the Groundwater Monitoring and Contingency Plan (Appendix A, Attachment A.3).

The plans referenced above make up the OMMP attachments and were prepared as individual stand-alone plans. The OMMP will also specify requirements for record keeping of inspections and repairs, and reporting.

6.2.6 Site Coordinator Responsibilities

A Landfill Site Coordinator will be designated to perform the long-term monitoring and reporting required under this CAP. The Site Coordinator will conduct the following work:

- Ongoing monitoring of LFG in perimeter probes as specified in the OMMP (Appendix A), including monitoring of off-site buildings if triggered by the results of the perimeter probe monitoring.
- Ongoing groundwater monitoring as specified in the OMMP (Appendix A).
- Annual inspections of the integrity of the landfill caps as specified in the OMMP.
- Annual inspections of surface water drainage effectiveness as specified in the OMMP.
- Creation and submittal of an annual report to Ecology of data/information related to the bullets above.
- Coordination and submittal of data required for Ecology 5-year site reviews.
- Informing Ecology of major OMM activities and incidents at the various parcels, as required in the OMMP, and acting as a central point of contact for field questions from Ecology, routing them to the appropriate person, as needed.

6.2.7 Environmental (Restrictive) Covenants

WAC 173-340-440 establishes that when the final remedy does not remove all contaminants from the property, appropriate institutional controls shall be established in an Environmental (Restrictive) Covenant on the property. The restrictive covenants shall run with the land and be binding on each owner's successors and assigns.

The proposed Environmental (Restrictive) Covenants for each parcel within the Settlement Area are attached as Appendix B and apply to the SRDS parcel and the SPPD parcel. As required by WAC 173-340-440(9), “the restrictive covenants shall:

(a) Prohibit activities on the site that may interfere with the cleanup action, operation and maintenance, monitoring, or other measures necessary to assure the integrity of the cleanup action and continued protection of human health and the environment.

(b) Prohibit activities that may result in the release of a hazardous substance that was contained as a part of the cleanup action.

(c) Require notice to the department of the owner's intent to convey any interest in the site.

(d) No conveyance of title, easement, lease, or other interest in the property shall be consummated by the property owner without adequate and complete provision for the continued operation, maintenance and monitoring of the cleanup action, and for continued compliance with this subsection.

(e) Require the landowner to restrict leases to uses and activities consistent with the restrictive covenant and notify all lessees of the restrictions on the use of the property.

(f) Require the owner to include in any instrument conveying any interest in any portion of the property, notice of the restrictive covenant under this section.

(g) Require notice and approval by the department of any proposal to use the site in a manner that is inconsistent with the restrictive covenant.

(h) Grant the department and other property owners the right to enter the property at reasonable times for the purpose of evaluating compliance with the cleanup action plan and other required plans, including the right to take samples, inspect any remedial actions taken at the site, and to inspect records."

The landfill extends under three roads in the area (Figure 6.3). Typically, the refuse was shallow in these locations and often indistinguishable from other fill sources (cement kiln dust, concrete, etc.) historically used for roads throughout the valley. Ecology will work with the Seattle Department of Transportation and the Washington State Department of Transportation under WAC 173-340-440(8)(b) to define a notification process that transmits requirements applicable to the ROWs, as captured in the Environmental (Restrictive) Covenants, to ROWs that do not fall under the traditional environmental covenant process. The schedule for completion is shown in Section 7.0.

As discussed in Section 6.0, control of LFG migration to the ROWs will be performed by the adjacent parcel.

6.3 COMPLIANCE WITH MODEL TOXICS CONTROL ACT REQUIREMENTS

MTCA cleanup standards for the Settlement Area portion of the Site are described in Section 4.0. This section describes how the cleanup action meets cleanup standards.

6.3.1 Requirements for Cleanup Actions (WAC 173-340-360(2))

The threshold criteria identified in WAC 173-340-360(2)(a) that must be met by the selected remedy and the reasons why the preferred alternative meets them, are as follows:

(a)(i) Protect human health and the environment

Landfill cap. The landfill cap described in Section 6.2.1 will prevent direct contact with solid waste by humans, plants, and animals. It will also ensure that stormwater that leaves the Settlement Area through the stormwater conveyance systems has not come into contact with solid waste.

By limiting infiltration of stormwater, the cap will also decrease the amount of leachate produced. As discussed in Section 6.2.3, because the landfill is unlined and the contents are already in contact with groundwater, this decrease in infiltrating stormwater is viewed as a minor benefit that may or may not produce measurable changes in groundwater quality.

Landfill gas controls. The LFG control described in Section 6.2.2 meets system requirements for preventing worker and visitor exposure to methane and carbon dioxide concentrations that pose a risk to human health. The concentrations in buildings adjacent to the Settlement Area are already at acceptable levels; therefore, LFG systems will be limited to the footprint of the Settlement Area. The LFG system will also collect any VOCs entrained in the LFG system to avoid the accumulation of VOCs in buildings (control vapor intrusion).

Stormwater controls. The stormwater controls described in Section 6.2.3 meet the MTCA requirements by effectively separating the stormwater from the landfill solid waste and contaminated soil. The captured stormwater will be conveyed and discharged off-site in accordance with the stormwater regulations and ordinances.

Groundwater monitoring. Long-term groundwater monitoring with contingent actions is an appropriate remedial action for groundwater because groundwater sampling data at the Landfill Property indicate that vinyl chloride, iron, and manganese are the only remaining COCs detected at concentrations greater than CULs for groundwater, is very close to being in compliance, and is continuing to decrease toward compliant concentrations less than CULs. The most recent concentrations of vinyl chloride data collected from CPOC wells range from not detected at 0.02 to 0.99 µg/L. Ecology has established a CUL for vinyl chloride in groundwater of 0.29 µg/L. This value was selected to protect potential drinking water uses, but it is also protective of surface water quality. There are no current or anticipated drinking water wells between the Settlement Area and the Lower Duwamish Waterway, located approximately 1,600 feet downgradient.

Operations, maintenance, and monitoring. OMM requirements combined with the Environmental (Restrictive) Covenants will ensure that the cleanup action is maintained over time, is protective of human health and the environment, and meets the expectations in WAC 173-340-7491 for protection of terrestrial receptors.

(a)(ii) Comply with cleanup standards (WAC 173-340-700 through 173-340-760)

The containment remedy is an effective MTCA remedy for soil that complies with cleanup standards and allows solid waste within the closed landfill to be left in place as long as the requirements for a containment remedy are met. Groundwater concentrations will comply with the MTCA Method B CULs at the conditional POC for landfills at the edge-of-refuse. The groundwater concentrations of all the historical contaminants except for vinyl chloride, iron, and manganese are already in compliance at the CPOC. As described in Section 6.2.4, the downgradient groundwater will meet the cleanup standards within a reasonable timeframe (10 years for vinyl chloride, iron, and manganese) and will be monitored routinely to ensure that the groundwater is achieving the desired conditions within a reasonable restoration time. The LFG controls comply with the standards developed to prevent LFG levels greater than the permissible percentages of methane and carbon dioxide and any applicable cleanup standards. The LFG controls will also control VOC emissions from the Landfill.

(a)(iii) Comply with applicable state and federal laws (WAC 173-340-710)

The landfill cover specifications meet the alternative cap requirements for the landfill cap and cover allowed by WAC 173-340-710. The landfill cap, in conjunction with the recommended

stormwater infrastructure, ensures compliance with these requirements. The LFG control requirements apply to the specific landfill regulations as outlined in Section 11.0 of the RI/FS. The other components of the remedy are consistent with the applicable regulations.

(a)(iv) Provide for compliance monitoring (WAC 173-340-410 and WAC 173-340-720 through 173-340-750)

Compliance monitoring will be conducted for both LFG and groundwater, as described in Appendix A, Attachments A.2 and A.3.

WAC 173-340-360(2)(b) specifies three other criteria that cleanup actions must achieve. The following list describes how these criteria are met by the preferred alternative:

(b)(i) Use permanent solutions to the maximum extent practicable

The preferred remedy is permanent to the maximum extent practicable for a closed solid waste landfill containing large volumes of hazardous substances at low concentrations. OMM requirements, along with Environmental (Restrictive) Covenants, ensure that the containment remedy for soil and solid waste will remain protective over time.

(b)(ii) Provide for a reasonable restoration time frame

Cleanup actions combined with OMM requirements in this CAP will ensure protection of human health and the environment. The IA cleanup actions were completed at the SPPD parcel in 2015 and are expected to be completed at the SRDS parcel in the next 3 to 5 years. A schedule for implementation of the remedial action is presented in Section 7.0. Groundwater contaminant concentrations are expected to come into compliance within 10 years as residual vinyl chloride degrades and iron and manganese attenuate; there are no current or anticipated uses of or exposures to the groundwater.

(b)(iii) Consider public concerns (WAC 173-340-600)

Ecology provides the CAP and associated Consent Decree for public review and comment and responds to comments raised by the public. Ecology finalizes the CAP and Consent Decree after consideration of public input.

6.3.2 Requirements for Containment Systems (WAC 173-340-740(6)(f))

WAC 173-340-740(6)(f) includes specific requirements of a containment cleanup action that allow soil and solid waste with concentrations greater than the soil CULs to remain in place. These requirements are met by the preferred alternative in the following ways:

(f)(iv) Institutional controls are put in place

An Environmental (Restrictive) Covenant will be established for each parcel that overlies the Settlement Area to ensure that the requirements of the remedy, including OMM of the landfill cap, LFG control systems, and groundwater monitoring, are met.

(f)(v) Compliance monitoring (WAC 173-340-410) and periodic reviews (WAC 173-340-430) are designed to ensure long-term integrity of the containment system

The OMMP (Appendix A) provides details for OMM requirements to ensure that the cleanup action components are implemented efficiently and are functioning as intended. In addition, each parcel with a LFG system will have a LFG OMMP designed to ensure the long-term integrity of the system. OMM information will be compiled and reported to Ecology in a Settlement Area Annual Monitoring Report. Periodic review of the remedial action in accordance with WAC 173-340-420 will occur as detailed in the Consent Decree.

(f)(vi) Types, levels, and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the CAP

The material remaining within the landfill is municipal solid waste containing low levels of hazardous substances. Containment of hazardous substances will be accomplished through the installation and maintenance of a landfill cap, as described in Section 6.2.1.

7.0 Implementation Schedule

Implementation of the remedial actions included in this CAP will occur over the next 10 years according to a parcel-by-parcel approach, as shown in Figure 7.1. The restoration timeframe for groundwater compliance is 10 years. Table 7.1 lists the milestones that have been identified, along with the schedule deadlines.

Table 7.1
Implementation Schedule

Item/Milestone	Timeframe
Construction and Operations of Remedial Components	
Remedial action construction at SPPD	Completed as IA in 2015.
Operation of LFG system at SPPD	Operations began as IA in 2015 and will continue until no longer needed per OMMP (Appendix A, Attachment A.2).
Remedial action construction at new SRDS (STSII)	To be performed as IA under the schedule in Agreed Order No. 6706.
Operation of LFG system at new SRDS (STSII)	Operations to begin as part of IA (expected between 2020 and 2022) and will continue until no longer needed per OMMP (Appendix A, Attachment A.2).
Installation of methane alarms in buildings	Part of remedial action; 180 days after the effective date of the Consent Decree for all existing buildings in the Settlement Area; or at time of occupancy for any future new buildings.
Long-Term Monitoring and Environmental (Restrictive) Covenants	
Long-term monitoring of LFG, groundwater, and landfill cap integrity	Part of OMMP; monitoring would begin 180 days after the effective date of the Consent Decree and will continue until no longer needed per OMMP (Appendix A).
Environmental (Restrictive) Covenants for SPPD and SRDS parcels	Filed with the County Recorder within 180 days after the effective date of the Consent Decree.
Alternate Environmental (Restrictive) Covenant for Seattle Department of Transportation and the Washington State Department of Transportation ROWs	Final draft available for Ecology review within 180 days after the effective date of the Consent Decree.

8.0 References

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Tables

Table 5.1
Applicable or Relevant and Appropriate Requirements

Potential Chemical-Specific ARARs[1]	Source[2,3]	Description and Relevance
National Ambient Air Quality Standards	40 CFR 50	Specifies primary and secondary National Ambient Air Quality Standards, National Emission Standards for Hazardous Air Pollutants, and performance standards for new and existing stationary sources. National Ambient Air Quality Standards are applicable to those elements of the Interim Action pertaining to the collection and management of LFG.
Federal Regulations Implementing the Toxic Substances Control Act (TSCA)	40 CFR 700—799, as applicable	Specifies testing, handling, and disposal requirements for materials contaminated with polychlorinated biphenyls (PCBs), dioxins/furans, etc. These regulations would apply to material generated during conduct of the Interim Action that is found to be contaminated with toxic substances regulated under TSCA.
State Dangerous Waste Regulations	WAC 173-303	Establishes regulatory requirements for the generation, handling, storage, transport, treatment, and disposal of dangerous wastes in the State of Washington under the provisions of the Washington State Hazardous Waste Management Act. These regulations apply to waste deemed dangerous or extremely hazardous to public health or the environment. The regulations would apply to material generated during conduct of the Interim Action that is found to be contaminated with dangerous waste, and requires treatment and disposal off-site.
Washington State Minimal Functional Standards for Landfills	WAC 173-304-460	This regulation applies to facilities that dispose of solid waste in landfills, with the exception of inert, demolition, and wood waste landfills. It specifies limits on methane concentrations at the property boundary and in on-site and off-site structures, and requires compliance with ambient air quality standards and emission standards at the property boundary. This regulation applies only to solid waste landfills that operated after 1985, but it is a minimum requirement for solid waste landfill cleanups.
Puget Sound Clean Air Agency (PSCAA) Notice of Construction	Regulation I	Requires a Notice of Construction and Application for Approval before constructing or modifying an air contaminant source. This would apply to the Interim Action due to potential emissions of LFG.
PSCAA Emission Standards for Toxic Air Pollutants	Regulation III	Implements at a regional level the National Emission Standards for Hazardous Air Pollutants (NESHAPS). It requires best available control technology for sources of toxic air contaminants; and requires that toxic air contaminants be quantified and compared against acceptable source impact levels for each contaminant. PSCAA Emission Standard for Toxic Air Pollutants are applicable to air emissions from the LFG collection system.
King County Board of Health Regulations	Title 10	The requirements established in this regulation meet or exceed the requirements established by the Washington State Minimum Functional Standards for Solid Waste Handling. Applicable chemical-specific requirements are the same as those described for the Minimal Functional Standards (see WAC 173-304-460 above).
Potential Location-Specific ARARs[1]	**Source[2,3]**	**Description and Relevance**
Federal Archaeological Resource Preservation	RCW 27-53	This law addresses the discovery, identification, excavation, and study of archaeological resources, and the communication of information to state and federal agencies regarding the possible impact of construction activities on Washington State archaeological resources.
State Permits for Archaeological Excavation and Removal	WAC 25-48	This establishes application and review procedures for the issuance of archaeological excavation and removal permits, for the issuance of civil penalties for violations.
Potential Action-Specific ARARs[1]	**Source[2,3]**	**Description and Relevance**
Monitoring and Maintenance		
Federal Occupational Safety and Health Standards	29 CFR 1910.120	This requires that employers develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program must be designed to identify, evaluate, and control safety and health hazards and to provide for emergency response for hazardous waste operations.
State Occupational Health Standards	WAC 296-62	This establishes rules designed to protect the health of employees and help to create a healthy workplace by establishing requirements to control health hazards. Requirements for chemical hazard communication programs, workplace lighting levels, and exposure records are in the core safety and health rules of this chapter.
Well Construction Standards	WAC 173-160, Part Two	Part Two of this regulation defines minimum standards for the construction and decommissioning of the water resource protection wells that will be installed as part of the groundwater monitoring program to be implemented as part of the cleanup action. Resource protection wells may not be used to withdraw or inject water for domestic, industrial, municipal, commercial, or agricultural purposes.

Table 5.1
Applicable or Relevant and Appropriate Requirements

Potential Action-Specific ARARs[1]	Source[2,3]	Description and Relevance
Monitoring and Maintenance (continued)		
Groundwater Monitoring Plan	WAC 173-304-490	This regulation addresses groundwater monitoring requirements for solid waste landfills including provision for a minimum of one upgradient and two downgradient monitoring wells. The monitoring plan must specify procedures for sample collection, preservation and shipment, laboratory analysis and associated quality control protocols, and health and safety. Although this requirement applies only to landfills that operated after 1985, these monitoring requirements will be incorporated into the long-term groundwater monitoring program that will be conducted as part of the cleanup action.
Excavation and Filling		
State Particulate Matter Standards	WAC 173-470	This establishes maximum acceptable levels for particulate matter in ambient air based on the criteria defining particulate matter that have been developed by the U.S. Environmental Protection Agency. This regulation establishes requirements for monitoring, measuring, and reporting particulate matter data. It applies to dust-producing activities during implementation of the cleanup action, particularly excavation and filling.
PSCAA Fugitive Dust Standards	Regulation I	This establishes emission standards for fugitive dust. Like the previous ARAR, this regulation applies to dust-producing activities during implementation of the cleanup action, particularly excavation and filling.
Treatment, Discharge, and Disposal		
NPDES Permit	WAC 173-220	This establishes a state individual permit program, applicable to the discharge of pollutants and other wastes and materials to the surface waters of Washington State, operating under state law. Permits issued under this chapter are designed to satisfy the requirements for discharge permits under both the Federal Water Pollution Control Act and Washington State Water Pollution Control Act. This requirement is applicable to the control, collection, management, and discharge of stormwater runoff during and after construction of the cleanup action.
State Waste Discharge General Permit Program	WAC 173-226	This establishes a state general permit program, applicable to the discharge of pollutants, wastes, and other materials to waters of the state, including discharges to municipal sewer systems. Permits issued under this regulation are designed to satisfy the requirements for discharge permits under the Federal Water Pollution Control Act and the Washington State Water Pollution Control Act. Although this permit is not required because of MTCA's permit exemption, it will be obtained for the drainage control systems to be constructed as part of the cleanup action because a NPDES permit is required and Ecology issues a combined NPDES/state waste discharge permit.
Industrial Waste Discharge to Metropolitan King County Sewer System	KCC 28.84.060	This establishes rules and regulations applicable to water pollution abatement activities, including the disposal of sewage into the metropolitan sewer system, whether delivered from within or from without the county. This also authorizes King County to develop and implement such procedures and to take any other actions necessary to ensure that local public sewers and private sewers discharging to or proposing to discharge into the metropolitan sewer system are constructed and developed in accordance with applicable laws, regulations, and plans. This regulation applies to implementation of the drainage control elements of the cleanup action.
State Minimum Functional Standards for Solid Waste Handling	WAC 173-304-460	This regulation applies to facilities that dispose of solid waste in landfills, with the exception of inert, demolition, and woodwaste landfills. The regulation establishes standards for landfill cover, surface water control, LFG collection, access control, and compliance monitoring.
King County Board of Health Regulations	Title 10	The requirements established in this regulation meet or exceed the requirements established by the Washington State Minimum Functional Standards for Solid Waste Handling (see above) and apply to the cleanup action for compliance monitoring programs and as performance standards for the design of control systems.
City of Seattle Review (in numerical order by SMC title and chapter)		
Street Use	SMC Title 15, as applicable	Requires a written permit for any proposed activities that use a City of Seattle street right-of-way, including construction activities and movement of equipment. Because the toe of the landfill extends into a City of Seattle right-of-way, it will be necessary to conduct work in the right-of-way to implement the cleanup action. City of Seattle review requirements apply to elements of the cleanup action.
Water Connection	SMC 21.04	This specifies an application and approval process for connecting to the City of Seattle water supply system. Water connection is potentially needed for dust control during grading.

Table 5.1
Applicable or Relevant and Appropriate Requirements

Potential Action-Specific ARARs[1]	Source[2,3]	Description and Relevance
City of Seattle Review (continued)		
Side Sewer Connection	SMC 21.16	This requires connection of all sources of polluted water with the nearest accessible sanitary sewer. Sewer connection will be needed for discharge of LFG condensate and possibly leachate.
Electrical Service Connection	SMC 21.49	This specifies an application and approval process for obtaining electrical service from Seattle City Light. Electrical service will be needed to power sump pumps for LFG condensate and blower motors for LFG control.
Building Codes	SMC Title 22, as applicable	This includes a number of requirements that apply to the cleanup action, including electrical, mechanical, fire, and energy codes, as well as regulations for grading, stormwater, drainage, and erosion control (see more detail below).
Stormwater, Drainage, and Erosion Control	SMC 22.802	This specifies a drainage control review and approval process for projects that involve land-disturbing activities or new or replaced impervious surface. The cleanup action will require a Drainage Control Plan and a Construction Stormwater Control Plan.
Grading	SMC 22.804	This specifies a process for application and approval of a grading permit for earth-moving activities. Grading must preserve natural drainage patterns and not create unstable slopes or contribute to increased turbidity or other forms of pollution in a watercourse.
Noise Control	SMC 25.08	This specifies maximum permissible noise levels for construction activities and facility operation in industrial zones, depending on the zoning designation of receiving properties.
Environmentally Critical Areas	SMC 25.09	This specifies development standards for actions affecting environmentally critical areas. Wetlands associated with drainage ditches were determined to not meet the City of Seattle's wetland definition.
City of Seattle Building Codes		
Methane Reduction Measures	SBC 1811.2	This specifies that all structures to be built within the 1,000-foot landfill zone need to be protected from potential methane migration. A licensed civil engineer will prepare and submit a report to the building official that will contain a description of the investigation and recommendations for preventing the accumulation of explosive concentrations of methane gas within or under enclosed portions of the building or structure.

Notes:

1 Because it is understood that MTCA is the overarching regulation governing all aspects of the cleanup action, it is not included in this table.
2 Pursuant to RCW Section 70.105D.090, potentially liable persons conducting a remedial action under an agreed order with Ecology are exempt from some state-administered procedural requirements and the procedural requirements of any local laws requiring or authorizing local government permits or approvals for the remedial action. However, the substantive requirements of state and local laws requiring permits or approvals shall be complied with.
3 Pursuant to WAC 173-340-710(9), the state agencies and local governments that have potential permits subject to the permit exemption have been consulted. The substantive requirements of the permits that are exempt, to the extent they are currently known, have been incorporated into this Cleanup Action Plan. Therefore, the substantive requirements of state and local laws subject to the permit exemption will be met during the cleanup action.

Abbreviations:

ARAR	Applicable or relevant and appropriate requirement
CFR	Code of Federal Regulations
Ecology	Washington State Department of Ecology
KCC	King County Code
LFG	Landfill gas
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
RCW	Revised Code of Washington
SBC	Seattle building code
SMC	Seattle Municipal Code
WAC	Washington Administrative Code

Table 6.1
Summary of Proposed Remedial Action by Parcel

Remedial Action Component	SPPD Parcel	SRDS (City of Seattle) Parcel	Right-of-Ways
Landfill Cap Installation and Maintenance	Interim Action specifications met the requirements; however, post-construction inspection indicated the presence of depressions in the paving where stormwater accumulated and erosion of one of the landscaped areas. This will be brought up to requirements as part of the final remedial action. Engineered cap consisting of: • A 12-inch minimum thickness of fill material placed over the solid waste to meet structural section requirements. • A 3-inch minimum thickness for asphaltic concrete or a 4-inch minimum thickness for cement concrete over the fill. Areas that will not be paved or receive hardscape will require: • A 24-inch minimum thickness soil layer. • A distinct visible barrier between the new improvements and the top of the solid waste. If redevelopment occurs that changes the existing building layout and pavement, then the new surface would need to be an engineered surface consistent with the requirements for the SPPD and SRDS parcels.	This parcel is undergoing Interim Action and redevelopment. The parcel will meet the requirements; details are presented in the IAWP and EDR. Post-construction confirmation will be included in the Construction Completion Report. Engineered cap consisting of: • A 12-inch minimum thickness of fill material placed over the solid waste to meet structural section requirements. • A 3-inch minimum thickness for asphaltic concrete or a 4-inch minimum thickness for cement concrete over the fill. Areas that will not be paved or receive hardscape will require: • A 24-inch minimum thickness soil layer. • A distinct visible barrier between the new improvements and the top of the solid waste. If redevelopment occurs that changes the existing building layout and pavement, then the new surface would need to be an engineered surface consistent with the requirements for the SPPD and SRDS parcels.	Annual monitoring and maintenance of the existing cap will be conducted to prevent direct contact with refuse. If redevelopment occurs that changes the existing building layout and pavement, then the new surface would need to be an engineered surface consistent with the requirements for the SPPD and SRDS parcels.
Landfill Cap Monitoring	Site-wide annual monitoring and reporting by the Subject PLPs to Ecology. Follow-up requirement for maintenance will be handled by the individual parcel owners.		
LFG Monitoring and Controls	Installation and operation of a combined active/passive LFG collection and treatment system. Monitoring will extend to the far side of 5th Avenue South. Existing and future buildings on the parcel will be monitored. Off-site monitoring of buildings along 5th Avenue South will be considered only if methane in perimeter probes persists at concentrations greater than the LEL and the supervising engineer concludes that methane cannot be effectively reduced by adjustments to the LFG control system.	Installation and operation of a LFG system designed to control off-site migration and protect all on-site structures in accordance with the MFS requirements. This system will be expected to protect not only the SRDS parcel but also the adjacent sections of 5th Avenue South. Monitoring of this system will extend to the SR 99 side of 5th Avenue South. Existing and future buildings on the parcel will be monitored. No off-site building monitoring is required.	LFG is located along 5th Avenue South only; monitoring and controls along 5th Avenue South are required as part of the SPPD and SRDS systems.
Stormwater Controls	Engineered stormwater collection and controls are designed to prevent direct contact between stormwater and refuse.	Engineered stormwater collection and controls are designed to prevent direct contact between stormwater and refuse.	The existing system provides adequate separation between solid waste and stormwater to prevent contamination of stormwater.
Stormwater Monitoring	Parcel-specific monitoring may be required consistent with NPDES permit requirements. The requirements are triggered by facility operations and not by the presence of the landfill.		
Groundwater Monitoring	Site-wide monitoring (including contingent actions related to groundwater contaminated by chemicals released from the landfill) and annual reporting by the Subject PLPs to Ecology.		

Table 6.1
Summary of Proposed Remedial Action by Parcel

Remedial Action Component	SPPD Parcel	SRDS (City of Seattle) Parcel	Right-of-Ways
OMMP	1. Establish an inspection and monitoring program to identify damaged or worn components of the landfill cap, stormwater system, and LFG systems and evaluate their potential to affect the remedial action. 2. Provide for timely repair and/or replacement of components. 3. Specify measures to minimize the potential for disturbances of solid waste, during routine use of the parcel, repair to subsurface structures (such as a utility line), and repairs to the remedial action components. 4. Specify requirements for record-keeping of inspections and repairs, and reporting.	1. Establish an inspection and monitoring program to identify damaged or worn components of the landfill cap, stormwater system, and LFG systems and evaluate their potential to affect the remedial action. 2. Provide for timely repair and/or replacement of components. 3. Specify measures to minimize the potential for disturbances of solid waste, during routine use of the parcel, repair to subsurface structures (such as a utility line), and repairs to the remedial action components. 4. Specify requirements for record-keeping of inspections and repairs, and reporting.	There is no OMMP for the roadways. Ongoing maintenance is addressed by the Environmental (Restrictive) Covenant that is being prepared jointly by the Seattle Department of Transportation and Ecology.
Environmental Covenants	Yes	Yes	No; handled through Interdepartmental Memorandum from Seattle Public Utilities to Seattle Department of Transportation for 5th Avenue South (refer to Appendix B of the Cleanup Action Plan).
Remedial Action Timeframe	Interim Action 2014	Interim Action or Final Action 2017	

Abbreviations:

Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
IAWP	Interim Action Work Plan
LEL	Lower explosive limit
LFG	Landfill gas
MFS	Minimal Functional Standards for Solid Waste Handling (Chapter 173-304 WAC)
NPDES	National Pollutant Discharge Elimination System
OMMP	Operations, Maintenance, and Monitoring Plan
PLP	Potentially liable person
SPPD	South Park Property Development, LLC
SR	State Route
SRDS	South Recycling and Disposal Station
WAC	Washington Administrative Code

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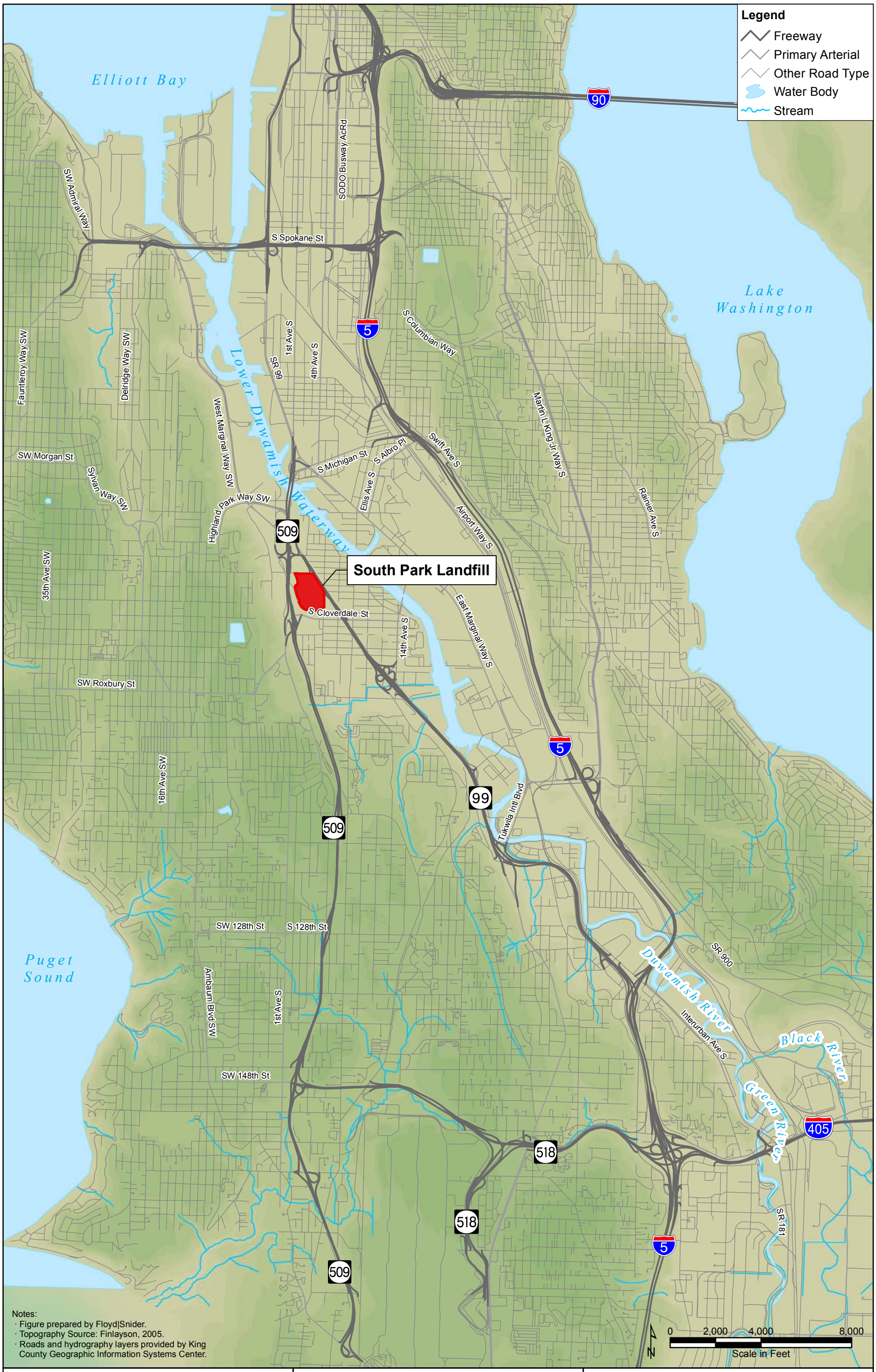
Cleanup Action Plan

Figures



DEPARTMENT OF ECOLOGY
State of Washington

Cleanup Action Plan
South Park Landfill
Seattle, Washington

Figure 2.1
Vicinity Map

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DEPARTMENT OF ECOLOGY
State of Washington

Cleanup Action Plan
South Park Landfill
Seattle, Washington

Figure 2.2
South Park Landfill Site Parcel Map with Right-of-Ways

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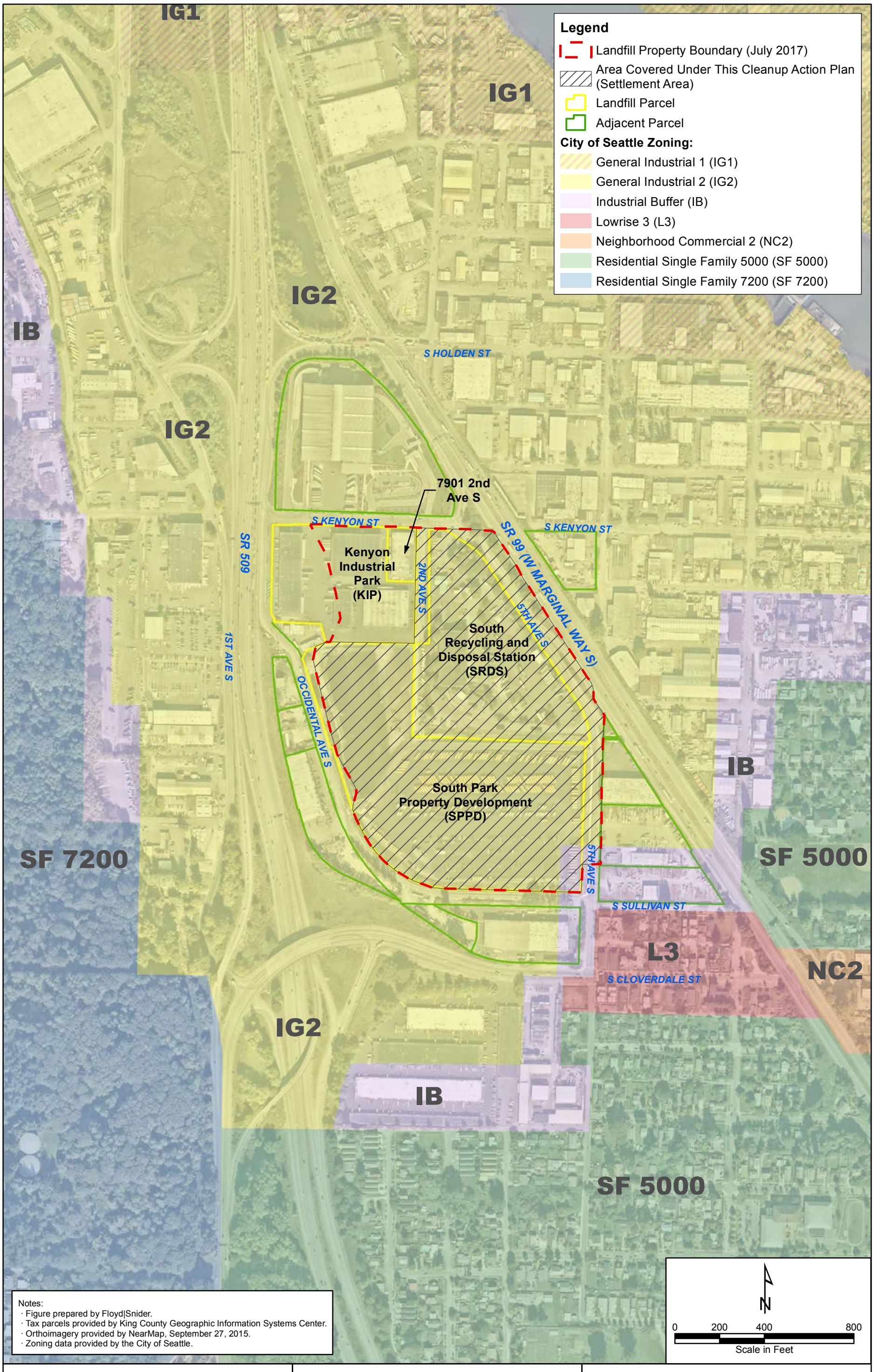

DEPARTMENT OF ECOLOGY
State of Washington

Cleanup Action Plan
South Park Landfill
Seattle, Washington

Figure 2.3
Land Use and Zoning

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	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5
Description	This stage occurs under aerobic conditions during placement of waste and for a period of days/weeks following. During this stage, H_2O and CO_2 are the main products. As wastes hydrolyze, the leachate becomes salty from the dissolution of major cations (sodium, potassium, calcium, and magnesium), chloride from food and other degradable waste, and carbonate from the CO_2. The leachate is neutral in pH and salty.	Stage 1 processes resulted in a depletion of O_2 in the waste and changed the waste to anaerobic conditions. Carbohydrates, proteins, and lipids are further decomposed to CO_2 , H_2, ammonia, and organic acids. Gas concentrations in the waste during Stage 2 may rise to levels of up to 80% CO_2 and 20% H_2. Organic acids that are produced at this stage make the leachate acidic, with acetic acid becoming one of the major constituents.	During this stage under anaerobic conditions, the H_2 and CO_2 levels begin to decrease. The low H_2 levels promote the methane-generating micro-organisms, the methanogens, which begin to generate methane and CO_2. The leachate continues to be salty and slightly acidic. The common solvents, PCE and TCE, which were relatively stable during the first two stages, now readily undergo reductive dechlorination to produce DCEs and vinyl chloride.	This stage is the main landfill gas (LFG) generation stage with the LFG typically composed of approximately 60% methane and 40% CO_2. The reactions during this stage are relatively slow, taking many years for completion. The conditions continue to be anaerobic as in Stages 2 and 3. Stage 4 typically commences 6 months to several years after the waste has been placed in the landfill depending on the water content and water circulation. Significant concentrations of LFG are generated after between 3 and 12 months, depending on the available micro-organisms and waste-degradation products. The LFG will continue to be generated for periods of between 15 and 30 years after final deposition of waste, but can continue to generate low levels of LFG for up to 100 years after waste placement. Early in this stage the majority of the easily degraded wastes, such as food, have been degraded. The salt content of the leachate decreases; the organic acids are consumed by micro-organisms as soon as they are produced to maintain the methane production and the leachate returns to neutral. Very little solvent (TCE and PCE) remains because it is degraded to DCEs as quickly as it comes into contact with the methanogenic microbes. The methanogenic microbes then convert the DCEs to vinyl chloride and vinyl chloride to non-toxic end-products. This conversion will continue past vinyl chloride as long as there is sufficient waste degradation occurring in the landfill mass to maintain methanogenic conditions.	This final stage of degradation occurs when the acids used in the production of methane and CO_2 have been depleted and the landfill returns to aerobic conditions.
Processes	Waste placement and burial Primary physical breakdown, hydrolysis, and aerobic degradation	Hydrolysis and fermentation	Acetogenesis	Methanogenesis	Oxidation
Leachate	Aerobic, salty	Organic acids, ammonia, anaerobic, pH begins to drop	Anaerobic, salty, pH acidic due to acetic acid	Anaerobic, slightly salty, near neutral pH	Aerobic, neutral pH
Landfill Gas	CO_2 & H_2O	H_2, CO_2, H_2O, & NH_3	H_2, CO_2, H_2O, NH_3, & CH_4	CH_4 & CO_2	CO_2

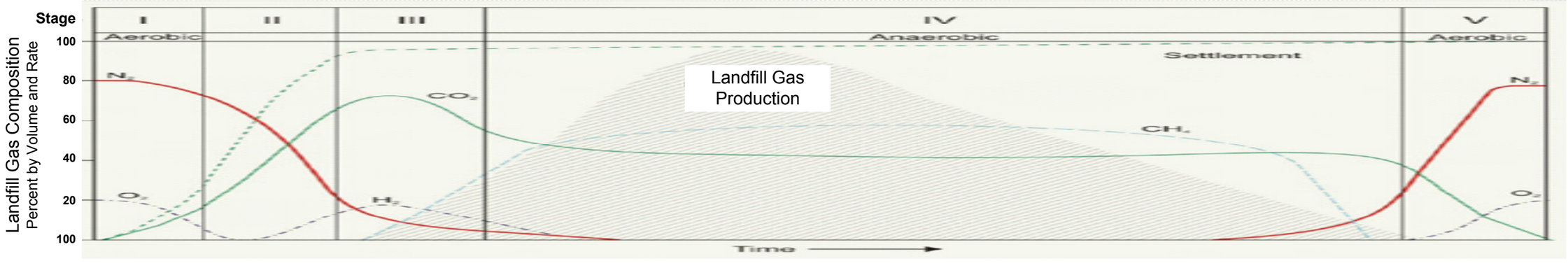

Figure: Changes in the Production and Composition of Landfill Gas with Time (based on Farquhar and Rovers 1973 with additions from Golder 2011).

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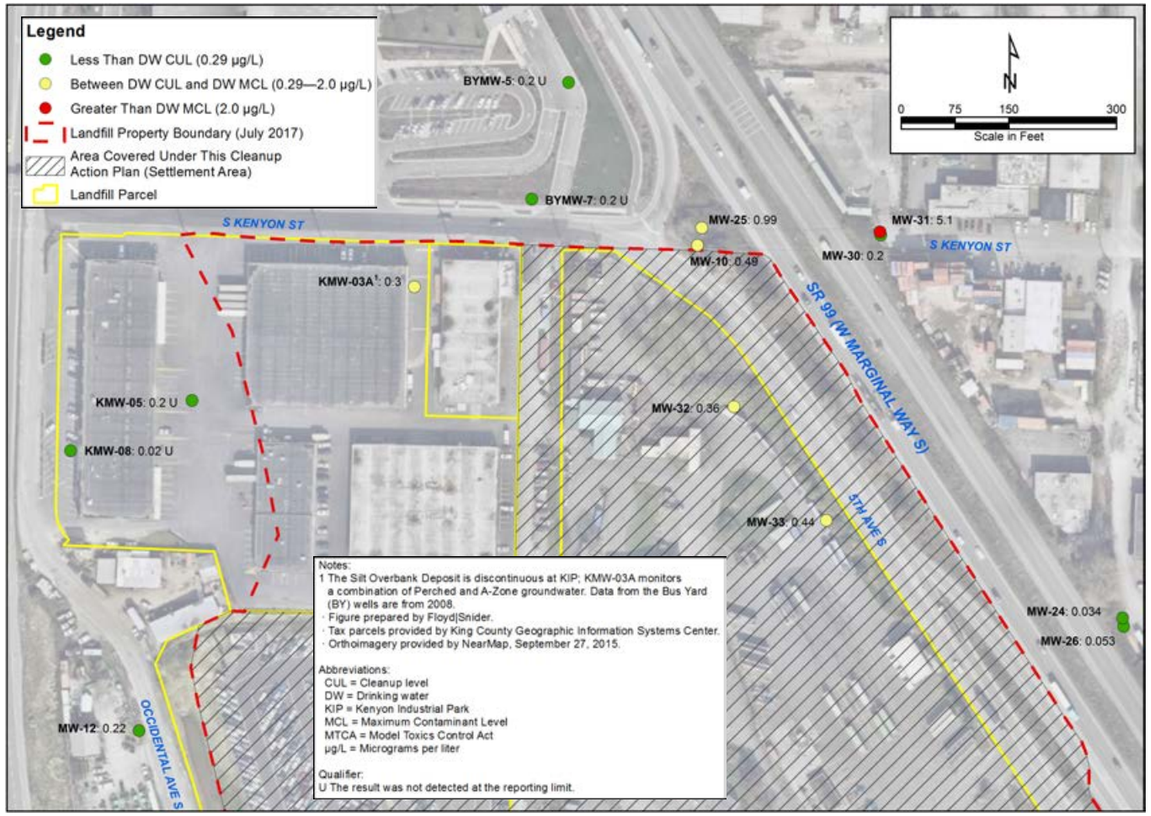
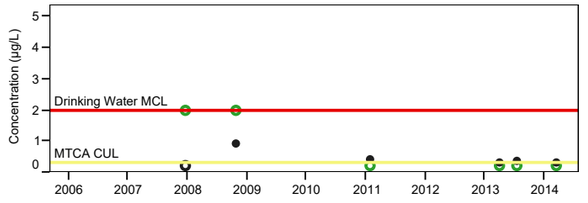
Figure 3.1
Changes in the Production and Composition of Landfill Gas with Time



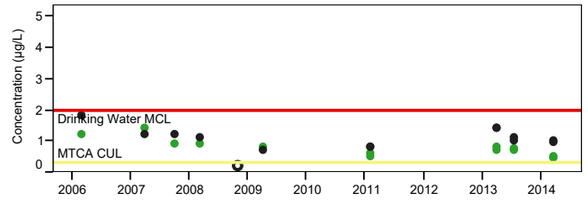
Interior Well

KMW-03A (Perched Zone and A-Zone)



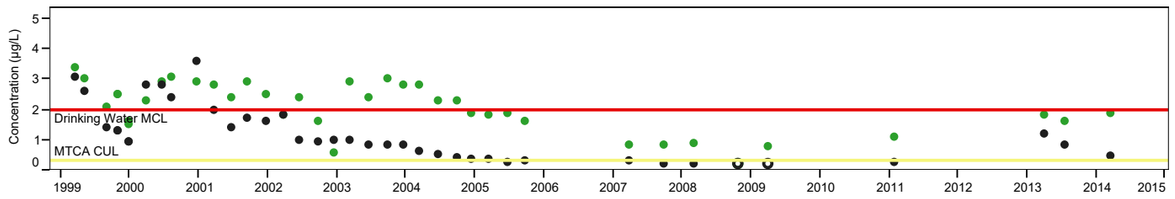
Point-of-Compliance Well

MW-25 (A-Zone)

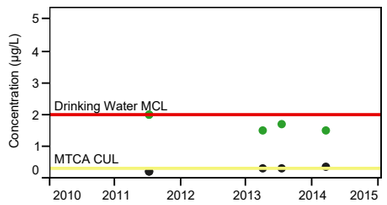


Point-of-Compliance Wells

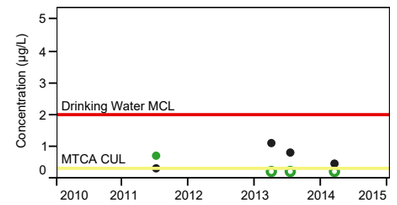
MW-10 (B-Zone)



MW-32 (A-Zone)

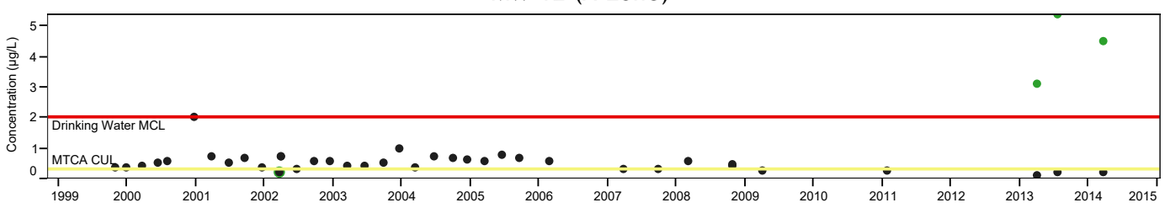


MW-33 (A-Zone)

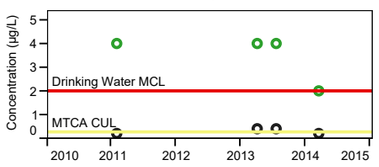


Upgradient Locations

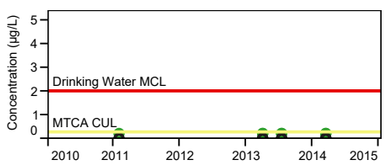
MW-12 (A-Zone)



KMW-05 (Perched Zone and A-Zone)

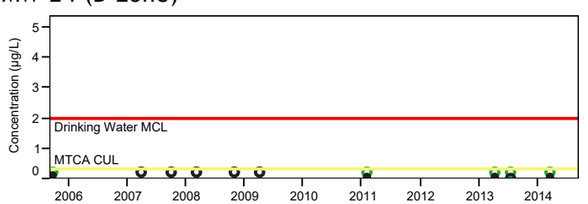


KMW-08 (Perched Zone and A-Zone)

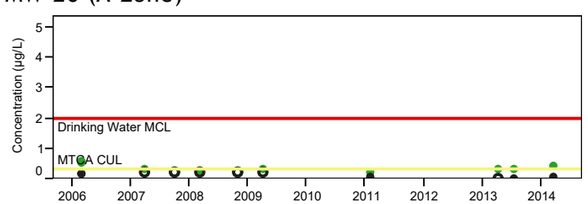


Downgradient Wells

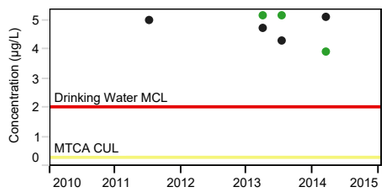
MW-24 (B-Zone)



MW-26 (A-Zone)



MW-31 (A-Zone)



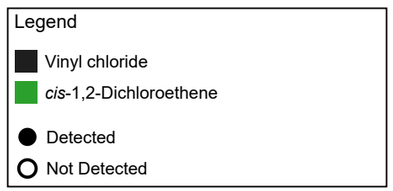


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Figure 4.1
Vinyl Chloride in Groundwater—
March 2014

F:\projects\COS-SPARK\5000 - CAP\06 SPARK CAP Public Review Final\Figures\Figure 4.1 VC in GW.pdf
9/25/2017

Notes:
- Data for probes adjacent to SPPD represent post-Interim Action data. Other probes represent the conditions during the RI/FS sampling. The most recent data are shown.
- Tax parcels provided by King County Geographic Information Systems Center.
- Orthoimagery provided by NearMap, September 27, 2015.

Abbreviations:
LEL = Lower explosive limit
RI/FS = Remedial Investigation/Feasibility Study

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Figure 4.2
Perimeter Landfill Gas Probe Network

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9/28/2017

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Figure 6.1
Landfill Cap Requirements by Parcel

I:\GIS\Projects\COS-SPARK\MXD\CAP\2017 CAP-OCT\Figure 6.1 Landfill Cap Requirements by Parcel.mxd
9/28/2017

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Figure 6.2
Locations of Long-Term Monitoring Wells and LFG Probes

I:\GIS\Projects\COS-SPARK\MXD\CAP\2017 CAP-OCT\Figure 6.2 Locations of Long-Term Monitoring Wells and LFP Probes.mxd
9/29/2017

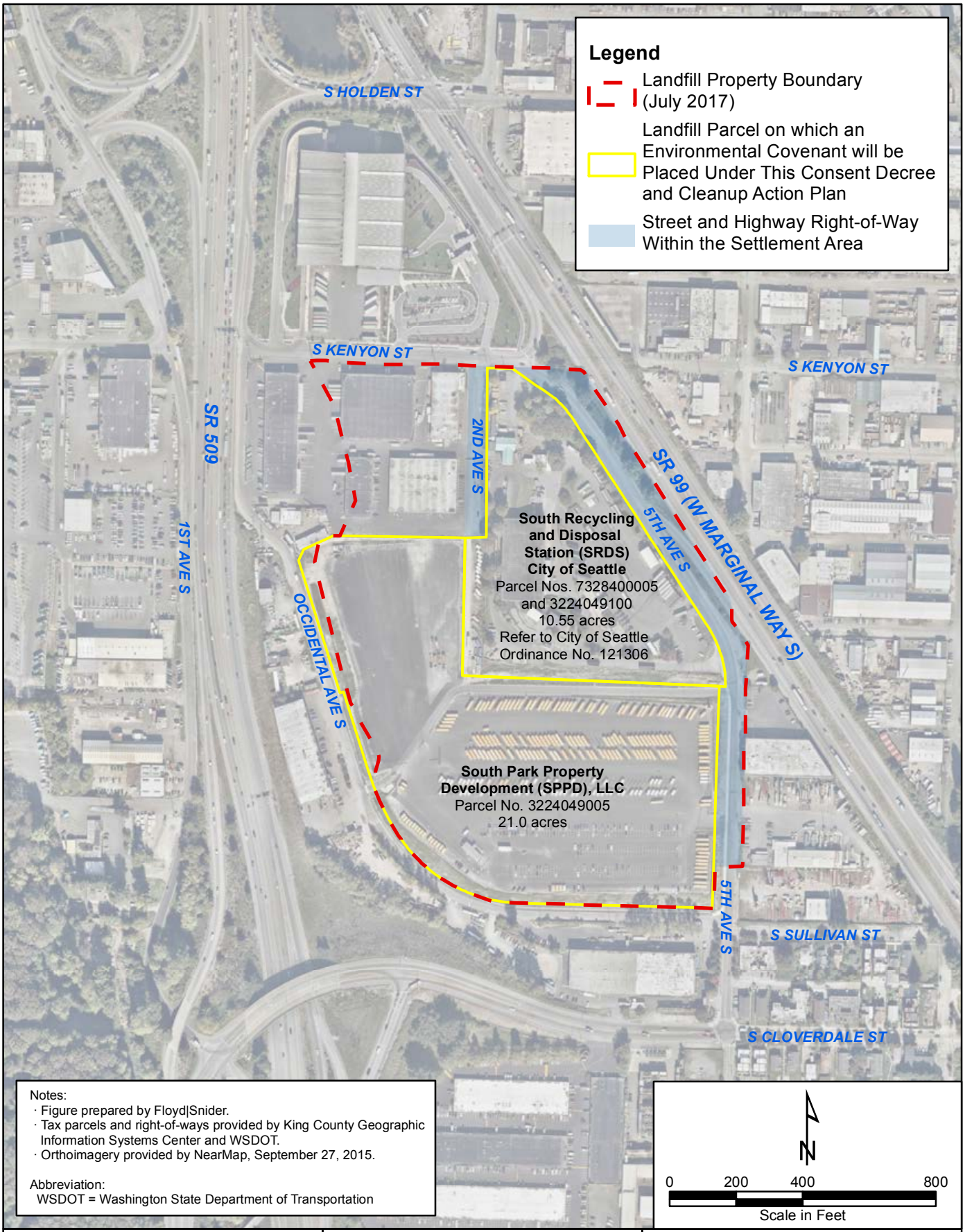

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Figure 6.3
Environmental Covenant Parcels

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9/28/2017

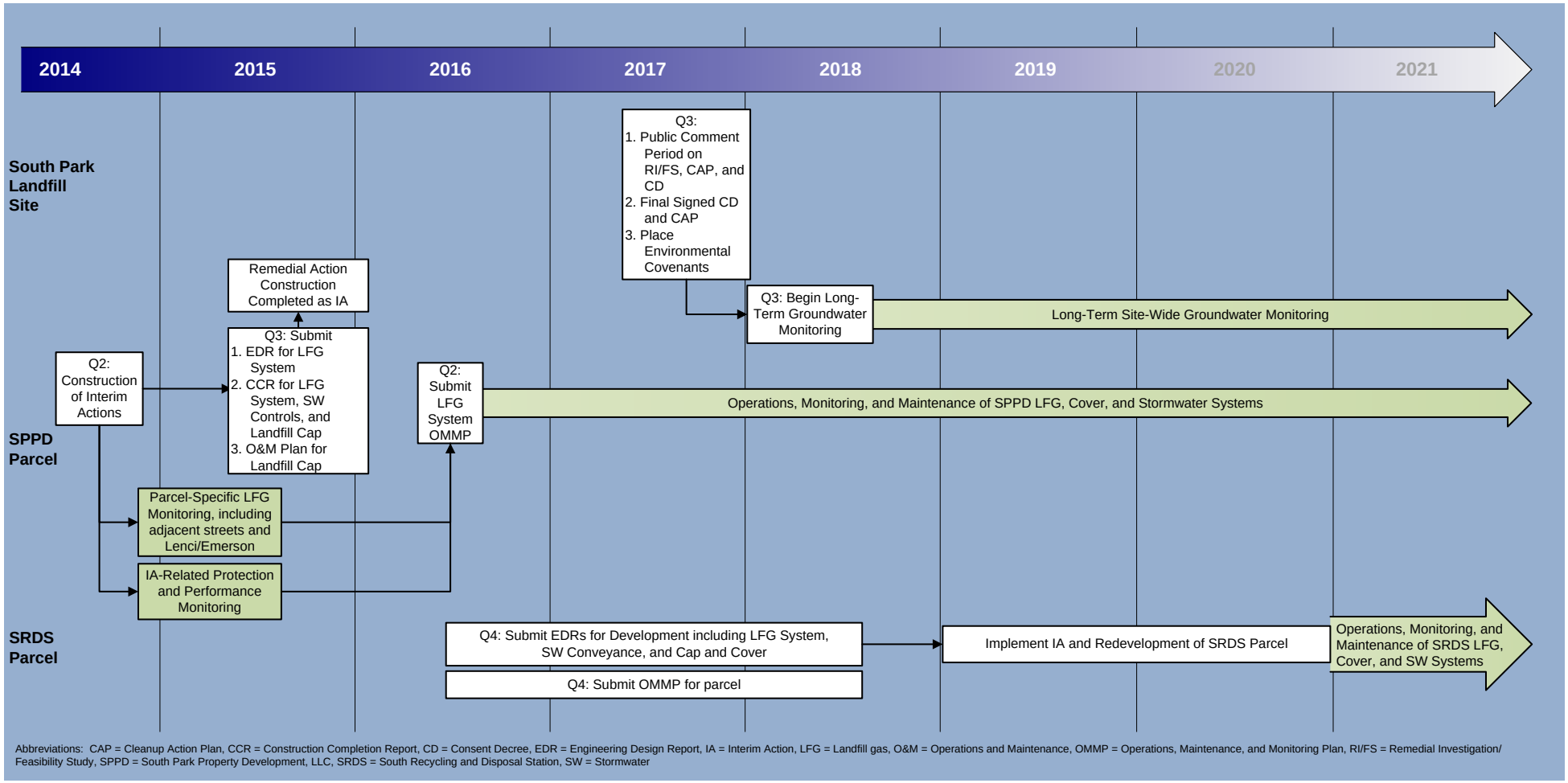

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Figure 7.1
Development Process and Timeline