FINAL CLEANUP ACTION PLAN

PHILLIPS 66 (AKA CONOCOPHILLIPS) RENTON TERMINAL SITE
2423 LIND AVENUE SOUTHWEST
RENTON, WASHINGTON

AGREED ORDER NO. DE 11313
FACILITY SITE NO. 2070

Issued by:

Washington State Department of Ecology
Toxics Cleanup Program
Northwest Regional Office
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DEPARTMENT OF
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1.0 INTRODUCTION

This Final Cleanup Action Plan (FCAP) presents a summary of the remedial alternatives evaluated in the Remedial Investigation and Feasibility Study (RI/FS) for the Phillips 66 Renton Terminal (formerly known as the ConocoPhillips Renton Terminal) located at 2423 Lind Avenue Southwest, Renton, Washington. In the RI/FS, CRA recommended DPE as the most prudent, cost-effective, and environmentally sustainable option relative to meeting the remedial objectives. Included in this Final CAP is the conceptual design information related to the DPE remediation equipment and layout, system installation, construction and startup, operation and maintenance, and monitoring program. A vicinity map is presented as Figure 1 and a Site Plan is presented as Figure 2.

The original name for the cleanup site – ConocoPhillips Renton Terminal – has changed to the Phillips 66 Renton Terminal.

1.1 REGULATORY CONTEXT

On August 5, 2010 ExxonMobil Oil Corporation (ExxonMobil), ConocoPhillips Risk Management and Remediation (ConocoPhillips) (now Phillips 66 Company [P66]), and The Washington State Department of Ecology (Ecology) entered into an Agreed Order (Order No. DE 7882). The mutual objective of Ecology, ExxonMobil Oil Corporation, and P66 under the Agreed Order is to provide for remedial action at a facility where there has been a release of hazardous substances. The Agreed Order was issued pursuant to the Model Toxics Control Act (MTCA), RCW 70.105D.050(1). The Agreed Order requires ExxonMobil and P66 to complete a remedial investigation in accordance with Washington Administrative Code (WAC) 173-340 determine the nature and extent of contamination associated with the Site and a feasibility study to determine the appropriate remedial action. A RI/FS has been completed at the Site to meet the requirements outlined in Exhibit B of the Agreed Order. Additionally, the Agreed Order requires the completion of a Draft CAP in accordance with WAC 173-340-380. The Draft CAP summarized in this report meets the requirements of the Agreed Order.

1.2 OBJECTIVES

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

i. Cleanup standards for each of the contaminants of concern for each media.
ii. Areas requiring remedial action for each media based on the Conceptual Site Model presented in the RI/FS report.
iii. Summary of other cleanup action alternatives evaluated during the RI/FS and rationale for selection of proposed alternatives.
iv. Description of the proposed cleanup actions including conceptual designs
v. Preliminary scope of work for implementation of the proposed cleanup actions.
vi. Schedule for implementation of the proposed cleanup actions.
vii. Applicable state or federal laws.

2.0 SITE IDENTIFICATION AND DESCRIPTION

2.1.1 SITE DESCRIPTION

The Property is an active bulk petroleum distribution terminal located at 2423 Lind Avenue Southwest in Renton, Washington (Figures 1 and 2 show the Property location and layout, respectively). The Property occupies approximately 7 acres and is situated at the northwest corner of the intersection of Lind Avenue Southwest and Southwest 27th Street.

The Property is located in King County in the northwest quarter of section 30; township 23 North; Range 5 East. The eastern portion of the parcel is occupied by the terminal facility and the western portion of the parcel is a wetland (King County Tax Parcel Number 3023059086).

2.1.2 CURRENT FACILITY USE AND DESCRIPTION

The facility receives, stores, loads and dispatches bulk petroleum products including gasoline, diesel fuel, kerosene, ethanol, and additives.

The facility is constructed on fill material surrounded by undeveloped land. The Property contains an earthen tank farm that stores refined petroleum products, one truck rack for loading/unloading products with a spill collection system, an office building and an associated fuel dispensing facility for vehicles.

The tank farm consists of seven primary refined product ASTs with a combined nominal capacity of 248,805 unit barrels of oil (bbls), and four ASTs storing additives. Figure 2 shows the Property layout.

Each AST is surrounded by concrete block walls approximately 3 feet in height. The entire AST tank farm area is surrounded by an earthen containment berm which provides secondary containment.

2.1.3 HISTORICAL OWNERSHIP AND HISTORY

Mobil (the predecessor to ExxonMobil) began terminal operations in 1968 and operated the facility until 1988 when the Property was sold to British Petroleum Exploration & Oil (BP). Tosco Corporation (predecessor to ConocoPhillips now Phillips 66) purchased the Property from BP in 1993 and P66 is the current owner/operator.

Four separate releases have been documented. The first release was documented in 1986 in the vicinity of the current loading racks on the northern portion of the Site. Additional suspected releases were documented in 1990 and 1991 in the vicinity of the loading racks but were never confirmed to be separate from the original release. In 2002, a confirmed release from above ground storage tank (AST) #2 was documented. Additional information regarding the four documented releases is available in the Remedial Investigation and Feasibility Study Work Plan.

Following the discovery of the initial release in 1986, ExxonMobil began investigation and cleanup activities under Enforcement Order DE 87-N301 issued by Ecology on October 14, 1987. Cleanup activities consisted of the operation of a groundwater extraction system equipped with two recovery trenches. Following the discovery of the 2002 release, ConocoPhillips began investigation and cleanup activities associated with the 2002 release under Ecology's Voluntary Cleanup Program (VCP). Cleanup activities consisted of product recovery from wells using a vacuum truck and operation of a dual phase extraction system. Additional information regarding the two remediation systems is available in the quarterly remediation progress reports for the Site.
Both the ExxonMobil/BP and P66 systems continued to be operated independently by the two parties. On August 5, 2010, Ecology, ExxonMobil, and ConocoPhillips (now P66) entered into an Agreed Order (DE 722), effectively combining both contaminated areas into one Site. The purpose of the agreed order is to facilitate completion of a Site-wide remedial investigation and implementation of a final remedial action.

2.2 GEOLOGIC/HYDROGEOLOGIC SETTING

2.2.1 REGIONAL GEOLOGIC/HYDROGEOLOGIC SETTING

The Site lies near the mouth of the Duwamish-Green River valley. Geologic deposition in the Duwamish-Green River Valley consists primarily of alluvial sand, silts, and gravels up to 600 feet thick at the south end of the valley and gradually taper out toward the north end of the valley. The alluvial deposits are underlain by Pleistocene deposits consisting of primarily glacial till and outwash. The Pleistocene deposits are underlain by igneous intrusive and volcanic bedrock. Thin, shallow peat and swamp deposits are present in some areas where closed depressions are present. Groundwater is typically present in significant capacity in the alluvial material deposited throughout the Duwamish-Green River Valley. Regional groundwater flow is to the northwest and typical depth to groundwater in the alluvial deposits is between 10 and 20 feet below ground surface (bgs). (source: J. E. Luzier, Geology and Groundwater Resources of Southwestern King County, 1969)

2.2.2 SITE-SPECIFIC GEOLOGIC/HYDROGEOLOGIC SETTING

The Site lies on the northern end of the Duwamish-Green River valley. Historically, the Site was primarily wetlands. When the Site was developed sometime between 1964 and 1968, a portion of the wetlands were filled and the Terminal built on it. Wetlands are still present surrounding the property. Current stratigraphy at the Site consists of 7 to 10 feet of structural fill (primarily silty sand with varying amounts of gravel). The fill is underlain by a 1 to 7-foot thick highly organic silt material, which are likely wetlands deposits. The organic silt layer appears to be thickest in the area just west of the loading racks and tends to thin out to the east. This silt layer is also discontinuous in areas beneath the site. The organic material is underlain by alluvial sand and silt deposits. The total thickness of the alluvial deposits has not been investigated at the Site. A well 1,600 feet west of the property indicates alluvial material to a maximum explored depth of 100 feet bgs. Groundwater at the Site consists of a shallow perched water bearing zone in the porous backfill material overlying the silty, less porous native silt layer. The perched water bearing zone appears to be primarily recharged by infiltration in the earthen tank farm area and nearby wetland areas. Groundwater tends to flow radially from this tank farm recharge area with often steep horizontal gradients and flows toward the wetlands, the stormwater retention basin in the southeast corner of the property, and to extraction wells located at the Site. Vertical gradients at the Site are downward indicating that a portion of the groundwater in the perched water bearing zone likely trends downward and recharges the water-bearing zone beneath the perched aquifer. The lower zone has a very shallow gradient and flows to the west-northwest. Groundwater elevations fluctuate seasonally. During the drier summer and fall months, surface water is not present in the adjacent wetlands. The Site-specific geology is derived from a review of historical subsurface investigations completed between 1986 and 2012.

3.0 CONTAMINANTS OF CONCERN AND CLEANUP AREAS

3.1 TYPES AND CONCENTRATIONS OF CONTAMINANTS

The contaminants of concern (COCs) associated with gasoline, diesel, and unknown releases per MTCA Table 830 1 are presented in the table below.

Analyte	*Present in Soil?*	*Present in Groundwater?*	*Present in Surface Water?*	*Present in Wetland or Retention Basin Soil?*	*Maximum Recent Concentration*			
					soil (mg/kg)	*Groundwater (µg/L)*	*Surface water (µg/L)*	*Wetland and Retention basin Soil (mg/kg)*
Benzene	Yes	Yes	Yes	Yes	931 (TW-5, 2012)	41,400 (B-3A, 2011)	194 (SW-3, 2012)	0.0549 (SE-7, 2012)
Toluene	Yes	Yes	Yes	Yes	3,100 (TW-5, 2012)	48,000 (B-3A, 2010)	1,770 (SW-3, 2012)	0.0383 (SE-10, 2012)
Ethylbenzene	Yes	Yes	Yes	Yes	1,100 (TW-5, 2012)	4,010 B-3A, 2012)	181 (SW-3, 2012)	0.0664 (SE-11, 2012)
Xylenes	Yes	Yes	Yes	Yes	6,570 (TW-5, 2012)	41,600 (W-1, 2012)	1,550 (SW-3, 2012)	0.209 (SE-11, 2012)
n-hexane	No Data	No Data	No Data	- -	- -	- -	- -	- -
EDB	No	No	No	No	- -	- -	- -	- -
EDC	No	Yes	No	No	- -	58.4 (HA-2, 2011)	- -	- -
MTBE	No	Yes	Yes	No	- -	94.2 (B-3A, 2010)	- -	- -
Lead	Yes	Yes	Yes	Yes	36.4 (DW-4, 2012)	158 (B-1, 2012)	3.8 (SW-4, 2012)	71.9 (SE-3, 2012)
cPAHs	Yes	Yes	No	No	6.0348 (TW-5, 2012)	51.79 (B-6, 2011)	- -	76.5 (SE-11, 2012)
PCBs	No Data	No	No Data	No Data	- -	- -	- -	- -
Methylene Chloride	No Data	Yes	No	No	- -	34.8 (HA-6, 2011)	- -	- -
Trichloroethylene	No Data	Yes	No	No	- -	3.7 (W-1, 2011)	- -	- -

Vinyl Chloride	No Data	Yes	No	No	- -	4.5 (D-6, 2011)	- -	- -
Arsenic	No Data	Yes	Yes	Yes	- -	91.8 (MW-3, 2012)	2.5 (SW-1, 2012)	22.5 (SE-7, 2012)
Naphthalenes	No Data	Yes	Yes	Yes	- -	3,388 (B-4, 2011)	55.6 (SW-3, 2012)	76.524 (SE-11, 2012)
TPHg	Yes	Yes	Yes	Yes	49,200 (TW-5, 2012)	179,000 (W-1, 2012)	13,300 (SW-3, 2012)	9 (SE-11, 2012)
TPHd	Yes	Yes	Yes	Yes	29,100 (TW-5, 2012)	184,000 (W-1, 2011)	140 (SW-3, 2012)	53.2 (SE-3, 2012)
TPHo	Yes	Yes	Yes	No	3020 (MW-11, 2012)	3,530 (W-2, 2011)	140 (2007)	- -

The maximum concentrations were compared to MTCA Method A cleanup levels for soil, groundwater, and surface water and the following were determined to be Site Specific COCs:

- Benzene
- Toluene
- Ethylbenzene
- Total Xylenes
- EDC
- MTBE
- Lead
- cPAHs
- Methylene Chloride
- Vinyl Chloride
- Arsenic
- Naphthalenes
- TPHg
- TPHd
- TPHo

3.2 PRIMARY SOURCES OF CONTAMINATION

Petroleum hydrocarbons were released to the subsurface from two areas of concern. In 1986, a release was discovered and determined to have occurred from cracks in the loading rack spill containment system located in the north-central portion of the Property. The exact timeframe of the release is unknown but it is likely to have occurred over a long period of time. Two additional suspected releases were documented in 1990 and 1991 but were never confirmed to be separate from the original release. Recent investigation indicates the presence of LNAPL in the shallow subsurface in the vicinity of the truck loading rack (north) and underground process tank adjacent (west) to the loading racks. The process tank is also considered a potential historical source.

In November 2002, a release was discovered and determined to have occurred from a bottom failure of AST #2. Approximately 14,000 gallons of product (unleaded gasoline) was released. Smaller releases have been suspected from the tank farm area but have not been confirmed.

3.3 CONTAMINATED MEDIA

Soil - Based on historic and recent investigations, petroleum contaminated soil (PCS) is present at the Site. Shallow PCS in the vadose zone is present near the source area associated with the 1986 loading rack release. A soil vapor extraction (SVE) system has operated to treat vadose zone PCS in the source area associated with the 2002 AST #2 release and has treated the majority of the vadose zone PCS in that area. The horizontal extent of vadose zone PCS has been established.

PCS in the smear zone is present throughout much of the Site extending near MW-7 to the east, LAIx-3 to the south, D-7 to the west, and MW-11 to the north. The area of thickest smear zone PCS is under and in the immediate vicinity of the loading racks. PCS extends as deep as 17 feet bgs just north of the loading racks. The horizontal and vertical extent of smear zone PCS has been established.

Groundwater – Based on recent groundwater sampling events, dissolved phase petroleum contamination in groundwater is present throughout much of the Site. Dissolved phase contaminants have been detected in wells HA-10, and MW-14 to the north, well HA-14 to the east, wells LAIx-3 and LAI-1 to the south, and wells MW-10 and MW-15 to the west. The areas with the highest concentrations are located in the vicinity of the two source areas. The horizontal and vertical extent of petroleum contaminated groundwater has been established. Surface water sampling in the wetlands indicates contaminated groundwater is not discharging to the wetlands.

Surface Water – The following surface water features are present at or near the Site:

- Stormwater retention basin in the southeast corner of the property
- Pond located directly across Lind Avenue Southwest to the east of the property

- Wetlands located directly across Southwest 27th Street to the south of the property
- Wetlands located on the western half property boundary
- Wetlands located directly across Lind Avenue Southwest. to the east of the property

The stormwater retention basin in the southeast corner of the Site, although it does contain water above ground surface during part of the year, is not categorized as surface water due to the fact that the retention basin is a manmade structure to retain surface water runoff during rain events. It only contains water during the wet season following rain events. There is no outlet to a natural surface water body. Water in the retention basin infiltrates to groundwater. Additionally, the retention basin does not contain benthic organisms typical of natural surface water bodies. Although it is not technically considered surface water, for the purposes of the conceptual site model, it is treated as a separate contaminated media and is referred to as surface water.

LNAPL was found in the southwest corner of the stormwater retention basin in 2003 shortly after the 2002 AST #2 release was discovered. LNAPL recovery efforts were undertaken and since then, LNAPL has not been present in the pond. Surface water samples collected in 2004, 2006, 2007, and 2012 indicate dissolved phase contamination is present in surface water in the southwest corner of the retention basin. Surface water samples and wells between source areas and surface water indicate no other areas of surface water are impacted.

The extent of petroleum contamination in surface water has been established.

Wetland and Retention basin Soil – Based on the recent soil investigation in these areas, contamination is minimal and is confined to the west of well MW-10 and the southwest corner of the retention basin. The extent of the petroleum contamination in these areas has been established.

4.0 CLEANUP ACTION AREAS

The cleanup action areas are those areas for each media where contaminant concentrations exceed the cleanup standards identified in Section 5.0. The cleanup action areas for each media are present on Figure 3. A description of the cleanup action areas are as follows:

- Soil – The source areas are considered to be near the truck loading racks and AST #2. The cleanup action areas include the source areas and extend to HA-10 to the north, just past HA-1 to the west, LAIx-2 to the south, D-4R to the east (northern portion of the Site) and LAIx-7 to the east (southern portion of the Site).

- Groundwater – The cleanup action area for groundwater is based on capture of the dissolved phase plume and free product plume and includes the soil cleanup action area but extends to include MW-10 and MW-15 to the west and HA-14 to the east.
- Surface Water – The cleanup action area for surface water is the southwest corner of the retention basin located at the southeast corner of the site.
- Soil in the wetlands and retention basin – The cleanup action area for soil in the wetlands and retention basin include the southwest corner of the retention basin and the area west of the site near SE-7. The arsenic impacts identified in samples SE-6 and SE-7 appear to be caused by natural background concentrations that naturally occur in the soil. Organic-rich wetland areas commonly have higher natural background concentrations of arsenic in soil. The benzene exceedence in sample SE-7 is likely to due benzene concentrations in groundwater. The benzene impacts identified in sample SE-7 will be remediated by treatment of the groundwater immediately upgradient. The arsenic concentrations will not be addressed as part of the final remedial action.
- Although the RI/FS lists vapor inhalation of volatilized contaminants in building and ambient air as a potential exposure pathway, the facility is an active bulk petroleum distribution terminal zoned for industrial use. The facility receives, stores, loads, and dispatches bulk petroleum products including gasoline, diesel fuel, kerosene, ethanol, and additives. Ecology's vapor intrusion guidance (publication 09-09-047) notes that such facilities are an exception to the guidance because workers in such industrial settings may be exposed to hazardous vapors used in their company's industrial or manufacturing process (see page 1-7 of the Vapor Intrusion guidance). In sites such as the Phillips 66 Renton Terminal, the receptors at risk are workers routinely exposed to higher concentrations of the same chemical(s) as part of an industrial/manufacturing process. In this case workplace safety is regulated by both the Washington Department of Labor & Industries (LNI) Division of Occupational Safety and Health (DOSH) and the federal Occupational Safety and Health Administration (OSHA). Therefore, further investigation of this pathway was not included in the RI and draft CAP. However, the soil vapor extraction component of the Dual Phase Extraction system proposed in this FCAP would also address this pathway by removing the source of potential vapors while controlling potential vapor intrusion from these sources.

5.0 CLEANUP STANDARDS

Cleanup Standards are determined to evaluate whether "cleanup" has been achieved at the Site. Cleanup standards consist of the contaminant concentration that are protective of human health and the environment (cleanup level) and the location on the Site where cleanup levels must be meet (point of compliance). Cleanup standards must be established for each contaminated media. The results of the RI/FS indicate the following media will be considered:

- Soil
- Groundwater
- Surface water

The following were determined to be Site Specific Contaminants:

- Benzene
- Toluene
- Ethylbenzene
- Total Xylenes
- EDC
- MTBE
- Lead
- cPAHs
- Methylene Chloride
- Vinyl Chloride
- Arsenic
- Naphthalenes
- TPHg
- TPHd
- TPHo

A summary of the proposed cleanup standards for each media are provided on Table 1.

5.1 SOIL

The following pathways were considered for establishment of soil cleanup levels at the site:

- Protection of human health via direct contact (dermal absorption) using MTCA Method A for industrial land use
- Protection of human health via ingestion using MTCA Method A for industrial land use
- Protection of ecological receptors via direct contact (dermal absorption) and ingestion
- Protection of groundwater resources from LNAPL and COCs leaching from contaminated soil
- Protection of indoor air from volatilized contaminants from contaminated soil

For contaminated soil at the Site, the primary concern is dissolution of contaminants trapped in soil to groundwater. Groundwater provides a mechanism of contaminant transport to potential receptors. MTCA Method A Soil Cleanup Levels For Industrial Land Use were selected as the most stringent cleanup level(s) for soil because it is considered protective of groundwater. See Table 1 for final cleanup levels. The point of compliance for soil is considered throughout the Site from ground surface to the maximum extent of soil contamination.

5.2 GROUNDWATER

The following pathways were considered for establishment of groundwater cleanup levels at the site:

- Protection of human health via direct contact (dermal absorption) using MTCA Method A for industrial land use
- Protection of human health via ingestion using MTCA Method A for industrial land use
- Protection of ecological receptors via direct contact (dermal absorption) and ingestion
- Protection of surface water resources from LNAPL and COCs in contaminated groundwater
- Protection of groundwater resources from LNAPL and COCs in contaminated groundwater

- Protection of indoor air from volatilized contaminants from contaminated groundwater

For contaminated groundwater at the Site, elevated concentrations of dissolved petroleum hydrocarbons are present due to free-phase LNAPL, LNAPL trapped in soil pore spaces below the water table (i.e., smear zone) and petroleum hydrocarbons adsorbed to subsurface soil, which are continuing sources of contamination. As the cleanup action is implemented and contaminant concentrations in soil decrease, dissolved contaminant concentrations in groundwater will decrease as well. Part of the cleanup action is designed to provide hydraulic control of dissolved-phase contaminants until contaminant concentrations decrease. Site specific cleanup levels using MTCA Method A cleanup levels will be used for groundwater since they are considered protective of drinking water. See Table 1 for final cleanup levels. The point of compliance for groundwater is considered throughout the Site from the uppermost level of the saturated zone extending vertically to the maximum extent of contamination.

5.3 SURFACE WATER

The following pathways were considered for establishment of surface water cleanup levels at the site:

- Protection of human health via direct contact (dermal absorption) using MTCA Method A for industrial land use
- Protection of human health via ingestion using MTCA Method A for industrial land use
- Protection of ecological receptors via direct contact (dermal absorption) and ingestion
- Protection of surface water resources from LNAPL and COCs in contaminated surface water
- Protection of indoor air from volatilized contaminants from contaminated surface water

Surface water at the Site consists of the adjacent wetlands and the stormwater retention basin in the southeast corner of the Site. The retention basin is part of a man-made stormwater system and water is retained intermittently following rain events and does not have an outlet to a natural surface water body. For surface water at the Site, Ecology's online Cleanup Level and Risk Calculations (CLARC) Tool provides the most appropriate cleanup level for each COC. EPA National Toxics Rule (40 CFR 131), EPA Clean Water Act, and MTCA Method B and C standard values were evaluated and the most stringent value for each constituent was selected as the most appropriate cleanup level. See Table 1 for final cleanup levels. The point of compliance for surface water is considered throughout the Site at all locations where Site contaminants may be released to the surface water.

5.4 SOIL IN THE WETLAND AREA AND RETENTION BASIN

The following pathways were considered for establishment of cleanup levels in soil in the wetland area and retention basin:

- Protection of human health via direct contact (dermal absorption) using MTCA Method A for industrial land use
- Protection of human health via ingestion using MTCA Method A for industrial land use
- Protection of ecological receptors via direct contact (dermal absorption) and ingestion
- Protection of surface water resources from COCs in contaminated soil and surface water in the retention basin
- Protection of air from volatilized contaminants from contaminated soil and surface water in the retention basin

Soil samples were collected during RI/FS activities from the wetlands bordering the western perimeter of the Site. Samples were also collected from the stormwater retention basin in the southeast corner of the Site. These samples were determined to be considered soil. The retention basin is part of a man-made stormwater system and water is retained intermittently following rain events and does not have an outlet to a natural surface water body.

MTCA Method A Soil Cleanup Levels For Industrial Land Use were selected as the cleanup level(s) for this area because it is the most stringent cleanup level for the site contaminants. See Table 1 for final cleanup levels. The point of compliance for soil is considered throughout the Site from ground surface to the maximum extent of soil contamination.

5.5 APPLICABLE REGULATORY REQUIREMENTS

The applicable laws and regulations provide the framework for the cleanup action. In addition to the cleanup standards developed through MTCA, other regulatory requirements must be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be "at least as stringent as all applicable state and federal laws" (WAC 173-340-700[6][a]). Besides establishing minimum requirements for cleanup standards, applicable State and Federal laws may also impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710. Potentially applicable State and Federal laws are identified in Table 2.

The permits or other state, federal, or local substantive requirements that are potentially applicable to the proposed cleanup action and that are known at this time are included in the "Cleanup Action Plan for Soil and Groundwater" section below (Section 10.0).

6.0 POINTS OF COMPLIANCE

In summary, the points of compliance at the site are as follows:

Soil: The point of compliance for soil is considered throughout the Site from ground surface to the maximum extent of soil contamination.

Groundwater: The point of compliance for groundwater is considered throughout the Site from the uppermost level of the saturated zone extending vertically to the maximum extent of contamination.

Surface Water: The point of compliance for surface water is considered throughout the Site at all locations where Site contaminants may be released to the surface water.

Soil in the wetland area and retention basin: The point of compliance for this area will be from ground surface to the maximum extent of soil contamination.

7.0 CLEANUP ACTION AREAS

The cleanup action areas are those areas for each media where contaminant concentrations exceed the cleanup standards identified in Section 5.0. The cleanup action areas for each media are present on Figure 3. A description of the cleanup action areas are as follows:

- Soil – The source areas are considered to be near the truck loading racks and AST #2. The cleanup action areas include the source areas and extend to HA-10 to the north, just past HA-1 to the west, LAIx-2 to the south, D-4R to the east (northern portion of the Site) and LAIx-7 to the east (southern portion of the Site).

- Groundwater – The cleanup action area for groundwater is based on capture of the dissolved phase plume and free product plume and includes the soil cleanup action area but extends to include MW-10 and MW-15 to the west and HA-14 to the east.
- Surface Water – The cleanup action area for surface water is the southwest corner of the retention basin located at the southeast corner of the site.
- Soil in the wetlands and retention basin – The cleanup action area for soil in the wetlands and retention basin include the southwest corner of the retention basin and the area west of the site near SE-7. The arsenic impacts identified in samples SE-6 and SE-7 appear to be caused by natural background concentrations that naturally occur in the soil. Organic-rich wetland areas commonly have higher natural background concentrations of arsenic in soil. The benzene exceedence in sample SE-7 is likely to due benzene concentrations in groundwater. The benzene impacts identified in sample SE-7 will be remediated by treatment of the groundwater immediately upgradient. The arsenic concentrations will not be addressed as part of the final remedial action.

8.0 CLEANUP ACTION ALTERNATIVES FOR SOIL AND GROUNDWATER

8.1 APPLICABLE CLEANUP GOALS

The Site will be cleaned up in accordance with the following minimum threshold and other requirements under MTCA WAC 173-340-360(2), including:

- Compliance with Cleanup Standards.
- Compliance with Applicable State and Federal Laws.
- Protect Human Health and the Environment.
- Provide for Compliance Monitoring.
- Use Permanent Solutions to the Maximum Extent Practicable.
- Provide for a Reasonable Restoration Time Frame.
- Consider Public Concerns.

Given the Site-specific conditions, the remedial objectives are as follows:

- Remove separate-phase hydrocarbons (SPH) presence to the extent practicable

- Remediate soil and groundwater in proximity to the truck loading racks and Tank #2 using the most practicable and environmentally sustainable technology
- Once the proposed remedial alternative reaches the practical limits of soil and groundwater cleanup, residual hydrocarbons may still be present at this industrial site. Institutional controls under MTCA will be provided as part of the cleanup (i.e., Environmental Covenant) after the agreed order has been signed. The schedule for implementation of the environmental covenant is presented in Section 13.0.
- Comply with the minimum threshold and other requirements under MTCA (see above).

The practical extent of the most cost effective remedial alternative may be reached before soil and water quality cleanup levels are achieved (i.e. reach an asymptotic level); thus, it is anticipated that monitored natural attenuation (MNA) may be the final, most prudent, and environmentally sustainable remedial method implemented after a more "active" remediation alternative is employed. If MNA is selected, a separate plan will be developed for Ecology's approval. Institutional controls in the form of an Ecology approved Environmental Covenant will be required following the signing of the agreed order for cleanup (see Schedule in Table 6). Chapter 11.0 outlines the details of the conditional post-DPE remedial activities.

Thus, the primary goal of remediation is to eliminate SPH presence and reduce residual hydrocarbon mass in the soils and groundwater such that declining COC concentration trends can be established, thereby providing protection for human health and the environment.

8.2 SUMMARY OF REMEDIAL ALTERNATIVES

In the RI/FS prepared for this Site, the following remedial technologies were evaluated based on their ability to achieve the remediation objectives for the Site:

- Monitored natural attenuation (MNA)
- Groundwater extraction (GWE)
- Excavation
- Dual Phase Extraction (DPE)
- In-situ enhanced biodegradation (ISEB) (with surfactant pre-treatment and limited groundwater recovery)
- In-Situ Chemical Oxidation (ISCO)

- Soil vapor extraction with air sparging (AS/SVE)

Table 3 summarizes the preliminary screening of these seven potentially applicable remedial technologies using the following screening criteria: effectiveness, implementability, short-term risk, and cost. As demonstrated by the information in the table, MNA, excavation, chemical oxidization, and AS/SVE are not considered feasible technologies to achieve the current cleanup objectives. DPE, plume containment, and ISEB are considered viable options to meet the goals and have been retained for further evaluation.

8.2.1 DUAL-PHASE EXTRACTION (DPE)

DPE consists of the vacuum-enhanced extraction of groundwater performed simultaneously with SVE. The vacuum increases the SPH recovery and groundwater yield compared to standard GWE in lower permeability formations. The extended dewatering of the saturated zone attained through GWE allows volatile constituents adsorbed to previously saturated soil to be removed in the vapor phase. In addition, the groundwater extraction component of DPE would provide hydraulic control of the dissolved-phase plume and reduce migration as well as remove dissolved-phase mass.

At this Site, smaller scale DPE is currently being performed in the area of Tank #2 by using submersible pneumatic operated groundwater pumps to extract groundwater simultaneously using a vacuum blower to extract soil vapors, and activated carbon use for recovered vapor treatment. The proposed DPE system would include the use of specifically designed and constructed DPE wells (i.e. with screened intervals set to target the mass presence and minimize short-circuiting); recovered vapor and groundwater conveyance piping; a vapor/liquid separator; a vapor extraction and treatment device; and a recovered groundwater temporary storage and treatment system.

DPE pilot testing has been completed and has been shown to be an effective remedial technology.

8.2.2 GROUNDWATER EXTRACTION (GWE)

Groundwater extraction (GWE) typically utilizes submersible pumps to extract groundwater from wells in order to remove aqueous-phase chemical mass. Extracted groundwater is typically routed to a treatment system utilizing granular-activated carbon (GAC) vessels, an air stripper, or other water treatment technology to remove chemicals from the water stream. The treated groundwater is typically discharged to the sanitary sewer, a storm drain, or to surface water after treatment. A network of extraction wells would be installed (or existing monitoring wells converted into extraction wells) in the plume source area, as well as at the boundaries of the plume adjacent to the offsite wetland areas. Total fluids (both groundwater and LNAPL) would be extracted to remove source mass, and groundwater would be extracted at the plume boundaries to mitigate dissolved hydrocarbon impacts to the wetlands.

8.2.3 SPH RECOVERY/SURFACTANT APPLICATION AND IN-SITU ENHANCED BIODEGRADATION (ISEB)

In-situ biodegradation (aerobic or anaerobic) is a treatment process whereby contaminants are metabolized into less toxic or non-toxic compounds by naturally occurring or injected supplemental microorganisms. The microorganisms utilize the hydrocarbons as a source of carbon and energy. In order to stimulate biological activity, biodegradation processes can be enhanced by the injection of oxygen (air or oxygen releasing compounds [ORC]), nutrients, microbial cultures, suitable electron acceptors, and carbon/energy sources. Site conditions can be manipulated to enhance in-situ biodegradation processes and speed up degradation rates of Site COCs. However, to facilitate effective ISEB application, SPH recovery should be performed first to the extent practicable. In addition, to ensure hydraulic control of the plume, a limited network of GWE wells would be operated to mitigate impacts to the offsite wetlands receptors.

8.2.4 DISPROPORTIONATE COST ANALYSIS

The MTCA disproportionate cost analysis (DCA) is used to evaluate which of the cleanup action alternatives are permanent to the maximum extent practicable. This analysis involves comparing the costs and benefits of the alternatives and selecting the alternative whose incremental costs over that of a lower cost alternative are not disproportionate to the incremental benefits achieved by the alternative over the lower cost alternative. The evaluation criteria for the DCA are specified in WAC 173-340-360(2) and (3), and include protectiveness, permanence, cost, long-term effectiveness, management of short-term risks, technical and administrative implementability, and consideration of public concerns. A summary of the DCA for the three selected potential remedies is presented in Table 4.

The three potential remedies described above were evaluated based on the MTCA DCA criteria. The alternatives were ranked on a scale of 1 (lowest) to 10 (highest) for each of the DCA criteria. Each of the DCA criteria was assigned a weighting factor in accordance with Ecology's direction, that ranged between 10 and 30 percent (the sum of the weighting factors equaled 100 percent). Results of the DCA are as follows:

- DPE: 7.7 (out of 10) benefit ranking; estimated cleanup cost of $3,856,000
- GWE: 5.9 (out of 10) benefit ranking; estimated cleanup cost of $14,969,000
- ISEB: 4.4 (out of 10) benefit ranking; estimated cleanup cost of $8,504,000

The high ranking of DPE is due to the higher level of contaminant mass removal achieved through direct removal of hydrocarbons in the vapor phase. GWE and ISEB have lower rankings than DPE due to the lower degree of immediate contaminant mass removal and uncertainty in short-term and long-term risks associated with these treatment technologies. The cost information provided for each technology is for comparison purposes only and has not been validated because the design is not complete and the costs have not been fully researched. Overall, given the high relative ranking, and the lowest estimated cost to implement, DPE is the selected remedial technology.

9.0 CLEANUP ACTION ALTERNATIVES FOR SOIL AND SURFACE WATER IN THE RETENTION BASIN

9.1 APPLICABLE CLEANUP GOALS

For contaminated soil and surface water in the retention basin, the objectives are to implement a remedial action that is both cost effective and meets the cleanup standards in a short timeframe. Given the Site-specific conditions, the remedial goals are as follows:

- Remove contaminated soil present along the embankment and bottom of the southwest corner of the retention basin to maximum extent possible
- Implement DPE technology to remediate contaminated soil and groundwater in the vicinity of the retention basin
- Maintain capture of the dissolved contaminant plume using DPE wells to prevent discharge to the retention basin or other adjacent wetlands

Given that surface water contamination in the southwest corner of the retention basin is likely due to dissolution of contaminants present in soil along the perimeter and in the vicinity of the retention basin, removal of the contaminated soil to the maximum extent practicable should provide immediate improvement in surface water quality. In addition, using DPE wells to remediate soil contamination that is unable to be removed and to provide capture of the dissolved-phase plume should meet the applicable cleanup goals.

9.2 SUMMARY OF REMEDIAL ALTERNATIVES

The remedial alternatives that were evaluated for surface water cleanup included in-situ capping and removal by excavation.

In-situ capping includes placement of a subaqueous covering or cap of either clean material or a geotextile liner and clean material. In-situ capping does reduce the risk of exposure and provides for a reasonable restoration timeframe. However, in-situ capping does require additional monitoring and inspection once implemented and since the area requiring cleanup action is relatively small, it is not practical to implement in-situ capping.

Removal by excavation includes excavation of contaminated soil that is in direct contact with surface water. Contaminated soil would be excavated within the direct contact zone (0 to 15 feet) until clean soil was observed or to the maximum extent practicable based on Site infrastructure. Areas that were excavated would be backfilled with clean material to the original grade. Excavation would eliminate the potential for exposure and provide for a reasonable restoration timeframe. DPE wells installed as part of the soil/groundwater cleanup action would provide hydraulic control of dissolved-phase contaminants preventing discharge to the retention basin. Based on evaluation of the remedial alternatives, excavation is the selected remedial alternative.

10.0 CLEANUP ACTION PLAN FOR SOIL AND GROUNDWATER

10.1 REMEDIAL OBJECTIVES

Based on the RI/FS prepared for this Site, and the results of the dual phase extraction (DPE) pilot test performed in April 2013, DPE was selected as a technically feasible remedial alternative for achieving the Site's remedial objective of eliminating the recurrence of SPH and reducing residual hydrocarbon mass such that declining COC concentration trends can be established.

10.2 SYSTEM DESIGN AND INSTALLATION

DPE utilizes separate mechanical systems for pumping groundwater and extracting soil vapor. This section provides the conceptual design information related to the DPE remediation equipment and layout, system installation, construction, system startup, operation and maintenance, and monitoring program. A detailed system layout, well configuration, and process flow diagram designs are provided in Figures 4 through 7. Completion of the design and layout of the remediation system will begin after the conceptual design presented in the draft CAP is approved.

The proposed remediation system will include a network of DPE wells, and piping connecting these wells to the DPE equipment which will be located in a treatment compound on-Site. The proposed treatment compound will be located along the east side of the property, in proximity to the existing P66 remediation system compound. Figure 5 presents the DPE well locations and the underground piping layout from the DPE wells to the proposed treatment compound. Based on specific field conditions and terminal operations, actual remediation system design, construction and final installation may be modified to address unforeseen circumstances and P66 Terminal's operational requirements.

10.2.1 DPE WELLS

Well Specifications: Based on historical assessments and current groundwater monitoring data, a total of 58 DPE wells will be necessary to address the area identified having soil and groundwater impacts. Existing well EX-1 will be used as a DPE well. Approximately 57 new DPE wells will be installed within the inferred impacted area in proximity to the truck loading racks, above ground storage tank (AST) #2, and AST #3. The locations of the proposed DPE wells are illustrated on Figure 5. The final locations of the wells will be based on the presence of underground utilities and other infrastructure. Additionally, since the site is an active industrial site, it is understood that a minor amount of residual hydrocarbons in soil beneath Tank #2, the Truck loading Rack, or other areas where a remediation well cannot be placed in close proximity will remain on Site. Such areas will be inaccessible due to their depth and location beneath structures. Post-DPE remedial actions are detailed in Section 11.0.

A total of 44 extraction wells will be installed in the area around and north of the loading racks. A total of 13 extraction wells will be installed in the tank farm around AST #2 and #3. The wells outside the tank farm will be constructed of 6-inch diameter PVC. Wells in the tank farm will be constructed of 4-inch diameter PVC. Each well will have up to 15 feet of 0.020-slot, V-wire wrapped PVC screen and a 5-foot blank PVC sump. The exact length and elevation of the screen interval will be based on historical soil data, known stratigraphy, and observed conditions during drilling. The wells will be screened such that the top of the screen extends a minimum of 2 feet above the native silt layer and extends a minimum of 1 foot past the contaminated zone and 5 feet past the historical low water level. Therefore, in those areas where the contaminated zone extends below the upper silt layer, several wells will be screened across the silt layer and into the formation below. The boring will be backfilled with hydrated bentonite chips to the bottom of the screened interval. Alternatively, the boring may be backfilled with native sand by allowing the formation to collapse around the well up to the bottom of the bottom of the screened interval. The annulus around the screen will be backfilled with 10-20 silica sand to 1 foot above the screen. After each 5-foot section of the screen is backfilled, the well will be surged for 5 to 10 minutes to allow the sand pack to settle. The sand pack elevation will be monitored during surging to ensure settling is complete prior to continuing. The sand pack will be sealed with a minimum of 2 feet of hydrated bentonite chips up to 2 feet below ground surface (bgs). The well will be completed with a traffic rated 18”x18” hinged steel vault.

For DPE wells installed outside of the tank farm, a limited access sonic rig equipped with 10-inch casing will used to advance the borings. For DPE wells installed inside the tank farm, a limited access hollow stem auger or sonic rig equipped with 8-inch casing will be craned into the tank farm and used to advance the borings. Continuous soil cores will be retrieved from the borehole and logged for stratigraphy using the Unified Soil Classification System (USCS). Soil will also be screened for VOCs using a photoionization detector (PID). All drill cuttings will be stored in 55-gallon steel drums or a roll-off bin and stored onsite for disposal at an approved disposal facility. Waste water generated during will be stored in 55-gallon steel drums and treated onsite through the existing remediation system(s).

Utility Locations: Prior to drilling, CRA will mark out the proposed well locations and contact the Washington State One Call (One Call) public utility locate service. A private utility locate contractor will used to identify any private utilities around the proposed well locations. The first 5 feet of each boring will be cleared using an air-knife assisted vacuum truck. For well locations in the tank farm, a variance will be obtained to clear the holes using a hand auger. All borehole clearance procedures will be in compliance with the P66 borehole clearance procedures outlined in the P66 contractor safety requirements document.

Permits: In order to drill in the tank farm, a crane will need to set up along Southwest 27th Street to lift a limited access drill rig over the berm. A construction permit with the City of Renton will be needed to work in the right of way during well installation.

Site Health and Safety Plan: CRA has prepared a Site-specific health and safety plan to protect site workers. The plan will be reviewed and updated to include any of the planned activities prior to commencing work. The plan will be kept on-Site during field activities and will be reviewed and signed by each crew member.

10.2.2 VAPOR AND GROUNDWATER EXTRACTION SYSTEMS

Vapor Extraction System: System design will allow soil vapors to be extracted from all 58 DPE wells utilizing an aboveground SVE and treatment unit. However, it is anticipated that 12 to 15 DPE wells will be operational at one-time. The treatment unit will include a trailer- or skid-mounted vacuum pump/blower and thermal/catalytic oxidizer that will be used as the extraction and vapor treatment device. Based on the DPE pilot test results, the SVE system selected will consist of a vacuum pump/blower that can generate a minimum vacuum of 23 inches of mercury at a minimum air flow rate of 1500 to 2,000 acfm. A throttle or recirculation valve will control the applied vacuum and vapor extraction flow rate at the vacuum pump/lower unit; vacuum application and corresponding vapor flow from each well will be controlled at the well head, by access through the well's vault box. The SVE system will be equipped with auto-dilution and manual dilution valves for additional vacuum and flow control, and to maintain oxidizer temperatures within the required destruction efficiency range.

Extracted soil vapors will be conveyed from the wells through underground and aboveground piping to the SVE blower and treatment unit. Pipe manifolds will be constructed either remotely and/or at the DPE equipment compound for connection to the SVE blower and treatment unit. Prior to the vacuum pump/blower, the extracted soil vapors will pass through an entrainment separator to remove moisture from the vapor stream. Soil vapors will leave the separator, pass through the vacuum pump/blower, and enter the oxidizer to be treated. A thermal catalytic oxidizer, fueled by natural gas, is the selected oxidizer for utilization on this project; however as extracted VOC concentrations diminish over time, the thermal oxidizer may be modified or switched out with a catalytic oxidizer.

Groundwater Extraction and Treatment System: Pneumatically driven submersible pumps, powered by an air compressor, will be installed in each of the DPE extraction wells. Individual air lines will be run to each wellhead. In addition to the 12 to 15 operating DPE wells, an additional 10 wells will be operated in GWE mode to ensure hydraulic containment of the dissolved-phase plume. Therefore, a total of approximately 25 wells will extract groundwater at any one time. Extracted groundwater will be pumped from the wells into a holding tank. The GWE conveyance piping from the wells to the GWE system holding tank will consist of compatible hoses placed inside of secondary containment piping, constructed both underground and aboveground. The manifolds will be constructed either remotely or within the DPE equipment compound. The liquid-level switch in the storage tank will shut off the air compressor when the tank is full to prevent overflow. Extracted groundwater will be pumped from the holding tank using a transfer pump through silt filters and then through a tray aerator for hydrocarbon mass stripping (if applicable) and then through aqueous-phase carbon vessels (typically three vessels in series) prior to discharge to the Site's sanitary sewer lateral (through a permit obtained from the King County Wastewater Treatment Division [King County}) and/or to the adjacent wetlands or storm drain through a National Pollutant Discharge Elimination System (NPDES) permit obtained through the Department of Ecology. Flow meters, pressure gauges, and sample ports will be installed to control and monitor system operation.

An electrical control panel with programmable logic controller will interlock and operate the DPE system (both the SVE and GWE portions) controls. A telemetry system will remotely notify CRA of system problems or shutdown events. The location of the proposed remediation equipment is presented in Figure 6. The final layout of the equipment will be detailed in the design drawings after the equipment has been selected.

CRA will complete the civil, mechanical, and electrical details of the design so that the required permits identified in the following sections can be procured and bids can be obtained from qualified contractors to install the system. The final DPE system design will be reviewed and approved by a Washington-licensed professional engineer.

Air Discharge Permitting: A Notice of Construction (NOC) application will be submitted to the Puget Sound Clean Air Agency (PSCAA) to obtain an air discharge permit for the remediation system prior to system installation.

Utilities: CRA will coordinate the installation of all utilities required to operate the proposed DPE system (i.e. electrical power and natural gas). CRA will provide Puget Sound Energy (PSE) and all required information and fees for procuring the necessary electrical and gas service. The installation contractor will provide and install all equipment or facilities to accommodate these utilities.

The electrical feed for the existing Phillips 66 remediation system can provide a three-phase, 480 volts, 100 ampere service to the equipment compound. Currently, a stepdown transformer is in place transform the 480 supply to 240 volt service. However, additional power is required in order to supplement the additional electrical requirements of approximately 600 amperes.

CRA will evaluate the current power supply at the terminal to determine if an additional power drop is needed for the remediation system. If an additional power drop is needed, trenching and installation of a new power supply, including permitting, will need to be completed before equipment is installed.

A thermal catalytic oxidizer fueled by natural gas will be utilized for vapor treatment. Currently the Site does not have a natural gas line running to the property. A natural gas line will need to be brought in from Lind Ave. prior to installation of the remediation equipment.

Water Discharge Permit: The existing P66 remediation system is currently discharging to the sanitary sewer service lateral servicing the Site. However, CRA will need to obtain a new permit to accommodate the anticipated increased flow rates of the proposed system. CRA estimates up to 50 gpm of groundwater will be continuously discharged into the sanitary sewer lateral with planned operation of the DPE system. An application for discharge will be submitted to the King County Wastewater Treatment Division to obtain a water discharge permit for the remediation system prior to system installation. Alternatively, an application for a National Pollutant Discharge Elimination System (NPDES) permit may be submitted to the Department of Ecology (DOE) to discharge to the nearby storm drain or wetlands.

Building Permits: CRA will ensure any building permits required by the City of Renton will be acquired. The installation contractor will be responsible for acquiring all applicable construction permits.

Request for Bid: CRA will prepare a request for bid for construction services to install the DPE system. A contractor will be selected based on quality of bid, availability, and quality of service. Similarly, a request for bid will be issued to qualified equipment vendors for the major pieces of equipment of the remediation system. The successful equipment vendor will be selected based on the same selection criteria.

Site Health and Safety Plan: The general contractor will be required to prepare a Site-specific health and safety plan to protect site workers. The plan will be kept on-Site during field activities and will be reviewed and signed by each worker and all visitors to the Site during construction activities. CRA will prepare a separate site safety plan to be employed by CRA staff to protect employees during construction oversight.

Construction: CRA will provide oversight of DPE system construction included in the contractor's scope of work. The contractor will arrange all required regulatory inspections. The schedule to install the DPE system is contingent on issuance of all applicable permits.

10.3 SYSTEM OPERATION AND MAINTENANCE

Health and Safety Plan: A Site-specific health and safety plan will be prepared for routine operation and maintenance activities and kept on-Site, which will be reviewed by and signed by CRA's technician during each Site visit; by any subcontractors performing work on the DPE system; and by any visitors or inspectors entering the established work zone.

Operations and Maintenance Plan: Prior to system startup, CRA will complete an operations and maintenance (O&M) plan in accordance with P66 A&OI requirements. The O&M plan will include the following:

- A description the remediation process including process and instrumentation diagrams
- A description of the equipment details and specifications
- A description of all critical safety devices
- Start/shutdown/emergency procedures
- Standard operating procedures
- Electrical and PLC logic diagrams

- Lock out tag out procedures

Start-up: Start-up of the DPE system will be conducted after final inspection approval and in accordance with the PSCAA air permit; King County wastewater discharge permit; or NPDES permit issued, as applicable.

As part of the system startup procedures, each component of the remediation system will be isolated and tested to ensure that the equipment and any critical safety devices are operational. Once each piece of equipment has been tested, each leg of the PLC logic will be tested to ensure the system components operate as they should. Once the PLC logic has been confirmed, the system components will be joined and tested together in a step-wise fashion starting at the inlet and working downstream. The system will be continuously monitored for at least 8 hours before being left on unattended overnight.

Once the system is running well, baseline operation parameters will be collected and recorded for each system component. Compliance samples will be collected from each well and before and after each control device. Samples will be submitted to the lab with a quick turnaround time requested. Once data is received, compliance with the applicable discharge permits will be verified. The PSCAA typically requires analysis of the inlet and exhaust streams within the first week of operation to confirm permit compliance with the total flow rate, TPH and benzene emission limits, and constituent destruction efficiency. A summary report of start-up activities will be submitted to the PSCAA (in accordance with permit conditions) and the DOE. CRA will perform required monitoring and collect treated water discharge compliance samples in accordance with the King County discharge permit requirements or the issued NPDES permit, as applicable.

Data Collection and Optimization: CRA anticipates conducting bi-weekly operation and maintenance Site visits, or more frequently as required by permits. Operational status, hour meter readings, groundwater flow rate, and flow totalizer meter readings will be recorded on Site-specific standard field forms during each Site visit. The depth to water in on-Site DPE wells and monitoring wells will be measured periodically to verify drawdown in the extraction wells and to assess the level of hydraulic control achieved by DPE.

CRA will monitor pump vacuum, system vacuum, well vacuum, system flow, dilution air flow, well flow, and system temperatures to assess soil vapor extraction and treatment unit operation. A thermo anemometer or pitot tube and magnehelic gauge will be used to measure extraction flow rates. CRA will monitor vapor concentrations entering and exiting the unit to evaluate destruction efficiency and permit compliance. Field vapor concentrations from each well head will be measured with a PID, organic vapor analyzer, flame-ionization detector, or equivalent, on a periodic basis. Vapor concentrations from the extraction wells will be monitored to assess DPE effectiveness and to confirm recovered vapor destruction efficiencies. Induced vacuum measurements from proximal wells will be measured to evaluate the vacuum ROI. DPE system adjustments will be implemented accordingly to ensure the DPE system is sufficiently covering the target area.

Sample Collection: CRA will collect vapor samples from the DPE system influent (both from the incoming vapor streams and prior to the oxidizer) and effluent streams according to the PSCAA permit requirements. The vapor samples will be collected in 1-liter tedlar bags using a rotary-vane vacuum pump or equivalent. During normal operation, this sampling schedule will satisfy PSCAA permit requirements and allow for verification of field measurements and evaluation of system effectiveness.

Influent, mid-point, and effluent water samples will be collected from the carbon vessels during and after start-up. During the normal operation, a sampling schedule that satisfies the discharge permit requirements and allows for effective system evaluation will be implemented.

Laboratory Analyses: All vapor and groundwater samples will be submitted to a State of Washington certified laboratory with a Site-specific chain of custody record. The samples will be analyzed in accordance with the EPA and/or Ecology Methods per the permit requirements.

Operation and Maintenance: Regular maintenance will be performed on the system which includes completing routine and preventive maintenance procedures as recommended by the manufacturer on the mechanical components.

DPE System Evaluation: A detailed review of system performance will be conducted during start-up and initial operation. This detailed review will be continued on a less frequent basis (monthly) once system operation is established, or may be increased as needed to maintain the system at a cost-efficient and mass-removal effective performance. A formal Compliance Monitoring Plan (CMP) will be completed in conjunction with the O&M plan. The schedule for completion of the CMP and O&M plan are presented in Section 13.0. In addition to the standard data previously discussed, mass removal rates, vapor concentration trends, and groundwater concentration trends will be used to evaluate system performance. DPE system data and evaluation will be presented in the quarterly remediation progress reports. The system will be operated until asymptotic levels of influent concentrations are observed or declining trends in dissolved COCs are observed.

The DPE system is estimated to operate for an approximate period of five years. Upon reaching the practical limits of the remedial action (which may or may not occur within the five year period), it is anticipated that the majority of the site will meet the identified cleanup goals. However, since this is an operating industrial site, residual hydrocarbons may still be present. Post-DPE remedial actions include Monitored Natural Attenuation wherein the groundwater plume(s) are demonstrated to be stable or shrinking and conditional points of compliance will be established at that time with Ecology approval. Institutional controls under MTCA will be employed (i.e., Environmental Covenant) shortly after the effective date of the Agreed Order for cleanup. Chapter 13.0 outlines these activities and their deliverables.

10.4 HYDRAULIC CONTAINMENT EVALUATION

As part of the cleanup action plan, an evaluation of hydraulic containment was completed using the groundwater flow model developed as part of the RI/FS. The purpose of the evaluation was to determine if hydraulic containment of the dissolved phase plume was attainable and, if so, how many wells are necessary and at what pumping rate. The wells used in the modeling are based on the well configuration presented in this CAP. The calibrated groundwater flow model prepared during RI/FS activities is used to evaluate the degree of hydraulic containment achieved by the simulation of proposed groundwater extraction scenarios. The degree of hydraulic containment is evaluated using established particle tracking methods. The particle tracking methodology applied to evaluate the degree of hydraulic containment achieved by the proposed groundwater extraction scenarios is presented in Section 10.4.1. A description of the proposed extraction scenarios evaluated is presented in Section 10.4.2. The results of the particle tracking simulations are presented in Section 10.4.3.

10.4.1 PARTICLE TRACKING METHODOLOGY

The degree of hydraulic containment of groundwater is evaluated using forward particle tracking. Forward particle tracking involves releasing artificial particles within the simulated groundwater flow field, and calculating the movement, or pathway, of these particles through the groundwater flow field by advective processes (i.e., particle movement is based on the direction and magnitude of groundwater flow velocities). Particle tracking demonstrates hydraulic, or advective, containment only, and does not account for hydrodynamic dispersion processes driven by concentration gradients that may overcome advective containment. As a result, the particle tracking simulations alone cannot be relied upon solely to provide a thorough assessment of contaminant plume containment.

From the particle initial release locations, particle pathways are calculated forward in time through the groundwater flow field until they either reach the edge of the model domain (such as a hydraulic head boundary), or reach an interior boundary condition (such as an extraction well), where water is removed from the model domain (resulting in the particle being removed). Releasing a series of particles upgradient of extraction wells and examining the particle tracking results to determine whether all, or some, of the particles are removed by the extraction well pumping is a common method of evaluating the degree of hydraulic containment achieved. The removal of all particles within a target area demonstrates hydraulic containment of that area, provided that a sufficient density of particles is released. It is important to note that no maximum time limit is specified for the particles removed from the system in the particle tracking simulation.

The particle tracking simulations are conducted using the groundwater flow field that is provided by specifying the pumping rates associated with the proposed extraction scenario in the calibrated high-flow steady-state groundwater flow model. A description of the development and calibration of the high-flow steady-state groundwater flow model is presented in appendix M of the RI/FS report.

The USGS's three-dimensional particle tracking program MODPATH (Pollock, 1994) was applied to conduct the particle tracking simulations used to assess the extent of hydraulic containment achieved by the extraction scenario. MODPATH uses the groundwater flow field simulated by MODFLOW-2000 to calculate particle pathways based on advective migration processes.

A single particle is initially released in the middle of each model cell. A porosity value of 25 percent is specified uniformly throughout the model to determine the groundwater flow velocities used to calculate the particle pathways. The particle pathways are simulated over a time-period necessary for all particles either to be removed by an extraction well, or to reach a model boundary condition. The removal of particles from the model domain is specified in MODPATH to occur only where a strong-sink, defined as groundwater flow being inward on all sides of a model cell, exists. If groundwater flow is inward on all sides of a model cell, groundwater outflow from the model domain must occur from that cell and a particle entering such a cell must also be removed. The strong-sink specification is applied as opposed to a weak-sink specification where particles can be removed from a model cell without inward flow on all sides of the model cell. The strong-sink specification offers a more conservative approach for evaluating particle removal and hydraulic containment.

The degree of hydraulic containment achieved is evaluated using the end-point location of each particle. The end-point of each particle is inspected to determine whether the particle is removed by an extraction well, and if it is, by which extraction well. The results of the particle tracking simulations are presented by color-coding the particle starting locations based on which extraction well removes the particle. If a particle is not captured, its starting location is assigned a color unique from the extraction well coloring. Color-coding the particle starting locations in this manner provides a clear visualization of where hydraulic containment is achieved and the relative extent of hydraulic containment achieved by each individual extraction well.

10.4.2 PROPOSED EXTRACTION WELL SCENARIOS

Three proposed extraction well scenarios and their implementation in the high-flow steady-state groundwater flow model are described herein. Table 5 presents a summary of the extraction well pumping rates applied for each extraction scenario. Figure 8 provides a visual representation of the proposed groundwater extraction well network. Out of the possible 58 groundwater extraction well locations, only 20 to 25 groundwater extraction wells are expected to be in operation at any given time (12 to 15 of which are to be run in DPE vapor extraction mode). Wells considered to be initially active for hydraulic containment are identified on Figure 8 and a flow rate, as per Table 5, is assigned to those well locations in the high-flow steady-state groundwater flow model. All other proposed extraction wells shown on Figure 8 are specified as inactive (i.e., shut off) for modeling purposes. It has been assumed that the proposed groundwater extraction scenarios will replace any previously implemented remediation alternatives such as previously constructed and operated extraction wells and remediation trenches.

Each well presented in Figure 8 was placed into the high-flow steady-state groundwater flow model assuming that the start of the well screen was 2 feet above the silt layer. Since the first model layer is considered to be uniformly fill material and the model layer below that to be silty clay, the wells were uniformly placed 2 feet above the bottom of model layer 1 corresponding to a well screen top elevation of 12 feet MSL. A 15-foot well screen was assumed and therefore the well screens are expected to be installed down to an elevation of -3 feet MSL (or span 13 model layers), which results in the bottom of the well screen being located below the silty clay layer defined in the model.

The proposed groundwater extraction scenarios are simulated as constant flux boundary conditions. The fluxes are specified based proposed extraction rates at individual extraction wells. The total proposed extraction rate for each well, as presented in Table 5, is specified over the model layers spanned by the screened interval for each well. The total extraction rate per well is distributed over the model cells proportional to the screen length within each cell and the horizontal hydraulic conductivity of each model cell intercepted by the well screen.

As Table 5 identifies, the Base Case Extraction Scenario evaluates the performance of 24 proposed extraction wells pumping uniformly at 2 gpm resulting in a total extraction rate of 48 gpm. The proposed active wells for the Base Case Extraction Scenario are presented in Figure 8. Groundwater Extraction Scenarios 1 and 2 are a variation of the base case scenario to determine how the hydraulic containment zone alters with decreased pumping rates at various wells. Scenario 1 has a total proposed extraction rate of 27 gpm with 21 wells pumping. In Scenario 1 groundwater extraction wells pumping are proposed to pump at 0.5 gpm and DPE vapor extraction wells proposed to pump at 1.5 gpm. DPE wells are expected to produce a higher groundwater extraction flow rate due to the vacuum applied at the well head. The vacuum suction would result in a greater radius of influence for groundwater extraction compared to a standard groundwater extraction well. Scenario 2 has a total proposed extraction rate of 6 gpm with 24 wells pumping at 0.25 gpm each.

Although the hydraulic containment simulation results may demonstrate advective containment of the groundwater plume, achieving hydraulic containment does not guarantee that dispersive containment of the groundwater plume will be achieved. As discussed in Section 10.4.1, dispersive contaminant migration is driven by concentration gradients from areas of elevated concentrations to areas of low concentrations. This is most significant where a large contrast in concentrations exists over a short distance and this contrast occurs near the limit of hydraulic containment for a particular extraction well. Under these conditions, it may be possible for the dispersive contaminant migration processes to overwhelm the advective containment process, allowing a limited amount of contaminant mass to migrate beyond the extraction well. This phenomenon is possible at the outer limit of the advective containment zone as well as at the interface between containment zones from individual wells in a multiple extraction well system.

10.4.3 HYDRAULIC CONTAINMENT EVALUATION RESULTS

The particle tracking simulation results for each of the remediation extraction scenarios described in Section 10.4.2 are presented below.

Base Case Extraction Scenario

The particle tracking results for particles released within the fill material, silty clay, and lower silty sand aquifer in the Base Case Extraction Scenario are presented on Figures 9, 10, and 11, respectively. Note that there is some cross-communication of particles between all the stratigraphic layers. For instance, particles released in the silty clay or fill material can be drawn downwards and captured within the lower silty sand aquifer. Therefore, even though the portion of the well-screen located within the fill material may become dry, particles released in the fill material may still be extracted by the local groundwater extraction well within the deeper stratigraphic layers.

From Table 5 it is evident that out of the 24 groundwater extraction wells set to active in the groundwater flow model, 15 wells become dry in model layer 1 (fill material). However, even though this occurs, since the majority of the 2 gpm flow rate is assigned to the lower silty sand aquifer (due to the higher horizontal hydraulic conductivity assigned to this material), the overall collective flow rate from all the proposed extraction wells only alters by 0.7 gpm. This means that instead of the proposed extraction rate of 48 gpm, an extraction rate of 47.3 gpm can be achieved in the groundwater flow model. In the field however, the 0.3 gpm expected to be extracted from the fill material would most likely still be extracted except it would be collected from the lower silty sand aquifer.

Figures 9, 10, and 11 display the capture zones of the 24 active groundwater extraction wells simulated in the high-flow steady-state groundwater flow model for particles released within the fill material, silty clay, and lower silty sand aquifer, respectively. As seen in Figures 9, 10, and 11, the hydraulic containment zone spans most of the Site for all stratigraphic layers when a 2 gpm flow rate is assigned to each of the 24 proposed extraction wells. The smallest area of hydraulic containment is observed in the fill material and the largest area of hydraulic containment is observed in the lower silty sand aquifer.

Extraction Scenario 1

The particle tracking results for particles released within the fill material, silty clay, and lower silty sand aquifer in Extraction Scenario 1 are presented on Figures 12, 13, and 14, respectively. Out of the 21 groundwater extraction wells set to active in the groundwater flow model, 8 extraction wells become dry in model layer 1 (fill material). However, the discrepancy between the proposed and achieved extraction rate in the groundwater flow model is reduced for Extraction Scenario 1 compared to the Base Case Extraction Scenario (from a discrepancy of 0.7 gpm down to a discrepancy of 0.1 gpm) largely due to the decreased overall extraction rates.

Figures 12, 13, and 14 display the capture zones of the 21 active groundwater extraction wells simulated in the high-flow steady-state groundwater flow model for particles released within the fill material, silty clay, and lower silty sand aquifer, respectively. As seen in Figures 12, 13, and 14, the hydraulic containment zone spans most of the Site for all stratigraphic layers with the smallest area of hydraulic containment being observed in the fill material and the largest area of hydraulic containment being observed in the lower silty sand aquifer. The decreased flow rates in Extraction Scenario 1 mainly affect the west side of the Site but the hydraulic containment areas are very similar to those observed in the Base Case Extraction Scenario.

Extraction Scenario 2

The particle tracking results for particles released within the fill material, silty clay, and lower silty sand aquifer in Extraction Scenario 2 are presented on Figures 15, 16, and 17, respectively. Due to the decreased flow rates in this extraction scenario, none of the 24 proposed groundwater extraction wells set to active in the groundwater flow model become dry in model layer 1 (fill material) and therefore there is no discrepancy between the proposed and achieved total extraction rate in the model.

Figures 15, 16, and 17 display the capture zones of the 24 active groundwater extraction wells simulated in the high-flow steady-state groundwater flow model for particles released within the fill material, silty clay, and lower silty sand aquifer, respectively. As seen in Figures 15, 16, and 17, the hydraulic containment zone spans most of the Site for all stratigraphic layers with the smallest area of hydraulic containment being observed in the fill material and the largest area of hydraulic containment being observed in the lower silty sand aquifer. The decreased flow rates in Extraction Scenario 2 also mainly affect the west side of the Site but the containment areas are visibly reduced when comparing to the Base Case Extraction Scenario.

10.4.4 HYDRAULIC CONTAINMENT EVALUATION SUMMARY

The results of the modeling to evaluate hydraulic containment indicate adequate hydraulic containment of the dissolved phase plume can be achieved under all three scenarios. Based on the results, the remediation system design including well locations, screen intervals, and anticipated extraction rates will meet the hydraulic containment requirements of the cleanup action plan.

11.0 POST-DPE REMEDIAL ACTIONS

The DPE system is estimated to operate for an approximate period of five years. Upon reaching the practical limits of the remedial action (which may or may not occur within the five year period), it is anticipated that the majority of the site will meet the identified cleanup goals. However, since this is an operating industrial site and certain areas of the Site are inaccessible for remediation; residual hydrocarbons may still be present and need to be left in place. In order for soil contamination to be left in place the following conditions must be met:

- All soil and groundwater that is able to be practically remediated, has been remediated to below site cleanup levels
- The remaining contaminant plume must be shown to be stable or shrinking
- The remaining soil and groundwater contamination must be contained to the extent that it is protective of human health and ecological receptors
- Institutional controls must set in place to prohibit or limit activities that may cause contaminant exposure to humans or the environment
- A Compliance Monitoring Plan (CMP) and 5-year review plan must be set in place to verify that the above conditions are met

Following active remediation, any areas where remediation goals are not able to be met using active DPE remediation, will meet the above conditions. Contaminant plumes will be shown to be stable or shrinking in these areas before active DPE remediation will be discontinued. The remaining soil and groundwater contamination will be contained by either an asphalt cap or site structure such as an above ground storage tank. Institutional controls under MTCA will be employed (i.e., Environmental Covenant) and conditional points of compliance will be established at that time with Ecology approval.

Monitored Natural Attenuation (MNA) in conjunction with long term monitoring will be used to show that contaminants are naturally attenuating, are not migrating, and do not present a hazard to human health and the environment. A CMP will be set in place detailing the specific sampling requirements associated with MNA and long term monitoring.

The schedule for implementation of any post-DPE remedial actions is presented in Section 13.0.

12.0 CLEANUP ACTION PLAN FOR THE SOUTHWEST CORNER OF THE RETENTION BASIN

12.1 EXCAVATION

The proposed cleanup action plan for the contaminated soil and surface water in the southwest corner of the retention basin is removal of contaminated soil by excavation. The proposed extents of excavation are based the results of the sampling conducted as part of the RI/FS. The proposed excavation extents are present on Figure 18. The final excavation extents will be based on field screening during excavation.

Excavation will be conducted during the dry season when the southwest corner of the retention basin is dry. Excavation will be completed using an excavator by a qualified contractor. Excavation will begin in the area with highest concentration first and work outward. Excavation will be completed to a minimum depth of 1 foot into the underlying soil beneath the surface layer. After the first foot, soil samples will be collected for field screening. Field screening will include measurement of VOCs with a PID and visual inspection. Excavation will continue until clean soil is encountered, to a depth of 15 feet bgs, or until Site infrastructure prohibits further excavation. Contaminated soil will be stockpiled on a layer of polyethylene plastic liner and covered when work is not being performed. Contaminated soil will be transported to an approved disposal facility. Soil samples will be collected from the final excavation extents and transported to an approved Laboratory for analysis of the Site COCs listed on Table 1. The excavation will be backfilled with clean fill material and compacted to ensure the slope of the embankment is stable.

Utility Locations: Prior to excavation, CRA will mark out the proposed excavation limits and contact the Washington State One Call (One Call) public utility locate service.

A private utility locate contractor will used to identify any private utilities around the proposed excavation.

Permits: In order to excavate in the retention basin, a staging area in the landscaping area along Southwest 27th Street will be needed. A construction permit with the City of Renton will be acquired to work in the right of way during excavation.

Site Health and Safety Plan: CRA has prepared a Site-specific health and safety plan to protect site workers. The plan will be reviewed and updated to include any of the planned activities prior to commencing work. The plan will be kept on-Site during field activities and will be reviewed and signed by each crew member.

12.2 CONFIRMATION SAMPLING

Once excavation and backfilling is complete, confirmation surface water sampling will be completed to confirm surface water contamination has been remediated. Confirmation sampling may not be conducted for several months after excavation is completed, as the retention basin contains water seasonally. Surface water samples will be collected and transported to an approved laboratory for analysis of the Site COCs presented on Table 1.

13.0 SCHEDULE

The new Agreed Order No. DE 11313 contains the schedule for preparation and implementation of the Final CAP, including an Engineering Design Report with final system drawings and compliance monitoring plan. Once work commences, implementation of the Final CAP will take an estimated 3-6 months.

Table 6 outlines the general activities, deliverables, and timetable of remedial activities, decisions and deliverables for the remediation. The cleanup will follow this schedule and will be an enforceable part of the Agreed Order for the site.

14.0 REFERENCES

CRA. 2013. *Draft Remedial Investigation and Feasibility Study, Phillips 66 Renton Terminal.* September 2013

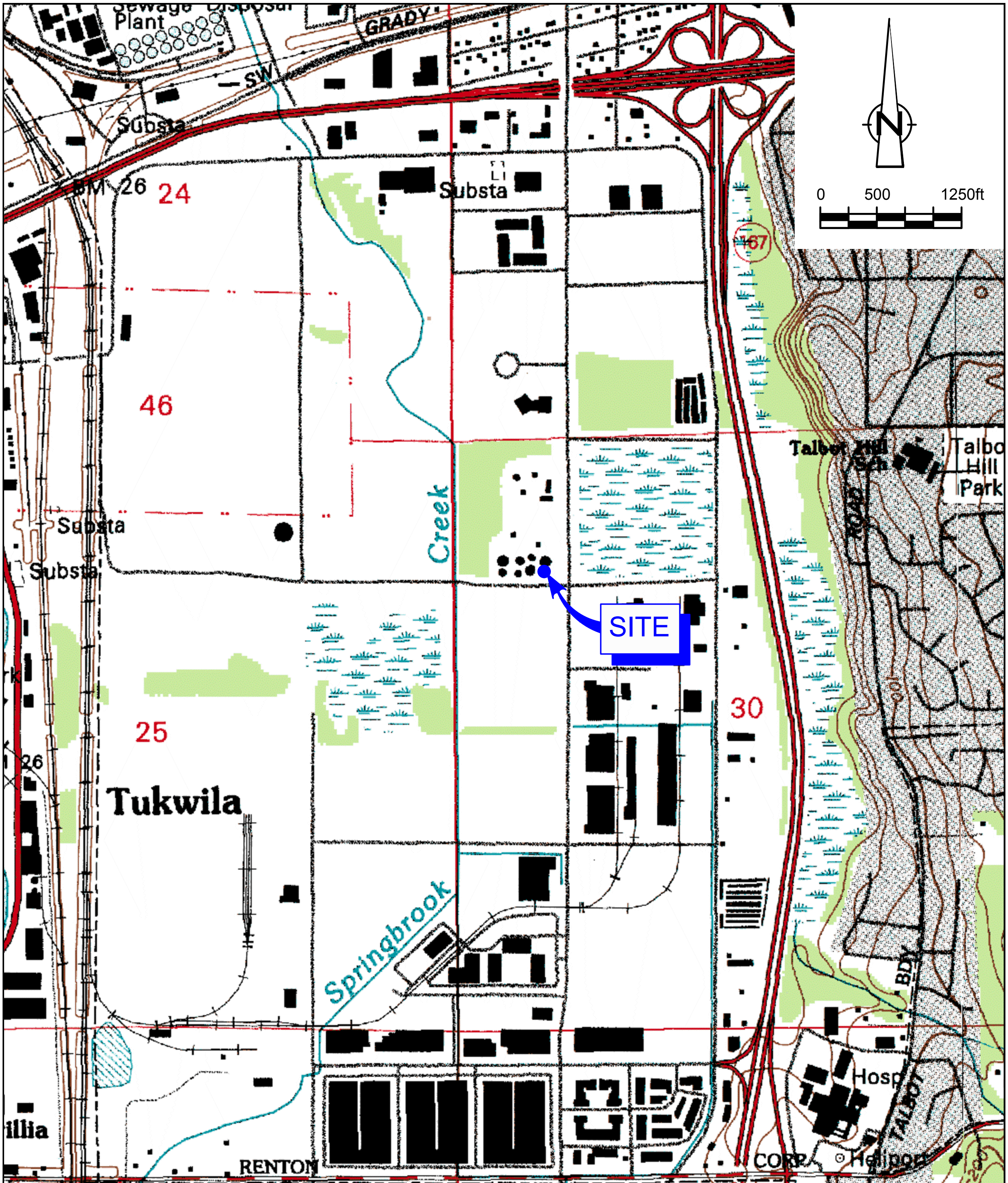
Model Toxics Control Act (MTCA). 2007. Washington State Department of Ecology. November 2007.

Agreed Order DE-7882, August 2010, Washington State Department of Ecology

Luzier, J.E., 1969. *Geology and Ground-Water Resources of Southwestern King County, Washington*.

Pollock, D. 1994. Users Guide for MODPATH/MODPATH-PLOT Version 3.0: A Particle Tracking Post Processing Package for MODFLOW, the U.S. Geological Survey Finite - Difference Groundwater Flow Model, USGS Open File Report 94-464, September.

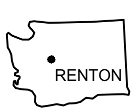
FIGURES



SOURCE: USGS QUADRANGLE MAP:
RENTON, WASHINGTON

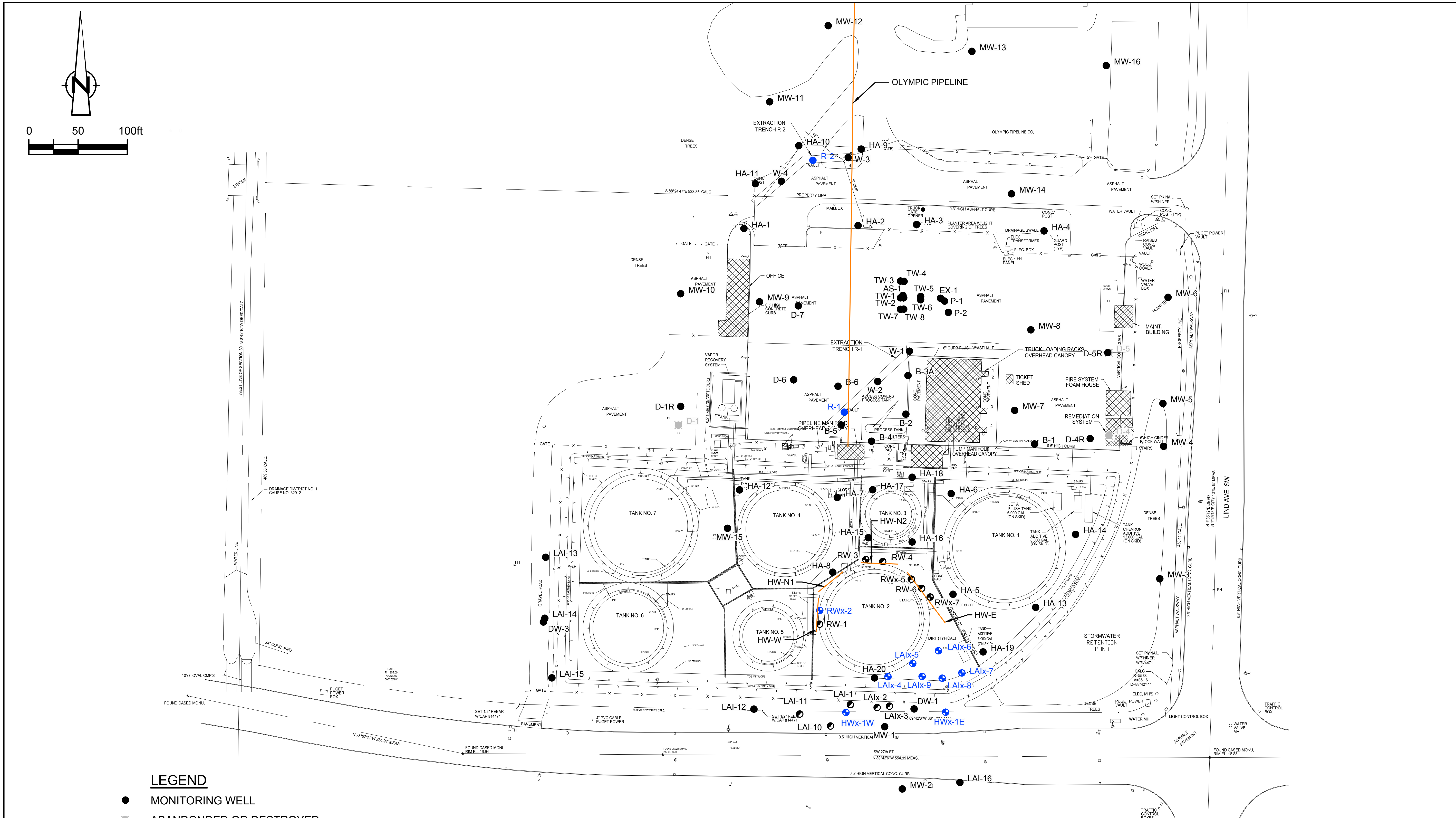
figure 1

VICINITY MAP
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington



WASHINGTON

70496-RI00(027)GN-WA001 AUG 1/2013



LEGEND

- MONITORING WELL
- ABANDONDED OR DESTROYED MONITORING WELL LOCATION
- 4" DIAMETER VERTICAL RECOVERY WELL (ACTIVELY PUMPING)
- 4" DIAMETER VERTICAL RECOVERY WELL (INACTIVE- NOT PUMPING)
- REMEDIATION WELL LOCATION

SOURCE: STATEWIDE LAND SURVEYING INC., DATED 1/26/12.

figure 2

SITE PLAN
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

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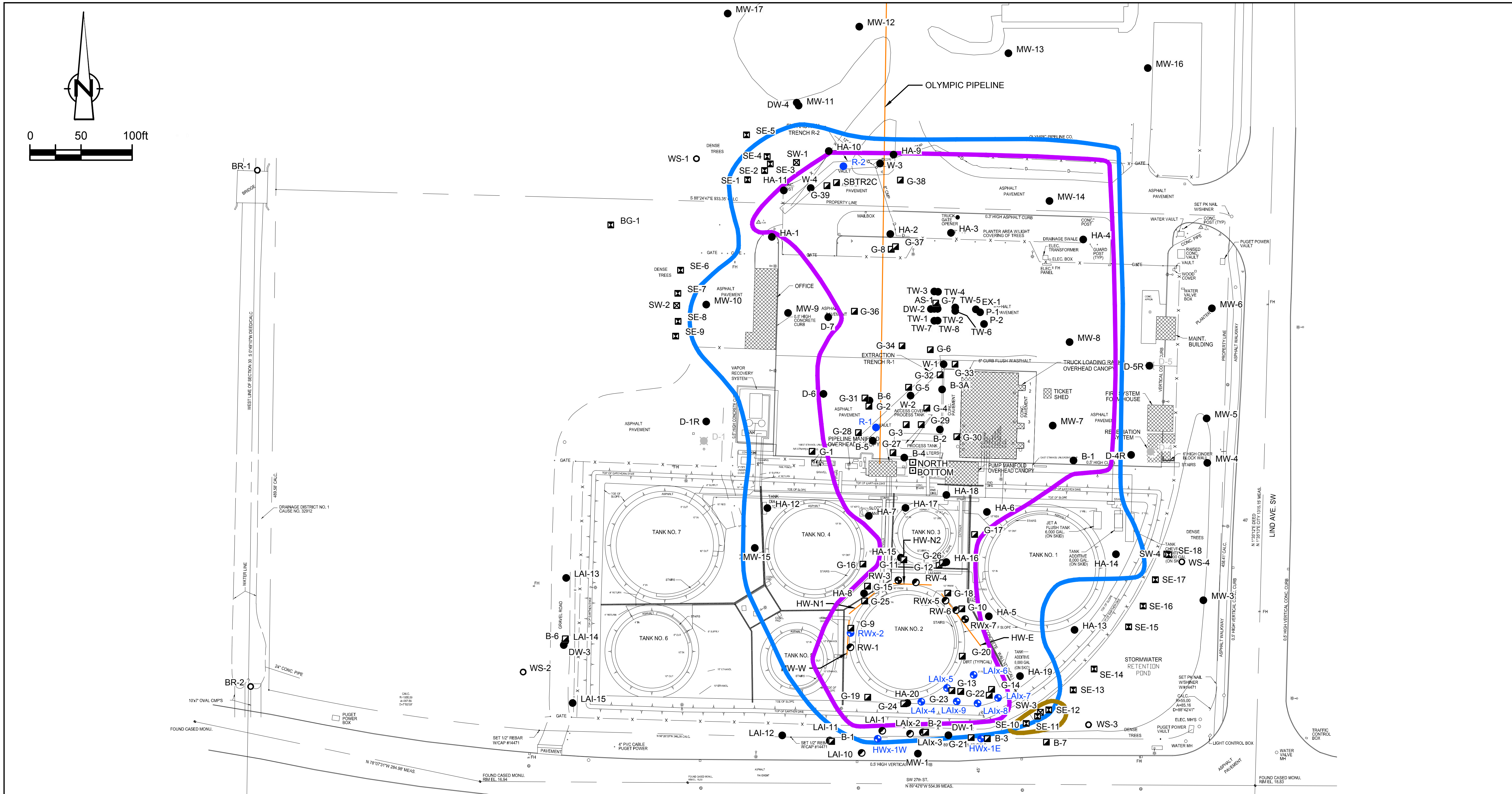


LEGEND

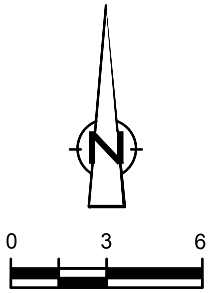
- ● MONITORING WELL
- ABANDONDED OR DESTROYED MONITORING WELL LOCATION
- 4" DIAMETER VERTICAL RECOVERY WELL (ACTIVELY PUMPING)
- 4" DIAMETER VERTICAL RECOVERY WELL (INACTIVE- NOT PUMPING)
- REMEDIATION WELL LOCATION
- SURFACE WATER SAMPLE LOCATION
- EXCAVATION SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- STAFF GAUGE LOCATION
- SOIL BORING LOCATION
- APPROXIMATE EXTENT OF SOIL CONTAMINATION
- APPROXIMATE EXTENT OF GROUNDWATER CONTAMINATION
- APPROXIMATE EXTENT OF SEDIMENT AND SURFACE WATER CONTAMINATION

SOURCE: STATEWIDE LAND SURVEYING INC., DATED 1/26/12.

figure 3

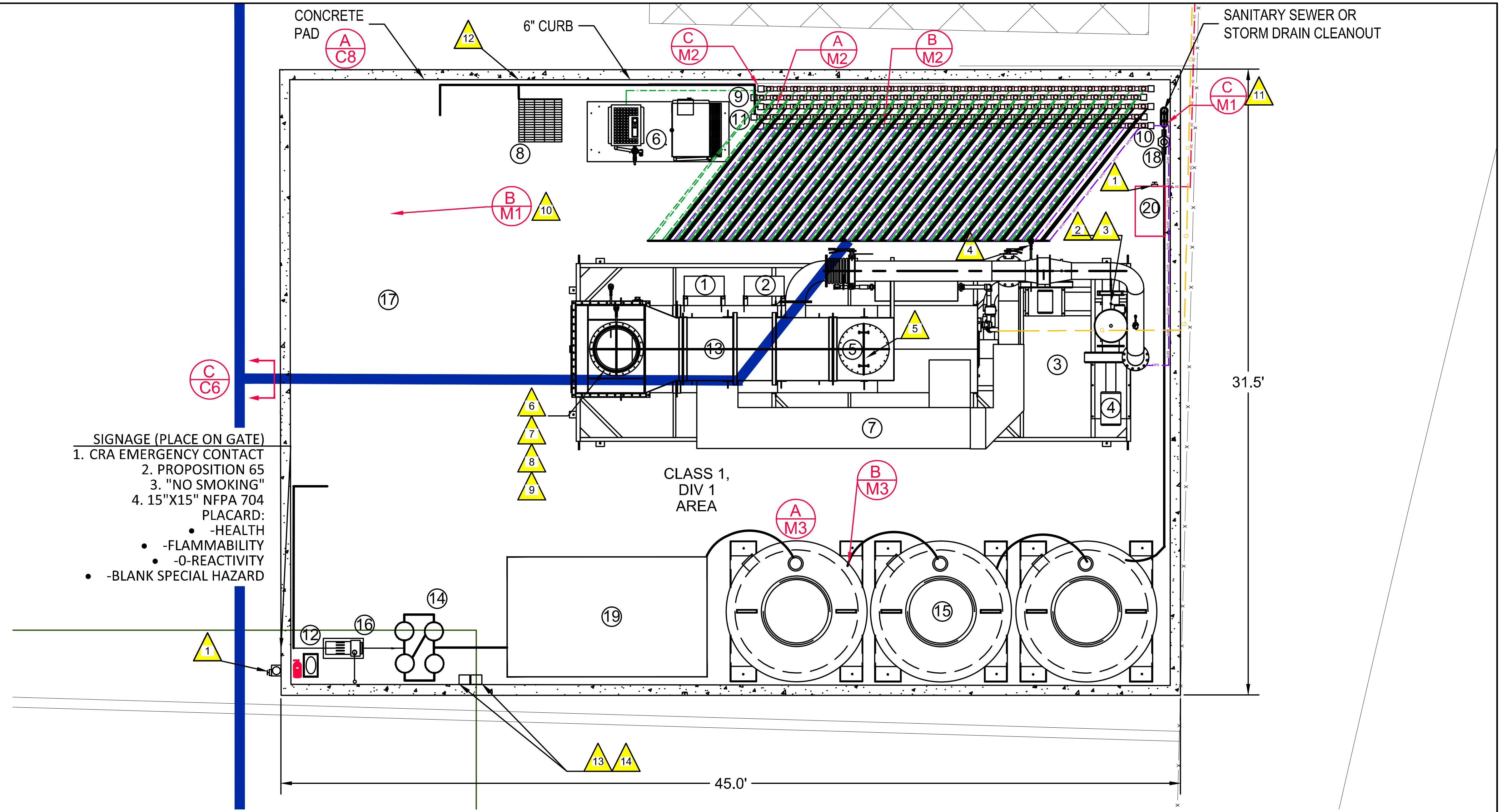
SITE PLAN WITH CLEANUP ACTION AREAS
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

70496-RI00(027)GN-WA003 AUG 1/2013



EQUIPMENT LEGEND

1. VFD CONTROL PANEL
2. MAIN CONTROL PANEL
3. STACKED 75 HP BLOWERS
4. TRANSFER PUMP - A
5. AIR/WATER SEPARATOR
6. AIR COMPRESSOR
7. 2,000 SCFM TCAT
8. FLOOR SUMP
9. COMPRESSED AIR MANIFOLD
10. SVE MANIFOLD
11. GWE MANIFOLD
12. EYE WASH & FIRE EXTINGUISHER STA. - A
13. SOUND ENCLOSURE FOR FLAME ARRESTOR
14. SILT FILTERS (4)
15. 6000# LIQUID PHASE GAC VESSELS (3)
16. TRANSFER PUMP - B
17. 7,000 GALLON STEEL PHASE SEPERATOR & EQUALIZATION TANK
18. FLOW METER/TOTALIZER
19. TANK AERATOR
20. MAIN CONTROL PANEL



CRITICAL DEVICES:

1. EMERGENCY SHUTOFF SWITCH (SHUTS DOWN THE MPE SYSTEM WHEN PRESSED)
2. AUTOMATIC SHUT OFF VALVE - WELL GAS (SHUTS OFF WELL GAS IF THE OXIDIZER TEMPERATURE IS OUT OF OPERATIONAL RANGE)
3. AUTOMATIC DILUTION AIR VALVE ON WELL GAS (PREVENTS THE OXIDIZER FROM GOING OVER TEMPERATURE BY INTRODUCING FRESH AIR)
4. HIGH VACUUM SWITCH (SHUTS DOWN THE SVE SYSTEM AT HIGH VACUUM CONDITIONS)
5. HIGH-HIGH LEVEL SWITCH IN AIR/WATER SEPARATOR (SHUTS DOWN THE SVE SYSTEM AT HIGH WATER LEVEL)
6. HIGH TEMPERATURE SWITCH - OXIDIZER OUTLET (SHUTS DOWN THE SVE SYSTEM AT HIGH TEMPERATURE)
7. FLAME ARRESTER AT OXIDIZER INLET (ENSURES THE OXIDIZER FLAME CANNOT PROPAGATE THROUGH UPSTREAM PIPING)
8. THERMOCOUPLE AT CATALYST ENTRY (OPENS WELL GAS WHEN CATALYST IS AT TEMPERATURE)
9. FLOW SWITCH (DISABLES HEATING ELEMENT IF THERE IS NO AIR FLOW)
10. HIGH LEVEL SWITCH ON PHASE SEPARATOR & EQUALIZATION TANK WARRICK CONTROLS - MULTI-PROBE FTG (MODEL# 3G4E1 OR EQUIVILANT)
11. LEL METER
12. SECONDARY CONTAINMENT LEVEL SWITCH WARRICK CONTROLS - MULTI-PROBE FTG (MODEL# 3G4E1 OR EQUIVILANT)
13. HIGH PRESSURE SWITCH - UNITED ELECTRIC PRESSURE SWITCH (TYPE H100) (CARBON)
14. HIGH PRESSURE SWITCH - UNITED ELECTRIC PRESSURE SWITCH (TYPE H100) (SILT FILTERS)

figure 4

DUAL PHASE EXTRACTION SYSTEM LAYOUT
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

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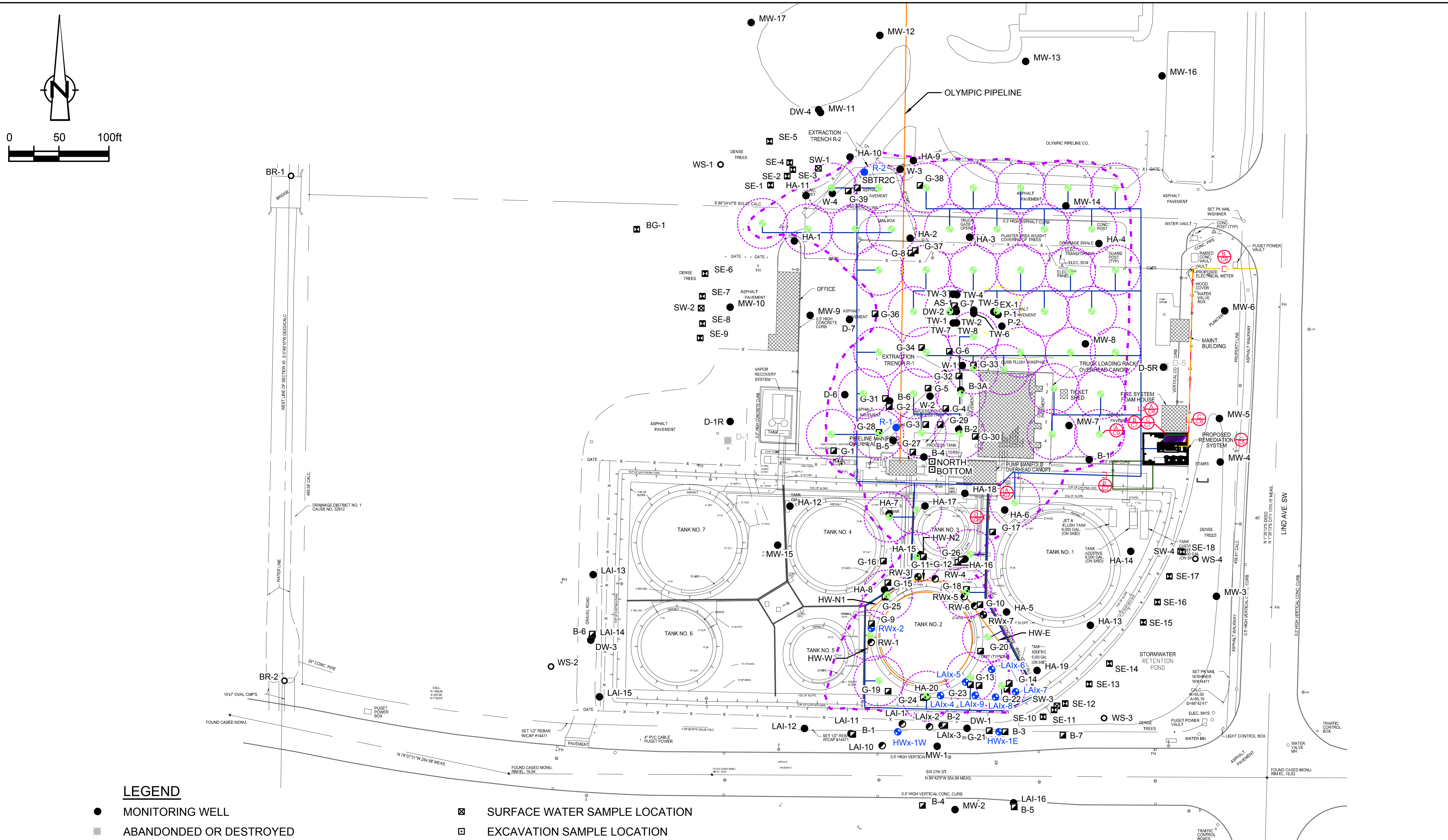

LEGEND

- MONITORING WELL
- ABANDONDED OR DESTROYED MONITORING WELL LOCATION
- 4" DIAMETER VERTICAL RECOVERY WELL (ACTIVELY PUMPING)
- 4" DIAMETER VERTICAL RECOVERY WELL (INACTIVE- NOT PUMPING)
- REMEDIATION WELL LOCATION
- SURFACE WATER SAMPLE LOCATION
- EXCAVATION SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- STAFF GAUGE LOCATION
- SOIL BORING LOCATION
- ELECTRICAL (E)
- DPE LINES
- GAS (G, 2" DIA.)

SOURCE: STATEWIDE LAND SURVEYING INC., DATED 1/26/12.

figure 5

DUAL PHASE EXTRACTION WELL CONFIGURATION
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

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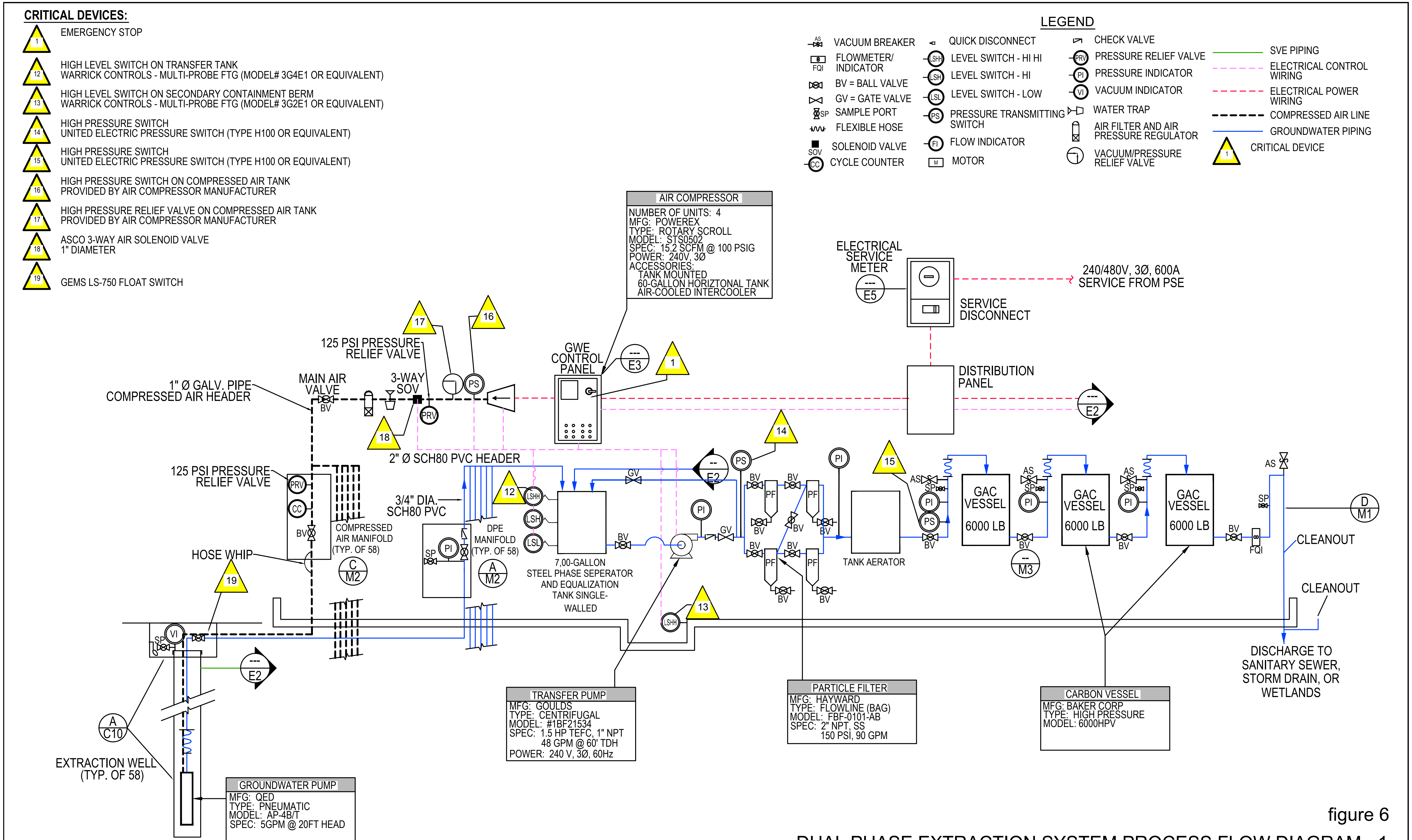


figure 6

DUAL PHASE EXTRACTION SYSTEM PROCESS FLOW DIAGRAM - 1
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

70496-RI00(027)GN-WA006 AUG 1/2013

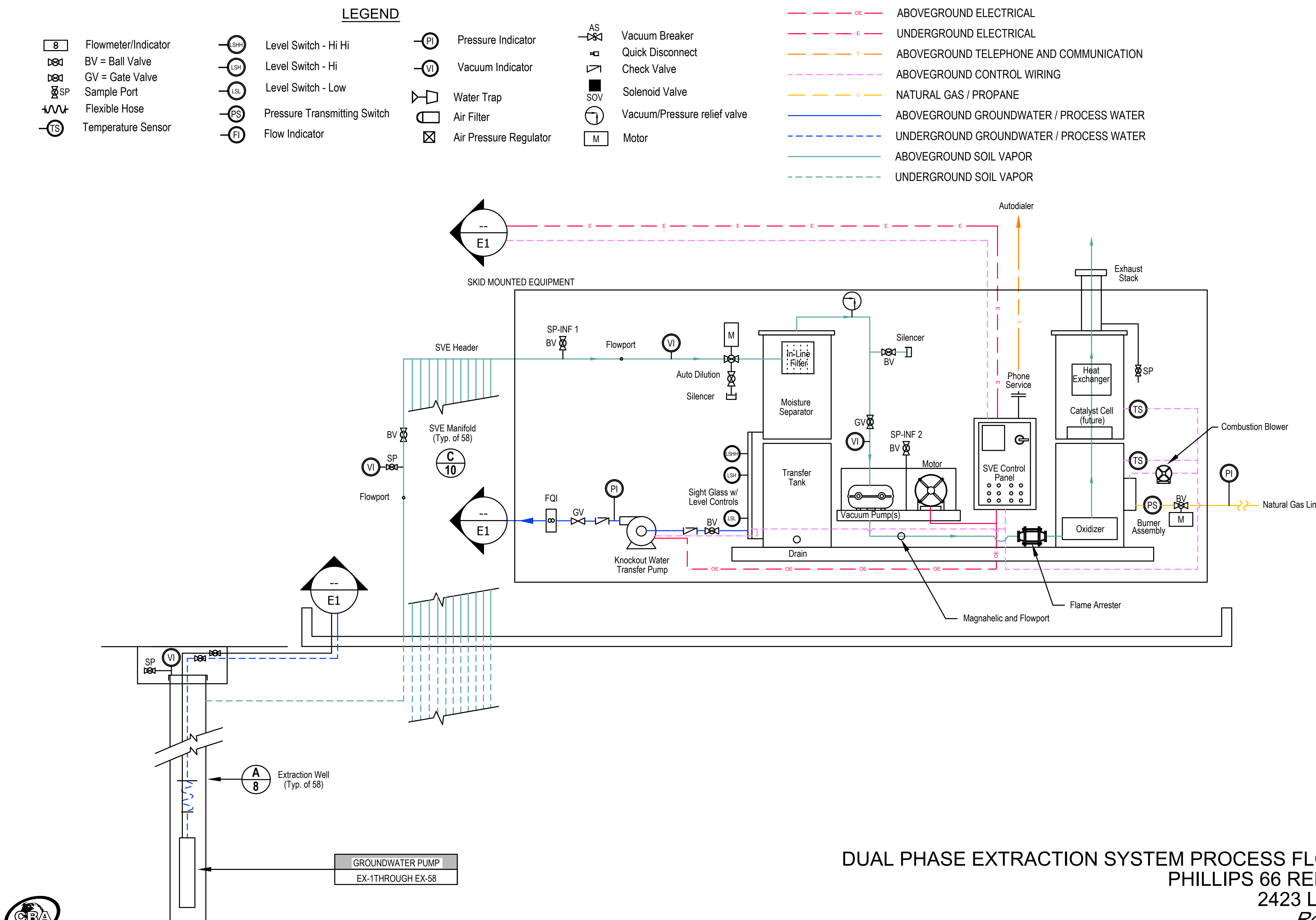


figure 7

DUAL PHASE EXTRACTION SYSTEM PROCESS FLOW DIAGRAM - 2
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW

Renton, Washington

70496-RI00(027)GN-WA007 AUG 1/2013

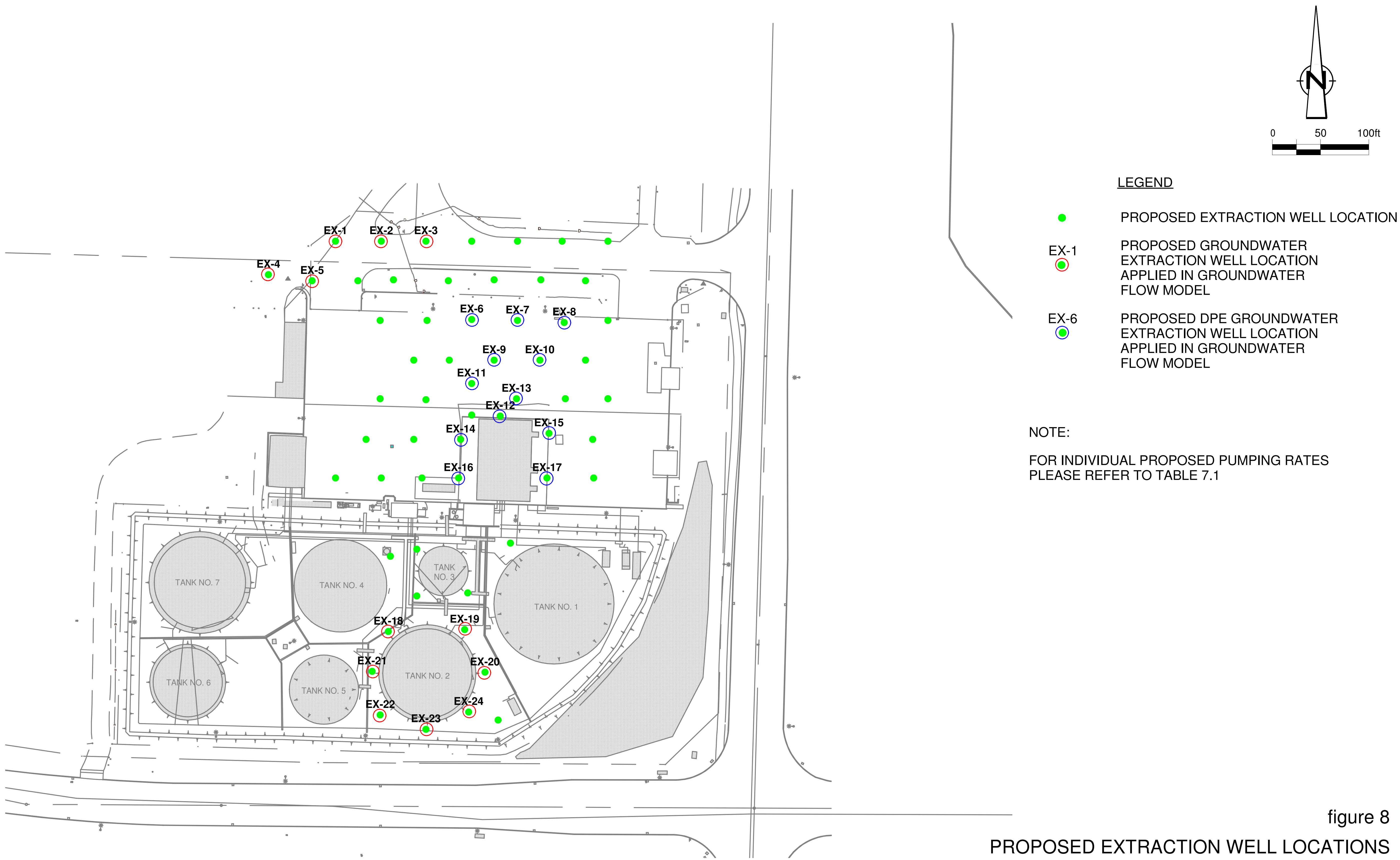
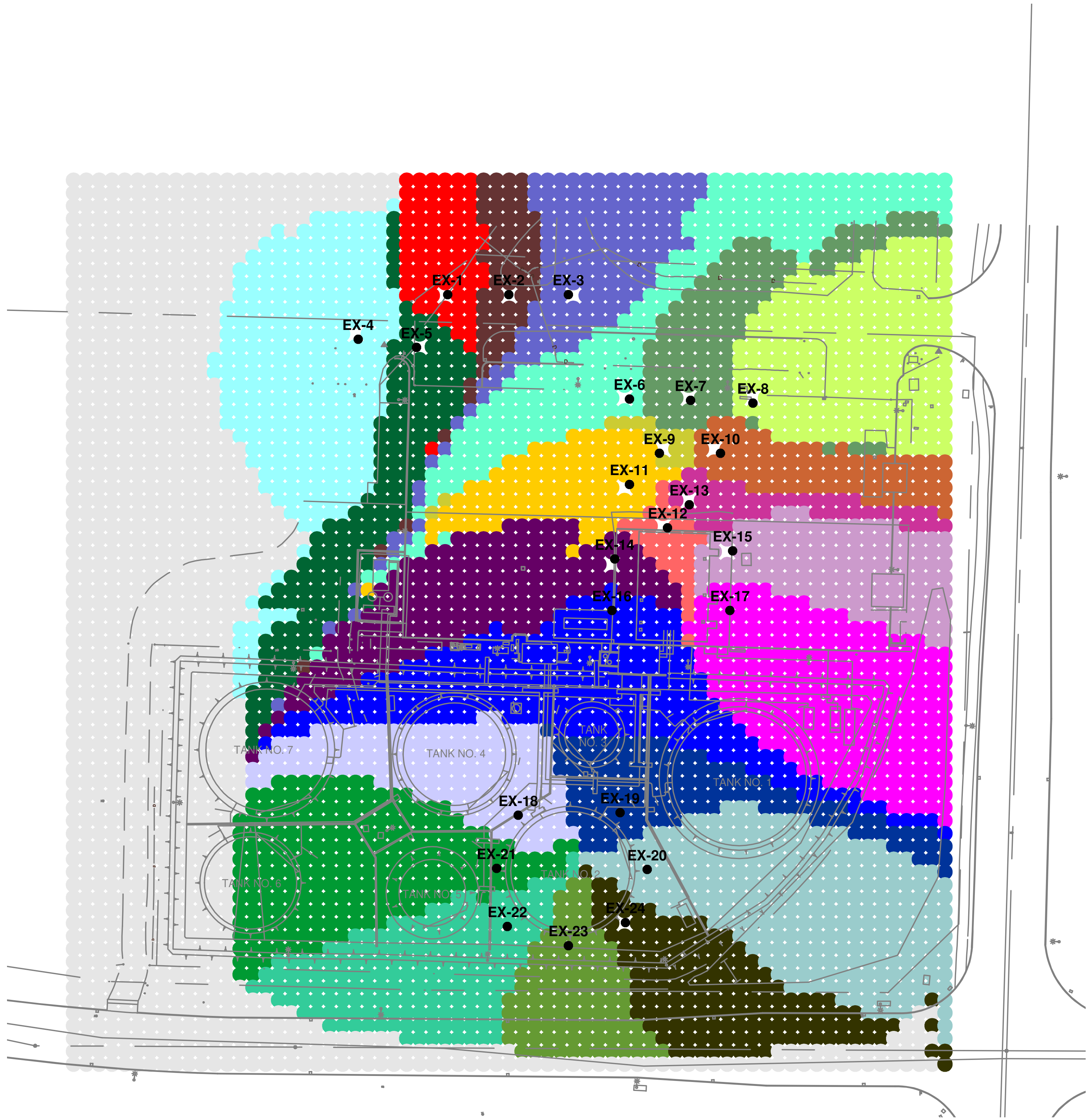
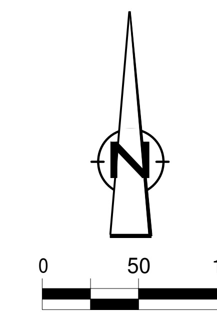


figure 8

PROPOSED EXTRACTION WELL LOCATIONS
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington





LEGEND

EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24

- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 9

BASE CASE EXTRACTION SCENARIO
CAPTURE OF RELEASED PARTICLES - FILL MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

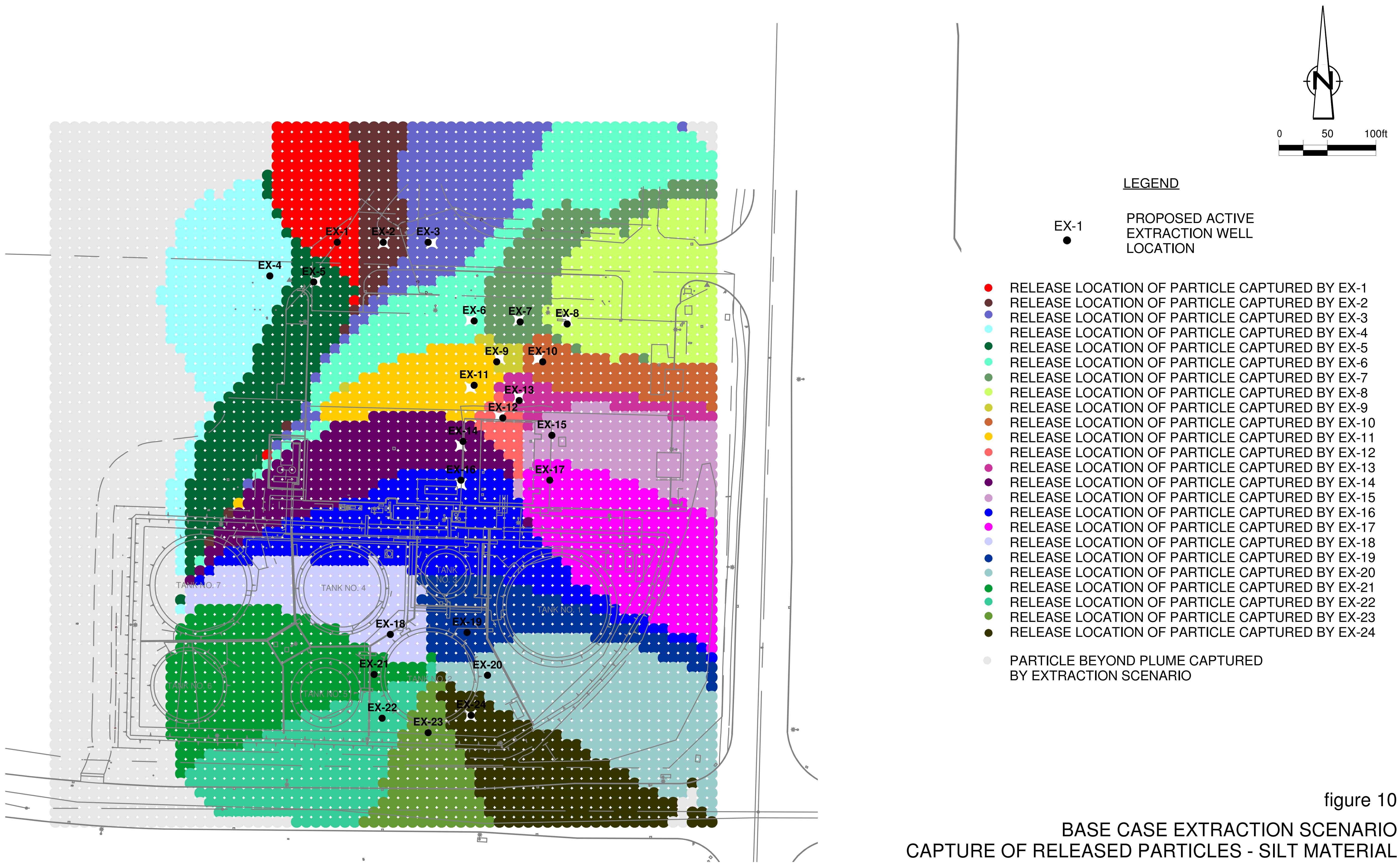


figure 10

BASE CASE EXTRACTION SCENARIO
CAPTURE OF RELEASED PARTICLES - SILT MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

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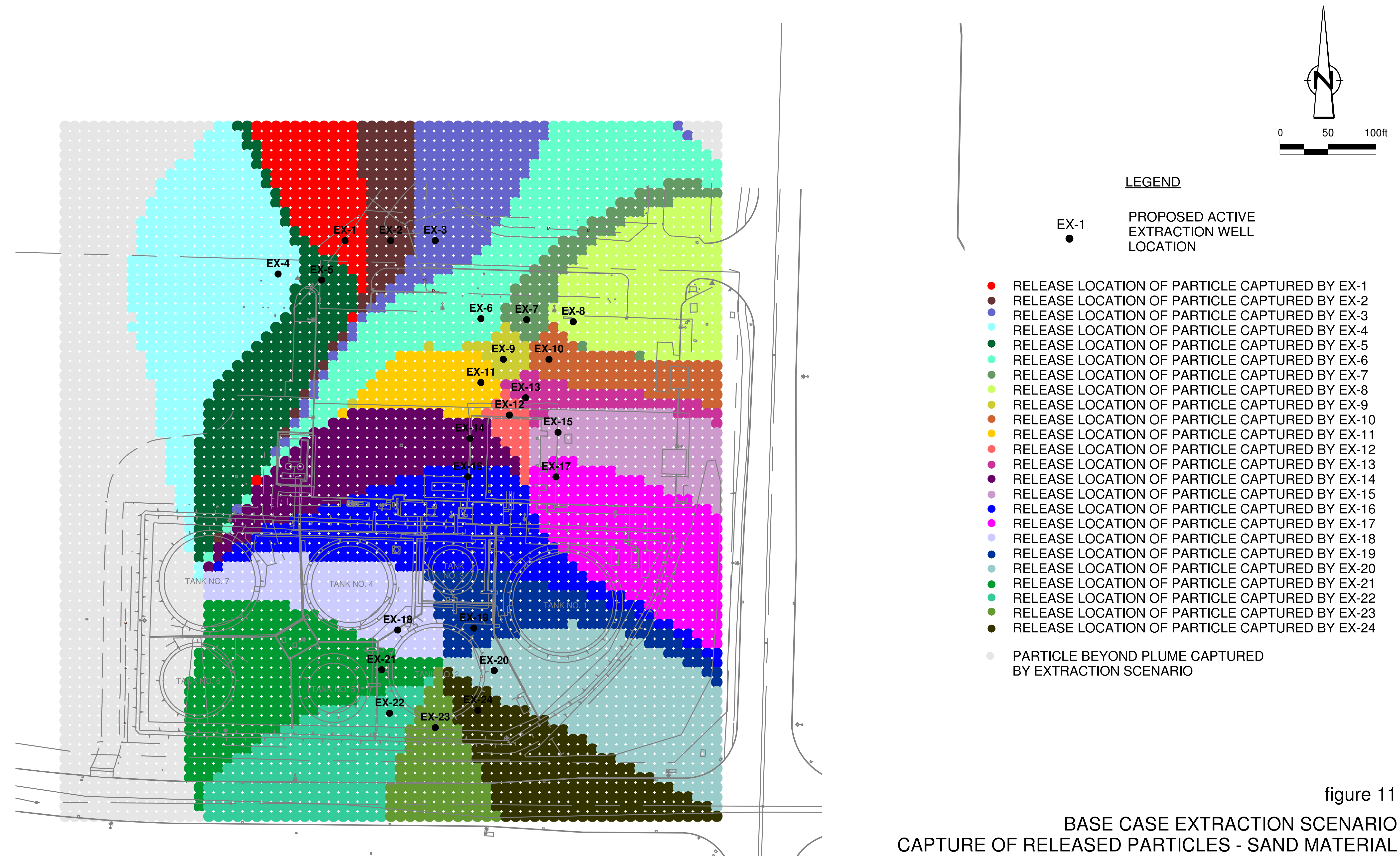


figure 11

BASE CASE EXTRACTION SCENARIO
CAPTURE OF RELEASED PARTICLES - SAND MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

070496-GWM00(027)GN-WA-HYD (N:\HEG\70496\GW Modeling\Report27\Figures\Figure 7.4.srf) JULY 23/2013

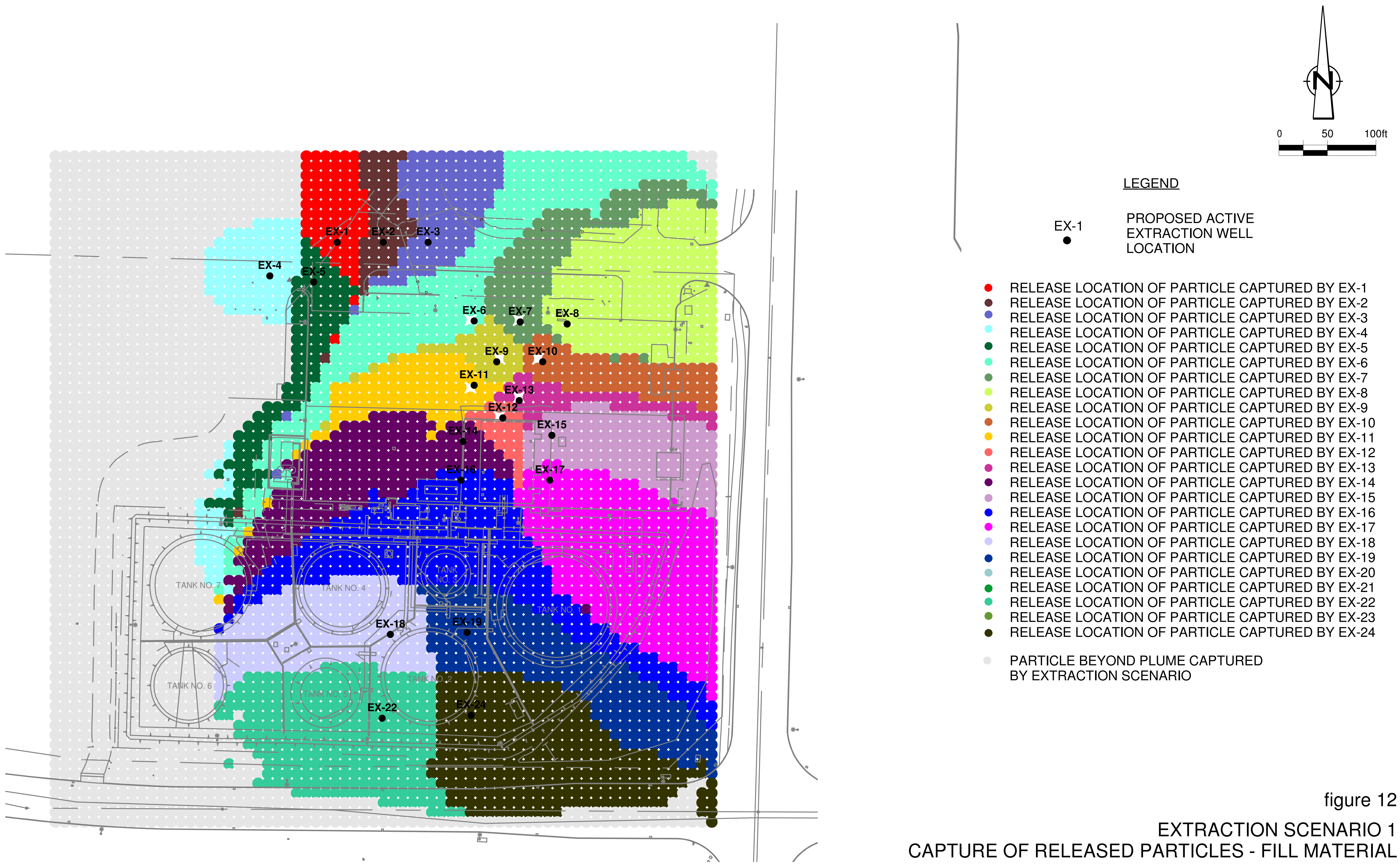
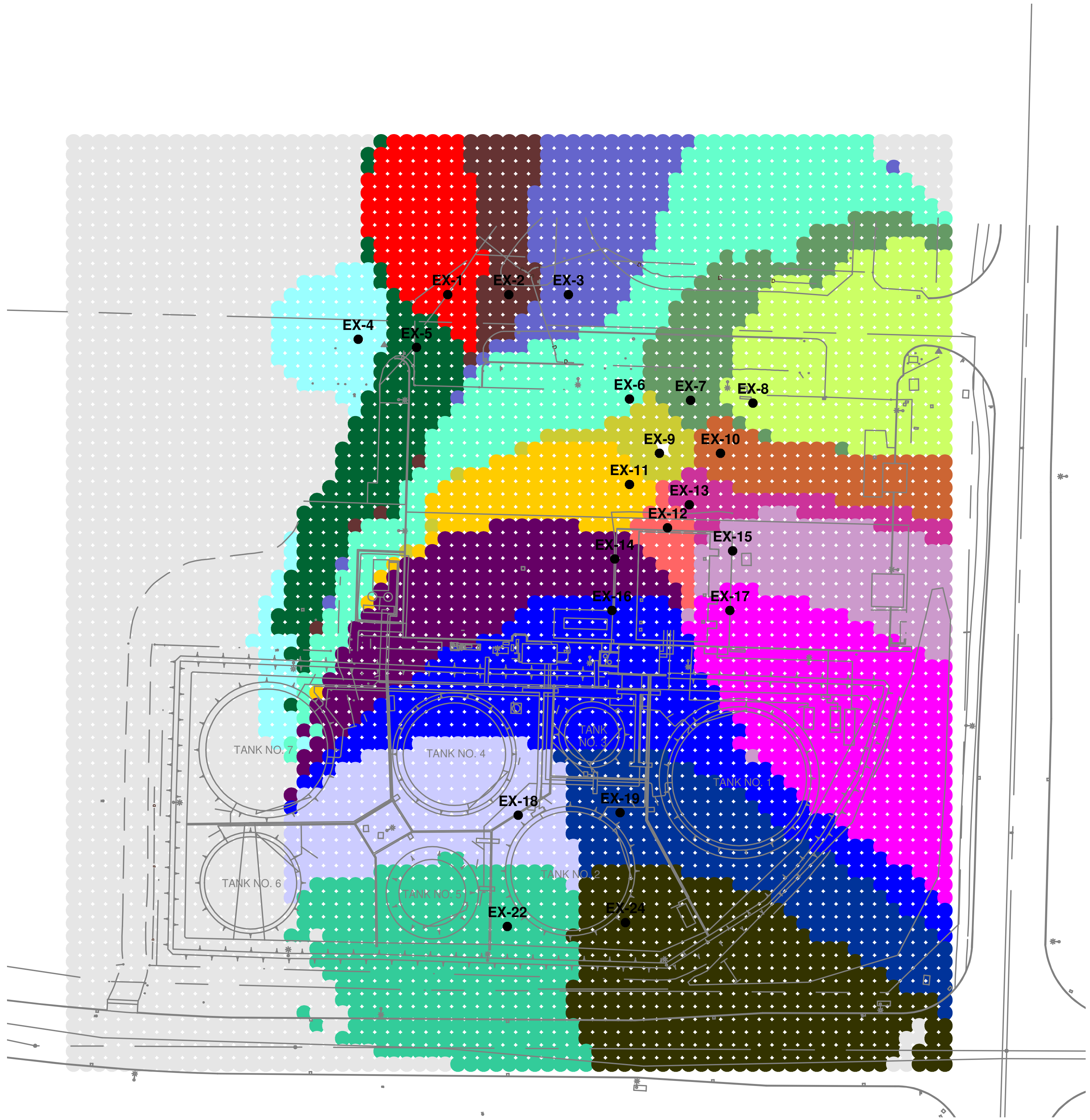
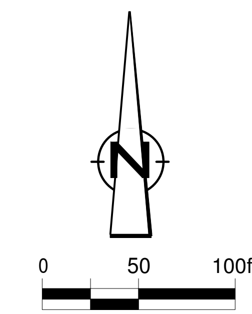


figure 12

EXTRACTION SCENARIO 1
CAPTURE OF RELEASED PARTICLES - FILL MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

070496-GWM00(027)GN-WA-HYD (N:\HEG\70496\GW Modeling\Report27\Figures\Figure 7.5.srf) JULY 23/2013





LEGEND

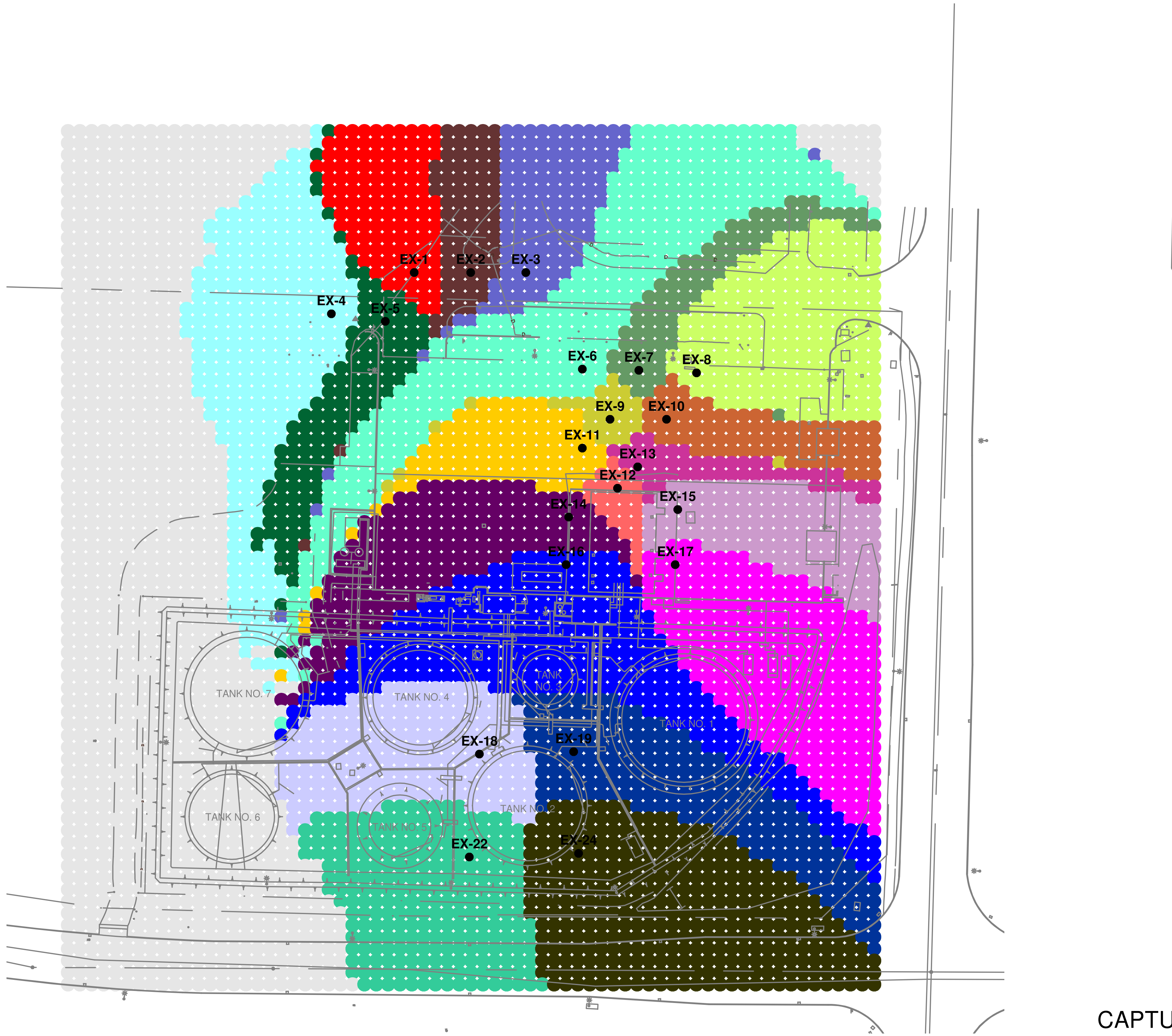
EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

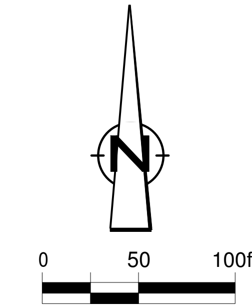
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24

- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 13

EXTRACTION SCENARIO 1
CAPTURE OF RELEASED PARTICLES - SILT MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington





LEGEND

EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

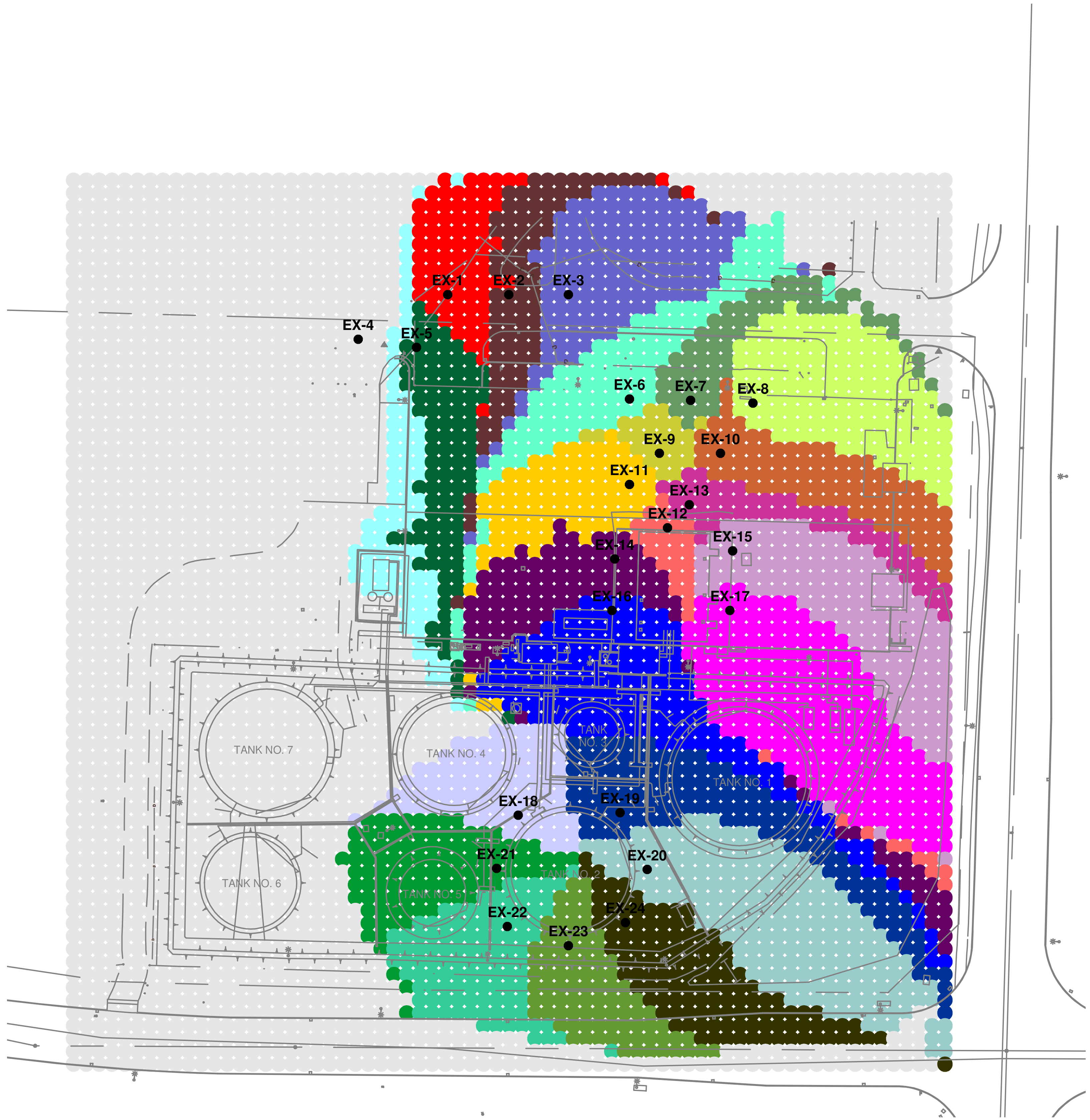
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24

- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 14

EXTRACTION SCENARIO 1
CAPTURE OF RELEASED PARTICLES - SAND MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

070496-GWM00(027)GN-WA-HYD (N:\HEG\70496\GW Modeling\Report27\Figures\Figure 7.7.srf) JULY 23/2013



N

0 50 100ft

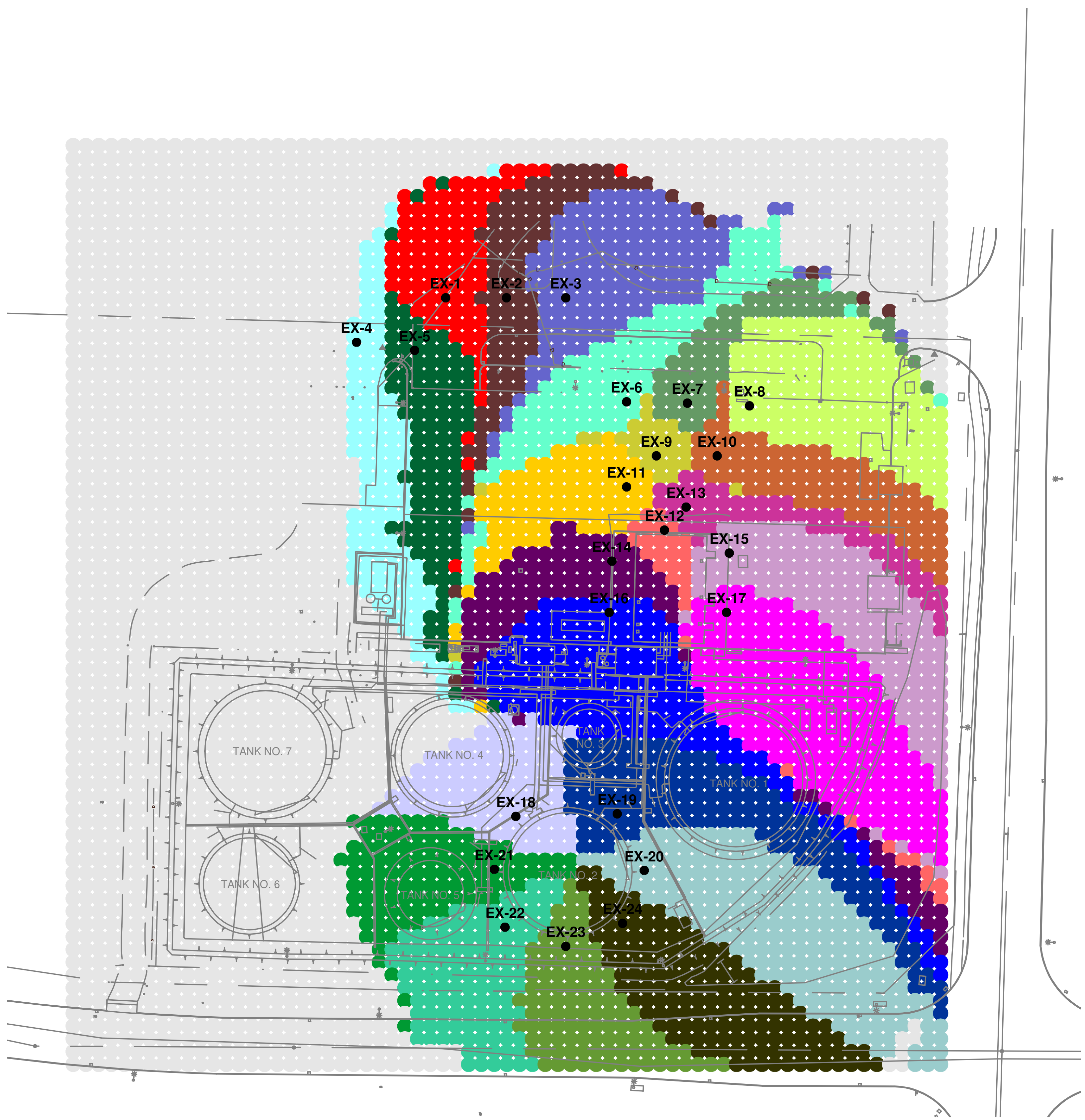
LEGEND

EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24
- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 15

EXTRACTION SCENARIO 2
CAPTURE OF RELEASED PARTICLES - FILL MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington



0 50 100ft

LEGEND

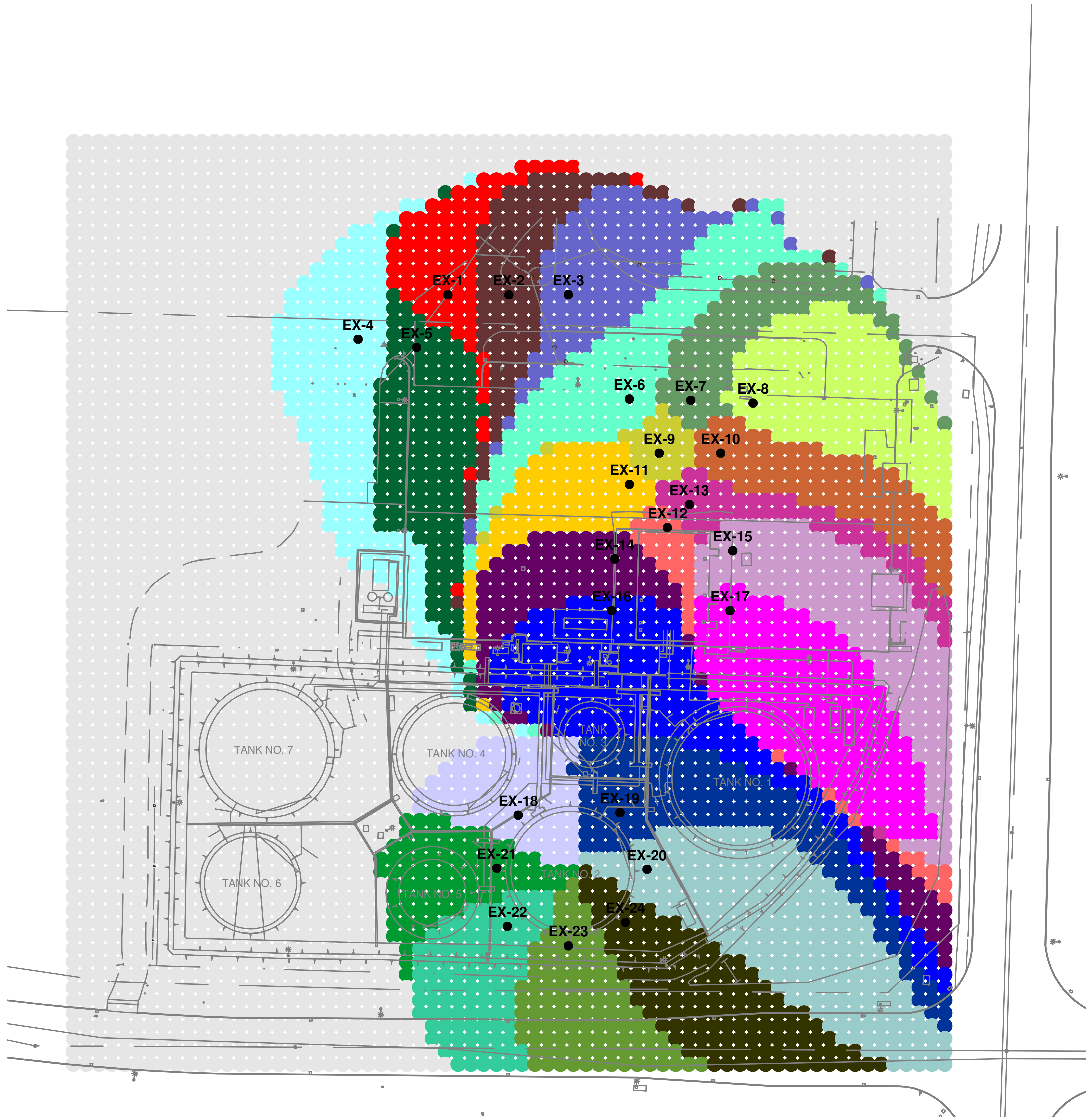
EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24

- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 16

EXTRACTION SCENARIO 2
CAPTURE OF RELEASED PARTICLES - SILT MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington



N

0 50 100ft

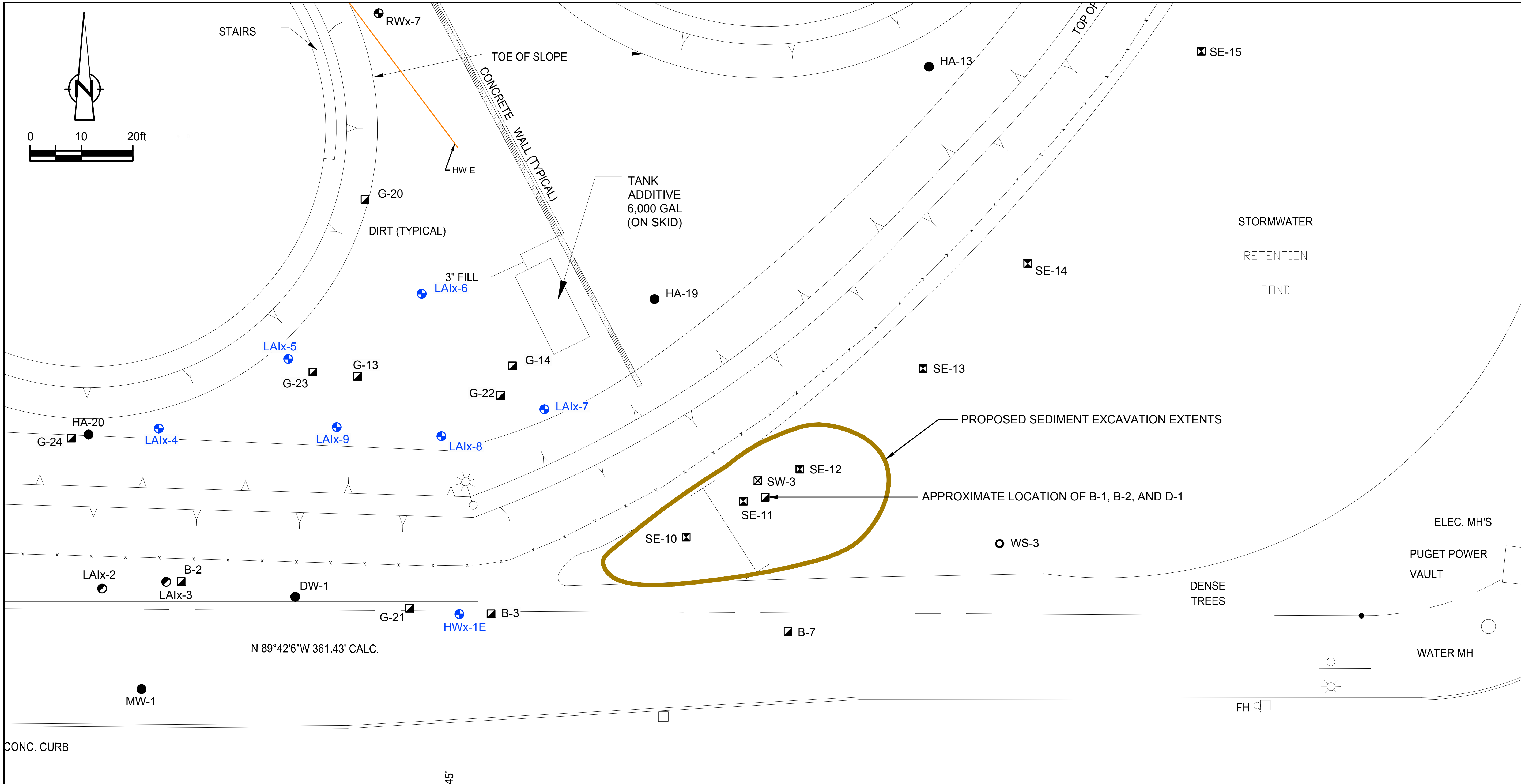
LEGEND

EX-1 ● PROPOSED ACTIVE EXTRACTION WELL LOCATION

- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-1
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-2
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-3
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-4
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-5
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-6
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-7
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-8
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-9
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-10
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-11
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-12
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-13
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-14
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-15
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-16
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-17
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-18
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-19
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-20
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-21
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-22
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-23
- RELEASE LOCATION OF PARTICLE CAPTURED BY EX-24
- PARTICLE BEYOND PLUME CAPTURED BY EXTRACTION SCENARIO

figure 17

EXTRACTION SCENARIO 2
CAPTURE OF RELEASED PARTICLES - SAND MATERIAL
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington



LEGEND

- MONITORING WELL
- ABANDONDED OR DESTROYED MONITORING WELL LOCATION
- 4" DIAMETER VERTICAL RECOVERY WELL (ACTIVELY PUMPING)
- 4" DIAMETER VERTICAL RECOVERY WELL (INACTIVE- NOT PUMPING)
- REMEDIATION WELL LOCATION
- SURFACE WATER SAMPLE LOCATION
- EXCAVATION SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- STAFF GAUGE LOCATION
- SOIL BORING LOCATION
- PROPOSED SEDIMENT EXCAVATION EXTENTS

figure 18

SITE PLAN WITH PROPOSED SEDIMENT EXCAVATION EXTENTS
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
Renton, Washington

SOURCE: STATEWIDE LAND SURVEYING INC., DATED 1/26/12.

70496-RI00(027)GN-WA008 APR 11/2014

TABLES

TABLE 1

SITE-SPECIFIC CLEANUP STANDARDS
PHILLIPS 66 RENTON TERMINAL
RENTON, WASHINGTON

Soil[1]

Chemical	*Concentration (mg/kg)*
Benzene	0.03
Toluene	7
Ethylbenzene	6
Total Xylenes	9
cPAHs[3]	2
Naphthalenes[4]	5
TPHg	30
TPHd	2,000
TPHo	2,000

Groundwater[2]

Chemical	*Concentration (µg/L)*
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylenes	1,000
MTBE	20
Lead	15
cPAHs[3]	0.1
Naphthalenes[4]	160
Methylene Chloride	5
Vinyl Chloride	0.2
Arsenic	5
EDC	5
TPHg	800
TPHd	500
TPHo	500

Soil/Sediment[5]

Chemical	*Concentration (mg/kg TOC)*
Benzene	0.03
Toluene	7
Ethylbenzene	6
Total Xylenes	9
cPAHs[3]	2
Naphthalenes[4]	5
TPHg	30
TPHd	2,000
TPHo	2,000

Surface Water[6]

Chemical	*Concentration (µg/L)*
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylenes	1,000
TPHg	800
TPHd	500
TPHo	500

Notes:
1 Soil cleanup levels based on MTCA Method A cleanup levels for industrial properties
2 Groundwater cleanup levels based on MTCA Method A cleanup levels
3 cPAHs equal the sum of each cPAH analyte multiplied by the MTCA toxicity factor
4 Napthalenes equal the sum of 1-Methylnaphthalene, 2-Methylnaphthalene, and Naphthalene
5 Soil/sediment cleanup levels for soil/sediment in the retention basin are based on MTCA Method A cleanup levels for industrial properties
6 Surface water cleanup levels for water collected in the retention basin are based on MTCA Method A cleanup levels for groundwater

TABLE 2

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PHILLIPS 66 RENTON TERMINAL
RENTON, WASHINGTON

Local ARARs	
King County Industrial Waste Local Discharge Limits	(King County Code 28.84.060)
Puget Sound Clean Air Agency	(PSCAA Regulation I,II, and III)
Current Electrical Laws	(Chapter 296-46B WAC)
Building and Fire Prevention Standards	(Renton Municipal Code Chapter 4-5)
State ARARs	
Model Toxics Control Act Cleanup	(Chapter 173-340 WAC)
Sediment Quality Standards	(Chapter 173-203-320 WAC)
Regulation and Licensing of Well Contractors and Operators	(Chapter 173-162 WAC)
State Environmental Policy Act (SEPA)	(Chapter 197-11, 173-802 WAC)
Minimum Functional Standards for Solid Waste Handling	(Chapter 173-304 WAC)
Washington Dangerous Waste Regulations	(Chapter 173-303 WAC)
Federeal ARARs	
The Clean Water Act	(33 USC 1251 et seq.)
National Toxics Rule	(40 CFR 131)
Resource Conservation and Recovery Act (RCRA)	(40 CFR 260-268)
National Primary Drinking Water Regulations	(40 CFR 141)

Notes:

ARAR Applicable or Relevant and Appropriate Requirements
WAC Washington Administrative Code
USC United States Code
CFR Code of Federal Regulations

TABLE 3

PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES
PHILLIPS 66 TERMINAL
2423 LIND AVENUE SOUTHWEST
RENTON, WASHINGTON

Potential Remedial Technology	*Description*	*Effectiveness*	*Implementability*	*Short-term Risk*	*Cost*
Monitored Natural Attenuation	Petroleum hydrocarbons in soil and groundwater will naturally degrade over time without treatment. MNA does not include any active remediation to remove or treat hydrocarbons in the subsurface. Natural attenuation is monitored through collection of groundwater concentration data until cleanup objectives have been met.	Is eventually effective, but considering the magntitude of hydrocarbon impacts, it will take an unacceptably long time. It also will do nothing to prevent migration of the current impacts offsite, potentially impacting the sensitive wetland receptor.	Easily implementable, but is not considered an effective remedy.	Would likely affect human health or the environment through impact to the adjacent wetland receptor.	Low
Groundwater Extraction	A network of groundwater extraction wells would be operated within the main area of the plume to remove source and at the site boundaries to hydraulically control the plume from migrating offsite and impacting the adjacent wetlands. Extracted groundwater is conveyed to a fixed system for treatment prior to discharge under permit to the sanitary sewer or to surface water.	Effective at eliminating risk, but would not reduce concentrations quickly.	Not difficult to implement, but would require construction of groundwater extraction wells, conveyance piping, and treatment system. Operation would be extremely lengthy given the magnitude of the existing LNAPL source.	May be some risk during construction of system. Minimal risk to human health and environment during operation.	Low to Moderate
Excavation	Removal of impacted soil source with treatment of soil and/or off-site disposal	Highly effective	Not feasible unless existing site use is curtailed and overlying structures are demolished	May be some risk during execution of the excavation work. May still affect human health or the environment without proper dissolved plume controls.	High*
Multi-Phase Extraction	Remedy includes groundwater extraction in the area of soil source to dewater and expose soil source concurrent with soil vapor extraction to volatilize and remove petroleum hydrocarbon impacts. Extracted groundwater and soil vapor will be treated aboveground at a fixed treatment compound located on-site.	Based on results of operation of existing interim remediation systems and on results of additional feasibility testing, MPE will be moderately effective at reducing source mass.	System will be reasonably easy to implement, but the spacing of extraction wells may be limited due to the existence of current buildings and other features at the facility.	May be some risk during construction of system. Minimal risk to human health and environment during operation.	Moderate to High
Biological Treatment with Surfactant Flushing Pre-Treatment and Limited Groundwater Recovery	In-situ bioremediation (aerobic or anaerobic) is a treatment process whereby contaminants are metabolized into less toxic or non-toxic compounds by naturally occurring microorganisms. Biological treatment would not be effective in the presence of significant LNAPL source; therefore, surfactant flushing would be implemented to mitigate LNAPL source prior to implementing biological treatment.	The likelihood of success for surfactant flushing to adequately mitigate LNAPL source is very low. In addition, the likelihood of success with biological treatment is also considered very low.	Both surfactant application and biological treatment are reasonably easy to implement, although it may take many applications of both treatments to achieve cleanup objectives, or to determine it is technically infeasible.	There may be some risk during treatment applications. There is also risk to human health and environment due to increased mobilization of hydrocarbon plume in groundwater. A series of groundwater extraction wells downgradient of the source area and at the plume boundaries adjacent to the wetlands would be required to mitigate impact to	Moderate to High
Chemical Oxidation	The use of strong oxidizing agents to oxidize contaminants into non-toxic byproducts.	Effective in reducing groundwater concentrations, but would likely be ineffective at treating LNAPL source in soil. Chemical oxidation is also not considered safe to implement with the presence of significant LNAPL source	Relatively easy to implement, but it would not be considered safe to implement this technology at this site due to the presence of significant LNAPL source in soil.	Highly risky to implement in the presence of significant LNAPL source in soil. May affect human health or the environment without proper controls	Moderate
Soil Vapor Extraction / Air-sparging	Removes hydrocarbon compounds from soil beneath the water table by injecting air into the substrate to volatilize compounds and extracting vapors from the vadose zone to remove volatilized compounds. Extracted soil vapor is treated aboveground at a fixed treatment compound.	Will not be effective at this site based on lithology beneath the facility. A lithologic barrier exists above the soil source that will limit the migration of volatilized hydrocarbons into the	System would be reasonably easy to implement, but this is not considered an effective remedy	May be some risk during construction of system. May affect human health or the environment due to lack of hydraulic control of plume.	Moderate to High

* The cost evaluation of excavation is based current facility use. Excavation of all impacted soil would require removal of the existing buildings, and construction of a new structure. If and when the facility use changes, the cost will change from high to moderate.

DISPROPORTIONATE COST ANALYSIS
PHILLIPS 66 TERMINAL
2423 LIND AVENUE SOUTHWEST
RENTON, WASHINGTON

Alternative No.	1				2				3			
Remediation Type	Dual-Phase Extraction				Groundwater Extraction				In-Situ Enhanced Biodegradation (with Surfactant Pre-Treatment and Limited Groundwater Recovery)			
Ranking Criteria												
1. Meets All Cleanup Action Objectives	Yes				Yes				Yes			
2. Compliance with MTCA Threshold Criteria [WAC 173-340-360 (2)(a)]												
- Protect Human health and the environment	Yes				Yes				Yes			
- Comply with cleanup standards	Yes				Yes				Yes			
- Comply with applicable state/federal laws	Yes				Yes				Yes			
- Provide for compliance monitoring	Yes				Yes				Yes			
3. Restoration Timeframe [WAC 173-340-360 (2)(b)(ii) and WAC 173-340-360 (4)]												
- Potential risks posed by the site to human health and the environment	Low				Low				Low			
- Practicability of achieving a shorter restoration time frame	See DCA below				See DCA below				See DCA below			
- Affect on current site use, surrounding areas and associated resources	Low, Industrial Site				Low, Industrial Site				Low, Industrial Site			
- Affect on future site use, surrounding areas and associated resources	Low, Industrial Site				Low, Industrial Site				Low, Industrial Site			
- Availability of alternative water supplies	Water supplied by City of Renton				Water supplied by City of Renton				Water supplied by City of Renton			
- Likely effectiveness and reliability of institutional controls	High				High				High			
- Ability to control and monitor migration of hazardous substances from the site	High				High				High			
- Toxicity of the hazardous substances at the site	Low				Low				Low			
- Natural processes that reduce concentration of hazardous substances	Low to Moderate				Low to Moderate				Low to Moderate			
Overall Reasonable Restoration Timeframe	Yes				Yes				Yes			
4. Relative Benefits Ranking for DCA [WAC 173-340-360 (2)(b)(i) and WAC 173-340-360(3)(f)]												
	Comparative ranking	Score	Weighing factor	Weighted Score	Comparative ranking	Score	Weighing factor	Weighted Score	Comparative ranking	Score	Weighin g factor	Weighted Score
- Overall Protectiveness	Medium High	8	0.3	2.4	Medium	6	0.3	1.8	edium Low to Mediu	5	0.3	1.5
- Permanence	Medium High	8	0.2	1.6	Medium	6	0.2	1.2	Medium Low	4	0.2	0.8
- Long-term effectiveness	dium High to H	7	0.2	1.4	edium Low to Mediur	5	0.2	1	Low to Medium Low	3	0.2	0.6
- Manageability of Short Term Risk	dium High to H	7	0.1	0.7	Medium Low	4	0.1	0.4	Low	2	0.1	0.2
- Implementability	Medium High	8	0.1	0.8	Medium High	8	0.1	0.8	edium to Medium Hi	7	0.1	0.7
- Consideration of Public Concerns	Medium High	8	0.1	0.8	Medium High to High	7	0.1	0.7	Medium	6	0.1	0.6
Comparative Overall Benefit				7.7				5.9				4.4
5. Disproportionate Cost Analysis												
- Estimated Remedy Cost	$3,856,000				$14,969,000				$8,504,000			
- Magnitude of Cost Compared to Lowest Cost Alternative	---				388%				221%			
- Relative Remedy Costs	1.00				3.88				2.21			
- Magnitude of relative benefit to most permanent alternative	100%				77%				75%			
- Relative Comparative Benefit	1.75				1.34				1.00			
- Ratio of Relative Remedy Cost to Relative comparative benefit	0.57				2.90				2.21			
- Costs disproportionate to incremental benefits?	No				Yes				Yes			
- Remedy permanent to the maximum extent practicable?	Yes				Yes				Yes			
Preferred Alternative for Cleanup?	**Yes**				**No**				**No**			

Comparative Ranking Scale

Very Low	1
Low	2
Low to Medium Low	3
Medium Low	4
Medium Low to Medium	5
Medium	6
Medium to Medium High	7
Medium High	8
Medium High to High	9
High	10

TABLE 5

SUMMARY OF REMEDIAL SCENARIO EXTRACTION WELLS AND PUMPING RATES
PHILLIPS 66 RENTON TERMINAL
2423 LIND AVENUE SW
RENTON, WASHINGTON

	Proposed Groundwater Extraction Rate (US GPM)		
	Base Case	*Scenario 1*	*Scenario 2*
Proposed Extraction Wells :			
EX-1	2.0	0.5	0.25
EX-2	2.0	0.5	0.25
EX-3	2.0	0.5	0.25
EX-4	2.0	0.5	0.25
EX-5	2.0	0.5	0.25
EX-6	2.0	1.5	0.25
EX-7	2.0	1.5	0.25
EX-8	2.0	1.5	0.25
EX-9	2.0	1.5	0.25
EX-10	2.0	1.5	0.25
EX-11	2.0	1.5	0.25
EX-12	2.0	1.5	0.25
EX-13	2.0	1.5	0.25
EX-14	2.0	1.5	0.25
EX-15	2.0	1.5	0.25
EX-16	2.0	1.5	0.25
EX-17	2.0	1.5	0.25
EX-18	2.0	0.5	0.25
EX-19	2.0	0.5	0.25
EX-20	2.0	0	0.25
EX-21	2.0	0	0.25
EX-22	2.0	0.5	0.25
EX-23	2.0	0	0.25
EX-24	2.0	0.5	0.25
Total Proposed Pumping (US GPM):	48.0	27.0	6.0
Total Pumping Achieved in Model (US GPM)(1):	47.3	26.9	6.0

Notes:
* Groundwater extraction as a result of DPE vapor extraction process.
[shaded] Extraction well becomes dry in model layer 1 corresponding to fill material.
(1) Flow within model layer 1 (fill material) cannot be sustained at all pumping locations, thereby reducing the overall achieved pumping rate.

TABLE 6

GENERAL SCHEDULE FOR IMPLEMENTATION OF REMEDIAL ACTIONS IN THE CAP
PHILLIPS 66 RENTON TERMINAL
RENTON, WASHINGTON

Activity	**Deliverables**	**Due Dates in Calendar Days***
Dual Phase Extraction (DPE) System Draft Design	• Draft Engineering Design Report (EDR) • Draft Compliance Monitoring Plan (CMP) • Draft Operation and Maintenance Plan (OMP) • Draft Environmental Covenant for Soil and Groundwater	90 days after effective date of the Agreed Order.
Dual Phase Extraction (DPE) System Final Design	• Final Engineering Design Report (EDR) • Final Compliance Monitoring Plan (CMP) • Final Operation and Maintenance Plan (OMP)	Within 30 days after Ecology approval of draft documents
Environmental Covenant for Soil and Groundwater submitted to County recorder as part of Property Deed	Environmental covenant (using Ecology boilerplate, subject to final approval by Ecology)	30 days after approval of Environmental Covenant by Ecology.
Retention Pond cleanup (soil excavation and confirmation sampling)	Retention Pond cleanup action report	To be carried out in accordance with schedule in EDR.
Draft Cleanup Action Report to Ecology	Draft Cleanup Action Report	Within 120 days of completion of DPE system construction
Submit Final Cleanup Action Report to Ecology	Final Cleanup Action Report	Within 60 days of receiving Ecology's approval of the Draft Cleanup Action Report.
DPE Performance and Confirmation Monitoring	Quarterly Remediation Progress Reports and other Reports as detailed in CMP	Estimated duration of six (6) years after DPE system design, including one year of confirmation monitoring following system shutdown.
Preliminary Evaluation of Effectiveness of DPE Cleanup and MTCA compliance of site	Draft DPE Cleanup Report (to include decision on post-DPE remedial action if it is concluded that DPE system has reached its limit of practical contaminant recovery)	• 45 days after DPE System Shutdown, **or** • 45 days after such time that it is demonstrated that DPE System has reached its limits of practical contaminant recovery (subject to Ecology approval).
Final Evaluation of Effectiveness of DPE Cleanup and MTCA compliance of site	Final DPE Cleanup Report	Within 60 days of receiving Ecology's approval of Draft DPE Cleanup Report
Post-DPE remedial actions (based on recommendation of Final DPE Cleanup Report	Supplemental Cleanup Plan that will implement any or all of the following: • Monitored Natural Attenuation • Ecology Approved Environmental Covenant for Groundwater and conditional points of compliance • Other Active Corrective Remedial Action Proposals subject to Ecology Approval	90 days after Ecology approval of DPE Cleanup Report.
Five Year Periodic Reviews	Reports or Memoranda as detailed in CMP	Reports or memoranda to be submitted no less than 90 days before scheduled periodic review meeting with Ecology.

***** *An extension to the listed due dates may be granted by Ecology under the terms of the Agreed Order.*

APPENDIX A

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

This document presents standard field methods for drilling and sampling soil borings and installing, developing and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

SOIL BORINGS

Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor or staining, and to collect samples for analysis at a State-certified laboratory. All borings are logged according to the Unified Soil Classification System by a trained geologist working under the supervision of a California Professional Geologist (PG).

Soil Boring and Sampling

Soil borings are typically drilled using hollow-stem augers or direct-push technologies such as the Geoprobe®. Soil samples are collected at least every five feet to characterize the subsurface sediments and for possible chemical analysis. Additional soil samples may be collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments at the bottom of the borehole.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent and rinsed twice.

Sample Analysis

Sampling tubes chosen for analysis are trimmed of excess soil, covered with Teflon tape, and capped with plastic end caps. Soil samples are labeled and stored at or below 4° C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytical laboratory.

Field Screening

Soil is removed from one of the remaining tubes and placed in a plastic bag which is set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a photo ionization detector measures volatile hydrocarbon vapor concentrations in the bag, extracting the vapor through a small hole in the bag. Volatile vapor analyzer measurements are used along with the field observations, odors, stratigraphy and groundwater depth to select soil samples for analysis.

Water Sampling

Water samples, if they are collected from the boring, are either collected using a driven Hydropunch® type sampler or are collected from the open borehole using bailers. The groundwater samples are decanted into the appropriate containers supplied by the analytical laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Grouting

If the borings are not completed as wells, the borings are filled to the ground surface with cement or bentonite grout poured or pumped through a tremie pipe.

MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

Well Construction and Surveying

Groundwater monitoring wells are installed to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 fee below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand is placed in the annular space between the boring and the well screen to about one to two feet above the well screen. A three feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of either Portland type I,II cement or bentonite grout. A three foot thick concrete surface seal extends from the surface to the top of the grout.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface.

The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

Well Development

Wells are generally developed using a combination of groundwater surging and extraction. This process can occur prior to installing the sanitary surface seal to ensure sand pack stabilization. If development occurs after surface seal installation, then development occurs at least 48 hours after seal installation to ensure that the Portland cement or bentonite grout has set up correctly. Surging agitates the groundwater and dislodges fine sediments from the sand pack. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible.

All equipment is steam-cleaned prior to use. Wells are not sampled until at least 72 hours after they are developed.

Groundwater Sampling

1.5 borehole volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized. Groundwater samples are collected using bailers or pumps and are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Waste Handling and Disposal

Soil cuttings from drilling activities are usually placed in sealed 55-gallon drums or stockpiled onsite and covered by plastic sheeting. At least three individual soil samples are collected from the stockpiles and composited at the analytical laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples in addition to any analytes required by the receiving disposal facility. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Groundwater removed during development and sampling is typically stored onsite in sealed 55-gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Upon receipt of analytic results, the water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.

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