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REMEDIAL ACTION WORK PLAN ADDENDUM NO. 1

**MANHATTAN VILLAGE SHOPPING CENTER AND
HARRIS PROPERTIES
VCP NW1873
NORMANDY PARK, WASHINGTON**

JUNE 29, 2021

By:

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Activated Carbon
AS	Air Sparging
bgs	Below Ground Surface
CID	Contained-In Determination
CUL	Cleanup Level
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ft	Foot (or feet)
gpm	Gallons per Minute
Manhattan Cleaners	Manhattan Cleaners and Coin-Op Laundry
µg/L	Micrograms per Liter (parts per billion)
µg/m ³	Micrograms per Cubic Meter
mg/kg	Milligrams per Kilogram (parts per million)
mg/L	Milligrams per Liter (parts per million)
MTCA	Model Toxics Control Act
MVSC	Manhattan Village Shopping Center
NAVD 88	North American Vertical Datum of 1988
NFA	No Further Action
O&M	Operation and Maintenance
ORP	Oxidation Reduction Potential
PCE	Perchloroethylene/Tetrachloroethylene
PES	PES Environmental, Inc.
PFM	Passive Flux Meter
PID	Photo-Ionization Detector
PQL	Practical Quantitation Limit
PRB	Permeable Reactive Barrier
PSI	Pounds per Square Inch
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RPI	Remediation Products Incorporated Group
RRS	Regenesis Remediation Systems
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TEE	Terrestrial and Ecological Evaluation
UIC	Underground Injection Control
VCP	Voluntary Cleanup Program
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
ZOI	Zone of Influence
ZVI	Zero Valent Iron

1.0 INTRODUCTION

PES Environmental, Inc. (PES) has prepared this addendum to the 2016 Remedial Action Work Plan¹ (RAWP) on behalf of Manhattan Tenants in Common and the Harris Family, LTD to describe updates to the final cleanup action to be implemented at the Manhattan Village Shopping Center (MVSC) property located at 17835 First Avenue South (the “MVSC property”) and the Harris property located at 17817 – 17825 First Avenue South in Normandy Park, Washington (the “Harris property”), collectively referred to as the “Property.” The location and current features of the Property are shown on Figures 1 and 2.

All areas where hazardous substances released from historical dry cleaning operations at the Property have come to be located, whether on or off the Property, together constitute a “site” under the Model Toxics Control Act (MTCA), Chapter 70.105D RCW and its associated Cleanup Regulations, Chapter 173-340 of the Washington Administrative Code (WAC; collectively, MTCA). This site is referred to in this report as “the Site”.

In March 2017, Mr. Christopher Maurer at Washington State Department of Ecology (Ecology) reviewed the RAWP, agreed that the workplan was likely to bring the Site into compliance with State standards, and requested minor corrections related to the description of the terrestrial and ecological evaluation (TEE) in Appendix F. PES made the minor text corrections in Sections 3.3.3 and 4.3, inserted the corrected pages into the RAWP, and resubmitted the updated RAWP to Ecology along with two status reports in a transmittal dated May 8, 2018². Since the edits were minor, the RAWP retained its original title and October 2016 date.

1.1 Purpose

The scope of work described in the RAWP has been completed to the extent practicable. The air sparging (AS) and soil vapor extraction (SVE) systems were started-up in October 2016 and have been operated as planned to address the remedial action objectives (RAOs) identified in the RAWP. Operation of the remediation systems and natural attenuation has resulted in notable decreases in contaminant concentrations in soil and groundwater throughout the majority of the Site, and the RAOs have largely been achieved. There are a few areas, however, where additional remediation is needed to further minimize the potential for indoor air risks to nearby commercial building occupants, prevent additional off-Property migration of the tetrachloroethylene (PCE)-impacted groundwater beneath the north-central part of the Harris property, and allow for faster natural attenuation of the off-Property groundwater concentrations to below the cleanup standard. The primary purpose of preventing additional off-Property migration of the PCE-impacted groundwater is to obtain Property-specific no further action (NFA) opinions while the off-Property groundwater concentrations are naturally attenuating to below the cleanup standard. Institutional controls to prevent the use of the groundwater beneath the Harris property would be required for the Property-specific NFA. A Site-wide NFA may be

¹ PES. 2016. *Remedial Action Work Plan, Manhattan Village Shopping Center and Harris Properties, VCP NW1873, Normandy Park, Washington*. October.

² PES. 2018. *Remedial Action Work Plan and Status Report Submittals, Manhattan Village Shopping Center and Harris Properties, VCP NW1873, Normandy Park, Washington*. May 8.

pursued after the PCE concentrations in the groundwater throughout the Site have attenuated to below the cleanup standard.

The purpose of RAWP Addendum No. 1 is to describe additional remedial measures designed to enhance and expedite the ongoing cleanup such that the remaining risks associated with the PCE-impacted soil can be reduced to acceptable levels and that the off-Property groundwater concentrations can more rapidly attenuate to below the cleanup standard. This report describes the strategy for implementing and monitoring the recommended remedial measures, provides supporting background information, and describes the criteria and metrics for determining when to request Ecology's opinion on whether conditions on the Property are protective of human health and the environment such that Property-Specific NFAs may be issued.

We request that Ecology provide an opinion on the likelihood that implementation of the proposed scope of work will result in the reduction of environmental risks to acceptable levels and allow for the issuance of Property-specific NFAs (with the implementation of institutional controls as needed). In addition, we request that Ecology provide an opinion on the likelihood that the implementation of the proposed scope of work will result in the Site meeting the applicable cleanup standards and allow for the issuance of a Site NFA determination, if requested.

1.2 Current Status of Remediation

Implementation of the RAWP has been documented in multiple status reports submitted to Ecology that cover the reporting periods from October 2016 through December 2019^{3,4,5,6}. This report relies on and makes references to the information contained in these status reports. In addition to the status reports, Matt Dahl of PES and Mike Staton of SLR International Corporation met with Mr. Maurer of Ecology on August 30, 2018 to discuss the status of the remediation and the proposed plans.

The following includes a summary of items discussed with Mr. Maurer, information included in the status reports, and references data collected in 2020 and 2021 which has not previously been submitted to Ecology. The more recent data, which in general support the conceptual site model discussed with Mr. Maurer and documented in the progress reports, is summarized in this report, and will be described in detail in the forthcoming status report covering the period from January 2020 through June 2021.

The AS/SVE system (installed in 2016 and expanded in 2021; see Figures 3, 4, and 5) was designed to treat source area soil and groundwater and to allow treated groundwater to flow through and cause downgradient areas to naturally attenuate. The source area treatment largely

³ PES. 2017. *Status Report – October 2016 through April 2017, Manhattan Village Shopping Center and Harris Properties, Normandy Park, Washington*. July 19.

⁴ PES. 2018. *Status Report – May 2017 through October 2017, Manhattan Village Shopping Center and Harris Properties, Normandy Park, Washington*. January 17.

⁵ PES. 2019. *Status Report – November 2017 through December 2018, Manhattan Village Shopping Center and Harris Properties, Normandy Park, Washington*. July 2.

⁶ PES. 2020. *Status Report – 2019, Manhattan Village Shopping Center and Harris Properties, Normandy Park, Washington*. May 29.

proceeded as planned and has reduced PCE concentrations in groundwater to below the MTCA Method A Cleanup Level (CUL) for more than a year on the entire MVSC property and on the southern half of the Harris property. The northern (downgradient) portion of the contaminant plume has become detached from the source area, and PCE concentrations are trending downward. The rate of natural attenuation, however, is slower than originally anticipated in the RAWP, likely due to back diffusion of residual contaminants from finer grained soil within the historical groundwater plume. Back diffusion in groundwater typically occurs when contaminants that have been previously sorbed to fine-grained, low-permeability media (e.g., from an older plume) diffuse back out and later desorb from soil to groundwater and cause the passing clean/treated groundwater to become recontaminated. Current groundwater data is summarized on Figure 6. Copies of historical groundwater data are included in Appendix A for reference, and include a summary of well completions, historical water levels and PCE concentrations, and PCE time trend plots for key monitoring wells.

The persistence of PCE appears to be greatest in the north central area of the Harris property plume and has resulted in the plume migrating northward across SW 178th Street and onto the Dunn Lumber property. As indicated by the time trend plots, peripheral plume areas in the northeast and northwest portions of the Harris property and in SW 178th Street are declining more quickly than in the north-central area, and it is expected that PCE concentrations in the eastern and western portions of SW 178th Street will naturally attenuate to below the cleanup standard within the next few years. However, the north-central area of impacted groundwater, unless additional remedial measures are implemented, is expected to continue migrating off-Property for an extended period.

Regarding cleanup of the vadose zone soil, the SVE system has significantly reduced the contaminant concentrations, and the majority of vadose zone soil on the Site is now below the MTCA Method A CUL. However, as described in the 2018 status report, in the areas near the original source releases related to dry cleaning operations at Four Star Cleaners and the former Manhattan Cleaners and Coin-Op Laundry (Manhattan Cleaners; Figure 2), remediation has been slower due to incomplete SVE coverage across the 35- to 40-foot (ft)-thick vadose zone. In January and February 2021, the SVE system was expanded with shorter screened SVE wells and staggered screen positions to provide more complete coverage and address the sources of the sub-slab soil vapor concentrations in these two areas.

1.3 Remedial Action Objectives

Section 4.3 of the 2016 RAWP identified three RAOs that were focused on protection of human health through potential exposure to contaminated soil and groundwater. Based on the current conditions following implementation of the RAWP, a fourth RAO related to the vapor intrusion pathway has been developed to minimize the potential air exposure risk to Site contaminants. Each of the RAOs is listed below and includes a brief description on the current completeness of each objective.

- **RAO No. 1** – Prevent workers and occupants from direct contact with contaminated soil at concentrations exceeding CULs during construction, utility repairs, or redevelopment activities.

This RAO has been met throughout the Site; all soil containing PCE at the Site is below the MTCA Method B CUL for direct contact (480 milligrams per kilogram [mg/kg]).

- **RAO No. 2** – Control leaching and migration of PCE in soil at concentrations that will cause groundwater to exceed its applicable CUL at the point of compliance.

This RAO has been met throughout the Site. In most locations, PCE concentrations in vadose zone soil are below the MTCA Method A CUL (0.050 mg/kg). In source areas where PCE releases had originally occurred due to historical PCE dry cleaning, soil exceeding the Method A CUL is largely not in direct contact with groundwater. In source areas where vadose zone soil exceeds the Method A CUL and where saturated soil contains residual PCE, it can be shown empirically that the PCE concentrations are protective of groundwater because PCE concentrations in nearby and/or co-located groundwater have been below the Method A CUL (5 micrograms per liter [$\mu\text{g/L}$]) for multiple consecutive sampling events.

- **RAO No. 3** – Prevent consumption of groundwater containing PCE at concentrations exceeding the CUL by on- and off-Property residents and workers.

This RAO has been met throughout the majority of the Site, including the southern half of the Harris property and the entire MVSC property. Through remedial actions in the source area, groundwater PCE concentrations have been treated to below the Method A CUL, which is therefore protective of drinking water. PCE concentrations on the northern half of the Harris property and off-Site to the north (downgradient) have been naturally attenuating and overall are trending downward. Additional attenuation and/or additional remediation is needed to meet cleanup standards in these areas, especially in the north-central area of the Harris property and off-Property to the north.

- **RAO No. 4** – Minimize potential for indoor air risk to nearby commercial building occupants.

This new RAO was developed based on sub-slab soil vapor sampling conducted beneath Four Star Cleaners and the former Manhattan Cleaners suite in 2019 (see Section 2.1). The soil to indoor air exposure vapor intrusion pathway is currently being mitigated through SVE, and operation of the expanded SVE system will continue to remove contaminants and further reduce risk over time.

The groundwater to indoor air exposure pathway is not a complete pathway because groundwater PCE concentrations have been below the MTCA Method B screening level (24 $\mu\text{g/L}$) throughout the Site since 2013 and continues to trend downward.

1.4 Objectives for RAWP Addendum No. 1

The objectives of this addendum to the RAWP (termed as Work Plan for the remainder of this report) are to develop additional remedial measures, including monitoring strategies, needed to meet the outstanding RAOs for the Site:

- Prevent additional off-Property migration of the PCE-impacted groundwater beneath the north-central part of the Harris property, and allow for faster natural attenuation of the off-Property groundwater concentrations to below the cleanup standard; and
- Reduce contaminant concentrations in soil beneath commercial buildings such that PCE in soil vapors does not present a vapor intrusion risk.

1.5 Report Organization

Section 1 – Introduction: Describes the purpose and the organization of the report.

Section 2 – Background: Provides a summary of background conditions and remedial activities completed since the 2016 RAWP.

Section 3 – Approach for Additional Remedial Measures: Describes the basis for implementing additional remedial measures in groundwater and soil to address the outstanding RAOs. Measures include: (1) continued natural attenuation in groundwater consistent with the RAWP, (2) implementing a permeable reactive barrier (PRB) along the central portion of the northern Harris property line to reduce contaminant concentrations and expedite natural attenuation processes in off-Property groundwater, and (3) continuing to operate the existing SVE system to further reduce contaminant concentrations in soil and lower the potential vapor intrusion risk in the nearby commercial buildings.

Section 4 – Remediation Design and Implementation: Describes the plan to address the design and implementation of a PRB along the central portion of the northern Harris property line, installation of two new monitoring wells for PRB performance monitoring, and continued operation of the SVE system.

Section 5 – Remediation Monitoring and Reporting: Describes the approach for conducting performance monitoring of the PRB and SVE system, the criteria and metrics for determining when RAOs have been achieved, and reporting.

2.0 BACKGROUND

This section includes a summary of background conditions and remedial activities completed since RAWP. Detailed description of the information included in this section can be reviewed in the previously submitted progress reports covering the reporting periods between October 2016 and December 2019. Data and information collected in 2020 and 2021 are also summarized below, and laboratory results are summarized in Tables 1 and 2 and in Figure 6. This more recent information will be described in detail in the forthcoming status report covering the period from January 2020 through June 2021.

Discussion of current and background hydrogeologic conditions, including the contaminant flux evaluation and associated groundwater sampling are described in Section 3.1 as part of the recommended groundwater remediation approach.

2.1 AS and SVE System Operation and Performance Monitoring

There have been multiple rounds of remediation at the Site beginning in 1999. An interim SVE system operated on the MVSC property between October 1999 through July 2000 and was decommissioned shortly after the operating period. Follow-up remedial investigations led to commissioning a second interim SVE system in 2009 consisting of 10 wells (SVE-1 through SVE-10). Confirmation soil sampling performed in 2011 and 2012 indicated that the interim SVE system had removed PCE to below the CUL in most areas, although not all locations and depths that had previously exceeded the soil CUL were evaluated.

In October 2016, a 31-well AS system and an expanded 19-well SVE system was installed consistent with the RAWP and operated to remediate residual sources of PCE in soil and groundwater on the Property (Figure 3). The RAWP specified that the AS/SVE system was to be operated until: (1) PCE concentrations in groundwater in the vicinity of the AS wells were below the Method A CUL for four consecutive quarters, and (2) PCE concentrations in SVE discharge vapors reached asymptotic levels.

As described in the 2018 status report, after approximately 18 months of operation, SVE discharge vapor concentrations had declined significantly, and groundwater within the AS zone of influence (ZOI) had been below the CUL for several quarters. Confirmation soil samples were collected in April 2018 to test soil in the eight areas that had not been evaluated in 2011 and 2012 (soil borings SB-10 through SB-30; Figure 4). The results showed that PCE concentrations had declined through operation of the interim and current SVE systems, PCE concentrations throughout the Site were below the Method B CUL for direct contact, and PCE concentrations were generally below the MTCA Method A CUL for protection of groundwater (0.050 mg/kg).

The AS/SVE system continued to operate until December 2018, when the remediation system was shut down for approximately six months to conduct performance monitoring to assess potential rebound of PCE concentrations in groundwater. As described in the 2019 status report, by this time, groundwater PCE concentrations on the MVSC property and on the southern half of the Harris property had been below the CUL for at least 4 consecutive quarters. Performance

monitoring conducted in May and October 2019 showed that rebound of PCE concentrations exceeding the CUL had not occurred.

Two rounds of soil vapor sampling were conducted in March and June 2019 while the AS/SVE system was offline for groundwater rebound monitoring. Seven sub-slab soil vapor samples (SVS-10 through SVS-16; Figure 4) were collected beneath the Four Star Cleaners suite and beneath the former Manhattan Cleaners suite (currently Archie's Mexican Restaurant). As described in the 2019 status report, the results indicated that PCE concentrations exceeded the MTCA Method B screening level for unrestricted land use in both soil vapor probes beneath the Four Star Cleaners and in three of the five soil vapor probes beneath the former Manhattan Cleaners. Modified Method B screening levels were calculated for commercial occupancy (termed as remediation screening levels in the remainder of the report), and the results indicated that all sub-slab soil vapor results were below the remediation screening levels for samples collected beneath the Four Star Cleaners suite and for all but one sample collected beneath the former Manhattan Cleaners suite (SVS-13). Copies of the historical soil vapor sampling results are included in Appendix A.

An eighth soil vapor probe, SVS-17, was also sampled, and elevated concentrations of PCE, trichloroethene, and vinyl chloride were detected. SVS-17 is screened 4.5-5 ft below ground surface (bgs) and is located approximately 7 ft north of the Ian Fitness Center suite in the MVSC strip mall building and is within the asphalt paved alley.

2.2 SVE System Expansion and Limited Excavation

Based on the results of the confirmation soil sampling and soil vapor sampling, the SVE system was expanded by six new SVE wells (SVE-20 through SVE-25), and a limited excavation was conducted in the gravel parking area behind the former Manhattan Cleaners to remove shallow soil with PCE concentrations exceeding the MTCA Method A CUL within the upper 3 to 4 ft bgs. Two of the wells (SVE-24 and SVE-25) were installed at a 45 degree angle such that the well screens were located beneath the former Manhattan Cleaners suite. The purpose of the SVE expansion was to enhance SVE near the buildings to further treat vadose zone PCE and prevent future exceedance of the sub-slab soil vapor remediation screening level (1,067 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$]).

The SVE wells were installed in September 2020, and discrete soil samples were collected from the SVE well soil borings at locations based on field screening by using a photo-ionization detector (PID). Soil samples were also collected at that time from 15 locations (EX-1 through EX-15) to help define the planned limits of soil excavation and to profile conditions along the SVE lateral pipe trench alignment. The results were submitted to Ecology as part of a request for approval of a contained-in determination (CID) for off-Site soil disposal. Following Ecology approval of the CID determination request⁷, excavation and SVE expansion construction was completed in January and February 2021. Confirmation soil samples were collected from the base and sidewalls of the excavation (EX-16 through EX-27) in January. Soil samples were

⁷ Ecology. 2020. *Contained-In Determination for F002 Contaminated Soils at Manhattan Village Shopping Center and Harris Village Properties "Normandy Park PCE," in Normandy Park, Washington.* November 5.

submitted to Fremont Analytical in Seattle, Washington for analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (EPA) Method 8260.

Similar to the April 2018 soil confirmation sampling (see 2018 status report), all of the soil results were well below the MTCA Method B CUL for direct contact and in most cases below the MTCA Method A CUL. In some cases, the recent results indicate minor improvement since 2018, and this is likely due to the continued operation of the SVE system.

The soil results from SVE-25, an angled well extending beneath the former Manhattan Cleaners and screened below subslab soil vapor probe SVS-13, indicated that low level PCE impacts were present beneath the former Manhattan Cleaners suite at depths between 8 and 35 ft bgs at concentrations between 0.0373 and 0.0632 mg/kg. Soil samples had not previously been collected beneath this building.

Based on the pre-excavation sampling, the excavation limits were extended several feet to the west, and the depth of the excavation was limited to 3 ft bgs. Samples collected along the trench alignment indicated that PCE was below the laboratory practical quantitation limit (PQL) in all locations. Excavation confirmation sample results were also below the PQL except for a single sidewall sample EX-17 (0.0874 mg/kg at 1.5 ft bgs), however, over-excavation near EX-17 was not possible due to the adjacent shed and walk-in freezer associated with the current tenant, Archie's Mexican Restaurant.

Locations of the new SVE wells, reconnaissance soil samples, excavation confirmation soil samples, excavation limits, and shallow SVE pipe trench are shown on Figures 3 through 5, and PCE results are summarized in Table 1 and on Figure 5.

During excavation of the expanded SVE piping trench, groundwater monitoring well MW-1 was encountered and damaged. This well, installed in 1999, could not be located by PES nor by the previous consultants on the project since 2007; horizontal survey coordinates had not been documented, and its location had not been properly represented on historical site maps. Upon discovery, it was noted that the well monument and surface seal were damaged, and the well may have potentially been compromised. A new monument and concrete surface seal were installed, the well was redeveloped, a new expanding well plug was installed, and the well casing location and elevation were surveyed concurrent with the construction as-built survey.

The expanded SVE system has been operating since mid-February 2021, and monitoring of the vapor probes in both buildings indicate that the SVE system is maintaining a measurable vacuum directly beneath both the Four Star Cleaners and the former Manhattan Cleaners. A detailed description of the SVE expansion, limited excavation, sampling, startup, and associated laboratory reports will be included in the forthcoming status report for the period of January 2020 through June 2021.

3.0 APPROACH FOR ADDITIONAL REMEDIAL MEASURES

As described in Section 1.4, the outstanding RAOs that are the focus of this Work Plan include: (1) preventing additional off-Property migration of the PCE-impacted groundwater beneath the north-central part of the Harris property, and allowing for faster natural attenuation of the off-Property groundwater concentrations to below the cleanup standard, and (2) reducing contaminant concentrations in soil near the current and former dry cleaners such that soil vapors do not present a vapor intrusion risk to commercial building occupants. Section 3.1 provides additional background information regarding the groundwater conditions and describes the development of the recommended remediation approach to address the residual groundwater plume. Section 3.2 includes the approach for addressing the vapor intrusion pathway.

3.1 Groundwater Remediation Approach

The objective of additional groundwater measures is to further protect drinking water in the portions of the Site that have not yet achieved cleanup standards. Although the historical sources of PCE have been remediated and are no longer contributing to the contaminant plume, a detached residual plume persists on the northern half of the Harris property and off-Property to the north. PCE concentrations in these areas have been trending downward, especially on the east and west sides of the plume, where PCE concentrations are very close to the CUL and are expected to naturally attenuate to below the CUL within a few years. In the north-central area of the Harris property, however, it is expected that off-Property plume migration will continue for an extended period, unless additional remedial measures are implemented.

As described in detail below and in Section 4.1, the recommended remedial measure in the north-central portion of the Harris property includes installing a PRB along the northern Harris property line to prevent further off-Property migration of groundwater exceeding CULs. The PRB is intended to effectively cut off the plume and expedite natural attenuation of the residual off-Property PCE concentrations. An environmental covenant will be implemented on the Harris property to prevent the use of the groundwater for drinking water purposes.

After PCE concentrations have declined to below the CUL immediately downgradient of the PRB, property-specific NFAs will be pursued and will include potential environmental covenants on the Property, as necessary. A Site-wide NFA may be pursued when PCE concentrations drop below the CUL throughout the Site.

The remainder of this section includes a summary of hydrogeologic conditions in the area of the PRB (which are generally consistent with the rest of the Site), current groundwater chemistry, a summary of the contaminant flux testing performed in 2019, and the rationale for selecting the specific PRB for implementation at this Site. This information is used to develop the design basis and criteria for the PRB in Section 4.1.

Recent groundwater PCE results are included in Table 2, and copies of historical monitoring well data tables and select PCE time trend plots are included in Appendix A. A copy of the PCE flux testing results from the 2019 status report is included in Appendix B.

3.1.1 Hydrogeologic Conditions

Monitoring Well Installations in 2019 Near the Proposed PRB. Monitoring wells MW-17, MW-18, MW-19, and MW-20 were installed in 2019 to evaluate the PCE concentrations in groundwater near the northern Harris property line (Figure 6). MW-17 and MW-18 were installed in SW 178th Street. Deep and shallow well pair MW-19 and MW-20, respectively and together screened from 28 to 55 ft bgs, were installed to evaluate contaminant and groundwater flux conditions in the perched groundwater zone in the north-central area of the plume along the Harris property line.

Lithology. The lithology encountered during installation of these monitoring wells was consistent with previous investigations. Soil types consisted predominantly of sand, sand with silt, silty sands, sandy silts, and silt with sand, all with variable gravel. Fill material composed of silty sand was encountered in the upper 8 ft bgs, consistent with previous investigations. The fill was underlain by a fine to medium sand, sand with silt, and silty sand to the maximum depth of exploration (55.5 ft bgs). The sand layer contained discontinuous layers of silty sand and silt and became denser below approximately 22 to 25 ft in MW-17 and MW-18 and below approximately 34 ft bgs in MW-19 and MW-20. Coarser sand and pockets of gravel were also encountered below the denser soil. Other features including gradational grain size variation, bedding, and fining upward sequences, appear to be consistent with previous interpretations of these units as recessional outwash.

Groundwater Elevations and Flow. Groundwater elevations on the Property fluctuate seasonally by up to approximately 3 ft with the lowest levels in fall and highest levels in spring to early summer. Near the northern Harris property line in monitoring wells DC-7 and DC-8, the average seasonal low and high groundwater elevations over the last 15 years are approximately 271 and 272 ft North American Vertical Datum of 1988 (NAVD 88), respectively. The minimum and maximum groundwater elevations over the same period were approximately 270 and 273 ft NAVD 88.

The groundwater gradients and flow directions are generally consistent throughout the seasons. Typical groundwater flow has a north to north-northwest directional component on the Property and becomes more northerly across SW 178th Street. The typical gradient across the Property (0.005 ft/ft) is approximately an order of magnitude lower than the gradient to the north of the Property (0.03 ft/ft). Figure 6 includes groundwater elevation contours from the October 2019 groundwater sampling event.

3.1.2 Groundwater Chemistry

Currently, the northwest quadrant of the Harris property, the SW 178th Street right of way, and off-Property to the north on Dunn Lumber are the only areas of the Site where PCE exceeds the MTCA Method A CUL. Monitoring wells which exceed the CUL on the Property include DC-7, DC-8, DC-15, and DC-17, and off-Property in MW-7, MW-17, MW-18, KMW-3, and KMW-8 (Figure 6). The PCE plume does not appear to be continuous from east to west, as monitoring wells MW-14, DC-18, and KMW-7 have been below the CUL for over a decade, and PCE in MW-19 and MW-20 has been below the PQL since installation in 2019.

Groundwater chemistry in these northern areas has been steady to slowly improving in recent years. Discussion in this section is largely based on the results through December 2019 (see 2019 status report). More recently, samples were collected in June 2020 from MW-17 and MW-20 and in May 2021 from DC-7 to confirm the 2019 results, and these results are included in Table 2. A more detailed discussion of the 2020 results will be included in the forthcoming status report covering the period between January 2020 and June 2021.

Low level concentrations of PCE have been present in several off-Property wells located in SW 178th Street. In eastern and western portions of SW 178th Street, recent PCE concentrations have been slightly above to slightly below the CUL in KMW-3, KMW-8, and MW-17. Decommissioned DC-14, formerly located just north of the northern Harris property line, also had a similar range of PCE concentrations before it was destroyed during public utility construction work in 2019. To the east, PCE in groundwater upgradient of KMW-8 has been below the CUL for several years (DC-12, DC-13, and DC-18). To the west, on-Property PCE concentrations in DC-17 and DC-7 (upgradient of KMW-3, KMW-7, and MW-17) have been above the CUL but the overall trends are declining.

On-Property PCE concentrations in DC-8 and DC-15 have remained above the CUL, and in recent years the rate of decline has slowed. Concentrations of PCE in the north-central area of the Harris property have contributed to PCE exceeding the CUL in MW-18 in SW 178th Street and further downgradient in MW-7 on Dunn Lumber property. The furthest north monitoring well MW-9 bounds the plume to the north, where PCE has never exceeded the CUL and has not been detected above the PQL since 2008.

3.1.3 Contaminant Flux Evaluation

As described in the 2019 status report, deep/shallow monitoring well pair MW-19 (deep) and MW-20 (shallow) were tested to measure PCE mass flux and groundwater velocity (Darcy velocity). The wells were located within a likely PRB alignment and were constructed with screened intervals, which combined, covered the majority of the shallow perched water bearing zone (i.e., between approximately 32 ft and 55 ft bgs). The wells were intended to be installed directly north of DC-8, however, due to the presence of multiple large trees and vegetation in the residential parcel, the well pair had to be installed approximately 23 ft west of DC-8.

Passive flux meters (PFMs) were deployed into the saturated screened intervals of MW-19 and MW-20 over a 2.5-week period in November 2019. PFMs are 5-ft long activated carbon (AC) filled sock-like devices sold by EnviroFlux of Gainesville, Florida. The AC in the PFMs is pre-loaded with four tracers, each having a known sorption coefficient (Kd). During the deployment period, the tracers were depleted at a rate proportional to the groundwater velocity. Simultaneously, the AC sorbed the PCE from groundwater flowing through the well. After the deployment period, the PFMs were retrieved, and discrete interval samples of AC were placed in jars and submitted to EnviroFlux for laboratory analysis. The residual mass of tracers in each sample were used to estimate groundwater velocity. The mass of PCE in each sample was used to estimate a PCE concentration in the groundwater at each interval. Multiplying the groundwater velocity by PCE concentration results in a mass flux of PCE (milligrams) passing through a unit area of aquifer (square meter) per unit time (day). A copy of the PFM testing results is included in Appendix B.

Darcy velocities varied vertically by a factor of nearly 6 and overall were slightly higher in deeper groundwater. The highest mass flux zone was located approximately 1 to 3 ft below the groundwater table during the test period (elevation 267 to 269 ft NAVD 88) with an average flux of approximately 0.054 milligrams per square meter per day. Mass flux rates decreased with depth and dropped by an order of magnitude by around elevation 263 ft bgs. The average seepage velocity within the MW-20 screened interval (evaluated between approximately 35 to 44 ft bgs) was estimated to be approximately 400 ft per year assuming a gradient of 0.015 and an effective porosity of 0.25. The average seepage velocity in the deeper screened MW-19 (evaluated between approximately 44 to 53 ft bgs) was estimated to be approximately 630 ft per year.

The PFM data was also used to estimate PCE concentrations in groundwater by multiplying the flux by the inverse of the Darcy velocity. The estimated concentrations for MW-19 and MW-20 were 0.02 µg/L and at 0.36 µg/L in MW-20, respectively, and were consistent with the below PQL sampling results from these wells (PQL is 0.5 µg/L).

Based on the results of the PFM study, approximately 74 percent of the total PCE flux at the MW-19/MW-20 location occurred within the uppermost 7.5 ft of perched groundwater (i.e., above elevation 265.5 ft NAVD 88) and 89 percent of the total PCE flux occurs within the uppermost 10 ft of perched groundwater (i.e., above elevation 263 ft NAVD 88).

3.1.4 PRB Technology Description and Recommended Approach

Technology Description. A PRB is a common *in-situ* groundwater remediation technology that is used to cut off or contain a contaminant plume and prevent contamination from migrating downgradient by treating groundwater as it passes through the PRB. A PRB is a porous structure designed for groundwater to flow through it with minimal or no hydrologic impedance beyond that of the surrounding aquifer. PRB materials are selected to treat site-specific contaminants in groundwater. PRBs are typically oriented perpendicular to groundwater flow direction, and the PRB media is either injected or trenched into saturated soil across a target depth interval. Due to depth of groundwater at this Site along the northern Harris property (approximately 32 to 35 ft bgs), the PRB media will be injected using direct push technology tooling and specialized nozzles to promote even lateral media distribution in all directions.

The lateral thickness of a PRB (in the direction of groundwater flow) is designed to provide sufficient residence time such that contaminants are treated to below target levels prior to exiting the PRB. Residence time is based on contaminant concentrations and the groundwater velocity (e.g., contaminant flux) and treatment reaction kinetics. PRB materials are typically consumed and/or deactivated during contaminant treatment so the amount of reactive material determines the PRB design life. If needed, additional PRB materials can be placed to extend the functional life of the PRB.

There is a minimum quantity of a PRB material required to adequately distribute the material in saturated soil to create an effective PRB; i.e., a minimum density of PRB material needs to be placed so that there is a high degree of certainty that PCE molecules will come into direct contact with the PRB material as the groundwater flows through the PRB.

PRB Technologies. For this Site, PES consulted with two vendors of products commonly used in PRB applications: Remediation Products Incorporated Group (RPI) and Regensis Remediation Systems (RRS). Both vendors represent PRB materials which treat PCE using similar principals. AC is used to remove PCE molecules from groundwater through adsorption (e.g., binding the PCE to the AC), and zero valent iron (ZVI) is used to treat the bound PCE through abiotic dehalogenation mechanisms. Reaction byproducts from dehalogenation of chlorinated solvents include low levels of dissolved iron, chloride, and a series of non-toxic and unregulated hydrocarbon gases such as ethene and ethane.

Once a PCE molecule is treated by the ZVI, the AC adsorption site becomes available to capture another molecule of PCE. During treatment, the ZVI becomes partially oxidized (or passivated), and when a high enough fraction of the ZVI is oxidized, the ZVI will become inactive. ZVI is also passivated by dissolved oxygen (DO). When complete passivation occurs, the AC will continue to adsorb PCE, but the contaminant destruction process will cease to occur. Typically, the end of a PRBs design life is considered to occur when the reactive component is depleted. At this Site, with PCE concentrations in the low tens and single digit parts per billion, the required minimum dosage of PRB media contains enough AC to bind and hold several decades worth of PCE without treatment from the ZVI. So, it is important to tailor the design to include enough ZVI to treat PCE until target concentrations are met upgradient of the PRB.

RPI Group uses BOS 100[®], a granular AC and metallic ZVI alloy material in which 6.5 percent by weight of ZVI is heat fused inside the AC matrix. The BOS 100[®] media is delivered to the site in drums under a blanket of nitrogen gas to prevent the AC and ZVI from reacting with atmospheric oxygen. Prior to deployment, the nitrogen is first displaced with city water, and then a shear mixer is used to create a slurry prior to injection into the subsurface through borings to construct the PRB. The heat fusion manufacturing process along with wetting with city water protects the ZVI from passivation *in-situ*. Injection points are typically spaced on a 5-to 7-ft grid and injections proceed from the top down at 1.5-ft intervals under high pressure at a rate of 25 to 35 gallons per minute (gpm), taking approximately 20 to 30 seconds per injection interval. RPI Group injection pumps can achieve injection pressures of up to 2,000 pounds per square inch (psi) as needed.

RRS uses a mixture of two liquid products including a colloidal AC product called PlumeStop[®] and a sulfidated ZVI product called S-MicroZVI[™]. The two products are blended with city water, and the resulting water-like mixture is injected into the PRB area. The sulfidation coating on the ZVI protects the ZVI from passivation. The injected liquid flows with groundwater and thinly coats the saturated matrix (2 micron to 5 micron thickness). RRS indicated that at this site the injectate could travel up to 30 ft from the injection point over a 2 to 3 week period. Injection points are typically spaced on an 8- to 10-ft grid, and injections proceed from the top down at 2-ft intervals at pressures up to 150 psi and a rate of approximately 2 gpm, taking approximately 50 minutes per injection interval.

3.1.5 Recommended Approach

While both the RPI and RRS products have had proven success at numerous sites for degrading chlorinated solvents, PES recommends using RPI's BOS 100[®] product at this Site for several reasons:

- BOS 100[®] integrates the AC and ZVI through a high temperature manufacturing process (see manufacturers information in Appendix C), and this AC and metallic ZVI alloy material provides a very high probability that adsorbed PCE molecules will be efficiently destroyed through the several available electrochemical degradation pathways. The city water wetting process preconditions the ZVI, fills the void space, and protects the ZVI from passivation by groundwater flowing through the PRB. Dosing of BOS 100[®] is relatively straightforward and entirely dependent on the quantity and distribution of a single product. Conversely, dosing of the two separate RRS products is more complex and must be balanced to ensure that there is enough ZVI in close enough proximity to the colloidal AC to ensure that the destructive dehalogenation reaction occurs.
- The high pressure injection pump (up to 2,000 psi) for BOS 100[®] can overcome the variable formation backpressures at this Site. Since historical PCE concentrations in this area were nearly an order of magnitude higher than current (see DC-8 time trend plot in Appendix A), the PRB will need to treat two sources of PCE including: (1) PCE in passing groundwater, and (2) sorbed PCE that back-diffuses from fine grained soil within the PRB. High pressure injections are expected to fluidize the formation and more effectively mix the BOS 100[®] slurry into the formation, resulting in a relatively even distribution throughout the injection zone. Even distribution of PRB media allows for more efficient treatment of both sources of PCE. Conversely, the lower pressure RRS injection is expected to result in the PRB liquid media preferentially flowing into higher permeability zones. While the RRS products are expected to be effective at treating the passing groundwater, treatment of back diffusing PCE is expected to be less efficient and take a longer period. Additionally, the lower pressure RRS pump (up to 150 psi) is expected to have difficulty achieving adequate injection rates in some location based on reports that the 2010 ISCO pilot test required injection pressures of up to 200 psi in some areas.
- The BOS 100[®] slurry is expected to have an approximate 3-ft radius of influence such that a three-row PRB will cover an approximate 16-ft width and extend approximately up to the edge of the Harris property line. This geometry will allow for a new downgradient monitoring well (MW-21) to be installed on the south side of SW 178th Street. Results from new well MW-21 and existing MW-18 in SW 178th Street will be used to document downgradient performance and trends upgradient of the Dunn Lumber property. Conversely, since the RRS products flow with groundwater for a couple weeks following injection, it is expected that RRS media would extend into the street. Locations of buried utilities in SW 178th Street restrict access for installation of monitoring wells in the middle of the street and therefore MW-21 could not be installed and downgradient performance monitoring would use MW-18 (in SW 178th Street) and MW-7 on Dunn Lumber property. The performance monitoring well configuration for the RRS PRB would require a significantly longer period to document trends and performance compared to the preferred approach.

Section 4.1 describes the design and implementation of the PRB at this site using the BOS 100[®] product as the active treatment material.

3.2 Addressing the Vapor Intrusion Pathway

The potential for residual PCE contamination in soil to present a vapor intrusion risk to occupants of the nearby commercial buildings will be addressed by continued operation of the existing SVE to remove additional contamination from the upper portion of the vadose zone soil.

Operation of the SVE system has remediated vadose zone soil such that PCE concentrations are below the MTCA Method B CUL for direct contact everywhere throughout the Site and are not causing PCE to exceed its applicable CUL in groundwater beneath the former source areas. The SVE system will continue to be operated until PCE in sub-slab soil vapors beneath the nearby buildings is below the remediation screening level.

4.0 REMEDIATION DESIGN AND IMPLEMENTATION

This section describes the design implementation of the recommended remedial measures including the constructing a PRB along the northern Harris property line, installation of two new wells for monitoring performance of the PRB, and continued operation of the SVE system. Performance monitoring of the PRB and SVE system and the criteria and metrics for determining when the RAOs have been achieved are discussed in Section 5.

4.1 PRB Design and Implementation

4.1.1 PRB Design Criteria

The primary objective for implementing a PRB at this Site is to cut-off the PCE plume such that PCE is no longer migrating off-Property and causing PCE to exceed the CUL in downgradient monitoring wells. The following is a list of the design criteria needed to meet this objective.

Design Life. Based on existing PCE groundwater trends, a PRB design life of 15 years is recommended to allow time for PCE concentrations on the Harris property to reach the MTCA Method A CUL. Although the BOS 100[®] will be capable of adsorbing PCE for several decades, the design life is based on destructive treatment of PCE by the ZVI component.

Treatment Zone. The PRB should provide treatment in the central area of the plume where PCE is migrating off-Property towards Dunn Lumber property at concentrations above the applicable CUL. Treatment is not needed on the peripheral eastern and western portions of the plume where the PCE concentrations are already at or near the CUL. These peripheral areas are expected to naturally attenuate to below the CUL on their own within a few years.

Treatment Depth. The PRB should be deep enough to intersect the majority of PCE flux. As described in Section 3.1.3, approximately 89 percent of the total PCE flux occurs within the uppermost 10 ft of groundwater. Therefore, the PRB should provide coverage to at least 10 ft below high seasonal groundwater (e.g., between elevation 263 to 273 ft NAVD 88). At these elevations, the PRB will span the zone of highest PCE flux (elevation 267 to 269 ft NAVD 88) and reach to depth where the flux evaluation indicated that PCE flux becomes much less significant (elevation 263 ft NAVD 88). Treatment below elevation 263 ft NAVD 88 is not required, as the results of the PFM testing indicate that PCE concentrations in the deeper groundwater are well below the CUL and contribute less than 12 percent of the total flux in this area.

PRB Geometry. The PRB geometry is based on the amount of BOS 100[®] required to provide treatment over a specified design life, RPIs recommended minimum dosing of 7.5 pounds of BOS 100[®] per injection point interval with injection points on 5-ft centers. At this Site, with the relatively low PCE concentrations and 400 ft per year average groundwater seepage velocity, RPI recommends 3 rows of injection points with 5-ft spacing between rows. RPI limits the maximum dosing at 15 pounds of BOS 100[®] per injection point interval to prevent clogging of the injection equipment during construction. Additional injection borings would be necessary if a higher quantity of BOS 100[®] is required to meet PRB design life criteria. Since BOS 100[®] adsorption and treatment kinetics for PCE occur on the order of minutes to hours there is expected to be a high degree of certainty that within the recommended framework of dosing and

geometry, PCE molecules flowing in groundwater are expected to come into direct contact with and be treated by the BOS 100[®] material.

4.1.2 PRB Design

PES developed the PRB design in conjunction with the RPI Group. A copy of the design flux calculations, injection dosage for BOS 100[®], and manufactures specifications and safety information is included in Appendix C.

The design includes an 80-ft wide by 10.5-ft tall PRB constructed with 3 rows of injection points on 4-ft spacing between points and 5 ft between each row. The PRB will extend east starting adjacent to MW-20 (non-detect for PCE) to cover the flow paths from DC-8 and DC-15 and extend east at least half-way between non-detect DC-18 and KMW-8. A total of 61 injection points are included in the PRB (Figure 7). The PRB will include 7 injection intervals and be installed between elevations 262.5 and 273 ft NAVD 88 to intersect the plume where the PCE flux rates are highest. The nominal 16-ft thick PRB will include approximately 14 days of residence time. PCE adsorption kinetics in AC are typically on the order of minutes and dehalogenation kinetics are on the order of hours.

Based on this design, a total of 6,800 pounds of BOS 100[®] will be required, and each injection interval will receive 14.8 pounds of BOS 100[®] at each location. At this dose rate, the PRB is expected to have a minimum 15-year design life based on a sustained influent PCE concentration of 15 µg/L and influent DO concentration of 7.2 milligrams per liter (mg/L). The influent PCE concentration is based on the most recent PCE concentration in DC-8. This design PCE loading rate is conservative because the upgradient PCE concentrations will continue to decline over time such that the effective PRB design life is expected to be greater than 15 years.

The influent DO concentration is based on average concentrations measured in upgradient monitoring wells during routine groundwater sampling from 2013 through 2019. Although the proposed PRB is not directly downgradient from the AS system (operated from October 2016 through December 2018), it is possible that DO may have affected wells upgradient of the western edge of the PRB, and so the design basis DO concentration may be biased high. The iron demand is based on stoichiometric usage of 6 moles of iron per mole of PCE. The oxygen demand rate is empirically based on RPI Groups experience at 0.5 moles of iron per mole of oxygen. Because of the way that the BOS 100[®] is manufactured and prepared in the field, RPI Group believes that the estimated oxygen demand rate is conservatively high. RPI Group has been conducting ongoing research to further refine their estimated rate of oxygen demand on BOS 100[®].

The PRB efficacy will ultimately be proven through performance groundwater monitoring, and if it appears that the PRB is not achieving the desired results, additional BOS 100[®] may be installed to supplement the PRB.

4.1.3 PRB Implementation

The PRB implementation process will include underground injection control (UIC) program permitting with Ecology, preparing the PRB work area (including cutting down several trees and trimming back overgrown brush), using a vactor to clear the location of the sanitary sewer line

servicing the nearby residence, performing baseline groundwater monitoring (see Section 5.1.2), performing the BOS 100[®] injections over a period of 6 to 8 days, restoring the work area after injections, and performance groundwater monitoring. The injections will be performed by BB&A Environmental of Portland, Oregon, an operator who has been trained and certified by the RPI Group.

Drums of dry BOS 100[®] will be staged near the PRB area. A fork-lift will be used to shuttle drums of product to a nearby slurry mixing and injection trailer. City water for mixing will be provided from a garden hose bib at the nearby residence on the Harris property. The injection points will be advanced using a track mounted Geoprobe 7822 rig (or equivalent) using standard tooling and specialized injection tips. The injection rod will be advanced to the target depth, the full injection slurry volume will be emplaced, the injection rod will be advanced to the next depth, and the process will be repeated until all 7 intervals have been finished. The injection rod will then be extracted, and the boring will be decommissioned per WAC 173-365.

Groundwater levels will be monitored daily in nearby wells DC-8, MW-18, MW-19, and MW-20 during injections. At the injection operator's discretion, if necessary, one or more borings may be advanced in the middle of several injection points, and soil samples will be collected to inspect the distribution of BOS-100[®]. This information, if necessary, would be used to calibrate the injection dosing.

4.1.4 Monitoring Well Installation

Two groundwater monitoring wells will be installed to monitor the performance of the PRB along an approximate north-south line between DC-8 and MW-18. The wells will be installed after construction of the PRB is complete. One monitoring well will be installed immediately downgradient of the PRB (MW-21) along the southern edge of SW 178th Street and the other well will be installed in the approximate middle of the PRB (MW-22). The wells will be screened across the water table and installed to match the depth of the PRB at those locations (approximately 42.5 ft bgs).

New well MW-21 will be used to monitor downgradient performance of the PRB and the results will be compared to MW-18 to determine downgradient trends in PCE concentrations. New well MW-22 will be used to monitor treatment performance within the PRB. The proposed monitoring well locations are shown on Figure 7.

4.2 SVE System Operation

Addressing the vapor intrusion pathway will be accomplished by continuing the routine operation and maintenance (O&M), monitoring, and sampling of the SVE system to maintain optimal conditions and comply with discharge regulations as described in the O&M Plan⁸ until such time that the goal of permanently reducing vapor intrusion risk from PCE in soil has been achieved. At that time, the SVE system will be shut down for rebound monitoring and evaluation of whether sub-slab soil vapor concentrations remain below screening levels.

⁸ PES. 2016. *Operations and Maintenance Plan, Manhattan Village Shopping Center and Harris Properties, VCP NW1873, Normandy Park, Washington*. December.

O&M and monitoring will include monthly O&M and monitoring SVE system and well field parameters (flow, vacuum, field VOC concentrations).

4.2.1 Sub-Slab Soil Vapor Probe Installation

One sub-slab soil vapor probe (SVS-18) will be installed near the north wall and inside the Ian Fitness Center suite located east of the Four Star Cleaners to monitor performance of the SVE system. The soil vapor probe will be screened approximately 15 inches beneath the floor slab consistent with the other sub-slab soil vapor probes. The precise location of SVS-18 will be determined after conducting an inspection of the interior of the fitness center suite.

5.0 REMEDIATION MONITORING AND REPORTING

This section describes the approach for conducting performance monitoring of the PRB and SVE system, the criteria and metrics for determining when RAOs have been achieved, and reporting.

5.1 Remediation Approach and Monitoring Plan

5.1.1 Groundwater Monitoring Approach

Groundwater monitoring will include baseline sampling prior to PRB installation and performance monitoring after the PRB has been installed. During performance monitoring, PRB-related wells will be monitored quarterly until PCE concentrations indicate that they are declining and below MTCA Method A CUL on the downgradient side of the PRB for at least two consecutive quarters. At that time, a reduction of the scope and frequency of monitoring will be recommended, and Property-specific NFA determinations will be requested from Ecology. It is expected that the on-Property PCE concentrations will remain above the CUL for a period of years, and so an environmental covenant will be necessary for the Harris Property to prevent the use of the groundwater for drinking water purposes.

Selected on- and off-Property wells will continue to be monitored to document the longer-term natural attenuation. A Site-wide NFA may be pursued at a later date, when PCE concentrations are below the CUL throughout the Site.

Monitoring wells where PCE concentrations have been less than the CULs for 4 quarters or more will not be included in the future monitoring well network, and will be decommissioned. Including the two proposed monitoring wells (see Section 4.1.4), there are a total of 50 monitoring wells on the Site. There are 5 monitoring wells screened in the lower portion of the perched groundwater bearing zone, and 45 monitoring screened in the upper groundwater (see Figures 6 and 7).

The following includes a summary and basis for selecting monitoring wells for performance groundwater monitoring and for decommissioning. This information is also summarized in Table 3.

Post-Air Sparging Performance Monitoring within the AS ZOI (5 wells). PCE concentrations within AS ZOI in MW-4, MW-10, MW-11, DC-4, DC-10A, and KMW-2 dropped to below the CUL during or just prior to the AS monitoring period. MW-4, MW-10, MW-11, DC-4, DC-10A will continue to be monitored until PCE concentrations remain below the CUL for at least four consecutive monitoring events. Monitoring of KMW-2 is no longer needed because it is located only 20 ft upgradient from MW-10.

Performance monitoring is also no longer needed in the other 4 wells within the AS ZOI area, including MW-3, MW-12, MW-13, and DC-3. PCE concentrations in these wells have been below the CUL since at least 2013.

PRB Performance Monitoring Wells (8 wells). The performance of the proposed PRB and subsequent natural attenuation in downgradient monitoring wells will be determined through evaluation of PCE results upgradient of the PRB, within the PRB, and downgradient of the PRB.

The 8 wells to be monitored include MW-20, DC-8, DC-15, and proposed well MW-22 on Harris Property; MW-18 and proposed well MW-21 in SW 178th Street; MW-7 on Dunn Lumber property; and MW-9 in SW 176th Street.

Performance monitoring is no longer needed in the 5 wells located further upgradient (south) of the proposed PRB because PCE concentrations have been below the CUL for multiple sampling rounds including MW-2 (6 rounds), MW-15 (9 rounds), DC-1 (20 rounds), DC-2 (26 rounds), and KMW-9 (10 rounds).

Natural Attenuation Performance Monitoring Wells Located West of the Proposed PRB

(5 wells). PCE monitoring in this area has shown that the PCE concentrations in DC-7 and DC-17 (on Harris Property) have been declining. Downgradient of these wells, PCE has been naturally attenuating within SW 178th Street in MW-17, KMW-3, and KMW-7 over multiple sampling events. These 5 wells will be included for performance monitoring of natural attenuation in the area to the west of the proposed PRB.

Performance monitoring is no longer needed in the remaining 6 wells located on the western half of the Site. PCE in MW-14 and MW-16 on the Harris Property has not ever exceeded the CUL since well installation in 2012 and 2013, respectively. Off-Property wells MW-8, KMW-4, KMW-5, and KMW-6 have each been sampled twice (in 2007/2008 and 2012), and PCE concentrations were either well below the CUL and/or below the PQL. These results indicate that the wells are located outside (west) of the PCE plume and additional sampling is not warranted.

Natural Attenuation Performance Monitoring Wells Located East of the Proposed PRB

(1 well). Monitoring in this area has shown that PCE concentrations in KMW-8 and decommissioned DC-14 (destroyed during utility construction in SW 178th Street) have been naturally attenuating within SW 178th Street (just north of the Harris Property). Only KMW-8 will be included for monitoring the performance of natural attenuation in this area.

Performance monitoring is no longer needed in the remaining 10 wells on located on the eastern half of the Site. PCE concentrations have been below the CUL for multiple sampling rounds including DC-11 (10 rounds), DC-12 (9 rounds), DC-13 (8 rounds), DC-18 (7 rounds), DC-20 (8 rounds), and KWM-1 (5 rounds). DC-19, located approximately 40 ft upgradient (south) of DC-11, was well below the CUL in 2007 and 2008 and below the PQL in 2012. MW-5 and MW-6 have each been sampled twice (in 2008 and 2012), and PCE concentrations were either well below the CUL and/or below the PQL. These results indicate that the wells are located outside (east) of the PCE plume and additional sampling is not warranted.

Lastly, MW-1, which had been missing since 2007 and was recently rediscovered during excavation of the SVE piping trench in 2021 (see Section 2.2) will not be included in future performance monitoring. The well monument and concrete surface seal were damaged, and the well may have potentially been compromised. Because there are multiple wells near MW-1 that have been below the CUL for several consecutive monitoring events (MW-12, MW-13, and MW-18), we do not recommend collecting any additional samples from MW-1.

Deeper Screened Monitoring Wells. None of the 5 deep screened monitoring wells, including MW-19, DC-5, DC-10B, DC-16, and KMW-5D, will be included in future performance monitoring because these wells are screened below the PCE plume.

5.1.2 Pre-PRB Baseline Monitoring

Groundwater samples will be collected from the 17 existing monitoring wells across the Site prior to the PRB installation. The groundwater monitoring event will also document current conditions throughout the Site since a Site-wide monitoring event has not been conducted since October 2019. Baseline monitoring will include wells in the AS area which have only had one or two sampling events since the AS system was shut down in December 2018.

- Pre-PRB Baseline Monitoring Wells: MW-4, MW-7, MW-9, MW-10, MW-11, MW-17, MW-18, MW-20, DC-4, DC-7, DC-8, DC-10A, DC-15, DC-17, KMW-3, KMW-7, and KMW-8.

Depth to water will be recorded in all available shallow monitoring wells prior to sampling. Each well will be purged and sampled using low flow methods with a peristaltic pump. Field parameters (pH, specific conductance, temperature, DO, and oxidation reduction potential [ORP]) will be measured prior to sample collection. Groundwater samples will be analyzed for VOCs using EPA Method 8260 by Fremont Analytical in Seattle, Washington.

5.1.3 PRB and Natural Attenuation Performance Monitoring

Performance monitoring will be conducted until PCE concentrations in MW-21 and MW-22 (Figure 7) have been below the CUL for at least two consecutive quarters. At that time, the sampling frequency and number of wells will be reduced (see Section 5.1.4).

Performance monitoring will include quarterly sampling of wells associated with the PRB performance, semi-annual monitoring to document on-going natural attenuation, and annual monitoring to confirm plume geometry and continue to document compliance near the AS well ZOI. As described above, when PCE is below the CUL in any monitoring well for at least 4 consecutive sampling events, the well will be removed from the performance sampling program and will be decommissioned.

- Quarterly PRB Performance Monitoring Wells (8 wells): MW-7, MW-9, MW-18, MW-20, MW-21, MW-22, DC-8, and DC-15.
- Semi-Annual Natural Attenuation Monitoring Wells (5 wells): MW-17, DC-7, KMW-3, KMW-7, and KMW-8.
- Annual Plume Geometry and AS ZOI Documentation Monitoring Wells (6 wells): MW-4, MW-10, MW-11, DC-4, DC-10A, and DC-17.

Depth to water will be recorded in all wells to be sampled prior to sampling during quarterly and semi-annual sampling event. Depth to groundwater will be monitored in all available shallow monitoring wells during annual sampling events. Each monitoring well will be purged and sampled using low flow methods with a peristaltic pump. Field parameters will be measured

prior to sample collection. Groundwater samples will be analyzed for VOCs using EPA Method 8260 by Fremont Analytical.

5.1.4 Confirmation Monitoring in Off-Property Monitoring Wells

Confirmation monitoring will commence after PCE concentrations in MW-21 and MW-22 have been below the CUL for at least two consecutive quarters and we have applied for Property-specific NFAs from Ecology. Confirmation monitoring will initially be conducted annually for 2 years and then be reduced to bi-annual frequency. As described above, wells that have PCE below the CUL for at least 4 consecutive sampling events will be removed from the compliance monitoring program and will be decommissioned.

PRB Area (4 wells). MW-7, MW-9, MW-18, and MW-21 will be sampled to document natural attenuation downgradient of the Property. On-Property wells DC-8, DC-15, MW-20, and MW-22 will no longer be sampled because groundwater in this area will be treated by the PRB.

Natural Attenuation in Peripheral Areas (4 wells). MW-17, KMW-3, KMW-7, and KMW-8 will be sampled to document the ongoing continued natural attenuation. On-Property wells DC-7, DC-17, and the AS ZOI area wells will no longer be sampled due to long term declining trends in these wells.

Depth to water will be recorded in all wells to be sampled. Each monitoring well will be purged and sampled using low flow methods with a peristaltic pump. Field parameters will be measured prior to sample collection. Groundwater samples will be analyzed for VOCs using EPA Method 8260 by Fremont Analytical.

5.1.5 Soil Vapor Extraction System Monitoring

The metric for achieving the goal for the SVE system operation will include consistent demonstration that concentrations of PCE in soil vapor beneath Four Star Cleaners, the adjacent fitness center suite, and the former Manhattan Cleaners is below the remediation screening level. This monitoring will include measuring vacuum and field VOC concentrations in the vapor probes located inside the Four Star Cleaners suite, inside the Ian Fitness Center suite located directly east of Four Star Cleaners, and inside the former Manhattan Cleaners suite.

Performance Sampling. The following samples will be collected to document SVE system performance. Samples will be submitted to ALS Environmental (an accredited laboratory) for VOCs by EPA Method TO-15.

- **Quarterly SVE Stack Samples:** Stack samples will be collected to verify compliance with Puget Sound Clean Air Agency and Ecology discharge criteria and document mass removed.
- **Quarterly Sub-Slab Soil Vapor Samples:** Samples from soil vapor probes SVS-11 (inside Four Star Cleaners near the back door), SVS-13 (inside the former Manhattan Village Cleaners kitchen), and SVS-18 (proposed probe to be installed inside the Ian Fitness Center suite) will be collected to demonstrate declining sub-slab soil vapor

PCE concentrations to below the remediation screening level for unrestricted land use.

- Semi-Annual SVE well samples: Samples from operating SVE wells adjacent to Four Star Cleaners and the Former Manhattan Cleaners will be collected to maintain optimal SVE system performance.

SVE System Shut-Down Criteria. SVE O&M and monitoring will continue until PCE in soil vapor concentrations in SVS-11, SVS-13, and SVS-18 are consistently below the remediation screening level during active SVE operation. At the time when these conditions are met for at least two consecutive quarters, the SVE system will be shut-down for rebound monitoring. The SVE system will be shut down for a period of four months to document the potential rebound of PCE in soil gas beneath the commercial buildings. If sub-slab soil vapor PCE concentrations remain below the remediation screening level, the system will remain off-line. If sub-slab soil vapor concentrations rebound to above the screening levels, the SVE system will be restarted.

5.2 Reporting

Documentation of the remedial measures will occur in routine status reports at a minimum annual frequency. The status reports will be prepared in a manner suitable for submission to Ecology and will serve as updates on the progress of remedial actions at the Property and to document that the remedial actions are performing as designed. The reporting will consist of a summary of the baseline and performance monitoring results, PRB installation, monitoring well installation, sub-slab soil vapor probe installation, and monitoring well decommissioning. In addition to the status reports, the groundwater monitoring data and compliance soil vapor sample data collected during the reporting period will be compiled and submitted electronically to Ecology's Environmental Information Monitoring Systems database.

Prior to the project entering the confirmation groundwater monitoring of off-property wells phase, a closure report will be prepared and submitted to Ecology. The closure report will include a summary of current Site conditions, a request for property-specific NFAs for the Harris property and the MVSC property, a draft environmental covenant for the Harris property, and a confirmation monitoring plan for off-Property groundwater, consistent with Section 5.1.4.

TABLES

Table 1

Tetrachloroethene in Soil - 2020 and 2021
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Sample Location ID	Depth (ft bgs)	Date Date	PCE (mg/kg)	Other VOCs detected (mg/kg)	Comments
MTCA Method A Cleanup Level			0.050		
SVE-20	2	08/31/20	0.0907		
SVE-20	8.5	08/31/20	1.54		
SVE-20	11	08/31/20	1.30	Cis-1,2-dichloroethene = 0.0455; Trichloroethene = 0.0226	
SVE-21	2	08/31/20	0.254		
SVE-21	12	08/31/20	0.0381		
SVE-21	25	08/31/20	0.0558		
SVE-21	35	08/31/20	0.135		
SVE-22	2	09/01/20	0.0320		
SVE-22	26	09/01/20	0.102		
SVE-22	32	09/01/20	0.105		
SVE-23	2	09/01/20	0.0270 U		
SVE-23	19	09/01/20	0.0252	1,2,3-Trichlorobenzene = 0.0254; Hexachlorobutadiene = 0.0313	
SVE-23	25	09/01/20	0.0489		
SVE-24	3	08/31/20	0.0315 U		
SVE-24	8	09/01/20	0.0215 U		Vert depth = 5.7 ft
SVE-24	13.5	09/01/20	0.0245 U		Vert depth = 9.6 ft
SVE-25	2	09/01/20	0.0269 U		
SVE-25	11.5	09/02/20	0.0373		Vert depth = 8.2 ft
SVE-25	43.5	09/02/20	0.0632		Vert depth = 30.9 ft
SVE-25	49	09/02/20	0.0422		Vert depth = 34.8 ft
Trench	2.5	09/02/20	0.0240 U		Adj. to sanitary line
EX-1	1.5	09/17/20	0.144		
EX-1	4	09/17/20	0.0242 U		
EX-2	1	09/17/20	0.0233 U		
EX-2	4	09/17/20	0.0260 U		
EX-3	3	09/17/20	0.0239 U		
EX-3	4	09/17/20	0.0240 U		
EX-4	2	09/17/20	0.130		
EX-4	4	09/17/20	0.0224 U		
EX-5	2	09/17/20	0.0237 U		
EX-6	3	09/17/20	0.00565 U		

Table 1

**Tetrachloroethene in Soil - 2020 and 2021
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Sample Location ID	Depth (ft bgs)	Date Date	PCE (mg/kg)	Other VOCs detected (mg/kg)	Comments
MTCA Method A Cleanup Level			0.050		
EX-7	2	09/17/20	0.00620 U		
EX-8	1.5	09/17/20	0.00632 U		
EX-9	3	09/17/20	0.00666 U		
EX-10	3	09/17/20	0.00588 U		
EX-11	2	09/17/20	0.00642 U		
EX-12	2	09/17/20	0.00606 U		
EX-13	2	09/17/20	0.00642 U		
EX-14	2	09/17/20	0.00608 U		
EX-15	2	09/17/20	0.00576 U		
EX-16	1.5	01/27/21	0.0214 U		
EX-17	1.5	01/27/21	0.0876		
EX-18	1.5	01/27/21	0.0236 U		
EX-19	2	01/27/21	0.0265 U		
EX-20	2.5	01/27/21	0.0231 U		
EX-21	2	01/27/21	0.0229 U		
EX-22	2.5	01/27/21	0.0237 U		
EX-23	2	01/27/21	0.0273 U		
EX-24	2	01/27/21	0.0242 U		
EX-25	3	01/27/21	0.0264 U		
EX-26	3	01/27/21	0.0231 U		
EX-27	3	01/27/21	0.0193 U		
<p>NOTES:</p> <ol style="list-style-type: none"> Tetrachloroethene (PCE) concentrations in milligrams per kilogram (mg/kg). Samples analyzed using USEPA Methods 8260. Samples EX-6 through EX-15 analyzed by EPA Method 8260-SIM ND and U = concentration not detected at or above the laboratory practical quantitation limit (PQL). Detected concentrations are shown in bold. Concentrations exceeding the PCE MTCA Method A cleanup level of 0.050 mg/kg are bold and shaded. Other detected VOCs - only those which are above their respective cleanup level are listed. SVE-24 and SVE-25 were installed at a 45 degree angle and sample depths indicate length along boring. Vertical depths are included in the comments. 					

Table 2

**Tetrachloroethene in Groundwater - 2020 and 2021
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Monitoring Well	Date	Screened Interval Depth (feet TOC)	Depth to Water (feet TOC)	Pump Intake Depth (feet TOC)	PCE (µg/l)
MTCA Method A Ground Water Cleanup Level					5
June 2020 Event					
MW-17	6/3/2020	27.61-37.61	31.88	33.5	5.35
MW-20	6/3/2020	29.41-44.41	34.02	37.0	1.00 U
May 2021 Event					
DC-7	5/11/2021	34.35-39.35	31.15	35.0	8.35
<p><u>NOTES:</u></p> <ol style="list-style-type: none"> 1. Tetrachloroethene (PCE) concentrations in micrograms per liter (µg/l). Other VOCs, if detected above the laboratory practical quantitation limit (PQL), are listed in Table D3. 2. Groundwater samples analyzed using USEPA Method 8260C. 3. U = concentration not detected at or above the laboratory PQL. 4. J = the identification of the analyte is acceptable; the reported value is an estimate 5. Detected concentrations are shown in bold. 6. Concentrations exceeding the cleanup level are bold and shaded. 7. Screened interval depth is estimated using from surveyed elevations (top of casing elevations, ground surface, and monument rim) and field measurements at the time of drilling. 8. Pump intake depth and depth to water is measured in feet below the top of casing (TOC). 9. Screened intervals completely submerged are shaded. 					

Table 3

**Monitoring Wells - Monitoring and Decommissioning Status
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Monitoring Well	Monitoring Status		Wells To Be Decommissioned	Comments
	Performance	Post Air Sparging Compliance		
Wells Included in Current Performance and Compliance Monitoring Well Network				
MW-4		X		3 more below CUL sampling rounds needed.
MW-7	X			
MW-9	X			
MW-10		X		2 more below CUL sampling rounds needed.
MW-11		X		3 more below CUL sampling rounds needed.
MW-17	X			
MW-18	X			
MW-20	X			
MW-21	X			Proposed PRB well.
MW-22	X			Proposed well downgradient of PRB.
DC-4		X		4 more below CUL sampling rounds needed.
DC-7	X			
DC-8	X			
DC-10A		X		4 more below CUL sampling rounds needed.
DC-15	X			
DC-17		X		
KMW-3	X			
KMW-7	X			
KMW-8	X			
Wells to be Decommissioned				
MW-1			X	May have been compromised and nearby wells are below CULs
MW-2			X	Below CUL since 7/2017.
MW-3			X	Below CUL since 2013.
MW-5			X	Below CUL and ND all time.
MW-6			X	ND in 2008 and 2012. Not in plume.
MW-8			X	Below CUL and ND all time.
MW-12			X	ND all time.
MW-13			X	ND all time.
MW-14			X	Below CUL and ND all time.
MW-15			X	Below CUL and ND all time.
MW-16			X	Below CUL and ND all time.
DC-1			X	Below CUL and ND all time.
DC-2			X	Below CUL and ND all time.
DC-3			X	Below CUL since 2012.
DC-11			X	Below CUL since 2010.
DC-12			X	Below CUL since 2012.
DC-13			X	Below CUL since 2013.
DC-18			X	Below CUL since 2013.
DC-19			X	Below CUL and ND all time.
DC-20			X	Below CUL since 2013.

Table 3

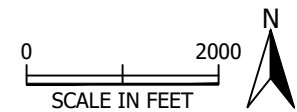
**Monitoring Wells - Monitoring and Decommissioning Status
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Monitoring Well	Monitoring Status		Wells To Be Decommissioned	Comments
	Performance	Post Air Sparging Compliance		
KMW-1			X	ND all time.
KMW-2			X	Duplicated by nearby MW-10.
KMW-4			X	Below CUL and ND all time.
KMW-5			X	Below CUL and ND all time.
KMW-6			X	Below CUL and ND all time.
KMW-9			X	Below CUL since 2010.
MW-19			X	Deep screen. ND all time.
DC-5			X	Deep screen. Below CUL and ND since 2006.
DC-10B			X	Deep screen. Below CUL and ND since 2005.
DC-16			X	Deep screen. Below CUL and ND all time.
KMW-5D			X	Deep screen. ND all time.
Totals	13	6	31	

NOTES:

1. Previously contaminated wells located within the air sparging zone of influence will continue to be monitored until 4 consecutive rounds of below CUL results are achieved. At that time, the wells will no longer be sampled and will be slated for decommissioning.
2. Wells will be decommissioned in accordance with the requirements of WAC 173-160.
3. CUL = cleanup level.
4. ND = not detected above the laboratory practical quantitation limit.
5. PRB = permeable reactive barrier.

ILLUSTRATIONS



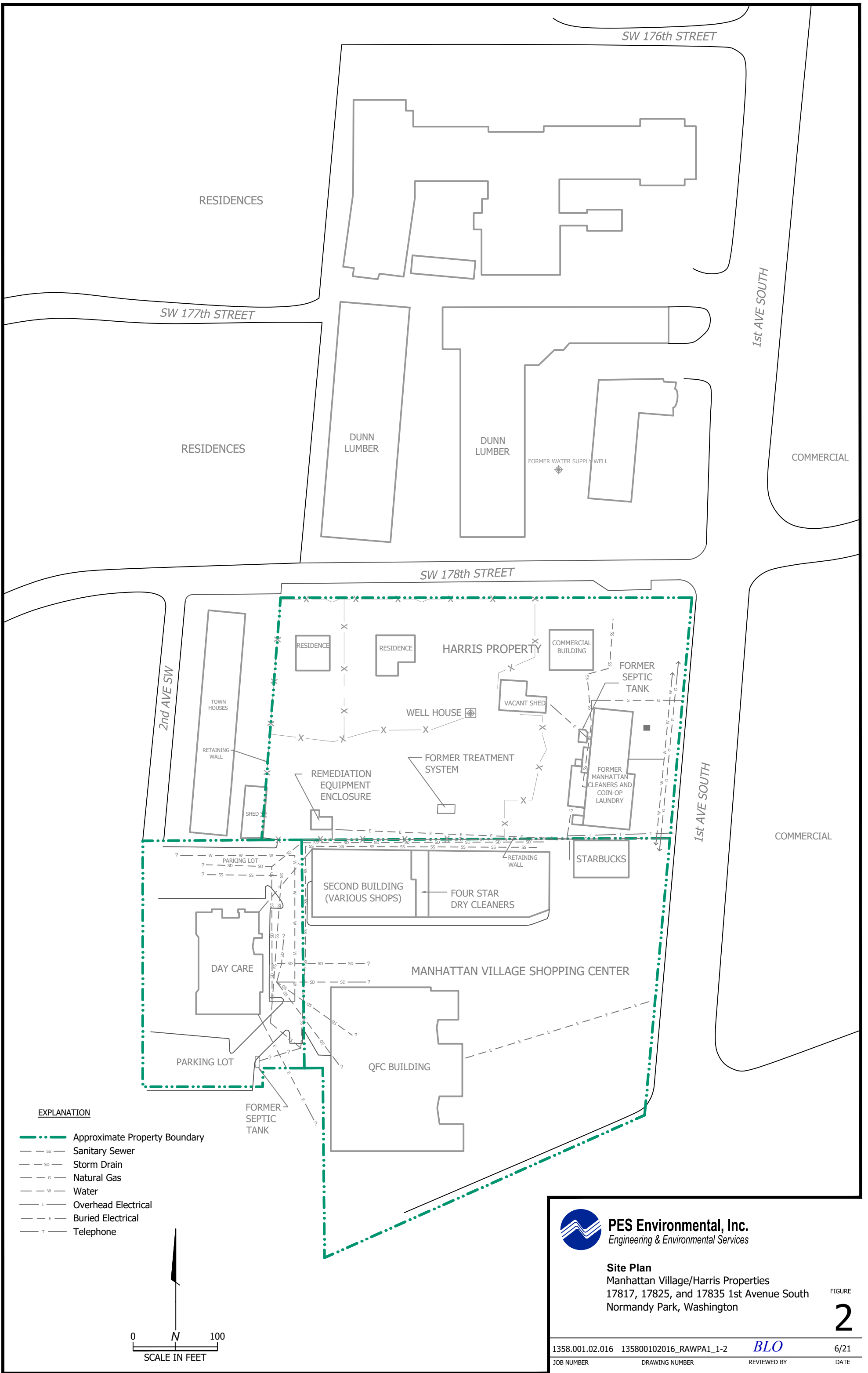
Aerial Photo: April 19, 2015 (Google 2016)



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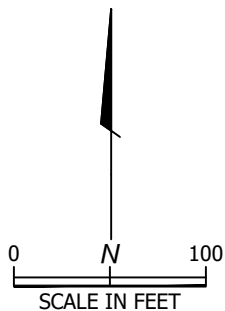
Subject Property Location Map
Manhattan Village/Harris Properties
17817, 17825, and 17835 1st Avenue South
Normandy Park, Washington

FIGURE
1



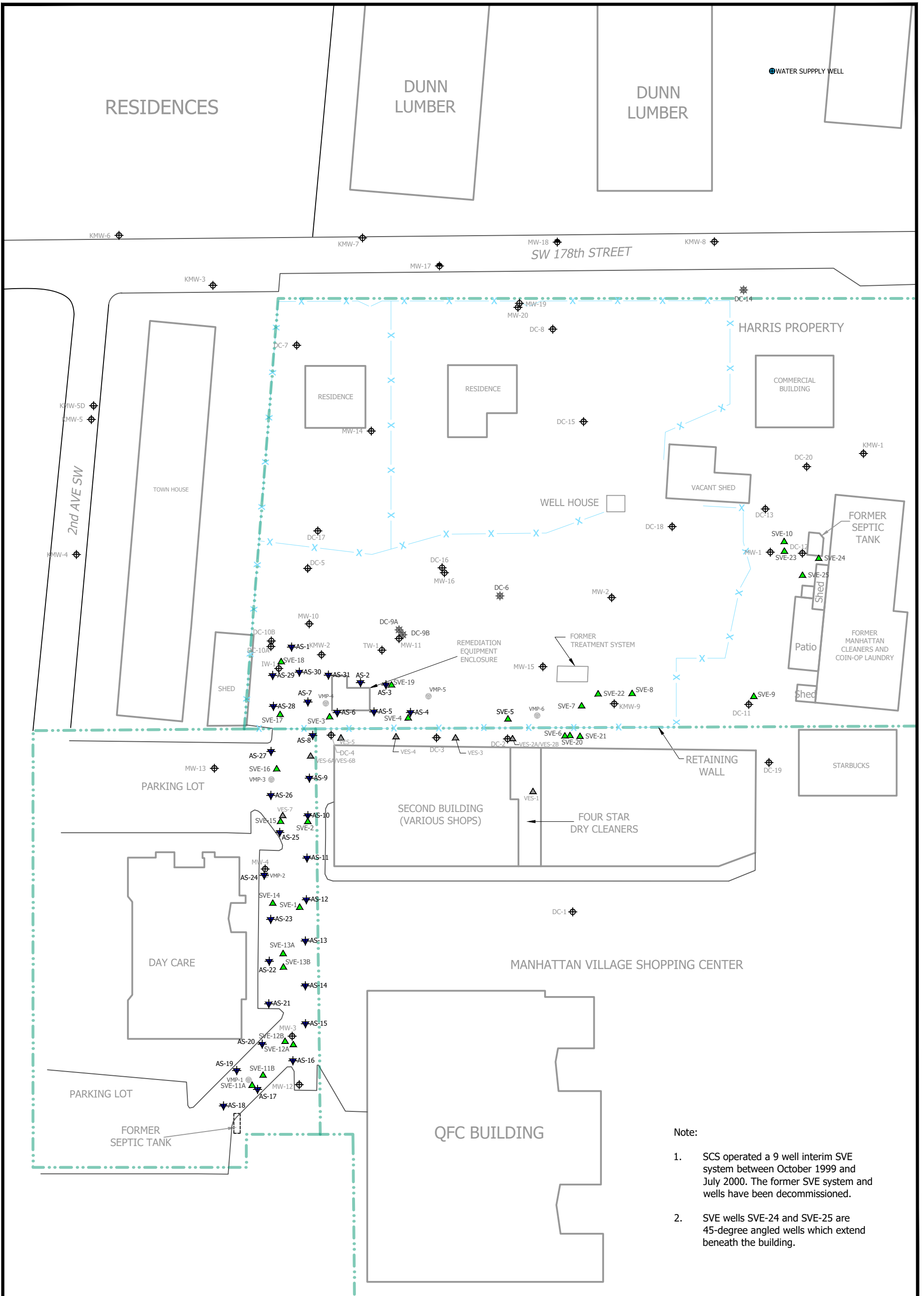
EXPLANATION

- Approximate Property Boundary
- SS— Sanitary Sewer
- SD— Storm Drain
- G— Natural Gas
- W— Water
- E— Overhead Electrical
- E— Buried Electrical
- T— Telephone



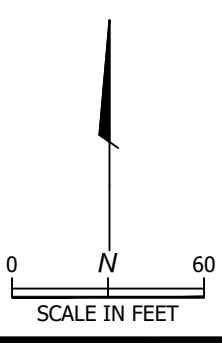
Site Plan
 Manhattan Village/Harris Properties
 17817, 17825, and 17835 1st Avenue South
 Normandy Park, Washington

FIGURE
2



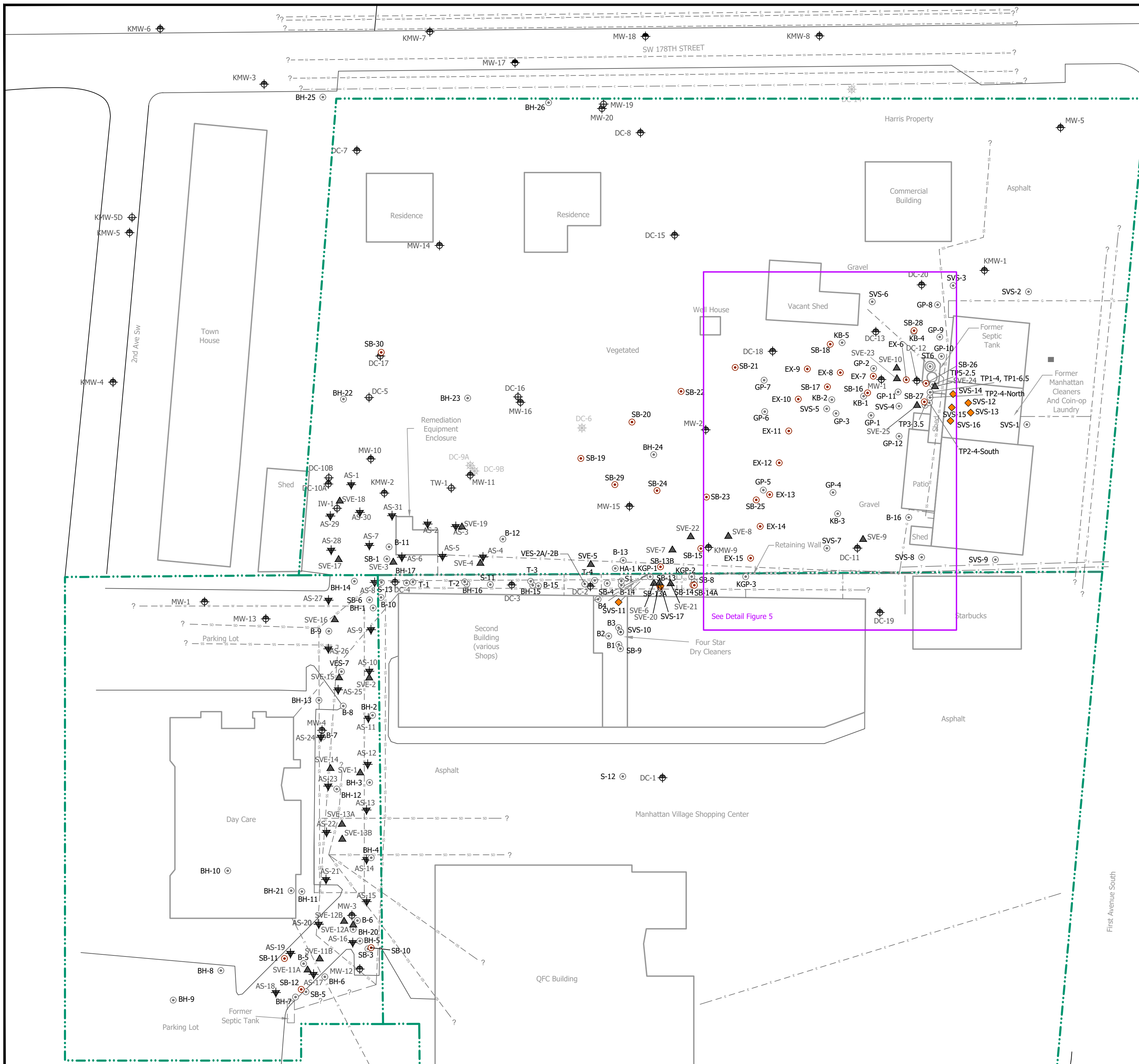
- Note:
1. SCS operated a 9 well interim SVE system between October 1999 and July 2000. The former SVE system and wells have been decommissioned.
 2. SVE wells SVE-24 and SVE-25 are 45-degree angled wells which extend beneath the building.

- EXPLANATION**
- Approximate Property Boundary
 - AS-1 Air Sparge Well
 - SVE-1 Soil Vapor Extraction Well
 - MW-12 Shallow Monitoring Well
 - DC-16 Deep Monitoring Well
 - VES-3 Decommissioned Soil Vapor Extraction Well (SCS, 1999)
 - DC-14 Decommissioned Monitoring Well
 - VMP-1 Vapor Monitoring Probe



Existing Remediation Well Locations
 Manhattan Village/Harris Properties
 17817, 17825, and 17835 1st Avenue South
 Normandy Park, Washington

FIGURE
3



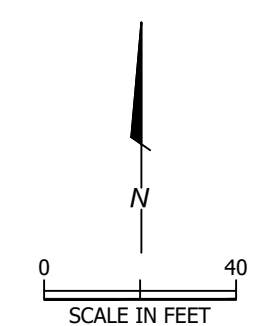
- EXPLANATION**
- Approximate Property Boundary
 - SVE Trench
 - DC-6 ☼ Decommissioned or Missing Monitoring Well
 - DC-15 ○ Shallow Monitoring Well
 - DC-16 ⊕ Deep Monitoring Well
 - SVE-1 ▲ Soil Vapor Extraction Well
 - AS-1 ▼ Air Sparge Well
 - TW-1 ⊕ Pilot Test Well (Kane 2006, ERM 2011)
 - KB-3 ○ Boring Location by Others (See Identification List)
 - SB-24 ○ Soil Boring (PES, 2018-2021)
 - SVS-11 ◆ Soil Gas Probe (PES, 2019)

Boring Identification List

Consultant	Boring IDs	Year
SCS	B1 - B4 / S1 - S13 / BH-1 / BH-26 / T-1 - T-4	1998-2000
ADAPT	HA-1	1999
Farallon	SVS-1 - SVS-10 / GP-1 - GP-12 / TP1 - TP5	2005 - 2008
Kane	KB-1 - KB-5 / KGP-1 - KGP-3 / ST6	2003 - 2007
ERM	B-5 - B-18 / SB-1 - SB-9	2008 - 2012
PES	SB-10 - SB-30 / SVS-11 - SVS-17 / EX-1 - EX-27	2018 - 2021

- W — Water
- SS — Sanitary Sewer
- E — Electrical Line
- SD — Storm Drain
- G — Gas
- C — Communication
- T — Telephone

- Notes:**
- Borings drilled from 1998 through 2012 were not surveyed. Locations are estimated from prior consultants' site maps.
 - Investigation borings B-5, B-7, B-9, B-11, B-12, and B-13 were completed as vapor monitoring probes VMP-1 through VMP-6.
 - The temporary SVE system installed in 1999 included nine wells which operated for approximately one year, and were subsequently decommissioned. Six SVE wells were installed in investigation borings B-1 (VES-1), BH-1 (VES6A/6B), BH-15 (VES-5), BH-16 (VES-4), and BH-17 (VES-3). The other three wells (VES-2A/2B and VES-7) were installed in separate locations.
 - The former septic tank on Harris Property was removed in April 2006. Four sidewall and two bottom samples were collected. Bottom sample ST6 represents the only detection in the 6 samples.
 - SCS borings B-1, B-2, and B-3 were completed as 1-inch diameter vapor monitoring probes in 1998. Well construction details are not available.
 - Soil gas sampling probes SVS-10 through SVS-16 are installed beneath the building slabs and requires specialized tools for access to the flush grade monuments. SVS-17 is installed in the asphalt behind Four Star Cleaners and includes a standard 6-inch diameter flush grade monument.
 - Borings EX-1 through EX-15 were advanced in September 2020 to evaluate conditions prior to excavation and constructing an SVE piping trench. The excavation was completed in January 2021 and confirmation samples were collected. The SVE trench was completed in February 2021. See Figure 5 for locations of borings EX-1 through EX-5 and excavation confirmation samples EX-16 through EX-27.



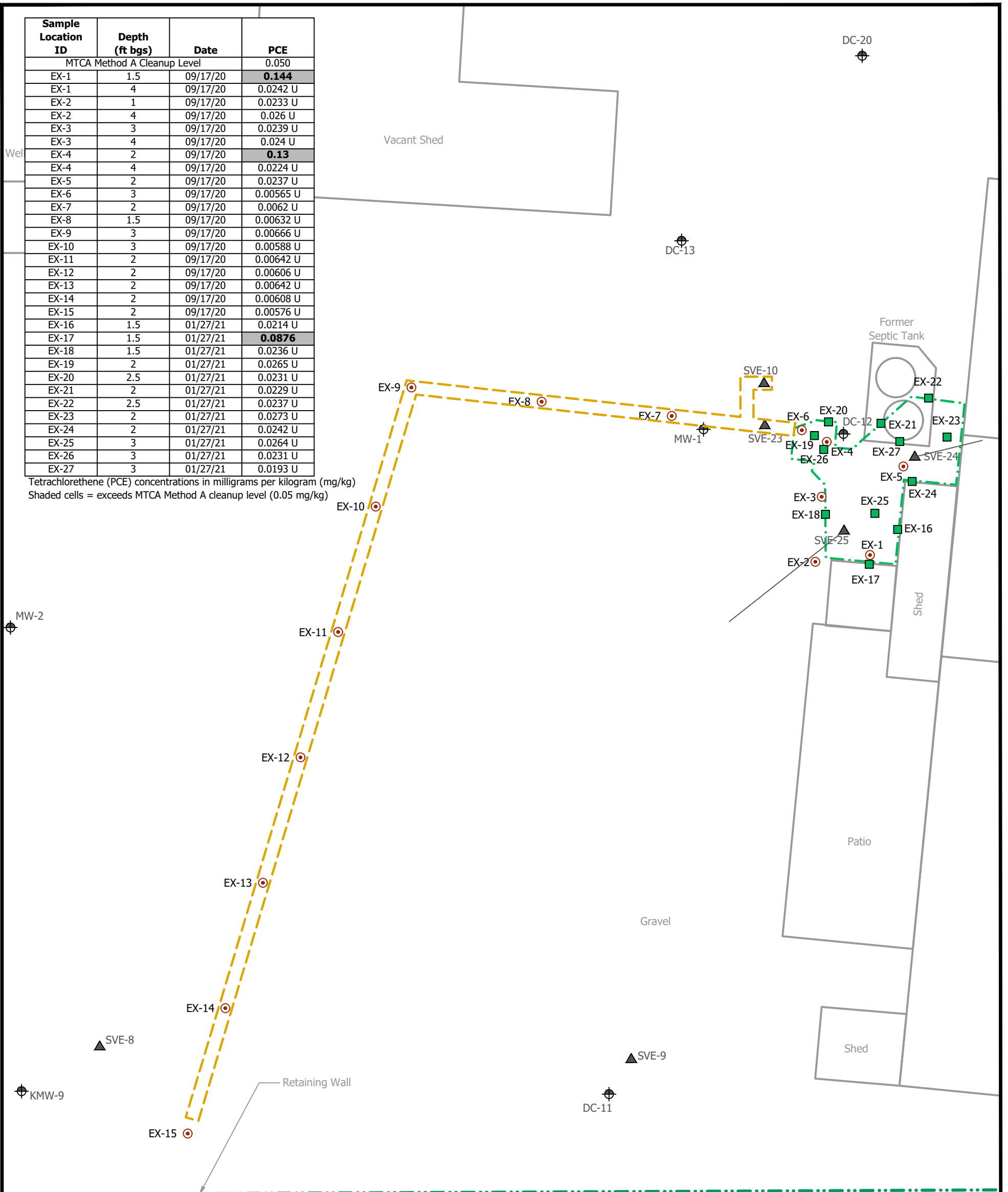
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Engineering & Environmental Services

Well and Boring Location Map
Manhattan Village/Harris Properties
17817, and 17825, and 17835 1st Avenue South
Normandy Park, Washington

FIGURE 4

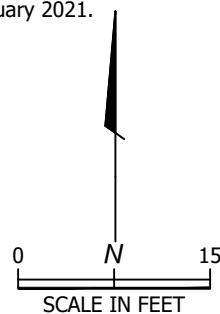
Sample Location ID	Depth (ft bgs)	Date	PCE
MTCA Method A Cleanup Level			0.050
EX-1	1.5	09/17/20	0.144
EX-1	4	09/17/20	0.0242 U
EX-2	1	09/17/20	0.0233 U
EX-2	4	09/17/20	0.026 U
EX-3	3	09/17/20	0.0239 U
EX-3	4	09/17/20	0.024 U
EX-4	2	09/17/20	0.13
EX-4	4	09/17/20	0.0224 U
EX-5	2	09/17/20	0.0237 U
EX-6	3	09/17/20	0.00565 U
EX-7	2	09/17/20	0.0062 U
EX-8	1.5	09/17/20	0.00632 U
EX-9	3	09/17/20	0.00666 U
EX-10	3	09/17/20	0.00588 U
EX-11	2	09/17/20	0.00642 U
EX-12	2	09/17/20	0.00606 U
EX-13	2	09/17/20	0.00642 U
EX-14	2	09/17/20	0.00608 U
EX-15	2	09/17/20	0.00576 U
EX-16	1.5	01/27/21	0.0214 U
EX-17	1.5	01/27/21	0.0876
EX-18	1.5	01/27/21	0.0236 U
EX-19	2	01/27/21	0.0265 U
EX-20	2.5	01/27/21	0.0231 U
EX-21	2	01/27/21	0.0229 U
EX-22	2.5	01/27/21	0.0237 U
EX-23	2	01/27/21	0.0273 U
EX-24	2	01/27/21	0.0242 U
EX-25	3	01/27/21	0.0264 U
EX-26	3	01/27/21	0.0231 U
EX-27	3	01/27/21	0.0193 U

Tetrachlorethene (PCE) concentrations in milligrams per kilogram (mg/kg)
 Shaded cells = exceeds MTCA Method A cleanup level (0.05 mg/kg)



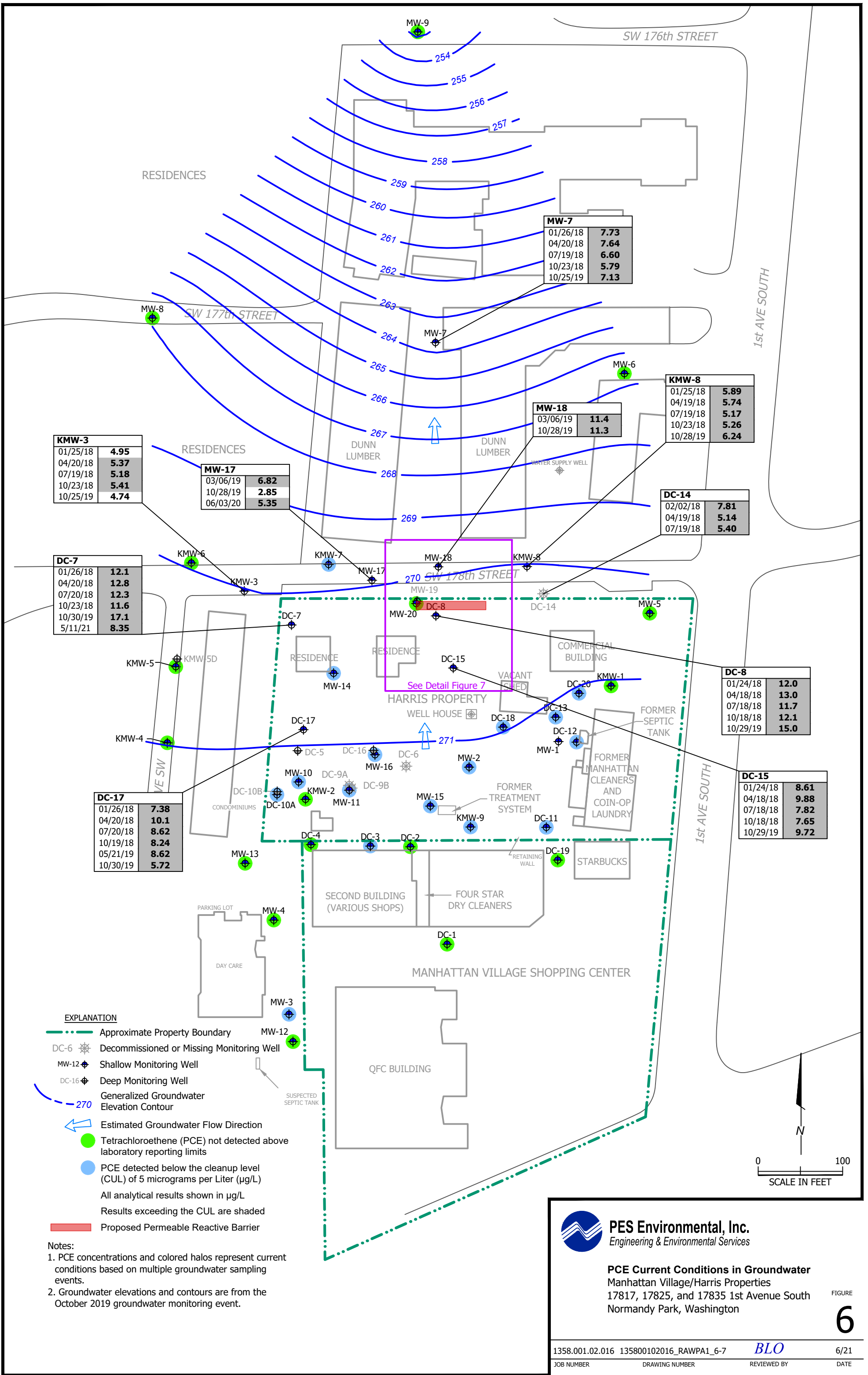
- EXPLANATION**
- - - Approximate Property Boundary
 - - - SVE Lateral Pipe Trench
 - - - Limits of Excavation
 - SVE-1 ▲ Soil Vapor Extraction Well
 - MW-12 ⊕ Shallow Monitoring Well
 - EX-14 ⊙ Pre-Trenching and Excavation Sample (PES, 2020)
 - EX-27 ■ Excavation Confirmation Sample (PES, 2021)

- Notes:**
1. EX-1 through EX-15 were advanced in September 2020 to evaluate conditions prior to excavation and trenching.
 2. Confirmation samples EX-16 through EX-27 were collected at the bottom and sidewalls of the excavation in January 2021.



Excavation and SVE Trench Detail
 Manhattan Village/Harris Properties
 17817, 17825, and 17835 1st Avenue South
 Normandy Park, Washington

FIGURE
5



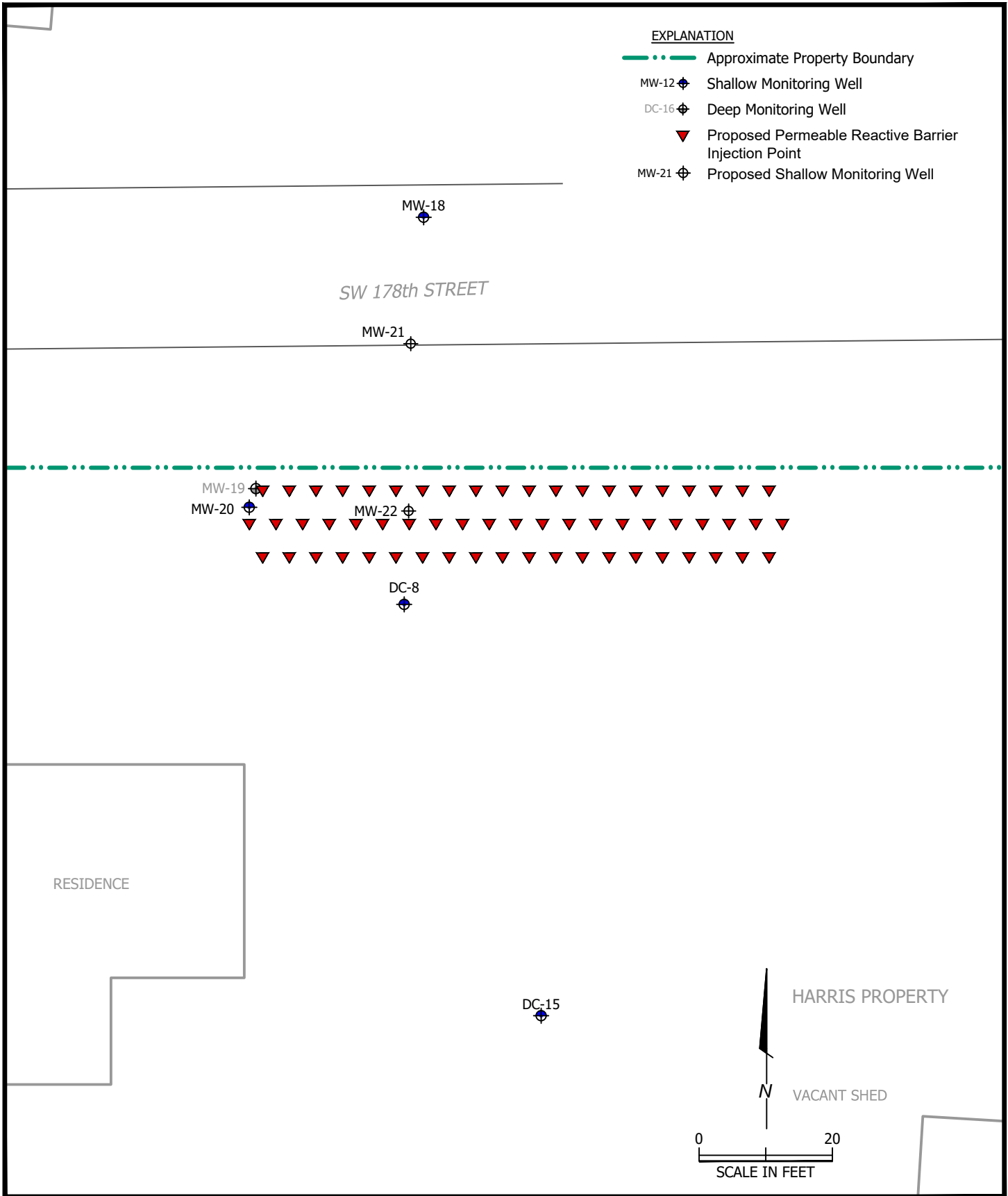
PES Environmental, Inc.
Engineering & Environmental Services

PCE Current Conditions in Groundwater
Manhattan Village/Harris Properties
17817, 17825, and 17835 1st Avenue South
Normandy Park, Washington

FIGURE **6**

1358.001.02.016 135800102016_RAWPA1_6-7 **BLO** 6/21

JOB NUMBER DRAWING NUMBER REVIEWED BY DATE



APPENDIX A
HISTORICAL DATA

- Groundwater Monitoring Data
 - Table A1 – Well Completions and Boring Details
 - Table A2 – Historical Summary of Groundwater Elevations (1999 – 2021)
 - Table A3 – Historical Summary of Groundwater Analytical Results (1999 – 2021)
 - Time Trend Plots for DC-7, DC-8, DC-15, DC-17, KMW-3, and KMW-8

- Soil Vapor Data
 - Table A4 – Soil Vapor Results – March 11 and June 3, 2019

Table A1
Well Completion and Boring Details
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Well	Ecology Well Tag Number	Date Installed	Drilling Method	Location (feet NAD 83/91)		Elevation (feet NAVD 88)			Survey Notes	Monument Type	Boring Depth (feet)	Well Diameter (inches)	Screen Depth (ft bgs)		Slot Size (inch)	Filter Pack (ft bgs)	Seal (ft bgs)
				Northing	Easting	Monitoring Point	Surface Casing Rim	Ground Surface					Below Ground	Below Top of Casing			
Shallow Monitoring Wells																	
MW-1		12/9/99	HSA	165,180.1	1,268,830.5	310.63	310.89	310.81	SCS, 1999; PES 03/2021	Flush	44	2	34-44	--	0.020	est. 32-44	0-est. 32
MW-2		12/9/99	HSA	165,149.8	1,268,724.6	308.34	309.13	309.12	PES, 08/2015	Flush	43	2	33-43	32.22-42.22	0.020	est. 31-43	0-est. 31
MW-3		4/8/08	HSA	164,857.2	1,268,511.5	311.41	311.76	311.74	PES, 08/2015	Flush	47	2	36-46	35.67-45.67	0.010	34-46	0-34
MW-4		4/8/08	HSA	164,968.5	1,268,493.6	310.47	311.03	311.02	PES, 08/2015	Flush	44	2	34-44	33.45-43.45	0.010	32-44	0-32
MW-5		4/8/08	HSA	165,331.6	1,268,938.6	310.38	310.84	--	PES, 02/2013	Flush	46	2	36-46	35.6-45.6	0.010	34-46	0-34
MW-6		4/9/08	HSA	165,615.5	1,268,908.5	304.14	304.71	304.68	PES, 02/2013; PES, 08/2015	Flush	45	2	35-45	34.46-44.46	0.010	33-45	0-35
MW-7		4/9/08	HSA	165,652.2	1,268,684.8	302.64	303.18	303.17	PES, 02/2013; PES, 08/2015	Flush	45	2	35-45	34.47-44.47	0.010	33-45	0-35
MW-8		8/18/08	HSA	165,681.2	1,268,349.8	280.68	281.05	280.97	PES, 02/2013; PES, 08/2015	Flush	26	2	13-23	12.71-22.71	0.010	11-23	0-11
MW-9		8/18/08	HSA	166,019.8	1,268,663.9	284.97	285.35	285.37	PES, 02/2013; PES, 08/2015	Flush	55	2	32-42	31.6-41.6	0.010	30-42	0-30
MW-10		2/3/11	HSA	165,132.3	1,268,522.8	306.71	307.20	307.19	PES, 02/2013; PES, 08/2015	Flush	42	2	32-42	31.52-41.52	0.010	30-42	0-30
MW-11		2/3/11	HSA	165,122.2	1,268,582.9	307.62	308.13	308.06	PES, 02/2013; PES, 08/2015	Flush	42	2	32-42	31.56-41.56	0.010	30-42	0-30
MW-12		3/28/12	HSA	164,825.0	1,268,516.1	312.80	313.12	313.10	PES, 02/2013; PES, 08/2015	Flush	46.5	2	36-46	35.7-45.7	0.010	34-46.5	0-34
MW-13		3/29/12	HSA	165,036.5	1,268,459.8	308.75	309.16	309.17	PES, 02/2013; PES, 08/2015	Flush	46.5	2	35-45	34.58-44.58	0.010	33-45	0-33
MW-14		3/27/12	HSA	165,261.1	1,268,564.6	303.82	304.24	--	PES, 02/2013	Flush	38	2	28-38	27.6-37.6	0.010	26-38	0-26
MW-15		3/28/12	HSA	165,103.9	1,268,678.7	312.44	312.81	310.30	PES, 02/2013	AG	46.5	2	35-45	37.14-47.14	0.010	33-45.5	0-33
MW-16	BHV646	5/16/13	HSA	165,164.5	1,268,613.3	310.37	311.21	307.92	PES, 05/2013	AG	43	2	27.2-42.2	29.45-44.65	0.020	25-43	0-25
MW-17	BLI196	3/1/19	HSA	165,371.0	1,268,609.7	303.01	303.56	303.60	PES, 03/2019; PES, 10/2019	Flush	39.5	2	28.2-38.2	27.61-37.61	0.010	26-39.5	0-26
MW-18	BLI195	2/28/19	HSA	165,386.9	1,268,688.3	305.26	305.74	305.70	PES, 03/2019; PES, 10/2019	Flush	41.5	2	30.3-40.3	29.86-39.86	0.010	27.5-41.5	0-27.5
MW-20	BLK428	10/24/19	HSA	165,343.4	1,268,662.1	305.51	305.86	306.10	PES, 10/2019	Flush	46	2	30.0-45.0	29.41-44.41	0.010	28-46	0-28
DC-1		10/12/98	HSA	164,940.2	1,268,698.6	312.82	313.34	--	PES, 02/2013	Flush	47	2	40-45	39.5-44.5	0.020	37-47	0-37
DC-2		10/13/98	HSA	165,055.6	1,268,655.1	312.92	313.61	313.70	PES, 02/2013; PES, 08/2015	Flush	50	2	42-47	41.22-46.22	0.020	40-50	0-40
DC-3		10/13/98	HSA	165,056.4	1,268,607.7	313.11	313.68	313.79	PES, 02/2013; PES, 08/2015	Flush	48	2	43-48	42.32-47.32	0.020	41-48	0-41
DC-4		10/13/98	HSA	165,058.1	1,268,537.4	312.35	312.96	312.99	PES, 02/2013; PES, 08/2015	Flush	49	2	44-49	43.36-48.36	0.020	41-49	0-41
DC-6		1/22/99	HSA	--	--	308.46	--	--	SCS, 1999 (converted)	Flush	45	2	40-45	--	0.020	37-45	0-37
DC-7		1/18/99	HSA	165,318.1	1,268,514.4	302.61	303.30	303.26	PES, 02/2013; PES, 08/2015	Flush	40	2	35-40	34.35-39.35	0.020	33-40	0-33
DC-8		1/18/99	HSA	165,328.8	1,268,685.4	306.23	306.70	306.59	PES, 02/2013; PES, 08/2015	Flush	42	2	37-42	36.64-41.64	0.020	34-42	0-34
DC-9A		4/6/99	HSA	165,124.7	1,268,587.3	308.02	--	--	ERM, 08/2008	Flush	38	2	33-38	32.6-37.6	0.020	31-38	0-31
DC-10A		4/5/99	HSA	165,117.2	1,268,497.2	307.73	307.83	307.72	PES, 02/2013; PES, 08/2015	Flush	37	2	32-37	32.01-37.01	0.020	30-37	0-30
DC-11		4/19/07	HSA	165,078.5	1,268,816.1	311.25	311.66	--	PES, 02/2013	Flush	42	2	32-42	31.6-41.6	0.010	30-42	0-30
DC-12		4/18/07	HSA	165,179.8	1,268,852.1	311.22	311.81	311.73	PES, 02/2013; PES 03/2021	Flush	42	2	32-42	31.7-41.7	0.010	30-42	0-30
DC-13		4/19/07	HSA	165,208.9	1,268,827.2	310.20	310.52	--	PES, 02/2013	Flush	42	2	32-42	31.7-41.7	0.010	30-42	0-30
DC-14		4/17/07	HSA	165,355.0	1,268,812.6	308.94	309.49	--	PES, 02/2013	Flush	45	2	35-45	34.4-44.4	0.010	33-45	0-33
DC-15		4/16/07	HSA	165,267.1	1,268,705.9	307.89	308.20	--	PES, 02/2013	Flush	42	2	31-41	30.7-40.7	0.010	29-41	0-29
DC-17		4/16/07	HSA	165,194.2	1,268,528.6	305.16	305.58	305.35	PES, 05/2013	Flush	40	2	30-40	29.81-39.81	0.010	28-40	0-28
DC-18		4/18/07	HSA	165,197.1	1,268,765.0	309.51	309.95	309.93	PES, 02/2013; PES, 08/2015	Flush	42	2	32-42	31.58-41.58	0.010	30-42	0-30
DC-19		6/1/07	HSA	165,039.3	1,268,829.6	313.62	313.82	--	PES, 02/2013	Flush	47	2	37-47	36.8-46.8	0.010	35-47	0-35
DC-20		5/28/08	HSA	165,237.2	1,268,854.8	310.92	311.13	--	PES, 02/2013	Flush	44	2	34-44	33.8-43.8	0.020	32-44	0-32
KMW-1		7/25/05	HSA	165,245.9	1,268,892.6	311.59	311.82	--	PES, 02/2013; PES, 08/2015	Flush	52	2	37-52	36.8-51.8	0.010	34-52	0-34
KMW-2		5/1/06	HSA	165,111.7	1,268,531.0	307.04	307.27	307.13	PES, 02/2013; PES, 08/2015	Flush	50	6	30-40	29.91-39.91	0.010	8-40	0-8
KMW-3		5/1/06	HSA	165,357.4	1,268,462.5	296.99	297.77	297.70	Farallon, 05/2007; PES, 10/2019	Flush	40	2	25.18-35.18	24.47-34.47	0.010	8-35	0-8
KMW-4		3/28/07	HSA	165,175.7	1,268,369.8	299.57	299.84	299.78	Farallon, 05/2007; PES, 08/2015	Flush	34	2	24-34	23.79-33.79	0.020	22-34	0-22
KMW-5		3/28/07	HSA	165,267.7	1,268,380.4	297.22	297.58	297.56	Farallon, 05/2007; PES, 08/2015	Flush	34	2	24-34	23.66-33.66	0.020	22-34	0-22
KMW-6	APS-343	3/27/07	HSA	165,391.1	1,268,399.1	294.80	295.27	295.20	Farallon, 05/2007; PES, 08/2015; PES, 10/2019	Flush	42.5	2	26.18-41.18	25.78-40.78	0.020	22-41	0-22
KMW-7		3/25/07	HSA	165,389.7	1,268,563.6	301.42	302.02	302.00	Farallon, 05/2007; PES, 08/2015; PES, 10/2019	Flush	44	2	29.35-44.35	28.77-43.77	0.020	27-44	0-27
KMW-8	APS-341	3/26/07	HSA	165,386.2	1,268,800.7	308.16	308.73	308.70	Farallon, 05/2007; PES, 08/2015; PES, 10/2019	Flush	44	2	29.24-44.24	28.70-43.70	0.020	27-44	0-29
KMW-9		3/27/07	HSA	165,079.0	1,268,726.3	310.33	310.83	310.83	PES, 02/2013; PES, 08/2015	Flush	44	2	34-44	33.5-43.5	0.020	32-44	0-32
Deep Monitoring Wells																	
MW-19	BLK427	10/24/19	HSA	165,346.1	1,268,663.1	305.35	305.77	305.90	PES, 10/2019	Flush	55.5	2	43.9-53.9	43.35-53.35	0.010	42-55	0-42
DC-5		1/22/99	HSA	165,166.5	1,268,526.9	306.03	306.28	306.24	PES, 02/2013; PES, 08/2015	Flush	58.5	2	41-46	40.79-45.79	0.020	39-47	0-39

**Table A1
Well Completion and Boring Details
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Well	Ecology Well Tag Number	Date Installed	Drilling Method	Location (feet NAD 83/91)		Elevation (feet NAVD 88)			Survey Notes	Monument Type	Boring Depth (feet)	Well Diameter (inches)	Screen Depth (ft bgs)		Slot Size (inch)	Filter Pack (ft bgs)	Seal (ft bgs)
				Northing	Easting	Monitoring Point	Surface Casing Rim	Ground Surface					Below Ground	Below Top of Casing			
DC-9B		4/5/99	HSA	165,122.8	1,268,589.4	308.16	--	--	ERM, 08/2008	Flush	60	2	53-58	--	0.020	50.5-58	0-50.5
DC-10B		4/6/99	HSA	165,120.4	1,268,497.5	307.80	308.29	307.89	PES, 02/2013; PES, 08/2015	Flush	56	2	45-50	44.91-49.91	0.020	43-50	0-43
DC-16		4/18/07	HSA	165,169.7	1,268,611.5	307.12	307.79	--	Farallon, 05/2007; PES, 02/2013	Flush	61.5	2	50-60	49.3-59.3	0.010	50-60	0-50
KMW-5D		3/28/07	HSA	165,276.5	1,268,382.0	297.04	297.35	297.32	Farallon, 05/2007; PES, 08/2015	Flush	46	2	41-46	40.72-45.72	0.020	41-46	0-41
Former SCS Soil Vapor Extraction Wells (1999)																	
VES-1 (B1)		1999	--	--	--	--	--	--	PES, 02/2013; PES, 08/2015	Flush	11.5	2	3-11	--	0.020	2.5-11.5	1.5-2.5
VES-2A		1999	--	--	--	--	--	--	PES, 02/2013; PES, 08/2015	Flush	6.5	2	3-6	--	0.020	2.5-6.5	1.5-2.5
VES-2B		1999	--	--	--	--	--	--	PES, 02/2013	Flush	36	2	11.5-35.5	--	0.020	7.5-36	1.5-2.5/6.5-7.5
VES-3 (BH-15)		1999	--	--	--	--	--	--	PES, 02/2013	Flush	6.5	2	3-6	--	0.020	2.5-6.5	1.5-2.5
VES-4 (BH-16)		1999	--	--	--	--	--	--	PES, 02/2013	Flush	6.5	2	3-6	--	0.020	2.5-6.5	1.5-2.5
VES-5 (BH-17)		1999	--	--	--	--	--	--	PES, 02/2013	Flush	6.5	2	3-6	--	0.010	2.5-6.5	1.5-2.5
VES-6A (BH-1)		1999	--	--	--	--	--	--	PES, 02/2013	Flush	6.5	2	3-6	--	0.020	2.5-6.5	1.5-2.5
VES-6B (BH-1)		1999	--	--	--	--	--	--	PES, 02/2013	Flush	36	2	11.5-35.5	--	0.020	7.5-36	1.5-2.5/6.5-7.5
VES-7		1999	--	--	--	--	--	--	PES, 02/2013	Flush	6.5	2	3-6	--	0.020	2.5-6.5	1.5-2.5
Soil Vapor Extraction Wells																	
SVE-1		6/29/09	HSA	164,943.5	1,268,516.2	311.85	312.02	--	PES, 02/2013; PES, 08/2015	Flush	35.5	2	10-35	9.7-34.7	0.020	8-35.5	0-8
SVE-2		6/29/09	HSA	165,000.3	1,268,522.6	312.41	312.58	--	PES, 02/2013; PES, 08/2015	Flush	35.5	2	10-35	9.6-34.6	0.020	8-35.5	0-8
SVE-3		6/30/09	HSA	165,070.2	1,268,536.4	308.28	--	307.84	PES, 02/2013	Flush	30.5	2	10-30	10.44-30.44	0.020	8-30.5	0-8
SVE-4		6/30/09	HSA	165,069.1	1,268,589.2	308.90	--	308.31	PES, 02/2013	Flush	30.5	2	10-30	10.59-30.59	0.020	8-30.5	0-8
SVE-5		6/30/09	HSA	165,068.8	1,268,655.3	309.91	--	309.31	PES, 02/2013	Flush	30.5	2	10-30	10.6-30.6	0.020	8-30.5	0-8
SVE-6		6/26/09	AKVAC	165,057.5	1,268,693.4	313.03	313.57	--	PES, 02/2013	Flush	10	2	5-10	4.6-9.6	0.010	4-10	0-4
SVE-7		6/30/09	HSA	165,077.5	1,268,704.6	310.71	--	309.95	PES, 02/2013	Flush	30.5	2	10-30	10.76-30.76	0.020	8-30.5	0-8
SVE-8		6/30/09	HSA	165,085.8	1,268,738.3	311.48	--	310.56	PES, 02/2013	Flush	30.5	2	10-30	10.92-30.92	0.020	8-30.5	0-8
SVE-9		6/29/09	HSA	165,060.0	1,268,819.5	313.31	--	312.13	PES, 02/2013	Flush	30.5	2	10-30	11.18-31.18	0.020	8-30.5	0-8
SVE-10		6/30/09	HSA	165,187.7	1,268,841.1	310.69	311.20	311.09	PES, 02/2013; PES 03/2021	Flush	30.5	2	10-30	9.8-29.8	0.020	8-30.5	0-8
SVE-11A	BIE307	11/18/13	HSA	164,824.5	1,268,484.7	--	311.21	--	PES, 08/2015	Flush	20	4	5-19.98	4.6-19.58	0.020	3-20	0-3
SVE-11B	BIE301	11/18/13	HSA	164,831.2	1,268,492.0	--	311.43	--	PES, 08/2015	Flush	57	4	20-35	19.6-34.6	0.020	18-36	0-18
SVE-12A	BIE303	11/19/13	HSA	164,851.6	1,268,512.2	--	312.06	--	PES, 08/2015	Flush	20	4	5-19.98	4.6-19.58	0.020	3-20	0-3
SVE-12B	BIE304	11/20/13	HSA	164,853.8	1,268,506.7	--	311.52	--	PES, 08/2015	Flush	57	4	20-35	19.6-34.6	0.020	18-36	0-18
SVE-13A	BIE306	11/22/13	HSA	164,912.3	1,268,505.4	--	310.95	--	PES, 08/2015	Flush	20	4	5-19.98	4.6-19.58	0.020	3-20	0-3
SVE-13B	BIE305	11/21/13	HSA	164,903.3	1,268,505.6	--	310.99	--	PES, 08/2015	Flush	57.5	4	20-35	19.6-34.6	0.020	18-36	0-18
SVE-14	BID732	10/13/14	HSA	164,945.9	1,268,498.5	--	311.06	--	PES, 08/2015	Flush	36	4	19.63-34.63	19.23-34.23	0.020	18.3-36	3-18.3
SVE-15	BID736	10/15/14	HSA	165,000.5	1,268,503.7	--	311.30	--	PES, 08/2015	Flush	36	4	20.61-34.96	20.21-34.56	0.020	19.3-36	3.5-19.3
SVE-16	BID737	10/15/14	HSA	165,035.5	1,268,501.1	--	310.83	--	PES, 08/2015	Flush	36	4	20.49-34.79	20.09-34.39	0.020	18-36	3.5-18
SVE-17	BID709	9/24/14	HSA	165,071.8	1,268,503.4	--	308.39	--	PES, 08/2015	Flush	31	4	19.91-29.91	19.51-29.51	0.020	18-31	3.3-18
SVE-18	BID708	9/23/14	HSA	165,107.0	1,268,504.1	--	307.34	--	PES, 08/2015	Flush	31	4	19.79-29.79	19.39-29.39	0.020	17.9-31	16-17.9
SVE-19	BID715	9/29/14	HSA	165,091.9	1,268,579.7	--	308.53	--	PES, 08/2015	Flush	31	4	19.99-29.99	19.59-29.59	0.020	18-31	3.5-18
SVE-20	BLZ 286	8/30/21	HSA	165,057.7	1,268,696.8	313.02	313.37	313.42	PES, 03/2021	Flush	30	4	10.3-25.4	9.9-25	0.020	8-25	3-8
SVE-21	BLZ 287	8/30/21	HSA	165,057.2	1,268,703.5	313.04	313.47	313.51	PES, 03/2021	Flush	38	4	25.7-37.7	25.3-37.3	0.020	23-38	3-23
SVE-22	BLZ 288	9/1/21	HSA	165,085.5	1,268,715.6	309.90	310.27	310.20	PES, 03/2021	Flush	36	4	20.6-35.6	20.2-35.2	0.020	18-36	3-18
SVE-23	BLZ 289	9/1/21	HSA	165,180.7	1,268,839.9	310.71	311.22	311.16	PES, 03/2021	Flush	35.7	4	20.3-35.3	19.9-34.9	0.020	18-36	3-18
SVE-24	BLZ 290	9/1/21	HSA	165,175.9	1,268,862.8	312.20	312.53	312.50	PES, 03/2021	Flush	23	4	10.3-22.6	9.9-22.2	0.020	8-23	3-8
SVE-25	BLZ 285	9/2/21	HSA	165,164.6	1,268,852.0	311.32	311.86	311.77	PES, 03/2021	Flush	36.9	4	22.8-35.7	22.4-35.3	0.020	18-37	3-18
Vapor Monitoring Probes																	
VMP-1 (B-5)		3/26/08	DP	164,828.0	1,268,482.4	310.91	311.01	--	PES, 02/2013; PES, 08/2015	Flush	30	0.75	10-15	9.7-14.7	0.010	7-30	0-7
VMP-2 (B-7)		3/25/08	DP	164,964.6	1,268,493.8	310.97	311.04	--	PES, 02/2013; PES, 08/2015	Flush	30	0.75	10-15	9.8-14.8	0.010	7-30	0-7
VMP-3 (B-9)		3/25/08	DP	165,028.4	1,268,497.6	310.58	310.71	--	PES, 02/2013	Flush	30	0.75	10-15	9.9-14.9	0.010	7-30	0-7
VMP-4 (B-11)		3/27/08	DP	165,079.0	1,268,533.8	307.67	308.00	--	PES, 02/2013	Flush	30	0.75	10-15	9.7-14.7	0.010	7-30	0-7
VMP-5 (B-12)		3/27/08	DP	165,083.7	1,268,602.8	308.22	308.48	--	PES, 02/2013	Flush	25	0.75	10-15	9.7-14.7	0.010	7-25	0-7
VMP-6 (B-13)		3/27/08	DP	165,071.2	1,268,674.9	308.95	309.18	--	PES, 02/2013	Flush	26	0.75	10-15	9.8-14.8	0.010	7-26	0-7

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Well Completion and Boring Details
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Well	Ecology Well Tag Number	Date Installed	Drilling Method	Location (feet NAD 83/91)		Elevation (feet NAVD 88)			Survey Notes	Monument Type	Boring Depth (feet)	Well Diameter (inches)	Screen Depth (ft bgs)		Slot Size (inch)	Filter Pack (ft bgs)	Seal (ft bgs)
				Northing	Easting	Monitoring Point	Surface Casing Rim	Ground Surface					Below Ground	Below Top of Casing			
Recirculation Well																	
TW-1		5/2/06	HSA	165,114.8	1,268,571.3	--	--	--	PES, 02/2013	AG	50	6	25-35/45-50	--	0.010	22-35/40-50	0-22/35-40
Pilot Test Injection Well																	
IW-1		--	--	--	--	--	--	--	--	AG	38	--	--	--	--	--	--
Air Sparging Wells																	
AS-1	BHV647	5/17/13	HSA	165,116.9	1,268,511.0	--	307.23	307.34	PES, 05/2013; PES, 08/2015	Flush	48	1	43.8-45.8	43.4-45.4	0.010	43.5-48	0-43.5
AS-2	BID714	9/29/14	HSA	165,093.2	1,268,557.0	--	308.30	--	PES, 08/2015	Flush	53	2	48.08-51.13	47.68-50.73	0.020	48-53	3.0-48
AS-3	BID718	10/1/14	HSA	165,091.7	1,268,574.0	--	308.44	--	PES, 08/2015	Flush	51	2	48.14-50.14	47.74-49.74	0.020	46-51	3.6-46
AS-4	BID717	9/30/14	HSA	165,073.3	1,268,590.4	--	308.25	--	PES, 08/2015	Flush	51	2	48.82-50.80	48.42-50.4	0.020	47.3-51	3.3-47.3
AS-5	BID716	9/30/14	HSA	165,073.7	1,268,566.0	--	307.97	--	PES, 08/2015	Flush	52	2	48.77-50.79	48.37-50.39	0.020	47.5-52	3.5-47.5
AS-6	BID713	9/26/14	HSA	165,073.2	1,268,541.5	--	307.89	--	PES, 08/2015	Flush	52	2	48.91-50.92	48.51-50.52	0.020	47.6-52	3.5-47.6
AS-7	BID710	9/24/14	HSA	165,080.3	1,268,521.9	--	308.01	--	PES, 08/2015	Flush	50.5	2	46.93-48.91	46.53-48.51	0.020	46-50.5	3.5-43
AS-8	BID740	10/17/14	HSA	165,058.0	1,268,525.1	--	312.52	--	PES, 08/2015	Flush	54	2	52.10-54.14	51.7-53.74	0.020	51-54.31	3.5-51
AS-9	BID739	10/16/14	HSA	165,029.5	1,268,522.9	--	312.52	--	PES, 08/2015	Flush	54	2	51.09-53.11	50.69-52.71	0.020	50-54	4-50
AS-10	BID733	10/14/14	HSA	165,004.5	1,268,521.9	--	312.52	--	PES, 08/2015	Flush	56	2	52.78-54.80	52.38-54.4	0.020	52-56	3.9-52
AS-11	BID731	10/13/14	HSA	164,976.2	1,268,521.3	--	312.57	--	PES, 08/2015	Flush	54.5	2	52.27-54.27	51.87-53.87	0.020	50.51-54.5	3-50.5
AS-12	BID729	10/10/14	HSA	164,948.4	1,268,520.9	--	312.34	--	PES, 08/2015	Flush	54.24	2	52.06-54.07	51.66-53.67	0.020	50.7-54.24	3.5-50.7
AS-13	BID728	10/9/14	HSA	164,920.9	1,268,520.2	--	311.72	--	PES, 08/2015	Flush	54	2	51.64-53.67	51.24-53.27	0.020	50.7-54	3.5-50.7
AS-14	BID726	10/8/14	HSA	164,891.0	1,268,520.2	--	311.93	--	PES, 08/2015	Flush	54.09	2	51.88-53.92	51.48-53.52	0.020	50.9-54.09	3.3-50.09
AS-15	BID723	10/6/14	HSA	164,865.7	1,268,520.3	--	312.35	--	PES, 08/2015	Flush	54	2	50.89-52.87	50.49-52.47	0.020	50-54	3.5-50
AS-16	BID724	10/7/14	HSA	164,841.0	1,268,511.9	--	312.37	--	PES, 08/2015	Flush	54	2	51.89-53.97	51.49-53.57	0.020	51-54.04	3.3-51
AS-17	BID721	10/3/14	HSA	164,821.9	1,268,488.3	--	311.44	--	PES, 08/2015	Flush	54.02	2	51.87-53.85	51.47-53.45	0.020	50.5-54.02	3.3-50.5
AS-18	BID719	10/2/14	HSA	164,810.9	1,268,465.6	--	310.51	--	PES, 08/2015	Flush	54.5	2	50.37-52.35	49.97-51.95	0.020	49.5-54.5	3.6-49.5
AS-19	BID720	10/3/14	HSA	164,834.5	1,268,474.4	--	310.67	--	PES, 08/2015	Flush	54.08	2	51.94-53.91	51.54-53.51	0.020	50.7-54.08	3.0-54.08
AS-20	BID722	10/6/14	HSA	164,852.1	1,268,491.4	--	311.00	--	PES, 08/2015	Flush	54	2	50.96-52.94	50.56-52.54	0.020	49.6-54	3.5-49.6
AS-21	BID725	10/7/14	HSA	164,879.0	1,268,495.8	--	310.98	--	PES, 08/2015	Flush	55	2	51.92-53.92	51.52-53.52	0.020	50.7-55	3.5-50.7
AS-22	BID727	10/8/14	HSA	164,907.4	1,268,496.1	--	310.72	--	PES, 08/2015	Flush	55	2	52.38-54.40	51.98-54	0.020	51.5-55	3.5-51.5
AS-23	BID730	10/10/14	HSA	164,935.3	1,268,497.1	--	310.88	--	PES, 08/2015	Flush	55	2	52.72-54.76	52.32-54.36	0.020	52-55	3.7-55
AS-24	BID734	10/14/14	HSA	164,963.7	1,268,494.9	--	311.08	--	PES, 08/2015	Flush	55	2	52.68-54.74	52.28-54.34	0.020	52-55	3.5-52
AS-25	BID735	10/15/14	HSA	164,993.3	1,268,503.1	--	311.33	--	PES, 08/2015	Flush	56	2	53.35-55.36	52.95-54.96	0.020	51.9-56	3.5-51.9
AS-26	BID738	10/16/14	HSA	165,018.0	1,268,497.2	--	310.75	--	PES, 08/2015	Flush	55.5	2	53.10-54.14	52.7-53.74	0.020	52-55.5	4-52
AS-27	BID741	10/17/14	HSA	165,047.3	1,268,497.3	--	310.99	--	PES, 08/2015	Flush	55.5	2	53.10-55.14	52.7-54.74	0.020	52-55.5	4-52
AS-28	BID706	9/22/14	HSA	165,077.4	1,268,498.9	--	308.11	--	PES, 08/2015	Flush	50.5	2	47.94-49.88	47.54-49.48	0.020	47.5-50.5	3.5-47.5
AS-29	BID707	9/23/14	HSA	165,098.0	1,268,498.4	--	307.74	--	PES, 08/2015	Flush	51	2	48.10-50.08	47.7-49.68	0.020	47-51	3.3-47
AS-30	BID711	9/25/14	HSA	165,100.2	1,268,516.2	--	307.36	--	PES, 08/2015	Flush	52	2	48.24-50.24	47.84-49.84	0.020	46.8-52	3.8-46.8
AS-31	BID712	9/26/14	HSA	165,098.2	1,268,535.6	--	308.10	--	PES, 08/2015	Flush	52.5	2	48.86-50.89	48.46-50.49	0.020	47.6-52.5	3.5-47.6
Supplemental Investigation Borings																	
SB-10	--	4/16/18	DP	164,837.8	1,268,523.0	--	--	313.30	PES, 05/2018	--	11	2.25	--	--	--	--	--
SB-11	--	4/16/18	DP	164,831.3	1,268,470.8	--	--	310.59	PES, 05/2018	--	15	2.25	--	--	--	--	--
SB-12	--	4/16/18	DP	164,812.7	1,268,480.9	--	--	311.18	PES, 05/2018	--	11	2.25	--	--	--	--	--
SB-13	--	4/16/18	DP	165,056.3	1,268,696.8	--	--	313.34	PES, 05/2018	--	29	2.25	--	--	--	--	--
SB-13A	--	4/25/18	DP	165,055.2	1,268,697.2	--	--	313.38	PES, 05/2018	--	33	2.25	--	--	--	--	--
SB-13B	--	4/25/18	DP	165,067.3	1,268,697.4	--	--	309.32	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-14	--	4/16/18	DP	165,056.3	1,268,717.0	--	--	313.60	PES, 05/2018	--	31.5	2.25	--	--	--	--	--
SB-14A	--	4/25/18	DP	165,056.2	1,268,717.8	--	--	313.60	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-15	--	4/17/18	DP	165,078.3	1,268,721.7	--	--	310.28	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-16	--	4/17/18	DP	165,172.1	1,268,822.2	--	--	310.61	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-17	--	4/18/18	DP	165,175.7	1,268,798.0	--	--	310.03	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-18	--	4/18/18	DP	165,201.4	1,268,799.7	--	--	309.93	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-19	--	4/19/18	DP	165,132.6	1,268,649.4	--	--	308.76	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--

**Table A1
Well Completion and Boring Details
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Well	Ecology Well Tag Number	Date Installed	Drilling Method	Location (feet NAD 83/91)		Elevation (feet NAVD 88)			Survey Notes	Monument Type	Boring Depth (feet)	Well Diameter (inches)	Screen Depth (ft bgs)		Slot Size (inch)	Filter Pack (ft bgs)	Seal (ft bgs)
				Northing	Easting	Monitoring Point	Surface Casing Rim	Ground Surface					Below Ground	Below Top of Casing			
SB-20	--	4/19/18	DP	165,154.5	1,268,680.2	--	--	309.00	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-21	--	4/19/18	DP	165,187.4	1,268,742.4	--	--	309.65	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-22	--	4/20/18	DP	165,173.0	1,268,709.8	--	--	309.07	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-23	--	4/20/18	DP	165,109.3	1,268,725.1	--	--	309.76	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-24	--	4/23/18	DP	165,113.2	1,268,695.3	--	--	310.24	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-25	--	4/23/18	DP	165,107.6	1,268,755.1	--	--	310.27	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-26	--	4/24/18	DP	165,177.8	1,268,857.4	--	--	312.30	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-27	--	4/24/18	DP	165,166.7	1,268,856.4	--	--	311.62	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-28	--	4/24/18	DP	165,209.6	1,268,850.2	--	--	310.94	PES, 05/2018	--	40	2.25	--	--	--	--	--
SB-29	--	4/24/18	DP	165,116.8	1,268,669.9	--	--	309.39	PES, 05/2018	--	40	2.25	36-40	--	0.004	--	--
SB-30	--	4/25/18	DP	165,196.5	1,268,529.1	--	--	304.82	PES, 05/2018	--	40	2.25	--	--	--	--	--
Soil Vapor Sampling Probes																	
SVS-10	--	11/5/03	HA	--	--	--	--	--	--	Flush	1.0	1.0	0.96-1.00	--	Mesh	0.5-1.0	0-0.5
SVS-11	--	4/16/18	HA	--	--	--	--	--	--	Flush	1.3	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-12	--	4/16/18	HA	--	--	--	--	--	--	Flush	1.3	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-13	--	4/16/18	HA	--	--	--	--	--	--	Flush	1.2	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-14	--	4/25/18	HA	--	--	--	--	--	--	Flush	1.3	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-15	--	4/25/18	HA	--	--	--	--	--	--	Flush	1.3	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-16	--	4/25/18	HA	--	--	--	--	--	--	Flush	1.3	0.63	1.27-1.30	--	Mesh	0.5-1.0	0-0.5
SVS-17	--	4/16/18	HA	--	--	--	--	--	--	Flush	5.0	2.25	4.5-5.0	--	Mesh	4-5	0-4

- Notes:**
- Northing and easting in feet relative to the Washington State Plane System North Zone (NAD 83/91)
 - Elevations in feet relative to the North American Vertical Datum (NAVD 88)
 - Monitoring point = top of the PVC well casing
 - All depths shown in feet below ground surface (ft bgs)
 - All wells completed with Schedule 40 PVC with the exception of AS-1 (Schedule 80 PVC)
 - Drilling methods include hollow stem auger (HSA), direct push (DP), vacuum truck with air knife (AKVAC), and hand augered (HA)
 - = not documented or unknown
 - Surface elevations for the direct push borings represents ground surface adjacent to the boring
 - Screened intervals are documented on boring logs and are typically based on a field measurements relative to ground surface at the time of drilling.
Screened intervals relative to top of casing are estimated using well field construction measurements, surveyed top of casing elevations, surveyed ground surface elevations, and in some cases surveyed monument rim elevations. If ground or rim elevations are not surveyed, then top of casing is assumed to be 0.4 ft depth.
 - Monitoring wells MW-1, DC-6, DC-9A, DC-9B are missing or destroyed. The 1999 SCS VES wells have been decommissioned.
 - Temporary well screens consisting of Geoprobe SP22 stainless steel slotted tooling were deployed in direct push borings SB-19 through SB-25 and SB-29.
 - Soil vapor sampling probe screens are constructed of fine metal mesh.
 - Soil vapor extraction wells SVE-24 and SVE-25 were installed at a 45 degree angle. The wells were cut off 4 feet below ground surface and the casings extended vertically. Depth intervals have been converted from length along the boring by dividing by 1.41.

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-1	12/10/1999	309.97	37.44	272.53
MW-1	2/9/2005	309.97	39.52	270.45
MW-1	4/11/2006	309.97	37.78	272.19
MW-1	10/26/2006	309.97	39.22	270.75
MW-1	4/24/2007	309.97	36.61	273.36
MW-1	8/21/2008	309.97	37.32	272.65
MW-2	12/10/1999	307.69	35.60	272.09
MW-2	11/5/2010	307.69	37.03	270.66
MW-2	2/11/2011	307.69	35.81	271.88
MW-2	5/30/2011	307.69	34.40	273.29
MW-2	7/19/2011	307.69	34.71	272.98
MW-2	10/17/2011	307.69	35.80	271.89
MW-2	4/2/2012	307.69	36.11	271.58
MW-2	5/28/2013	308.56	35.73	272.83
MW-2	4/14/2014	308.56	36.17	272.39
MW-2	10/21/2014	308.34	36.48	271.86
MW-2	12/11/2015	308.34	36.89	271.45
MW-2	12/13/2016	308.34	36.09	272.25
MW-2	3/13/2017	308.34	34.93	273.41
MW-2	7/17/2017	308.34	33.97	274.37
MW-2	10/20/2017	308.34	35.45	272.89
MW-2	1/24/2018	308.34	35.61	272.73
MW-2	4/17/2018	308.34	34.93	273.41
MW-2	7/18/2018	308.34	35.12	273.22
MW-2	10/15/2018	308.34	36.26	272.08
MW-2	10/24/2019	308.34	37.20	271.14
MW-3	8/21/2008	311.49	39.77	271.72
MW-3	11/5/2010	311.49	39.43	272.06
MW-3	2/11/2011	311.49	38.10	273.39
MW-3	5/30/2011	311.49	36.66	274.83
MW-3	7/19/2011	311.49	37.03	274.46
MW-3	10/17/2011	311.49	38.18	273.31
MW-3	4/2/2012	311.49	38.39	273.10
MW-3	5/28/2013	311.62	38.09	273.53
MW-3	10/21/2014	311.41	38.91	272.50
MW-3	12/9/2015	311.41	39.28	272.13
MW-3	12/13/2016	311.41	38.44	272.97
MW-3	3/13/2017	311.41	37.09	274.32
MW-3	7/17/2017	311.41	36.21	275.20
MW-3	10/20/2017	311.41	37.61	273.80
MW-3	1/24/2018	311.41	37.73	273.68
MW-3	4/17/2018	311.41	37.24	274.17
MW-3	7/18/2018	311.41	37.52	273.89
MW-3	10/15/2018	311.41	38.68	272.73
MW-3	10/24/2019	311.41	39.68	271.73

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-4	11/5/2010	310.54	38.74	271.80
MW-4	2/11/2011	310.54	37.41	273.13
MW-4	5/30/2011	310.54	35.99	274.55
MW-4	7/19/2011	310.54	36.37	274.17
MW-4	10/17/2011	310.54	37.50	273.04
MW-4	4/2/2012	310.54	37.67	272.87
MW-4	5/28/2013	310.68	37.40	273.28
MW-4	10/21/2014	310.47	38.13	272.34
MW-4	12/9/2015	310.47	38.60	271.87
MW-4	12/13/2016	310.47	37.36	273.11
MW-4	3/13/2017	310.47	36.42	274.05
MW-4	7/17/2017	310.47	35.59	274.88
MW-4	10/20/2017	310.47	37.17	273.30
MW-4	1/24/2018	310.47	37.04	273.43
MW-4	4/17/2018	310.47	36.59	273.88
MW-4	7/18/2018	310.47	36.86	273.61
MW-4	10/15/2018	310.47	38.01	272.46
MW-4	10/24/2019	310.47	39.00	271.47
MW-5	8/21/2008	310.28	39.96	270.32
MW-5	11/5/2010	310.28	39.73	270.55
MW-5	2/11/2011	310.28	38.60	271.68
MW-5	5/30/2011	310.28	37.24	273.04
MW-5	7/19/2011	310.28	37.51	272.77
MW-5	10/17/2011	310.28	38.54	271.74
MW-5	4/2/2012	310.28	38.90	271.38
MW-5	10/21/2014	310.38	39.17	271.21
MW-5	12/9/2015	310.38	39.69	270.69
MW-5	12/13/2016	310.38	38.80	271.58
MW-5	3/13/2017	310.38	37.80	272.58
MW-5	7/17/2017	310.38	36.80	273.58
MW-5	10/20/2017	310.38	38.17	272.21
MW-5	1/24/2018	310.38	38.60	271.78
MW-5	4/17/2018	310.38	37.71	272.67
MW-5	7/18/2018	310.38	37.89	272.49
MW-5	10/15/2018	310.38	38.92	271.46
MW-5	10/24/2019	310.38	39.85	270.53
MW-6	8/21/2008	304.27	37.46	266.81
MW-6	11/5/2010	304.27	37.25	267.02
MW-6	2/11/2011	304.27	36.30	267.97
MW-6	5/30/2011	304.27	35.50	268.77
MW-6	7/19/2011	304.27	35.38	268.89
MW-6	10/17/2011	304.27	36.24	268.03
MW-6	4/2/2012	304.27	36.53	267.74
MW-6	10/21/2014	304.14	37.79	266.35
MW-6	12/9/2015	304.14	37.22	266.92
MW-6	12/13/2016	304.14	36.49	267.65

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-6	3/13/2017	304.14	35.68	268.46
MW-6	7/17/2017	304.14	34.79	269.35
MW-6	10/20/2017	304.14	38.24	265.90
MW-6	1/24/2018	304.14	36.08	268.06
MW-6	4/17/2018	304.14	35.61	268.53
MW-6	7/18/2018	304.14	35.71	268.43
MW-6	10/15/2018	304.14	36.58	267.56
MW-6	10/25/2019	304.14	37.37	266.77
MW-7	8/21/2008	302.76	39.00	263.76
MW-7	11/5/2010	302.76	38.74	264.02
MW-7	2/11/2011	302.76	37.61	265.15
MW-7	5/30/2011	302.76	36.09	266.67
MW-7	7/19/2011	302.76	36.43	266.33
MW-7	10/17/2011	302.76	37.43	265.33
MW-7	4/2/2012	302.76	37.52	265.24
MW-7	5/28/2013	302.76	37.48	265.28
MW-7	10/30/2014	302.64	35.80	266.84
MW-7	12/9/2015	302.64	38.75	263.89
MW-7	12/13/2016	302.64	37.79	264.85
MW-7	3/13/2017	302.64	36.79	265.85
MW-7	7/17/2017	302.64	35.75	266.89
MW-7	10/20/2017	302.64	37.16	265.48
MW-7	1/24/2018	302.64	37.33	265.31
MW-7	4/17/2018	302.64	36.79	265.85
MW-7	7/18/2018	302.64	37.00	265.64
MW-7	10/23/2018	302.64	38.15	264.49
MW-7	10/25/2019	302.64	39.04	263.60
MW-8	8/21/2008	280.08	12.78	267.30
MW-8	2/11/2011	280.08	11.11	268.97
MW-8	5/30/2011	280.08	10.20	269.88
MW-8	7/19/2011	280.08	10.66	269.42
MW-8	10/17/2011	280.08	11.52	268.56
MW-8	4/2/2012	280.08	11.09	268.99
MW-8	10/21/2014	280.68	12.12	268.56
MW-8	12/9/2015	280.68	11.81	268.87
MW-8	12/13/2016	280.68	11.40	269.28
MW-8	3/13/2017	280.68	10.30	270.38
MW-8	7/17/2017	280.68	10.26	270.42
MW-8	10/20/2017	280.68	10.25	270.43
MW-8	1/24/2018	280.68	10.80	269.88
MW-8	4/17/2018	280.68	10.50	270.18
MW-8	7/18/2018	280.68	11.22	269.46
MW-8	10/16/2018	280.68	12.09	268.59
MW-8	10/25/2019	280.68	12.74	267.94
MW-9	8/21/2008	285.11	32.24	252.87

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-9	11/5/2010	285.11	31.98	253.13
MW-9	2/11/2011	285.11	30.93	254.18
MW-9	5/30/2011	285.11	29.76	255.35
MW-9	7/19/2011	285.11	30.12	254.99
MW-9	10/17/2011	285.11	31.04	254.07
MW-9	4/2/2012	285.11	31.05	254.06
MW-9	10/21/2014	284.97	31.68	253.29
MW-9	12/9/2015	284.97	32.06	252.91
MW-9	12/13/2016	284.97	31.24	253.73
MW-9	3/13/2017	284.97	30.20	254.77
MW-9	7/17/2017	284.97	29.59	255.38
MW-9	10/20/2017	284.97	30.75	254.22
MW-9	1/24/2018	284.97	30.84	254.13
MW-9	4/17/2018	284.97	30.43	254.54
MW-9	7/18/2018	284.97	30.60	254.37
MW-9	10/16/2018	284.97	31.40	253.57
MW-9	10/25/2019	284.97	32.22	252.75
MW-10	2/11/2011	306.70	34.04	272.66
MW-10	5/30/2011	306.70	32.69	274.01
MW-10	7/19/2011	306.70	33.05	273.65
MW-10	10/17/2011	306.70	34.13	272.57
MW-10	4/2/2012	306.70	34.31	272.39
MW-10	5/28/2013	306.91	34.03	272.88
MW-10	10/21/2014	306.71	34.81	271.90
MW-10	12/9/2015	306.71	35.22	271.49
MW-10	12/13/2016	306.71	34.41	272.30
MW-10	3/13/2017	306.71	33.15	273.56
MW-10	7/17/2017	306.71	32.34	274.37
MW-10	10/20/2017	306.71	33.82	272.89
MW-10	1/24/2018	306.71	33.82	272.89
MW-10	4/17/2018	306.71	33.30	273.41
MW-10	7/18/2018	306.71	33.55	273.16
MW-10	10/15/2018	306.71	34.66	272.05
MW-10	5/21/2019	306.71	34.62	272.09
MW-10	10/24/2019	306.71	35.62	271.09
MW-11	2/11/2011	307.63	35.01	272.62
MW-11	5/30/2011	307.63	33.63	274.00
MW-11	7/19/2011	307.63	33.97	273.66
MW-11	10/17/2011	307.63	35.05	272.58
MW-11	4/2/2012	307.63	35.29	272.34
MW-11	5/28/2013	307.85	34.98	272.87
MW-11	10/21/2014	307.62	35.78	271.84
MW-11	12/9/2015	307.62	36.16	271.46
MW-11	12/13/2016	307.62	35.33	272.29
MW-11	3/13/2017	307.62	34.11	273.51
MW-11	7/17/2017	307.62	33.25	274.37

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-11	10/20/2017	307.62	34.74	272.88
MW-11	1/24/2018	307.62	34.77	272.85
MW-11	4/17/2018	307.62	34.21	273.41
MW-11	7/18/2018	307.62	34.45	273.17
MW-11	10/19/2018	307.62	35.61	272.01
MW-11	5/21/2019	307.62	35.55	272.07
MW-11	10/24/2019	307.62	36.53	271.09
MW-12	4/2/2012	312.92	39.69	273.23
MW-12	5/28/2013	312.95	39.40	273.55
MW-12	10/21/2014	312.80	40.20	272.60
MW-12	12/9/2015	312.80	40.59	272.21
MW-12	12/13/2016	312.80	39.70	273.10
MW-12	3/13/2017	312.80	38.39	274.41
MW-12	7/17/2017	312.80	37.47	275.33
MW-12	10/20/2017	312.80	39.01	273.79
MW-12	1/24/2018	312.80	39.01	273.79
MW-12	4/17/2018	312.80	38.49	274.31
MW-12	7/18/2018	312.80	38.75	274.05
MW-12	10/15/2018	312.80	39.94	272.86
MW-12	10/24/2019	312.80	40.96	271.84
MW-13	4/2/2012	308.88	36.04	272.84
MW-13	5/28/2013	308.90	35.82	273.08
MW-13	10/21/2014	308.75	36.66	272.09
MW-13	12/9/2015	308.75	37.00	271.75
MW-13	12/13/2016	308.75	36.13	272.62
MW-13	3/13/2017	308.75	34.78	273.97
MW-13	7/17/2017	308.75	33.99	274.76
MW-13	10/20/2017	308.75	35.45	273.30
MW-13	1/24/2018	308.75	35.45	273.30
MW-13	4/17/2018	308.75	34.98	273.77
MW-13	7/18/2018	308.75	35.24	273.51
MW-13	10/15/2018	308.75	36.40	272.35
MW-13	10/24/2019	308.75	38.40	270.35
MW-14	4/2/2012	303.78	31.84	271.94
MW-14	5/28/2013	303.82	31.57	272.25
MW-14	10/21/2014	303.82	32.34	271.48
MW-14	12/11/2015	303.82	32.65	271.17
MW-14	12/13/2016	303.82	31.90	271.92
MW-14	3/13/2017	303.82	30.73	273.09
MW-14	7/17/2017	303.82	29.94	273.88
MW-14	10/20/2017	303.82	31.36	272.46
MW-14	1/24/2018	303.82	31.33	272.49
MW-14	4/17/2018	303.82	30.84	272.98
MW-14	10/15/2018	303.82	32.14	271.68
MW-14	10/24/2019	303.82	33.08	270.74

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
MW-15	4/2/2012	312.40	39.92	272.48
MW-15	5/28/2013	312.44	39.55	272.89
MW-15	4/14/2014	312.44	39.97	272.47
MW-15	10/21/2014	312.44	40.31	272.13
MW-15	12/9/2015	312.44	40.77	271.67
MW-15	12/13/2016	312.44	39.90	272.54
MW-15	3/13/2017	312.44	38.72	273.72
MW-15	7/17/2017	312.44	37.77	274.67
MW-15	10/20/2017	312.44	39.25	273.19
MW-15	1/24/2018	312.44	39.31	273.13
MW-15	4/17/2018	312.44	38.75	273.69
MW-15	7/18/2018	312.44	38.99	273.45
MW-15	10/15/2018	312.44	40.08	272.36
MW-15	10/24/2019	312.44	41.05	271.39
MW-16	5/28/2013	310.37	37.78	272.59
MW-16	10/21/2014	310.37	38.52	271.85
MW-16	12/9/2015	310.37	38.96	271.41
MW-16	12/13/2016	310.37	38.12	272.25
MW-16	3/13/2017	310.37	36.92	273.45
MW-16	7/17/2017	310.37	36.04	274.33
MW-16	10/20/2017	310.37	37.50	272.87
MW-16	1/24/2018	310.37	37.53	272.84
MW-16	4/17/2018	310.37	36.99	273.38
MW-16	7/18/2018	310.37	37.20	273.17
MW-16	10/15/2018	310.37	38.31	272.06
MW-16	10/24/2019	310.37	39.20	271.17
MW-17	3/6/2019	303.00	32.33	270.67
MW-17	10/24/2019	303.01	33.10	269.91
MW-17	6/3/2020	303.01	31.88	271.13
MW-18	3/6/2019	305.26	34.55	270.71
MW-18	10/24/2019	305.26	35.25	270.01
MW-19	10/24/2019	305.35	35.09	270.26
MW-19	12/4/2019	305.35	35.36	269.99
MW-20	10/24/2019	305.51	35.22	270.29
MW-20	12/4/2019	305.51	35.49	270.02
MW-20	6/3/2020	305.51	34.02	271.49
DC-1	11/14/2000	312.46	40.29	272.17
DC-1	3/6/2001	312.46	41.11	271.35
DC-1	6/20/2001	312.46	41.46	271.00
DC-1	9/17/2001	312.46	41.78	270.68
DC-1	12/20/2001	312.46	41.43	271.03

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-1	3/13/2002	312.46	39.75	272.71
DC-1	9/17/2002	312.46	39.75	272.71
DC-1	12/10/2002	312.46	40.69	271.77
DC-1	3/31/2003	312.46	40.33	272.13
DC-1	9/3/2003	312.46	40.69	271.77
DC-1	3/16/2004	312.46	39.77	272.69
DC-1	9/7/2004	312.46	40.57	271.89
DC-1	2/9/2005	312.46	41.31	271.15
DC-1	4/24/2007	312.46	38.29	274.17
DC-1	8/21/2008	312.72	40.93	271.79
DC-1	11/5/2010	312.72	40.64	272.08
DC-1	2/11/2011	312.72	39.37	273.35
DC-1	5/30/2011	312.72	37.91	274.81
DC-1	7/19/2011	312.72	38.21	274.51
DC-1	10/17/2011	312.72	39.37	273.35
DC-1	4/2/2012	312.72	39.72	273.00
DC-1	5/28/2013	312.82	39.30	273.52
DC-1	10/21/2014	312.82	40.05	272.77
DC-1	12/9/2015	312.82	40.51	272.31
DC-1	12/13/2016	312.82	39.63	273.19
DC-1	3/13/2017	312.82	38.46	274.36
DC-1	7/17/2017	312.82	37.40	275.42
DC-1	10/20/2017	312.82	39.26	273.56
DC-1	1/24/2018	312.82	39.02	273.80
DC-1	4/17/2018	312.82	38.43	274.39
DC-1	10/15/2018	312.82	39.80	273.02
DC-1	10/24/2019	312.82	40.84	271.98
DC-2	2/3/1999	312.80	39.04	273.76
DC-2	4/16/1999	312.80	36.90	275.90
DC-2	12/8/1999	312.80	39.88	272.92
DC-2	4/26/2000	312.80	39.11	273.69
DC-2	8/3/2000	312.80	39.85	272.95
DC-2	11/14/2000	312.80	41.04	271.76
DC-2	3/6/2001	312.80	41.82	270.98
DC-2	6/20/2001	312.80	42.18	270.62
DC-2	9/17/2001	312.80	42.50	270.30
DC-2	12/20/2001	312.80	42.12	270.68
DC-2	3/13/2002	312.80	40.45	272.35
DC-2	6/13/2002	312.80	39.64	273.16
DC-2	9/17/2002	312.80	40.50	272.30
DC-2	12/10/2002	312.80	41.42	271.38
DC-2	3/31/2003	312.80	41.03	271.77
DC-2	9/3/2003	312.80	41.41	271.39
DC-2	3/16/2004	312.80	40.51	272.29
DC-2	9/7/2004	312.80	41.30	271.50
DC-2	2/9/2005	312.80	41.99	270.81
DC-2	4/24/2007	312.80	39.03	273.77

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-2	8/21/2008	313.04	41.65	271.39
DC-2	11/5/2010	313.04	41.34	271.70
DC-2	2/11/2011	313.04	40.08	272.96
DC-2	5/30/2011	313.04	38.67	274.37
DC-2	7/19/2011	313.04	38.98	274.06
DC-2	10/17/2011	313.04	40.08	272.96
DC-2	4/2/2012	313.04	40.41	272.63
DC-2	10/21/2014	312.92	40.78	272.14
DC-2	12/9/2015	312.92	41.22	271.70
DC-2	12/13/2016	312.92	40.36	272.56
DC-2	3/13/2017	312.92	39.19	273.73
DC-2	7/17/2017	312.92	38.20	274.72
DC-2	10/20/2017	312.92	39.71	273.21
DC-2	1/24/2018	312.92	39.76	273.16
DC-2	4/17/2018	312.92	39.20	273.72
DC-2	7/18/2018	312.92	39.42	273.50
DC-2	10/15/2018	312.92	40.53	272.39
DC-2	10/24/2019	312.92	41.53	271.39
DC-3	10/21/1998	312.98	39.68	273.30
DC-3	2/3/1999	312.98	39.22	273.76
DC-3	4/16/1999	312.98	37.13	275.85
DC-3	12/8/1999	312.98	40.10	272.88
DC-3	4/26/2000	312.98	39.33	273.65
DC-3	8/3/2000	312.98	40.08	272.90
DC-3	11/14/2000	312.98	41.27	271.71
DC-3	3/6/2001	312.98	42.05	270.93
DC-3	6/20/2001	312.98	42.37	270.61
DC-3	9/17/2001	312.98	42.73	270.25
DC-3	12/20/2001	312.98	42.30	270.68
DC-3	3/13/2002	312.98	40.66	272.32
DC-3	6/13/2002	312.98	39.87	273.11
DC-3	9/17/2002	312.98	40.75	272.23
DC-3	12/10/2002	312.98	41.65	271.33
DC-3	3/31/2003	312.98	41.25	271.73
DC-3	9/3/2003	312.98	41.65	271.33
DC-3	3/16/2004	312.98	40.71	272.27
DC-3	9/7/2004	312.98	41.54	271.44
DC-3	2/9/2005	312.98	42.21	270.77
DC-3	4/24/2007	312.98	39.26	273.72
DC-3	8/21/2008	313.23	41.89	271.34
DC-3	11/5/2010	313.23	41.58	271.65
DC-3	2/11/2011	313.23	40.30	272.93
DC-3	5/30/2011	313.23	38.89	274.34
DC-3	7/19/2011	313.23	39.22	274.01
DC-3	10/17/2011	313.23	40.34	272.89
DC-3	4/2/2012	313.23	40.62	272.61
DC-3	10/21/2014	313.11	41.07	272.04

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-3	12/9/2015	313.11	41.47	271.64
DC-3	12/13/2016	313.11	40.59	272.52
DC-3	3/13/2017	313.11	39.39	273.72
DC-3	7/17/2017	313.11	38.44	274.67
DC-3	10/20/2017	313.11	39.94	273.17
DC-3	1/24/2018	313.11	39.98	273.13
DC-3	4/17/2018	313.11	39.47	273.64
DC-3	7/18/2018	313.11	39.67	273.44
DC-3	10/15/2018	313.11	40.80	272.31
DC-3	10/24/2019	313.11	41.78	271.33
DC-4	10/21/1998	312.20	39.96	272.24
DC-4	2/3/1999	312.20	38.37	273.83
DC-4	4/16/1999	312.20	36.34	275.86
DC-4	12/8/1999	312.20	39.32	272.88
DC-4	4/26/2000	312.20	38.55	273.65
DC-4	8/3/2000	312.20	39.33	272.87
DC-4	11/14/2000	312.20	40.52	271.68
DC-4	3/6/2001	312.20	41.29	270.91
DC-4	6/20/2001	312.20	41.60	270.60
DC-4	9/17/2001	312.20	41.89	270.31
DC-4	12/20/2001	312.20	41.49	270.71
DC-4	3/13/2002	312.20	39.86	272.34
DC-4	6/13/2002	312.20	39.11	273.09
DC-4	9/17/2002	312.20	40.00	272.20
DC-4	12/10/2002	312.20	40.92	271.28
DC-4	3/31/2003	312.20	40.44	271.76
DC-4	9/3/2003	312.20	40.88	271.32
DC-4	3/16/2004	312.20	39.94	272.26
DC-4	9/7/2004	312.20	40.81	271.39
DC-4	2/9/2005	312.20	41.42	270.78
DC-4	4/24/2007	312.20	38.50	273.70
DC-4	8/21/2008	312.12	41.13	270.99
DC-4	11/5/2010	312.12	40.81	271.31
DC-4	2/11/2011	312.12	39.51	272.61
DC-4	5/30/2011	312.12	38.13	273.99
DC-4	7/19/2011	312.12	38.48	273.64
DC-4	10/17/2011	312.12	39.57	272.55
DC-4	4/2/2012	312.12	38.82	273.30
DC-4	5/28/2013	312.56	39.50	273.06
DC-4	10/21/2014	312.35	40.34	272.01
DC-4	12/9/2015	312.35	40.34	272.01
DC-4	12/13/2016	312.35	39.84	272.51
DC-4	3/13/2017	312.35	38.59	273.76
DC-4	7/17/2017	312.35	37.70	274.65
DC-4	10/20/2017	312.35	39.50	272.85
DC-4	1/24/2018	312.35	39.21	273.14
DC-4	4/18/2018	312.35	38.61	273.74

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-4	7/18/2018	312.35	38.95	273.40
DC-4	10/15/2018	312.35	40.16	272.19
DC-4	10/24/2019	312.35	41.05	271.30
DC-5	2/3/1999	305.86	32.48	273.38
DC-5	4/16/1999	305.86	30.46	275.40
DC-5	4/11/2006	305.86	33.74	272.12
DC-5	4/24/2007	306.10	32.56	273.54
DC-5	8/21/2008	306.10	35.15	270.95
DC-5	11/5/2010	306.10	34.86	271.24
DC-5	2/11/2011	306.10	33.59	272.51
DC-5	5/30/2011	306.10	32.23	273.87
DC-5	7/19/2011	306.10	32.58	273.52
DC-5	10/17/2011	306.10	33.65	272.45
DC-5	4/2/2012	306.10	33.86	272.24
DC-5	5/28/2013	306.25	33.60	272.65
DC-5	10/15/2018	306.25	34.15	272.10
DC-6	2/3/1999	308.46	35.03	273.43
DC-6	4/16/1999	308.46	32.92	275.54
DC-7	2/3/1999	302.50	29.89	272.61
DC-7	4/16/1999	302.50	28.05	274.45
DC-7	12/8/1999	302.50	30.76	271.74
DC-7	4/26/2000	302.50	30.12	272.38
DC-7	8/3/2000	302.50	30.84	271.66
DC-7	11/14/2000	302.50	31.90	270.60
DC-7	3/6/2001	302.50	32.60	269.90
DC-7	6/20/2001	302.50	32.91	269.59
DC-7	9/17/2001	302.50	33.25	269.25
DC-7	12/20/2001	302.50	32.75	269.75
DC-7	3/13/2002	302.50	31.22	271.28
DC-7	6/13/2002	302.50	30.57	271.93
DC-7	9/17/2002	302.50	31.44	271.06
DC-7	12/10/2002	302.50	32.27	270.23
DC-7	3/31/2003	302.50	31.78	270.72
DC-7	9/3/2003	302.50	32.26	270.24
DC-7	2/9/2005	302.50	32.67	269.83
DC-7	4/11/2006	302.50	31.05	271.45
DC-7	10/26/2006	302.50	32.58	269.92
DC-7	4/24/2007	302.50	29.96	272.54
DC-7	8/21/2008	302.78	32.48	270.30
DC-7	11/5/2010	302.78	32.15	270.63
DC-7	2/11/2011	302.78	30.91	271.87
DC-7	5/30/2011	302.78	29.68	273.10
DC-7	7/19/2011	302.78	30.03	272.75
DC-7	10/17/2011	302.78	31.04	271.74
DC-7	4/2/2012	302.78	31.12	271.66

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-7	5/28/2013	302.88	30.94	271.94
DC-7	10/21/2014	302.61	31.71	270.90
DC-7	12/16/2015	302.61	31.79	270.82
DC-7	12/13/2016	302.61	31.19	271.42
DC-7	3/13/2017	302.61	30.03	272.58
DC-7	7/17/2017	302.61	29.37	273.24
DC-7	10/20/2017	302.61	30.51	272.10
DC-7	1/24/2018	302.61	30.69	271.92
DC-7	4/17/2018	302.61	30.19	272.42
DC-7	7/18/2018	302.61	30.48	272.13
DC-7	10/15/2018	302.61	31.52	271.09
DC-7	10/24/2019	302.61	32.42	270.19
DC-7	5/11/2021	302.61	31.15	271.46
DC-8	2/3/1999	306.09	33.45	272.64
DC-8	4/16/1999	306.09	31.43	274.66
DC-8	12/8/1999	306.09	34.27	271.82
DC-8	4/26/2000	306.09	33.55	272.54
DC-8	8/3/2000	306.09	34.26	271.83
DC-8	11/14/2000	306.09	35.37	270.72
DC-8	3/6/2001	306.09	36.11	269.98
DC-8	6/20/2001	306.09	36.45	269.64
DC-8	9/17/2001	306.09	36.75	269.34
DC-8	12/20/2001	306.09	36.40	269.69
DC-8	3/13/2002	306.09	34.82	271.27
DC-8	6/13/2002	306.09	34.05	272.04
DC-8	9/17/2002	306.09	34.85	271.24
DC-8	12/10/2002	306.09	35.74	270.35
DC-8	3/31/2003	306.09	35.71	270.38
DC-8	9/3/2003	306.09	35.73	270.36
DC-8	2/9/2005	306.09	36.26	269.83
DC-8	4/11/2006	306.09	34.60	271.49
DC-8	10/26/2006	306.09	36.00	270.09
DC-8	4/24/2007	306.11	33.47	272.64
DC-8	11/5/2010	306.38	35.69	270.69
DC-8	2/11/2011	306.38	34.49	271.89
DC-8	5/30/2011	306.38	33.15	273.23
DC-8	7/19/2011	306.38	33.46	272.92
DC-8	10/17/2011	306.38	34.51	271.87
DC-8	4/2/2012	306.38	34.77	271.61
DC-8	5/28/2013	306.46	34.45	272.01
DC-8	10/21/2014	306.46	35.17	271.29
DC-8	12/9/2015	306.23	35.58	270.65
DC-8	12/13/2016	306.23	34.71	271.52
DC-8	3/13/2017	306.23	33.65	272.58
DC-8	7/17/2017	306.23	32.75	273.48
DC-8	10/20/2017	306.23	34.14	272.09
DC-8	1/24/2018	306.23	34.21	272.02

**Table A2
 Historical Summary of Groundwater Elevations (1999 - 2021)
 Manhattan Village Shopping Center and Harris Properties
 Normandy Park, Washington**

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-8	4/17/2018	306.23	33.64	272.59
DC-8	7/18/2018	306.23	33.92	272.31
DC-8	10/15/2018	306.23	34.94	271.29
DC-8	10/29/2019	306.23	36.03	270.20
DC-9A	4/16/1999	307.76	32.19	275.57
DC-9A	12/8/1999	307.76	35.03	272.73
DC-9A	4/26/2000	307.76	34.35	273.41
DC-9A	8/3/2000	307.76	35.11	272.65
DC-9A	11/14/2000	307.76	36.30	271.46
DC-9A	4/11/2006	307.76	35.45	272.31
DC-9A	8/8/2006	307.76	36.25	271.51
DC-9A	11/2/2006	307.76	36.90	270.86
DC-9A	4/24/2007	307.75	34.30	273.45
DC-9A	8/21/2008	308.02	36.92	271.10
DC-9B	4/16/1999	307.91	32.34	275.57
DC-9B	3/6/2001	307.91	37.22	270.69
DC-9B	6/20/2001	307.91	37.52	270.39
DC-9B	9/17/2001	307.91	37.87	270.04
DC-9B	12/20/2001	307.91	37.45	270.46
DC-9B	4/11/2006	307.91	35.65	272.26
DC-9B	8/8/2006	307.91	36.40	271.51
DC-9B	10/26/2006	307.91	37.15	270.76
DC-9B	4/24/2007	307.94	34.45	273.49
DC-9B	8/21/2008	308.16	37.05	271.11
DC-10A	4/16/1999	307.59	31.85	275.74
DC-10A	12/8/1999	307.59	34.82	272.77
DC-10A	4/26/2000	307.59	34.05	273.54
DC-10A	8/3/2000	307.59	34.86	272.73
DC-10A	11/14/2000	307.59	36.05	271.54
DC-10A	2/11/2011	307.72	34.99	272.73
DC-10A	5/30/2011	307.72	33.65	274.07
DC-10A	7/19/2011	307.72	34.07	273.65
DC-10A	10/17/2011	307.72	35.12	272.60
DC-10A	4/2/2012	307.72	35.23	272.49
DC-10A	5/28/2013	307.93	35.04	272.89
DC-10A	10/21/2014	307.73	35.83	271.90
DC-10A	12/9/2015	307.73	36.19	271.54
DC-10A	12/13/2016	307.73	35.35	272.38
DC-10A	3/13/2017	307.73	34.09	273.64
DC-10A	7/17/2017	307.73	33.29	274.44
DC-10A	10/20/2017	307.73	34.79	272.94
DC-10A	1/24/2018	307.73	34.72	273.01
DC-10A	4/17/2018	307.73	34.23	273.50
DC-10A	4/17/2018	307.73	34.23	273.50
DC-10A	7/18/2018	307.73	34.50	273.23

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-10A	10/15/2018	307.73	36.12	271.61
DC-10A	10/24/2019	307.73	36.48	271.25
DC-10B	4/16/1999	307.66	31.92	275.74
DC-10B	3/6/2001	307.66	36.89	270.77
DC-10B	6/20/2001	307.66	37.46	270.20
DC-10B	9/17/2001	307.66	37.55	270.11
DC-10B	12/20/2001	307.66	37.03	270.63
DC-10B	2/9/2005	307.66	36.98	270.68
DC-10B	4/11/2006	307.66	35.24	272.42
DC-10B	4/24/2007	307.66	34.08	273.58
DC-10B	8/21/2008	307.89	36.74	271.15
DC-10B	11/5/2010	307.89	36.40	271.49
DC-10B	2/11/2011	307.89	35.06	272.83
DC-10B	5/30/2011	307.89	33.72	274.17
DC-10B	7/19/2011	307.89	34.09	273.80
DC-10B	10/17/2011	307.89	35.15	272.74
DC-10B	4/2/2012	307.89	35.34	272.55
DC-10B	12/13/2016	307.89	35.45	272.44
DC-10B	10/15/2018	307.89	35.70	272.19
DC-11	4/24/2007	311.02	37.29	273.73
DC-11	11/5/2010	311.02	39.59	271.43
DC-11	2/11/2011	311.02	38.36	272.66
DC-11	5/30/2011	311.02	36.91	274.11
DC-11	4/2/2012	311.02	38.67	272.35
DC-11	4/14/2014	311.25	38.73	272.52
DC-11	10/21/2014	311.25	39.00	272.25
DC-11	12/9/2015	311.25	39.48	271.77
DC-11	12/13/2016	311.25	38.56	272.69
DC-11	3/13/2017	311.25	37.49	273.76
DC-11	7/17/2017	311.25	36.43	274.82
DC-11	10/20/2017	311.25	37.66	273.59
DC-11	1/24/2018	311.25	38.00	273.25
DC-11	4/17/2018	311.25	37.40	273.85
DC-11	7/18/2018	311.25	37.63	273.62
DC-11	10/15/2018	311.25	38.74	272.51
DC-11	10/24/2019	311.25	39.73	271.52
DC-12	4/24/2007	310.90	37.54	273.36
DC-12	8/21/2008	310.90	40.05	270.85
DC-12	11/5/2010	310.90	39.79	271.11
DC-12	2/11/2011	310.90	38.60	272.30
DC-12	5/30/2011	310.90	37.17	273.73
DC-12	7/19/2011	310.90	37.45	273.45
DC-12	10/17/2011	310.90	38.54	272.36
DC-12	4/2/2012	310.90	38.91	271.99
DC-12	5/28/2013	311.25	38.50	272.75

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-12	4/14/2014	311.25	38.93	272.32
DC-12	10/27/2014	311.25	39.23	272.02
DC-12	12/9/2015	311.25	39.70	271.55
DC-12	12/13/2016	311.25	38.80	272.45
DC-12	3/13/2017	311.25	37.72	273.53
DC-12	7/17/2017	311.25	36.71	274.54
DC-12	10/20/2017	311.25	38.20	273.05
DC-12	1/24/2018	311.25	38.24	273.01
DC-12	4/17/2018	311.25	37.67	273.58
DC-12	7/19/2018	311.25	37.90	273.35
DC-12	10/15/2018	311.25	38.94	272.31
DC-12	10/25/2019	311.25	39.95	271.30
DC-13	4/24/2007	310.85	36.64	274.21
DC-13	8/21/2008	310.85	39.13	271.72
DC-13	11/5/2010	310.85	38.88	271.97
DC-13	2/11/2011	310.85	37.68	273.17
DC-13	5/30/2011	310.85	36.28	274.57
DC-13	7/19/2011	310.85	36.57	274.28
DC-13	10/17/2011	310.85	37.65	273.20
DC-13	4/2/2012	310.85	38.01	272.84
DC-13	5/28/2013	310.20	37.61	272.59
DC-13	4/14/2014	310.20	38.02	272.18
DC-13	10/27/2014	310.20	38.37	271.83
DC-13	12/9/2015	310.20	38.37	271.83
DC-13	12/13/2016	310.20	37.89	272.31
DC-13	3/13/2017	310.20	36.82	273.38
DC-13	7/17/2017	310.20	37.82	272.38
DC-13	10/20/2017	310.20	37.26	272.94
DC-13	1/24/2018	310.20	37.33	272.87
DC-13	4/17/2018	310.20	36.77	273.43
DC-13	7/18/2018	310.20	36.97	273.23
DC-13	10/15/2018	310.20	38.06	272.14
DC-13	10/24/2019	310.20	39.05	271.15
DC-14	4/24/2007	308.60	36.15	272.45
DC-14	8/21/2008	308.60	38.59	270.01
DC-14	11/5/2010	308.60	38.34	270.26
DC-14	2/11/2011	308.60	37.18	271.42
DC-14	5/30/2011	308.60	35.83	272.77
DC-14	7/19/2011	308.60	36.12	272.48
DC-14	10/17/2011	308.60	37.14	271.46
DC-14	4/2/2012	308.60	37.49	271.11
DC-14	5/28/2013	308.94	37.10	271.84
DC-14	10/21/2014	308.94	37.77	271.17
DC-14	12/9/2015	308.94	38.23	270.71
DC-14	12/13/2016	308.94	37.40	271.54
DC-14	3/13/2017	308.94	36.38	272.56

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-14	7/17/2017	308.94	35.40	273.54
DC-14	10/20/2017	308.94	36.78	272.16
DC-14	1/24/2018	308.94	36.84	272.10
DC-14	4/17/2018	308.94	36.31	272.63
DC-14	7/18/2018	308.94	36.51	272.43
DC-14	10/15/2018	308.94	Well Missing	Decomissioned 3/2019
DC-15	4/24/2007	307.54	34.64	272.90
DC-15	11/5/2010	307.54	36.93	270.61
DC-15	2/11/2011	307.54	35.68	271.86
DC-15	5/30/2011	307.54	34.32	273.22
DC-15	7/19/2011	307.54	34.62	272.92
DC-15	10/17/2011	307.54	35.68	271.86
DC-15	4/2/2012	307.54	35.94	271.60
DC-15	5/28/2013	307.89	35.61	272.28
DC-15	4/14/2014	307.89	36.02	271.87
DC-15	10/21/2014	307.89	36.35	271.54
DC-15	12/9/2015	307.89	36.79	271.10
DC-15	12/13/2016	307.89	35.91	271.98
DC-15	3/13/2017	307.89	34.82	273.07
DC-15	7/17/2017	307.89	33.91	273.98
DC-15	10/20/2017	307.89	34.31	273.58
DC-15	1/24/2018	307.89	35.40	272.49
DC-15	4/17/2018	307.89	34.81	273.08
DC-15	7/18/2018	307.89	35.08	272.81
DC-15	10/16/2018	307.89	36.12	271.77
DC-15	10/24/2019	307.89	37.10	270.79
DC-16	4/24/2007	307.12	33.81	273.31
DC-16	8/21/2008	307.12	36.41	270.71
DC-16	11/5/2010	307.12	36.10	271.02
DC-16	2/11/2011	307.12	34.85	272.27
DC-16	5/30/2011	307.12	33.48	273.64
DC-16	7/19/2011	307.12	33.83	273.29
DC-16	10/17/2011	307.12	34.91	272.21
DC-16	4/2/2012	307.12	35.14	271.98
DC-16	12/13/2016	307.12	35.15	271.97
DC-16	3/13/2017	307.12	34.80	272.32
DC-16	10/15/2018	307.12	35.37	271.75
DC-17	4/24/2007	304.89	31.65	273.24
DC-17	5/28/2013	305.16	32.65	272.51
DC-17	10/21/2014	305.16	33.44	271.72
DC-17	12/16/2015	305.16	33.58	271.58
DC-17	3/13/2017	305.16	31.80	273.36
DC-17	7/17/2017	305.16	--	--
DC-17	10/20/2017	305.16	32.51	272.65
DC-17	1/24/2018	305.16	32.42	272.74

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-17	4/17/2018	305.16	31.94	273.22
DC-17	7/18/2018	305.16	32.18	272.98
DC-17	10/15/2018	305.16	33.24	271.92
DC-17	5/21/2019	305.16	33.21	271.95
DC-17	10/24/2019	305.16	34.20	270.96
DC-18	4/24/2007	309.37	36.10	273.27
DC-18	5/28/2013	309.64	37.05	272.59
DC-18	10/21/2014	309.51	37.81	271.70
DC-18	12/9/2015	309.51	38.26	271.25
DC-18	12/13/2016	309.51	37.35	272.16
DC-18	3/13/2017	309.51	36.26	273.25
DC-18	7/17/2017	309.51	35.28	274.23
DC-18	10/20/2017	309.51	36.73	272.78
DC-18	1/24/2018	309.51	36.81	272.70
DC-18	4/17/2018	309.51	36.24	273.27
DC-18	7/18/2018	309.51	36.46	273.05
DC-18	10/15/2018	309.51	37.54	271.97
DC-18	10/24/2019	309.51	38.52	270.99
DC-19	8/21/2008	313.53	42.02	271.51
DC-19	11/5/2010	313.53	41.75	271.78
DC-19	2/11/2011	313.53	40.52	273.01
DC-19	5/30/2011	313.53	39.06	274.47
DC-19	7/19/2011	313.53	39.36	274.17
DC-19	10/17/2011	313.53	40.47	273.06
DC-19	4/2/2012	313.53	40.85	272.68
DC-19	5/28/2013	313.62	40.40	273.22
DC-19	12/9/2015	313.62	41.66	271.96
DC-19	12/13/2016	313.62	40.73	272.89
DC-19	3/13/2017	313.62	39.65	273.97
DC-19	7/17/2017	313.62	38.57	275.05
DC-19	10/20/2017	313.62	40.07	273.55
DC-19	1/24/2018	313.62	40.16	273.46
DC-19	4/17/2018	313.62	39.57	274.05
DC-19	7/18/2018	313.62	39.78	273.84
DC-19	10/15/2018	313.62	40.90	272.72
DC-19	10/29/2019	313.62	42.03	271.59
DC-20	6/2/2008	--	39.46	--
DC-20	5/28/2013	310.92	38.42	272.50
DC-20	4/14/2014	310.92	38.86	272.06
DC-20	10/21/2014	310.92	39.12	271.80
DC-20	12/15/2015	310.92	39.44	271.48
DC-20	12/13/2016	310.92	38.69	272.23
DC-20	3/13/2017	310.92	37.65	273.27
DC-20	7/17/2017	310.92	36.64	274.28
DC-20	10/20/2017	310.92	38.08	272.84

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
DC-20	1/24/2018	310.92	38.17	272.75
DC-20	4/17/2018	310.92	37.59	273.33
DC-20	10/15/2018	310.92	38.87	272.05
DC-20	10/25/2019	310.92	39.85	271.07
KMW-1	4/24/2007	311.21	38.15	273.06
KMW-1	8/21/2008	311.21	40.60	270.61
KMW-1	11/5/2010	311.21	40.37	270.84
KMW-1	2/11/2011	311.21	39.19	272.02
KMW-1	5/30/2011	311.21	37.79	273.42
KMW-1	7/19/2011	311.21	38.06	273.15
KMW-1	10/17/2011	311.21	39.13	272.08
KMW-1	4/2/2012	311.21	39.50	271.71
KMW-1	5/28/2013	311.59	39.08	272.51
KMW-1	10/21/2014	311.59	39.81	271.78
KMW-1	12/9/2015	311.59	40.29	271.30
KMW-1	12/13/2016	311.59	39.36	272.23
KMW-1	3/13/2017	311.59	38.34	273.25
KMW-1	7/17/2017	311.59	37.31	274.28
KMW-1	10/20/2017	311.59	38.85	272.74
KMW-1	1/24/2018	311.59	38.83	272.76
KMW-1	4/17/2018	311.59	38.27	273.32
KMW-1	7/18/2018	311.59	38.47	273.12
KMW-1	10/15/2018	311.59	39.55	272.04
KMW-1	10/24/2019	311.59	40.55	271.04
KMW-2	4/24/2007	306.90	33.33	273.57
KMW-2	8/21/2008	306.90	35.96	270.94
KMW-2	11/5/2010	306.90	34.59	272.31
KMW-2	2/11/2011	306.90	34.32	272.58
KMW-2	5/30/2011	306.90	32.96	273.94
KMW-2	7/19/2011	306.90	33.30	273.60
KMW-2	10/17/2011	306.90	34.39	272.51
KMW-2	4/2/2012	306.90	34.59	272.31
KMW-2	5/28/2013	307.25	34.30	272.95
KMW-2	10/21/2014	307.04	35.14	271.90
KMW-2	12/9/2015	307.04	35.51	271.53
KMW-2	12/13/2016	307.04	34.70	272.34
KMW-2	3/13/2017	307.04	33.42	273.62
KMW-2	7/17/2017	307.04	32.60	274.44
KMW-2	10/20/2017	307.04	34.02	273.02
KMW-2	1/24/2018	307.04	34.11	272.93
KMW-2	4/17/2018	307.04	33.56	273.48
KMW-2	7/18/2018	307.04	33.80	273.24
KMW-2	10/15/2018	307.04	34.92	272.12
KMW-2	10/24/2019	307.04	35.90	271.14
KMW-3	4/24/2007	296.92	24.51	272.41

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
KMW-3	8/21/2008	296.92	27.01	269.91
KMW-3	11/5/2010	296.92	26.37	270.55
KMW-3	5/30/2011	296.92	24.22	272.70
KMW-3	7/19/2011	296.92	24.61	272.31
KMW-3	10/17/2011	296.92	25.58	271.34
KMW-3	4/2/2012	296.92	25.59	271.33
KMW-3	10/21/2014	296.92	26.25	270.67
KMW-3	12/13/2016	296.92	25.69	271.23
KMW-3	3/13/2017	296.92	24.33	272.59
KMW-3	7/17/2017	296.92	23.99	272.93
KMW-3	10/20/2017	296.92	25.35	271.57
KMW-3	1/24/2018	296.92	25.16	271.76
KMW-3	4/17/2018	296.92	24.69	272.23
KMW-3	7/18/2018	296.92	25.04	271.88
KMW-3	10/15/2018	296.92	26.09	270.83
KMW-3	10/25/2019	296.99	26.96	270.03
KMW-4	4/24/2007	299.45	25.95	273.50
KMW-4	8/21/2008	299.45	28.62	270.83
KMW-4	11/5/2010	299.45	28.22	271.23
KMW-4	2/11/2011	299.45	26.87	272.58
KMW-4	5/30/2011	299.45	25.59	273.86
KMW-4	7/19/2011	299.45	25.99	273.46
KMW-4	10/17/2011	299.45	27.07	272.38
KMW-4	4/2/2012	299.45	27.10	272.35
KMW-4	10/21/2014	299.57	27.80	271.77
KMW-4	12/9/2015	299.57	28.08	271.49
KMW-4	12/13/2016	299.57	27.24	272.33
KMW-4	3/13/2017	299.57	25.90	273.67
KMW-4	7/17/2017	299.57	25.25	274.32
KMW-4	10/20/2017	299.57	27.26	272.31
KMW-4	1/24/2018	299.57	26.58	272.99
KMW-4	4/17/2018	299.57	26.13	273.44
KMW-4	7/18/2018	299.57	26.50	273.07
KMW-4	10/15/2018	299.57	27.60	271.97
KMW-4	10/25/2019	299.57	28.57	271.00
KMW-5	4/24/2007	297.10	24.32	272.78
KMW-5	8/21/2008	297.10	26.85	270.25
KMW-5	11/5/2010	297.10	26.49	270.61
KMW-5	2/11/2011	297.10	25.21	271.89
KMW-5	5/30/2011	297.10	24.00	273.10
KMW-5	7/19/2011	297.10	24.41	272.69
KMW-5	10/17/2011	297.10	25.41	271.69
KMW-5	4/2/2012	297.10	25.37	271.73
KMW-5	5/28/2013	297.22	25.30	271.92
KMW-5	10/21/2014	297.22	26.09	271.13
KMW-5	12/9/2015	297.22	26.30	270.92

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
KMW-5	12/13/2016	297.22	25.52	271.70
KMW-5	3/13/2017	297.22	24.30	272.92
KMW-5	7/17/2017	297.22	24.75	272.47
KMW-5	10/20/2017	297.22	24.82	272.40
KMW-5	1/24/2018	297.22	24.95	272.27
KMW-5	4/17/2018	297.22	24.50	272.72
KMW-5	7/18/2018	297.22	24.87	272.35
KMW-5	10/31/2018	297.22	26.09	271.13
KMW-5	10/25/2019	297.22	27.15	270.07
KMW-5D	4/24/2007	296.94	24.19	272.75
KMW-5D	8/21/2008	296.94	26.72	270.22
KMW-5D	11/5/2010	296.94	26.35	270.59
KMW-5D	2/11/2011	296.94	25.10	271.84
KMW-5D	5/30/2011	296.94	23.89	273.05
KMW-5D	7/19/2011	296.94	24.28	272.66
KMW-5D	10/17/2011	296.94	25.28	271.66
KMW-5D	4/2/2012	296.94	25.19	271.75
KMW-5D	12/13/2016	296.94	25.40	271.54
KMW-5D	3/13/2017	296.94	25.19	271.75
KMW-5D	10/15/2018	296.94	25.79	271.15
KMW-6	4/24/2007	294.70	22.40	272.30
KMW-6	8/21/2008	294.70	24.90	269.80
KMW-6	11/5/2010	294.70	24.51	270.19
KMW-6	2/11/2011	294.70	23.26	271.44
KMW-6	5/30/2011	294.70	22.12	272.58
KMW-6	7/19/2011	294.70	22.52	272.18
KMW-6	10/17/2011	294.70	23.48	271.22
KMW-6	4/2/2012	294.70	23.39	271.31
KMW-6	10/21/2014	294.81	21.05	273.76
KMW-6	12/9/2015	294.81	24.31	270.50
KMW-6	12/13/2016	294.81	23.53	271.28
KMW-6	3/13/2017	294.81	22.34	272.47
KMW-6	7/17/2017	294.81	21.90	272.91
KMW-6	10/20/2017	294.81	23.31	271.50
KMW-6	1/24/2018	294.81	23.30	271.51
KMW-6	4/17/2018	294.81	22.54	272.27
KMW-6	7/18/2018	294.81	22.98	271.83
KMW-6	10/15/2018	294.81	23.98	270.83
KMW-6	10/28/2019	294.80	24.80	270.00
KMW-7	4/24/2007	301.32	29.22	272.10
KMW-7	8/21/2008	301.32	31.65	269.67
KMW-7	11/5/2010	301.32	31.36	269.96
KMW-7	2/11/2011	301.32	30.14	271.18
KMW-7	5/30/2011	301.32	28.92	272.40
KMW-7	7/19/2011	301.32	29.27	272.05

Table A2
Historical Summary of Groundwater Elevations (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
KMW-7	10/17/2011	301.32	30.25	271.07
KMW-7	4/2/2012	301.32	30.35	270.97
KMW-7	10/21/2014	301.43	30.88	270.55
KMW-7	12/15/2015	301.43	31.03	270.40
KMW-7	12/13/2016	301.43	30.40	271.03
KMW-7	3/13/2017	301.43	28.98	272.45
KMW-7	7/17/2017	301.43	28.61	272.82
KMW-7	10/20/2017	301.43	30.19	271.24
KMW-7	1/24/2018	301.43	28.66	272.77
KMW-7	4/17/2018	301.43	29.28	272.15
KMW-7	7/18/2018	301.43	29.70	271.73
KMW-7	10/15/2018	301.43	30.87	270.56
KMW-7	10/29/2019	301.42	31.71	269.71
KMW-8	4/24/2007	308.08	35.73	272.35
KMW-8	8/21/2008	308.08	38.14	269.94
KMW-8	11/5/2010	308.08	37.87	270.21
KMW-8	2/11/2011	308.08	36.72	271.36
KMW-8	5/30/2011	308.08	35.40	272.68
KMW-8	7/19/2011	308.08	35.68	272.40
KMW-8	10/17/2011	308.08	36.71	271.37
KMW-8	4/2/2012	308.08	37.02	271.06
KMW-8	10/21/2014	308.15	37.34	270.81
KMW-8	12/9/2015	308.15	37.76	270.39
KMW-8	12/13/2016	308.15	36.92	271.23
KMW-8	3/13/2017	308.15	35.94	272.21
KMW-8	7/17/2017	308.15	34.98	273.17
KMW-8	10/20/2017	308.15	36.35	271.80
KMW-8	1/24/2018	308.15	36.41	271.74
KMW-8	4/17/2018	308.15	35.87	272.28
KMW-8	7/18/2018	308.15	36.10	272.05
KMW-8	10/15/2018	308.15	37.12	271.03
KMW-8	10/28/2019	308.16	38.06	270.10
KMW-9	4/24/2007	310.18	36.49	273.69
KMW-9	11/5/2010	310.18	38.78	271.40
KMW-9	2/11/2011	310.18	37.51	272.67
KMW-9	5/30/2011	310.18	36.11	274.07
KMW-9	7/19/2011	310.18	36.49	273.69
KMW-9	10/17/2011	310.18	37.51	272.67
KMW-9	4/2/2012	310.18	37.84	272.34
KMW-9	4/14/2014	310.53	37.91	272.62
KMW-9	10/21/2014	310.33	38.24	272.09
KMW-9	12/9/2015	310.33	38.71	271.62
KMW-9	12/13/2016	310.33	37.79	272.54
KMW-9	3/13/2017	310.33	36.65	273.68
KMW-9	7/17/2017	310.33	35.66	274.67
KMW-9	10/20/2017	310.33	37.16	273.17

**Table A2
 Historical Summary of Groundwater Elevations (1999 - 2021)
 Manhattan Village Shopping Center and Harris Properties
 Normandy Park, Washington**

Location	Date	Well Casing Elevation (feet NAVD88)	Depth to Water (feet below well casing)	Water Level Elevation (feet NAVD88)
KMW-9	1/24/2018	310.33	37.22	273.11
KMW-9	4/17/2018	310.33	36.64	273.69
KMW-9	7/18/2018	310.33	36.87	273.46
KMW-9	10/15/2018	310.33	37.97	272.36
KMW-9	10/24/2019	310.33	39.00	271.33
<p>NOTES:</p> <ol style="list-style-type: none"> 1. '--' = not measured or not applicable. 2. Well monument types: flush grade monuments and above ground (AG) monuments. 3. Depth to water is measured from top of well casing. 4. Elevations are reported relative to North American Vertical Datum of 1988 (NAVD 88). 5. Top of casing (TOC) elevations were surveyed by D.R. Strong Consulting Engineers, Inc. in February and May 213 and by Lanktree Land Surveying, Inc. in July 215. 				

**Table A3
 Historical Summary of Groundwater Analytical Results (1999 - 2021)
 Manhattan Village Shopping Center and Harris Properties
 Normandy Park, Washington**

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
Shallow Monitoring Wells			
MW-1	12/10/1999	21.6	
MW-1	7/25/2005	15	
MW-1	4/11/2006	14	
MW-1	10/26/2006	11	
MW-1	4/25/2007	13	
* Monitoring well cannot be located			
MW-2	12/10/1999	16.7	
MW-2	4/5/2012	7.1	
MW-2	5/30/2013	2.4	
MW-2	4/14/2014	3.2	
MW-2	10/24/2014	1.4	
MW-2	12/11/2015	1.00	U
MW-2	3/13/2017	6.02	
MW-2	7/18/2017	2.43	
MW-2	10/26/2017	1.55	
MW-2	4/19/2018	3.39	
MW-2	7/17/2018	1.78	Chloroform (0.569)
MW-2	10/18/2018	1.17	Chloroform (0.843)
MW-2	10/25/2019	1.20	Chloroform (1.53)
MW-3	4/14/2008	2.31	Chloroform (0.990)
MW-3	11/1/2010	2.9	
MW-3	5/31/2011	2.0	U
MW-3	7/20/2011	2.0	U
MW-3	10/18/2011	6.1	
MW-3	4/4/2012	5.8	
MW-3	5/29/2013	4.0	
MW-3	10/24/2014	1.0	
MW-3	12/10/2015	1.34	
MW-3	12/14/2016	1.00	U
MW-3	3/13/2017	1.00	U
MW-3	7/18/2017	1.76	
MW-3	10/25/2017	4.21	
MW-3	4/20/2018	1.00	
MW-3	10/16/2018	0.500	U
MW-4	4/14/2008	33	Chloroform (0.780), cis-1,2-DCE (0.320), TCE (0.490)
MW-4	3/9/2010	7.8	
MW-4	11/1/2010	16	
MW-4	5/31/2011	10	
MW-4	7/21/2011	25	
MW-4	10/19/2011	21	
MW-4	4/4/2012	11	
MW-4	5/29/2013	8.1	
MW-4	10/29/2014	7.3	
MW-4	12/14/2015	4.89	

**Table A3
 Historical Summary of Groundwater Analytical Results (1999 - 2021)
 Manhattan Village Shopping Center and Harris Properties
 Normandy Park, Washington**

Monitoring Well	Date	PCE (µg/l)		Other VOCs detected (µg/l)
MW-4	12/14/2016	1.00	U	
MW-4	3/14/2017	1.00	U	
MW-4	7/18/2017	1.40		
MW-4	10/25/2017	3.23		
MW-4	4/20/2018	0.500	U	
MW-4	10/16/2018	0.500	U	
MW-5	4/11/2008	0.470		
MW-5	4/2/2012	2.0	U	
MW-6	4/15/2008	2.0	U	
MW-6	4/2/2012	2.0	U	
MW-7	4/16/2008	22.4		
MW-7	4/2/2012	14		
MW-7	10/29/2014	20		
MW-7	12/15/2015	7.42		
MW-7	3/17/2017	8.08		
MW-7	7/19/2017	7.20		
MW-7	10/25/2017	7.47		
MW-7	1/26/2018	7.73		
MW-7	4/20/2018	7.64		
MW-7	7/19/2018	6.60		
MW-7	10/23/2018	5.79		
MW-7	10/25/2019	7.13		
MW-8	8/21/2008	0.20	J	
MW-8	4/2/2012	2.0	U	
MW-9	8/21/2008	0.10	J	
MW-9	4/2/2012	2.0	U	
MW-9	10/24/2014	1.0	U	
MW-9	12/10/2015	1.00	U	
MW-9	3/13/2017	1.00	U	
MW-9	10/23/2017	0.500	U	
MW-9	4/18/2018	0.500	U	
MW-9	10/17/2018	0.500	U	
MW-9	10/25/2019	0.500	U	
MW-10	2/8/2011	10		
MW-10	5/31/2011	2.0	U	
MW-10	7/20/2011	4.1		
MW-10	10/18/2011	4.9		
MW-10	4/6/2012	6.7		
MW-10	5/29/2013	4.1		
MW-10	10/24/2014	1.7		
MW-10	12/11/2015	1.00	U	TCE (3.22)
MW-10	12/14/2016	1.13		

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)		Other VOCs detected (µg/l)
MW-10	3/14/2017	1.09		
MW-10	7/18/2017	1.00	U	
MW-10	10/23/2017	0.500	U	
MW-10	4/18/2018	0.716		
MW-10	10/18/2018	0.500	U	
MW-10	5/21/2019	0.630		
MW-10	10/25/2019	1.01		
MW-11	2/8/2011	47		
MW-11	5/31/2011	2.0	U	Acetone (51)
MW-11	7/20/2011	2.0	U	Acetone (154)
MW-11	10/18/2011	2.0	U	Acetone (130)
MW-11	4/6/2012	29		
MW-11	5/31/2013	22		
MW-11	10/29/2014	15		
MW-11	12/14/2015	11.9		
MW-11	12/15/2016	7.99		
MW-11	3/16/2017	4.66		
MW-11	7/19/2017	2.52		
MW-11	10/26/2017	2.15		
MW-11	1/25/2018	2.52		
MW-11	4/19/2018	2.97		
MW-11	10/19/2018	2.44		
MW-11	5/21/2019	3.92		
MW-12	4/4/2012	2.0	U	
MW-12	5/28/2013	1.0	U	
MW-12	10/23/2014	1.0	U	
MW-12	12/10/2015	1.00	U	
MW-12	12/14/2016	1.00	U	
MW-12	3/13/2017	1.00	U	
MW-12	7/18/2017	1.00	U	
MW-12	10/23/2017	0.500	U	
MW-12	4/18/2018	0.500	U	
MW-12	10/16/2018	0.500	U	
MW-13	4/3/2012	2.0	U	
MW-13	5/30/2013	1.0	U	
MW-13	10/23/2014	1.0	U	
MW-13	12/10/2015	1.00	U	
MW-13	12/13/2016	1.00	U	
MW-13	3/14/2017	1.00	U	
MW-13	7/18/2017	1.00	U	
MW-13	10/23/2017	0.500	U	
MW-13	4/18/2018	0.500	U	
MW-13	10/16/2018	0.500	U	
MW-14	4/5/2012	2.0	U	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)		Other VOCs detected (µg/l)
MW-14	5/29/2013	1.0	U	
MW-14	10/30/2014	1.0	U	
MW-14	12/11/2015	1.00	U	
MW-14	3/14/2017	1.00	U	
MW-14	10/24/2017	0.910		
MW-14	4/20/2018	1.27		
MW-14	10/23/2018	0.500	U	
MW-15	4/5/2012	2.0	U	
MW-15	5/28/2013	1.0	U	
MW-15	4/14/2014	1.0	U	
MW-15	10/23/2014	1.0	U	
MW-15	12/10/2015	1.00	U	
MW-15	3/14/2017	1.00	U	
MW-15	10/24/2017	0.954		
MW-15	4/19/2018	1.13		
MW-15	10/18/2018	0.500	U	
MW-16	5/31/2013	2.5		
MW-16	10/23/2014	1.3		
MW-16	12/11/2015	1.20		
MW-16	12/13/2016	1.63		
MW-16	3/16/2017	1.13		
MW-16	7/18/2017	1.00	U	
MW-16	10/24/2017	1.26		
MW-16	4/19/2018	1.33		
MW-16	10/18/2018	0.912		Chloroform (0.539)
MW-17	3/6/2019	6.82		
MW-17	10/28/2019	2.85		
MW-17	6/3/2020	5.35		
MW-18	3/6/2019	11.4		
MW-18	10/28/2019	11.3		
MW-20	10/29/2019	0.500	U	Chloroform (0.547)
MW-20	12/4/2020	0.500	U	
MW-20	6/3/2020	1.00	U	
DC-1	10/21/1998	0.60		Toluene (0.8)
DC-1	2/3/1999	0.5	U	
DC-1	4/7/1999	0.5	U	Toluene (8.7)
DC-1	12/8/1999	1.0	U	
DC-1	4/26/2000	1.0	U	
DC-1	8/3/2000	1.0	U	
DC-1	11/14/2000	1.0	U	
DC-1	3/6/2001	1.0	U	
DC-1	6/20/2001	1.0	U	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)		Other VOCs detected (µg/l)
DC-1	9/17/2001	1.0	U	
DC-1	12/20/2001	1.0	U	
DC-1	3/13/2002	1.0	U	
DC-1	9/17/2002	1.0	U	
DC-1	12/10/2002	1.0	U	
DC-1	3/31/2003	1.0	U	
DC-1	9/3/2003	1.0	U	
DC-1	3/16/2004	1.0	U	
DC-1	9/7/2004	1.0	U	
DC-1	4/25/2007	0.2	U	
DC-1	4/4/2012	2.0	U	
DC-2	10/21/1998	2.4		Chloroform (1.8), Toluene (0.6)
DC-2	2/3/1999	0.7		
DC-2	4/7/1999	0.5	U	Chloroform (1.4), Toluene (14)
DC-2	12/8/1999	0.5	U	
DC-2	4/26/2000	1.0	U	
DC-2	8/3/2000	1.0	U	
DC-2	11/14/2000	1.0	U	
DC-2	3/6/2001	1.0	U	
DC-2	6/20/2001	1.0	U	
DC-2	9/17/2001	1.0	U	
DC-2	12/20/2001	1.0	U	
DC-2	3/13/2002	4.0		
DC-2	6/13/2002	1.0	U	
DC-2	9/17/2002	1.0	U	
DC-2	12/10/2002	0.50		
DC-2	3/31/2003	3.37		
DC-2	9/3/2003	1.0	U	
DC-2	3/16/2004	0.74		
DC-2	9/7/2004	1.0	U	
DC-2	4/26/2007	1.2		
DC-2	4/14/2008	0.340		Chloroform (1.60)
DC-2	11/3/2010	2.0	U	
DC-2	5/31/2011	2.0	U	
DC-2	7/21/2011	2.0	U	
DC-2	10/18/2011	2.0	U	
DC-2	4/4/2012	2.0	U	
DC-3	10/28/1998	54		Chloroform (1.9), Toluene (0.6)
DC-3	2/4/1999	25		
DC-3	4/8/1999	36		Chloroform (1.2), Toluene (15)
DC-3	12/8/1999	45		
DC-3	4/26/2000	56		
DC-3	8/3/2000	25		
DC-3	11/14/2000	1.0	U	
DC-3	3/6/2001	4.7		
DC-3	6/20/2001	2.8		

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-3	9/17/2001	1.0 U	
DC-3	12/20/2001	9.2	
DC-3	3/13/2002	40.0	
DC-3	6/13/2002	42.3	
DC-3	9/17/2002	33.4	
DC-3	12/10/2002	5.40	
DC-3	3/31/2003	7.34	
DC-3	9/3/2003	2.08	
DC-3	3/16/2004	1.0 U	
DC-3	9/7/2004	3.43	
DC-3	4/26/2007	42.0	
DC-3	4/14/2008	27.8	Chloroform (1.50)
DC-3	3/9/2010	2.0 U	
DC-3	11/3/2010	2.0 U	
DC-3	5/30/2011	3.9	
DC-3	7/20/2011	12	
DC-3	10/18/2011	6.7	
DC-3	4/4/2012	2.9	
DC-3	10/27/2014	1.4	
DC-3	12/11/2015	1.49	
DC-3	12/14/2016	1.00 U	
DC-3	3/14/2017	2.11	
DC-3	7/18/2017	1.00 U	
DC-3	10/24/2017	0.786	
DC-3	4/18/2018	1.23	
DC-3	10/17/2018	0.500 U	
DC-4	10/28/1998	227	Chloroform (0.9), Toluene (0.7)
DC-4	2/4/1999	144	
DC-4	4/8/1999	110	Toluene (2.6)
DC-4	12/8/1999	71	
DC-4	4/26/2000	120	
DC-4	8/3/2000	42	
DC-4	11/14/2000	64	
DC-4	3/6/2001	52	TCE (3.0)
DC-4	6/20/2001	40	
DC-4	9/17/2001	23	
DC-4	12/20/2001	15	
DC-4	3/13/2002	55	
DC-4	6/13/2002	17.9	
DC-4	9/17/2002	28.8	
DC-4	12/10/2002	22.4	
DC-4	3/31/2003	12.5	
DC-4	9/3/2003	14.1	
DC-4	3/16/2004	19.8	
DC-4	9/7/2004	18.5	
DC-4	4/26/2007	19.0	
DC-4	4/11/2008	30.2	Chloroform (1.2)

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-4	3/9/2010	9.2	
DC-4	11/3/2010	13	
DC-4	5/31/2011	2.0	U Acetone (46)
DC-4	7/20/2011	2.0	U Acetone (77)
DC-4	10/18/2011	22	
DC-4	4/4/2012	22	
DC-4	5/30/2013	11	
DC-4	10/29/2014	13	
DC-4	12/14/2015	5.49	
DC-4	12/14/2016	1.00	U
DC-4	3/14/2017	1.00	U
DC-4	7/18/2017	1.00	U
DC-4	10/24/2017	0.500	U
DC-4	4/18/2018	0.500	U
DC-4	10/17/2018	0.500	U
DC-6	2/4/1999	5.1	
DC-6	4/8/1999	3.7	Chloroform(1.3), Toluene (2.3)
* Monitoring well cannot be located			
DC-7	2/4/1999	74	
DC-7	4/8/1999	64	Toluene (1.3)
DC-7	12/8/1999	107	
DC-7	4/26/2000	130	
DC-7	8/3/2000	50	
DC-7	11/14/2000	130	
DC-7	3/6/2001	140	
DC-7	6/20/2001	96	
DC-7	9/17/2001	81	
DC-7	12/20/2001	47	
DC-7	3/13/2002	31	
DC-7	6/13/2002	41.5	
DC-7	9/17/2002	77.7	
DC-7	12/10/2002	91.8	
DC-7	3/31/2003	40.1	
DC-7	9/3/2003	57.4	
DC-7	7/25/2005	37.0	
DC-7	4/11/2006	23.0	
DC-7	10/26/2006	51.0	
DC-7	4/24/2007	27.0	
DC-7	4/16/2008	50.8	
DC-7	11/3/2010	34	
DC-7	6/1/2011	15	
DC-7	7/21/2011	38	
DC-7	10/18/2011	42	
DC-7	4/5/2012	18	
DC-7	5/30/2013	15	
DC-7	10/30/2014	23	
DC-7	12/16/2015	13.3	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-7	3/17/2017	10.4	
DC-7	10/23/2017	6.67 J	
DC-7	1/26/2018	12.1	
DC-7	4/20/2018	12.8	
DC-7	7/20/2018	12.3	
DC-7	10/23/2018	11.6	
DC-7	10/30/2019	17.1	
DC-7	5/11/2021	8.35	
DC-8	2/4/1999	56	
DC-8	4/8/1999	48	Toluene (1.2)
DC-8	12/8/1999	98	
DC-8	4/26/2000	87	
DC-8	8/3/2000	70	
DC-8	11/14/2000	130	
DC-8	3/6/2001	82	
DC-8	6/20/2001	80	
DC-8	9/17/2001	62	
DC-8	12/20/2001	50	
DC-8	3/13/2002	31	
DC-8	6/13/2002	26.6	
DC-8	9/17/2002	38.4	
DC-8	12/10/2002	53.1	
DC-8	3/31/2003	36.4	
DC-8	9/3/2003	34.7	
DC-8	7/25/2005	26.0	
DC-8	4/11/2006	14.0	
DC-8	10/26/2006	28.0	
DC-8	4/24/2007	24.0	
DC-8	4/16/2008	39.4	
DC-8	11/3/2010	25	
DC-8	6/1/2011	11	
DC-8	7/21/2011	25	
DC-8	10/19/2011	26	
DC-8	4/5/2012	18	
DC-8	5/30/2013	11	
DC-8	10/30/2014	18	
DC-8	12/16/2015	8.61	
DC-8	3/16/2017	9.69	
DC-8	7/19/2017	8.94	
DC-8	10/23/2017	14.8	
DC-8	1/24/2018	12.0	
DC-8	4/18/2018	13.0	
DC-8	7/18/2018	11.7	
DC-8	10/18/2018	12.1	
DC-8	10/29/2019	15.0	
DC-9A	4/8/1999	135	Toluene (3.2)

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-9A	12/8/1999	73	
DC-9A	4/26/2000	240	
DC-9A	8/3/2000	110	
DC-9A	4/11/2006	78	
DC-9A	8/8/2006	49	
DC-9A	11/2/2006	2.9	
DC-9A	4/26/2007	33	
* Monitoring well cannot be located			
DC-10A	4/8/1999	150	Toluene (1.7)
DC-10A	12/8/1999	73	TCE (1.1)
DC-10A	4/26/2000	210	
DC-10A	4/5/2012	41	
DC-10A	5/31/2013	19	
DC-10A	10/30/2014	17	
DC-10A	12/15/2016	10.8	
DC-10A	3/17/2017	8.62	
DC-10A	7/19/2017	4.69	
DC-10A	10/26/2017	4.72	
DC-10A	1/25/2018	3.62	
DC-10A	4/20/2018	4.67	
DC-10A	7/17/2018	2.68	
DC-11	4/26/2007	12	
DC-11	3/9/2010	4.6	
DC-11	11/1/2010	4.8	
DC-11	4/4/2012	3.1	
DC-11	4/15/2014	1.2	
DC-11	10/27/2014	1.4	
DC-11	12/11/2015	1.48	
DC-11	3/15/2017	1.97	
DC-11	10/26/2017	1.35	
DC-11	4/19/2018	1.21	
DC-11	10/18/2018	1.25	
DC-12	4/25/2007	16	
DC-12	4/4/2012	3.7	
DC-12	5/30/2013	2.3	
DC-12	4/15/2014	1.4	
DC-12	10/27/2014	1.8	
DC-12	12/14/2015	2.04	
DC-12	3/15/2017	2.02	
DC-12	10/27/2017	1.66	
DC-12	4/20/2018	1.50	
DC-12	10/19/2018	1.66	
DC-13	4/25/2007	15	
DC-13	4/16/2008	23	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-13	3/1/2010	10	
DC-13	11/2/2010	9.2	
DC-13	4/5/2012	6.4	
DC-13	5/30/2013	1.7	
DC-13	4/14/2014	3.2	
DC-13	10/27/2014	2.7	
DC-13	12/14/2015	2.78	
DC-13	3/15/2017	4.32	
DC-13	10/27/2017	2.79	
DC-13	4/20/2018	2.87	
DC-13	10/19/2018	2.74	
DC-14	4/25/2007	11	
DC-14	4/3/2012	11	
DC-14	5/30/2013	6.0	
DC-14	10/29/2014	19	
DC-14	12/15/2015	6.02	
DC-14	3/16/2017	6.20	
DC-14	7/19/2017	4.94	
DC-14	10/26/2017	5.40	Chloroform (2.23)
DC-14	2/2/2018	7.81	
DC-14	4/19/2018	5.14	Chloroform (2.27)
DC-14	7/19/2018	5.40	Chloroform (1.25)
DC-15	4/24/2007	11	
DC-15	4/5/2012	20	
DC-15	4/15/2014	10	
DC-15	10/30/2014	5.8	
DC-15	12/16/2015	5.93	
DC-15	3/16/2017	8.96	
DC-15	10/23/2017	7.42	
DC-15	1/24/2018	8.61	
DC-15	4/18/2018	9.88	
DC-15	7/18/2018	7.82	
DC-15	10/18/2018	7.65	
DC-15	10/29/2019	9.72	
DC-17	4/25/2007	47	
DC-17	4/16/2008	74.6	
DC-17	5/31/2013	21	
DC-17	10/23/2014	17	
DC-17	12/16/2015	15.1	
DC-17	3/17/2017	13.9	
DC-17	10/23/2017	8.06	
DC-17	1/26/2018	7.38	
DC-17	4/20/2018	10.1	
DC-17	7/20/2018	8.62	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
DC-17	10/19/2018	8.24	
DC-17	5/21/2019	8.62	
DC-17	10/30/2019	5.72	
DC-18	4/25/2007	19	
DC-18	4/5/2012	7.2	
DC-18	5/30/2013	4.8	
DC-18	10/28/2014	3.0	
DC-18	12/14/2015	3.19	
DC-18	3/16/2017	3.24	
DC-18	10/26/2017	3.26	Chloroform (3.00)
DC-18	4/20/2018	3.31	Chloroform (3.23)
DC-18	10/19/2018	2.79	Chloroform (2.36)
DC-19	6/4/2007	0.79	
DC-19	4/14/2008	0.66	
DC-19	4/4/2012	2.0	U
DC-20	6/2/2008	8.1	
DC-20	5/30/2013	1.7	
DC-20	4/14/2014	1.4	
DC-20	10/28/2014	1.0	U
DC-20	12/15/2015	1.74	1,2-Dichlororpropane (1.82)
DC-20	3/15/2017	2.00	
DC-20	10/27/2017	0.991	
DC-20	4/19/2018	1.14	
DC-20	10/19/2018	0.885	Benzene (0.54), sec-Butylbenzene (0.6 0)
KMW-1	4/11/2006	1.0	U
KMW-1	10/26/2006	1.0	U
KMW-1	4/25/2007	0.2	U
KMW-1	4/14/2008	0.2	U Chloroform (0.450)
KMW-1	4/3/2012	2.0	U
KMW-2	6/12/2006	130	
KMW-2	8/8/2006	130	
KMW-2	10/26/2006	190	
KMW-2	4/24/2007	63	
KMW-2	4/16/2008	96	
KMW-2	3/8/2010	81	
KMW-2	11/3/2010	74	
KMW-2	6/1/2011	12	Acetone (140)
KMW-2	7/20/2011	44	
KMW-2	10/19/2011	40	
KMW-2	4/6/2012	25	
KMW-2	5/31/2013	22	
KMW-2	10/29/2014	18	
KMW-2	12/15/2015	15	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)
KMW-2	12/15/2016	1.18	
KMW-2	3/14/2017	1.00 U	
KMW-2	7/18/2017	1.00 U	
KMW-2	10/24/2017	0.500 U	
KMW-2	4/18/2018	0.500 U	
KMW-2	10/16/2018	0.500 U	
KMW-3	6/12/2006	20	
KMW-3	10/26/2006	13	
KMW-3	4/24/2007	9.9	
KMW-3	11/2/2010	11	
KMW-3	5/31/2011	6.2	
KMW-3	7/20/2011	12	
KMW-3	10/18/2011	11	
KMW-3	4/3/2012	6.8	
KMW-3	10/28/2014	1.0 U	
KMW-3	3/14/2017	3.23	
KMW-3	10/26/2017	5.78	
KMW-3	1/25/2018	4.95	
KMW-3	4/20/2018	5.37	
KMW-3	7/19/2018	5.18	
KMW-3	10/23/2018	5.41	
KMW-3	10/25/2019	4.74	
KMW-4	4/25/2007	0.73	
KMW-4	4/3/2012	2.0 U	
KMW-5	4/25/2007	0.82	
KMW-5	4/3/2012	2.0 U	
KMW-6	4/24/2007	3.8	
KMW-6	4/3/2012	2.0 U	
KMW-7	4/24/2007	3.8	
KMW-7	4/15/2008	3.9	
KMW-7	11/3/2010	2.0 U	
KMW-7	5/30/2011	2.3	
KMW-7	7/20/2011	2.0 U	
KMW-7	10/18/2011	2.0 U	
KMW-7	4/3/2012	3.3	
KMW-7	10/28/2014	2.0	p-isopropyltoluene (2.8)
KMW-7	12/15/2015	2.17	
KMW-7	3/16/2017	1.17	
KMW-7	10/25/2017	0.500 U	
KMW-7	4/19/2018	1.59	
KMW-7	10/23/2018	0.711	
KMW-7	10/29/2019	0.631	

Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)	Other VOCs detected (µg/l)	
KMW-8	4/24/2007	11		
KMW-8	4/15/2008	17.4		
KMW-8	4/3/2012	10		
KMW-8	10/28/2014	5.9		
KMW-8	12/15/2015	3.98		
KMW-8	3/16/2017	6.71		
KMW-8	7/19/2017	5.00		
KMW-8	10/26/2017	4.99		Chloroform (1.15)
KMW-8	1/25/2018	5.89		Chloroform (2.01)
KMW-8	4/19/2018	5.74		Chloroform (1.68)
KMW-8	7/19/2018	5.17		Chloroform (1.13)
KMW-8	10/23/2018	5.26		Chloroform (1.16)
KMW-8	10/28/2019	6.24		
KMW-9	4/26/2007	9.3		
KMW-9	3/8/2010	4.4		
KMW-9	11/4/2010	2.8		
KMW-9	4/5/2012	4.0		
KMW-9	4/15/2014	1.0		
KMW-9	10/27/2014	1.0	U	
KMW-9	12/10/2015	1.47		
KMW-9	3/15/2017	2.07		
KMW-9	10/26/2017	0.770		
KMW-9	4/18/2018	1.02		
KMW-9	10/18/2018	0.500	U	Chloroform (0.699)
Deep Monitoring Wells				
MW-19	10/29/2019	0.500	U	Chloroform (0.560)
MW-19	12/4/2020	0.500	U	
DC-5	2/4/1999	2.4		
DC-5	4/8/1999	1.6		Chloroform (2.6), Toluene (1.0)
DC-5	7/25/2005	37		
DC-5	4/11/2006	1.3		
DC-5	4/26/2007	2.1		
DC-5	11/3/2010	2.1		
DC-5	5/30/2011	2.0	U	
DC-5	7/19/2011	2.0	U	
DC-5	10/18/2011	2.0	U	
DC-5	4/6/2012	2.0	U	
DC-5	5/29/2013	1.0	U	
DC-9B	4/8/1999	1.4		Chloroform (1.4), Toluene (2.9)
DC-9B	3/6/2001	2.0		
DC-9B	6/20/2001	1.0	U	
DC-9B	9/17/2001	1.0	U	
DC-9B	12/20/2001	6.4		
DC-9B	7/25/2005	1.0	U	

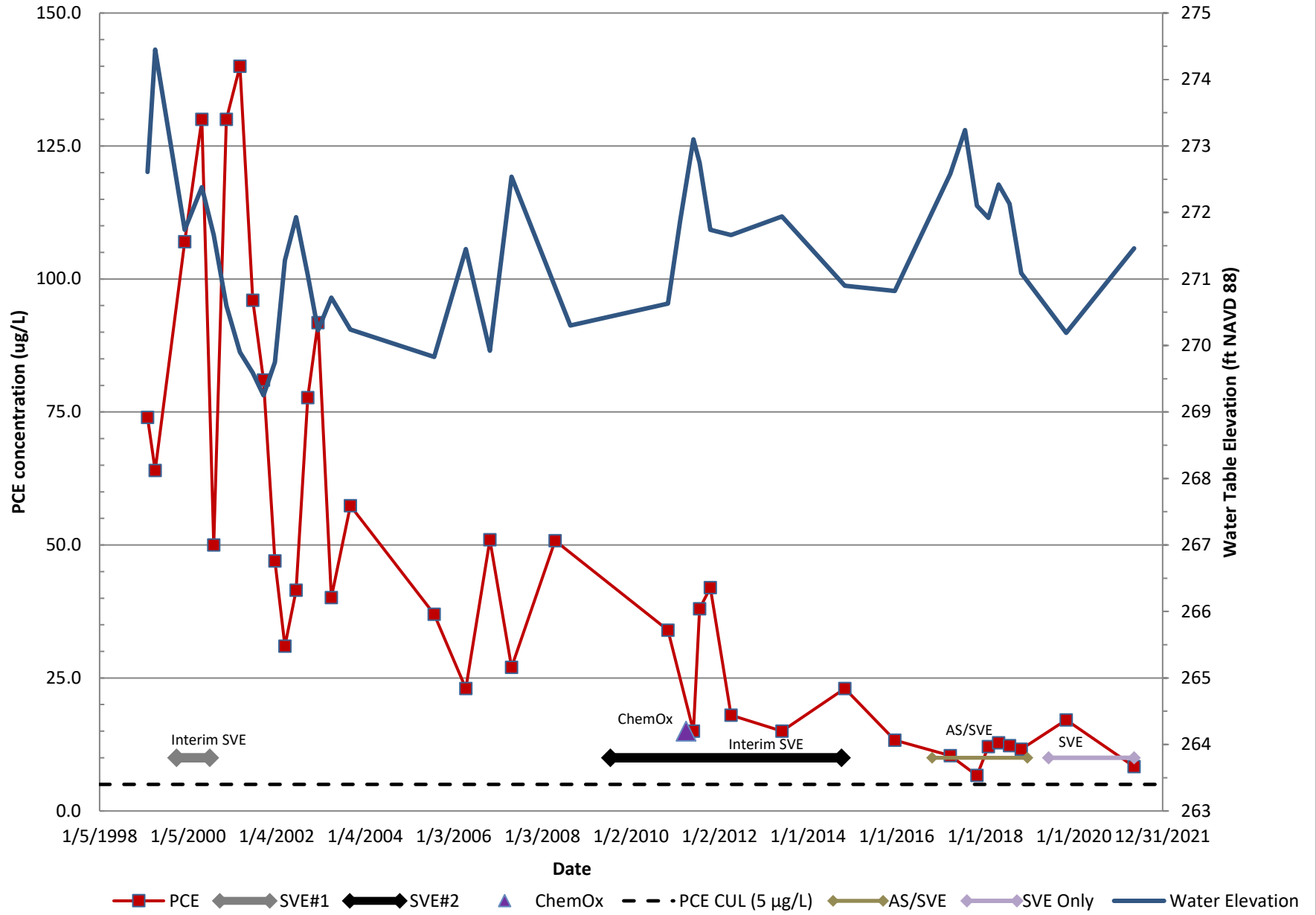
Table A3
Historical Summary of Groundwater Analytical Results (1999 - 2021)
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington

Monitoring Well	Date	PCE (µg/l)		Other VOCs detected (µg/l)
DC-9B	4/11/2006	1.0	U	
DC-9B	8/8/2006	1.0	U	
DC-9B	10/26/2006	1.0	U	
DC-9B	4/26/2007	0.2	U	
DC-9B	4/15/2008	0.60		
* Monitoring well has been decommissioned				
DC-10B	4/8/1999	1.8		Chloroform (1.2), Toluene (1.9)
DC-10B	3/6/2001	3.3		TCE (1.7)
DC-10B	6/20/2001	2.4		
DC-10B	9/17/2001	1.0	U	
DC-10B	12/20/2001	1.0	U	
DC-10B	7/25/2005	1.0	U	
DC-10B	4/11/2006	1.0	U	
DC-10B	4/26/2007	0.34		
DC-10B	11/3/2010	2.6		
DC-10B	5/30/2011	2.0	U	Acetone (290)
DC-10B	7/19/2011	2.0	U	Acetone (54)
DC-10B	10/18/2011	2.0	U	Acetone (31)
DC-10B	4/6/2012	2.0	U	
DC-16	4/25/2007	0.42		
DC-16	11/5/2010	2.0	U	
DC-16	5/31/2011	2.0	U	
DC-16	7/19/2011	2.0	U	
DC-16	10/18/2011	2.0	U	
DC-16	4/6/2012	2.0	U	
KMW-5D	4/25/2007	0.2	U	
KMW-5D	4/3/2012	2.0	U	

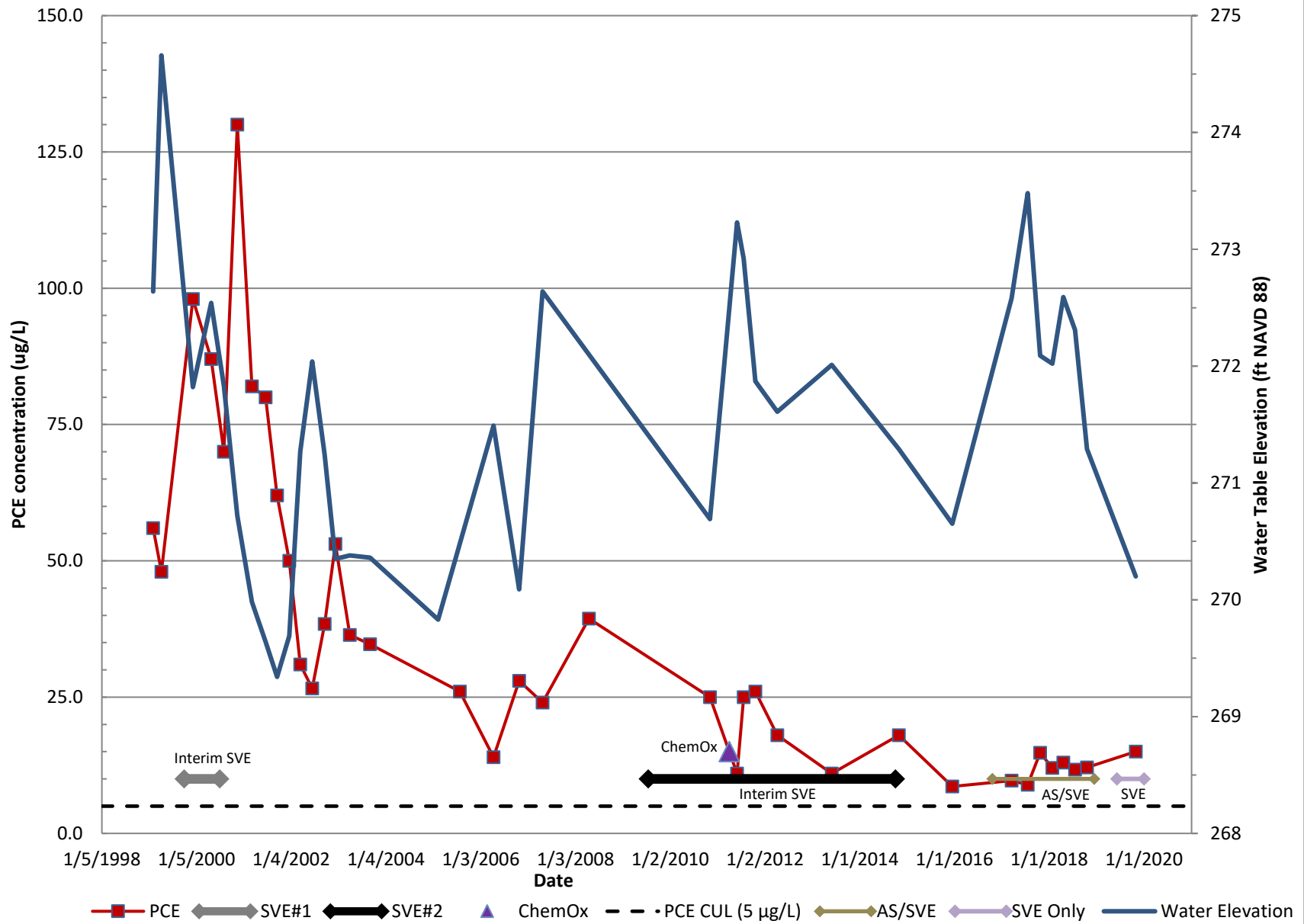
NOTES:

1. Tetrachloroethene (PCE) concentrations in micrograms per liter (µg/l).
2. Groundwater samples analyzed using USEPA Method 8260B.
3. U = concentration not detected at or above the laboratory practical quantitation limit (PQL).
4. J = the identification of the analyte is acceptable; the reported value is an estimate
5. Detected concentrations are shown in **bold**.
6. Concentrations exceeding the cleanup level are **bold and shaded**.
7. Other detected VOCs are below their respective cleanup level unless otherwise noted.
8. Shallow monitoring wells are screened at the top of the shallow aquifer, and deep monitoring wells are screened below and deeper within the shallow aquifer.
9. Review of historical results indicate that DC-17 was inadvertently sampled as DC-5 in 2010, 2011 and 2012. This table reports the 2010 - 2012 DC-17 data as DC-5.

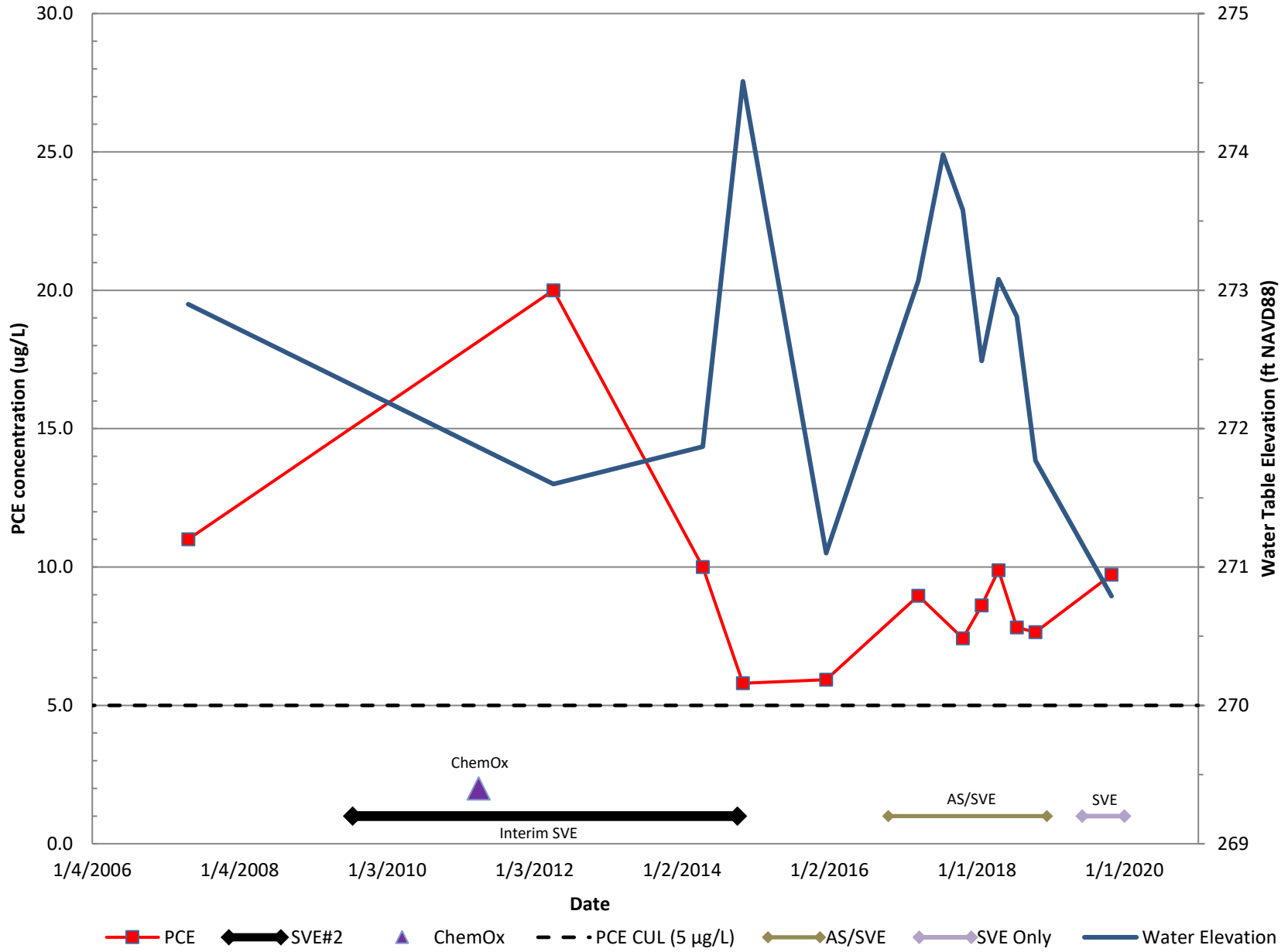
DC-7



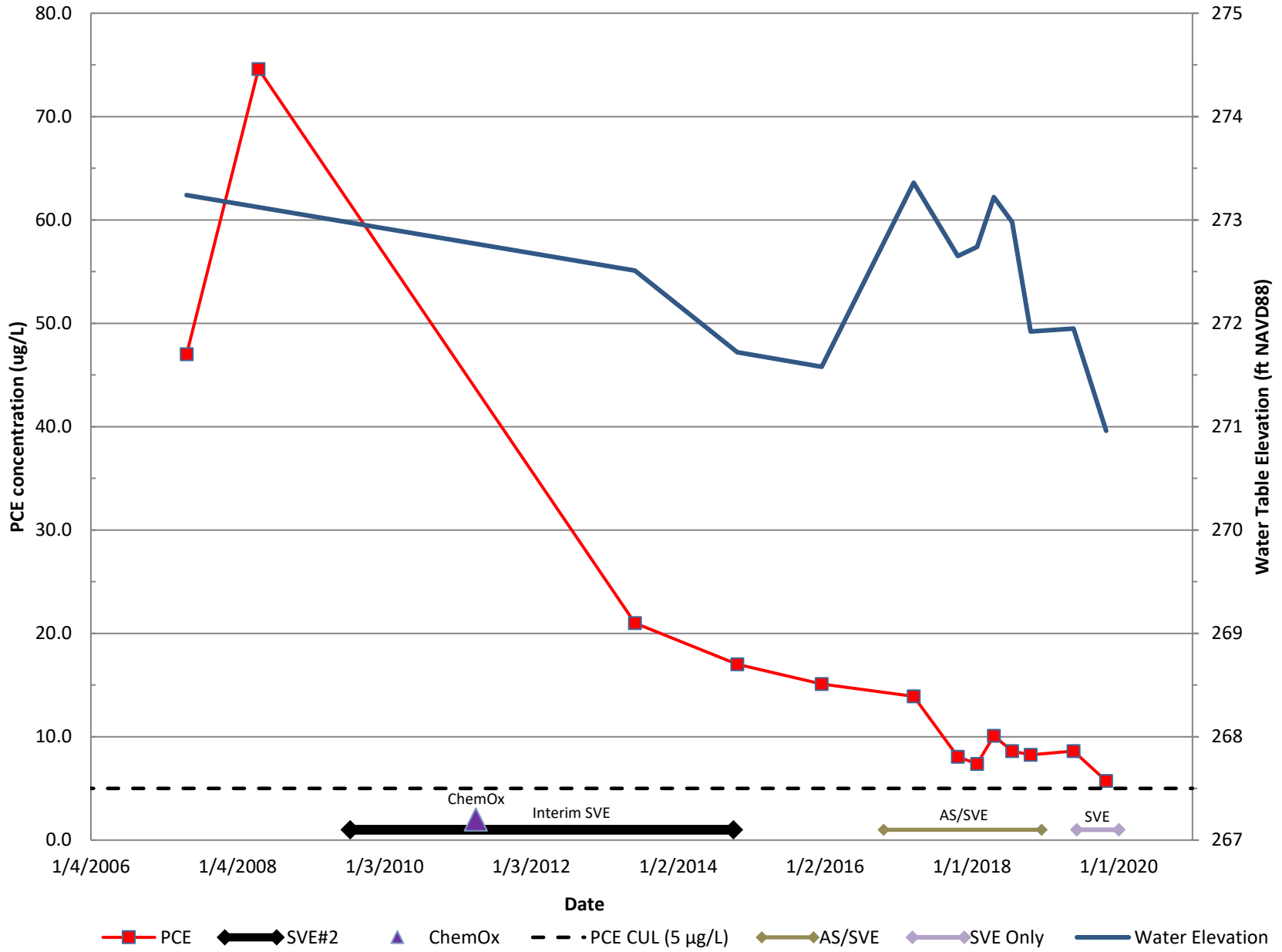
DC-8



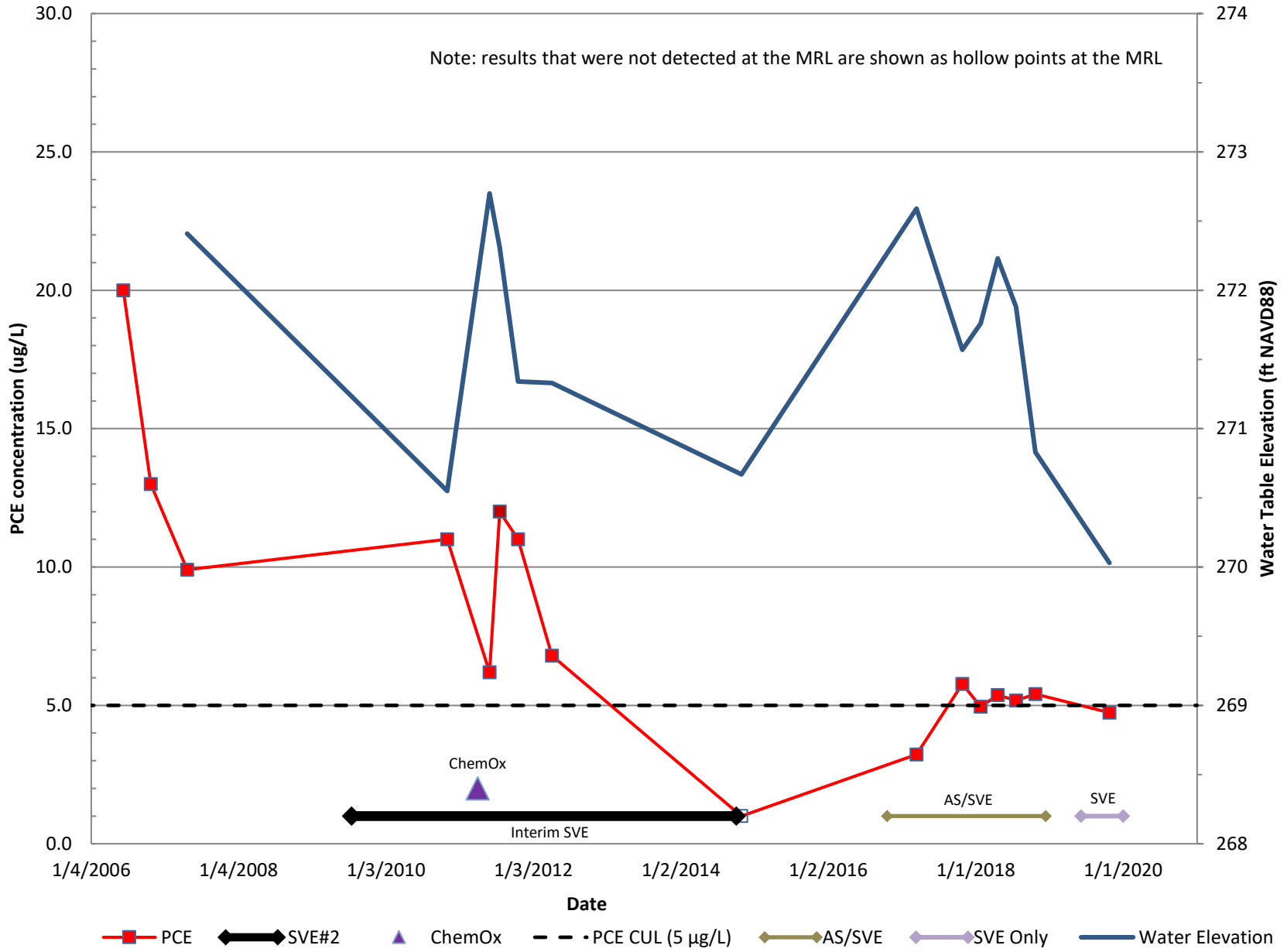
DC-15



DC-17



KMW-3



KMW-8

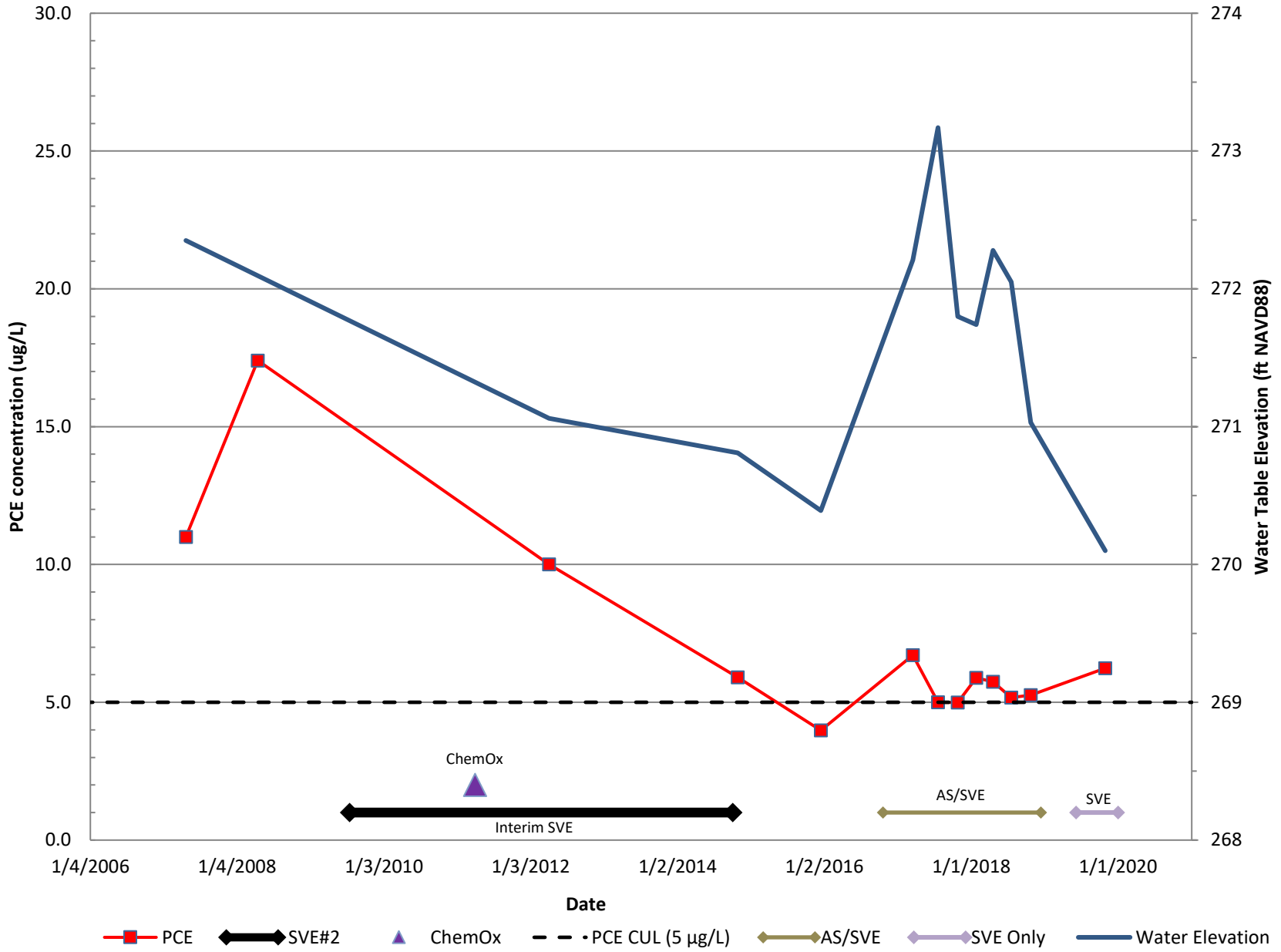


Table A4

**Soil Vapor Results - March 11 and June 3, 2019
Manhattan Village Shopping Center and Harris Properties
Normandy Park, Washington**

Parameter	CAS Number	Commercial Remediation Screening Level	Subslab Soil Gas Sample ID										Soil Gas Sample ID			
			SVS-10		SVS-11		SVS-12	SVS-13		SVS-14		SVS-15		SVS-16	SVS-17	
			3/11/2019	6/3/2019	3/11/2019	6/3/2019	6/3/2019	3/11/2019	6/3/2019	3/11/2019	6/3/2019	3/11/2019	6/3/2019	3/11/2019	3/11/2019	6/3/2019
		Screen Depth (ft)	1.3		1.3		1.3	1.2		1.3		1.3		1.3	4.5 to 5	
cis-1,2-Dichloroethene	156-59-2	-	1.59 U	1.59 U	1.59 U	15.0	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1,230	8,600
trans-1,2-Dichloroethene	156-60-5	-	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	1.59 U	43.4	519
Tetrachloroethene	127-18-4	1,067	105	485	108	537	367	611	1,500	9.93	168	50.5	115	369	26,900	104,000
Trichloroethene	79-01-6	36.7	2.52	2.14 U	2.14 U	5.64	2.14 U	2.14 U	2.14 U	2.14 U	2.14 U	2.14 U	2.14 U	2.14 U	319	3,290
Vinyl Chloride	75-01-4	31.7	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	1.02 U	44.7	21.4

NOTES:

- All results in µg/m³ (micrograms per cubic meter).
- U = not detected at or above the method reporting limit shown.
- = not applicable
- Commercial remediation screening levels (SLs) for tetrachloroethene, trichloroethene, and vinyl chloride have been calculated using Equation 750-2 (Washington Administrative Code 173-340-750). Per Ecology's *Frequently Asked Questions (FAQs) Regarding Vapor Intrusion (VI) and Ecology's Guidance Implementation Memorandum No. 21 (November 1, 2018)*, an exposure frequency (EF) factor of 0.3 was used (instead of 1.0) to reflect a commercial exposure of 52 weeks at 50 hours per week. Ecology has not assigned vapor intrusion SLs to cis- and trans-1,2-dichloroethene.
- Detected concentrations are shown in **bold**.
- Concentrations exceeding the commercial remediation screening level are **bold and shaded**.
- Only tetrachloroethene and breakdown daughter products are shown. See lab reports for other detected VOCs unrelated to tetrachloroethene including acetone, carbon disulfide, chloroform, chloromethane, 1,2-dichlorobenzene, 1,1-dichloroethene, 1,4-dioxane, ethanol, ethylbenzene, trichlorofluoromethane, dichlorofluoroethane, hexane, methylene chloride, 2-butanone, isopropyl alcohol, 1-propene, styrene, tetrahydrofuran, toluene, 1,1,1-trichloroethane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene, and o-xylene.
- SVS-10 and SVS-11 were collected beneath the slab in Four Star Cleaners on MVSC Property.
- SVS-12, SVS-13, SVS-14, SVS-15, and SVS-16 were collected beneath the slab in Archies Restaurant on Harris Property. The sample from SVS-12 was not analyzed in March 2019 due to leakage in the sampling train. SVS-16 was not sampled in June 2019 due to floor wax in sampling probe tip.
- SVS-17 was collected beneath the asphalt paved alley behind Four Star Cleaners on MVSC Property.

APPENDIX B

PCE FLUX TESTING RESULTS

**Attachment F
Passive Flux Meter Test Results**

Table F1. Summary of flux values for each well

Well_ID	Sample_ID	Depth below top of well casing (ft)	Darcy Velocity (cm/day)	PCE flux (mg/m ² /day)
MW-19	MW-19-43.9-45.3	44.7	17.9	0.0072
	MW-19-45.3-46.4	45.9	5.9	0.0020
	MW-19-46.4-47.5	47.0	7.1	0.0006
	MW-19-47.5-48.5	48.1	20.8	0.0020
	MW-19-49.0-50.0	49.6	9.5	0.0011
	MW-19-50.0-51.3	50.7	15.4	0.0020
	MW-19-51.3-52.5	52.0	15.2	0.0028
	MW-19-52.5-53.3	53.0	14.2	0.0017
MW-20	MW-20-35.3-36.4	35.9	9.1	0.0281
	MW-20-36.4-37.5	37.0	7.8	0.0507
	MW-20-36.4-37.5 DUP	37.0	7.9	0.0568
	MW-20-37.5-38.5	38.1	8.1	0.0572
	MW-20-38.5-39.6	39.1	12.7	0.0220
	MW-20-40.0-41.2	40.7	3.7	0.0223
	MW-20-41.2-42.5	41.9	4.3	0.0103
	MW-20-42.5-43.5	43.1	5.5	0.0047
MW-20-43.5-44.3	44.0	15.4	0.0058	

Table F2. Summary of flux average contaminant concentration

Well_ID	Sample_ID	Depth below top of well casing (ft)	Darcy Velocity (cm/day)	PCE (ug/L)
MW-19	MW-19-43.9-45.3	44.7	17.9	0.040
	MW-19-45.3-46.4	45.9	5.9	0.034
	MW-19-46.4-47.5	47.0	7.1	0.009
	MW-19-47.5-48.5	48.1	20.8	0.009
	MW-19-49.0-50.0	49.6	9.5	0.012
	MW-19-50.0-51.3	50.7	15.4	0.013
	MW-19-51.3-52.5	52.0	15.2	0.018
	MW-19-52.5-53.3	53.0	14.2	0.012
MW-20	MW-20-35.3-36.4	35.9	9.1	0.308
	MW-20-36.4-37.5	37.0	7.8	0.647
	MW-20-36.4-37.5 DUP	37.0	7.9	0.716
	MW-20-37.5-38.5	38.1	8.1	0.705
	MW-20-38.5-39.6	39.1	12.7	0.174
	MW-20-40.0-41.2	40.7	3.7	0.608
	MW-20-41.2-42.5	41.9	4.3	0.240
	MW-20-42.5-43.5	43.1	5.5	0.086
MW-20-43.5-44.3	44.0	15.4	0.038	

Chart F1. MW-19

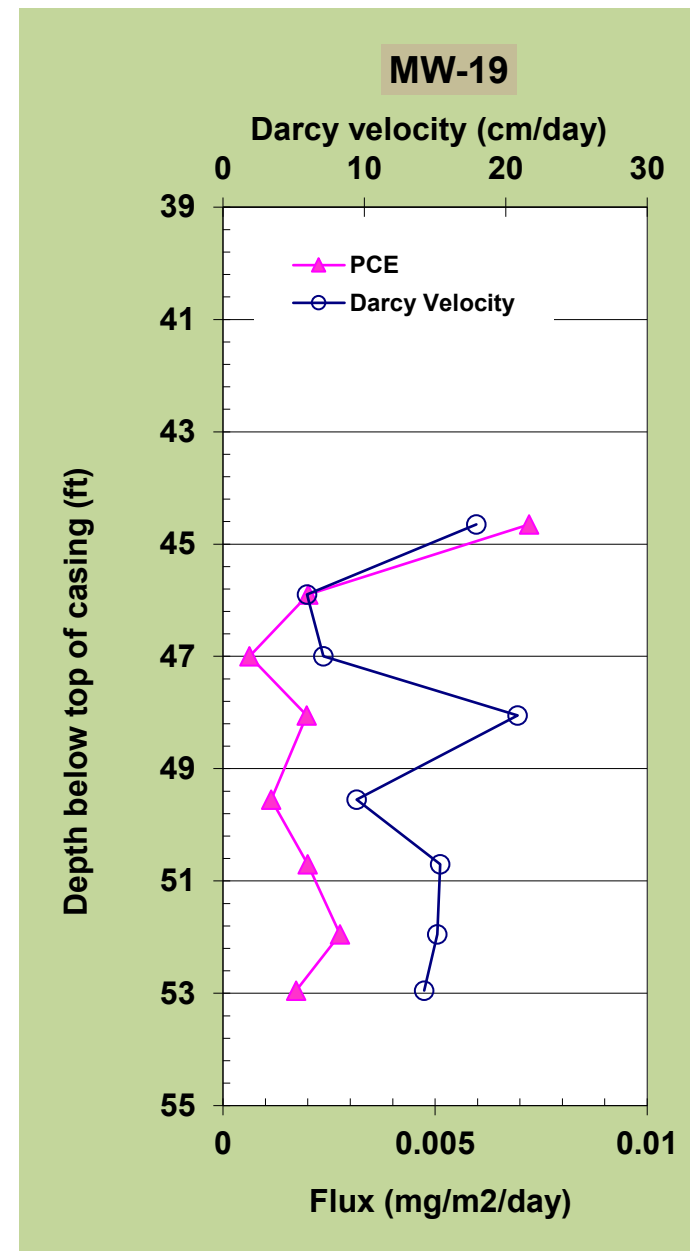
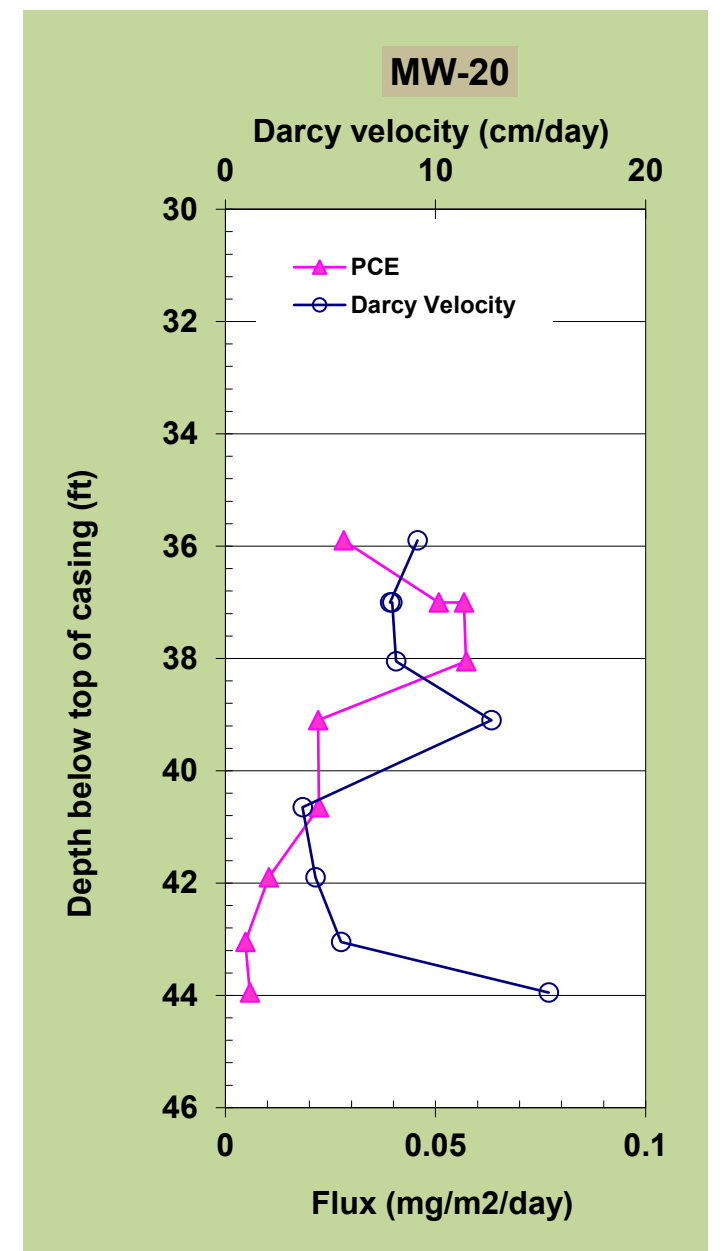


Chart F2. MW-20



**Attachment F
Passive Flux Meter Test Results**

Table F3. Mass discharge per unit width for aquifer of each well

Well	Darcy Velocity (cm/day)	PCE Discharge (mg/m/day)
MW-19	13.2	0.01
MW-20	8.3	0.08

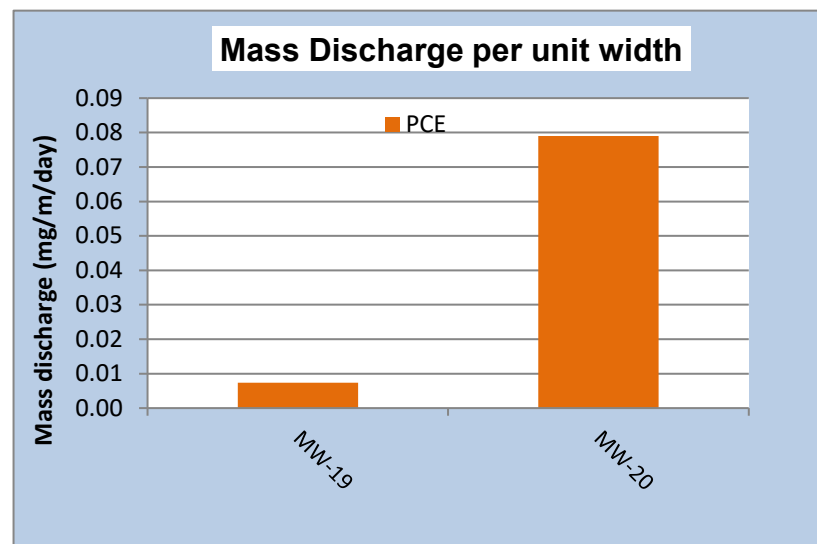


Table F4. Well average values of mass flux based on PFMs

Well	Darcy Velocity (cm/day)	PCE flux (mg/m ² /day)
MW-19	13.2	0.002
MW-20	8.3	0.026

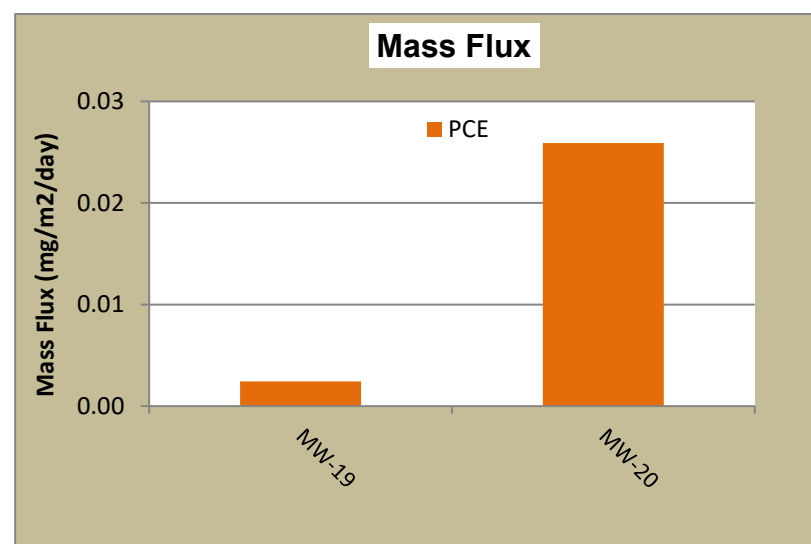
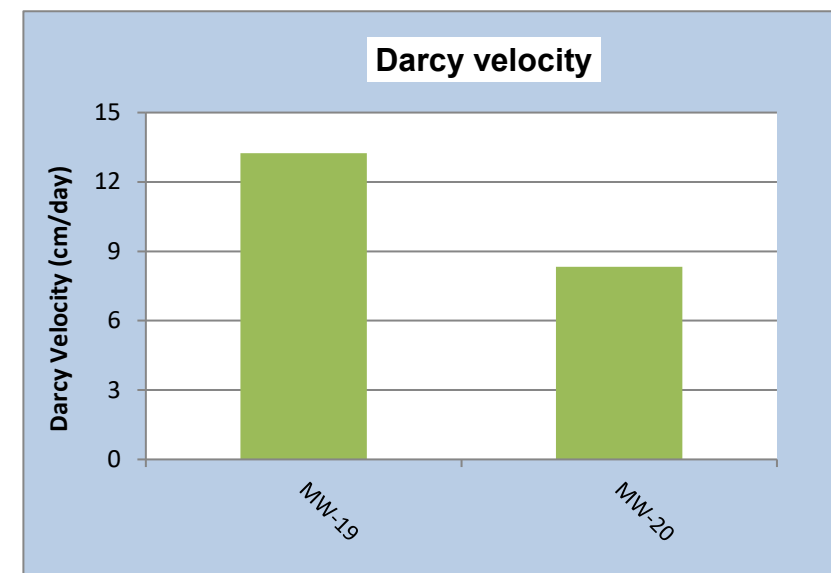
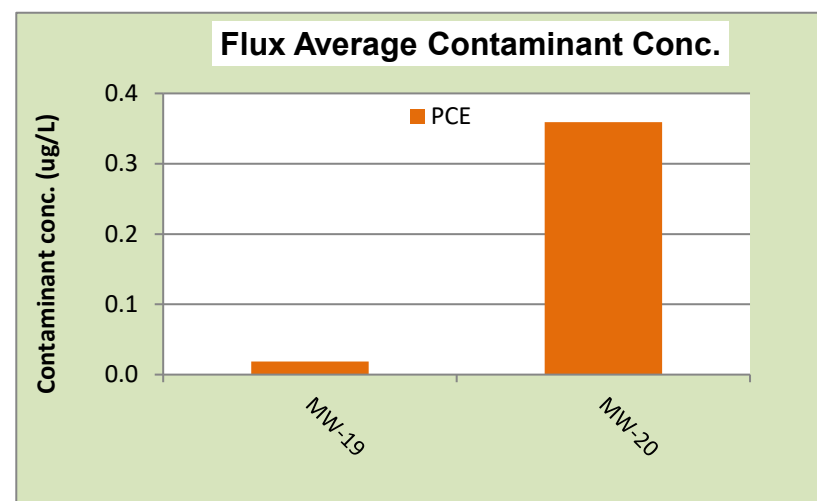


Table F5. Flux average contaminant concentration on PFMs

Well	Darcy Velocity (cm/day)	PCE (ug/L)
MW-19	13.2	0.02
MW-20	8.3	0.36



APPENDIX C

PRB MANUFACTURERS DATA



Client Name	PES
Project Location	Normandy Park, WA v6

Flux Based Calculations																
Barrier	COC	Ci (mg/L)	K (ft/day)	K (m/sec)	i (H/L)	Barrier Length (ft)	Top of Treatment Zone (ft)	Bottom of Treatment Zone (ft)	Barrier Thickness (ft)	Area (ft^2)	Darcy Velocity (ft/yr)	Mass (lb/yr)	Fe Demand (lb/yr)	BOS 100® (lb/yr)	Longevity (Yrs)	Total BOS 100 (lb)
SW 178th St PRB	PCE	0.015	16	5.60E-05	0.015	80	34	44.5	10.5	840	86.9	0.1	0.1	2.1	15	32
	Oxygen	7.2	16	5.60E-05	0.015	80	34	44.5	10.5	840	86.9	32.8	28.6	439.7	15	6,595
Totals												32.8	28.7	441.8		6,627

Injection Design							
Barrier	Spacing (ft)	# Rows	# Points	# Intervals/Pt	# Intervals	BOS 100 Loading (lbs)	Total BOS 100 (lbs)
SW 178th St PRB	5	3	61	7.5	458	14.8	6,800
Totals							

Total BOS 100 - Flux Calcs	6,627	lb
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BOS 100 Total (lb)	6,800
BOS 100 Unit Price (\$, per RPI website)	\$10.75
Estimated Shipping and Tax (\$/lb)	\$0.75
Total Material Price (\$)	\$78,200

BOS 100[®]

REMEDIATION PRODUCTS INC.

Primary Use

In Situ Chlorinated Solvent
Remediation

Treatment Mechanism

Trap & Treat[®] - Activated
Carbon Adsorption + Chemical
Reduction via Impregnated
Reactive Iron

Delivery Methods

RPI-Approved Direct Push
or Packer Injection. Direct
Application via Soil Mixing
or Trenching



BOS 100[®] Product Description

BOS 100[®] is a Trap & Treat[®] in situ remediation technology specifically designed to degrade chlorinated solvents. It is a unique material manufactured from high grade virgin carbons (intended for use in food or drinking water applications). The food grade carbon is impregnated with metallic iron formed under reducing conditions at a temperature of roughly 850 degrees C. At this temperature, as the metallic iron is formed it partially dissolves into the carbon forming a new and unique material with properties of both the carbon and iron but with capabilities exceeding ZVI in terms of rates of destruction and the range of halogenated compounds it can degrade. As manufactured, the product contains roughly 6.5% (wt) metallic iron. Reaction end products include dissolved iron, chloride, and a series of unregulated gases such as ethylene and methane. The product is insensitive to groundwater geochemistry (e.g. pH, oxidation-reduction potential).

BOS 100[®] Product Applications

The product is typically mixed with water to create a slurry that can be applied using a variety of techniques including: Direct push injection, soil mixing techniques, and trenching. It is commonly employed in plume wide treatment including treatment of source, mid, and downgradient plume regions. Plume area treatment is normally accomplished using slurry injection across the impacted thickness at a number of points located using a triangular grid pattern. Effective barriers can be constructed by injection using a tight point grid layout or through trenching or soil mixing. The product has been successfully used to treat excavation residuals by spraying slurry into the pit with subsequent mixing into the shallow soils of the excavation floor. Specialized injection techniques have been developed to address a variety of lithologic settings. BOS 100[®] has been successfully applied on hundreds of sites in North America and Europe since 2004 including dry cleaners, industrial, DOE, and DOD. Case studies describing the use of BOS 100[®] can be found on RPI's website at www.trapandtreat.com.

RPI Group

RPI Group is comprised of Remediation Products, Inc. (RPI) and a group of select remediation contractors that employ a three-pronged approach to ensure success: High density soil and groundwater sampling to support detailed conceptual site model development, expert design, and proven installation techniques to ensure distribution of the BOS 100[®] in the targeted intervals. The RPI Quality Assurance Laboratory located in Golden, CO provides cradle to grave analytical support throughout the project at no charge to the client. AST Environmental (AST) acts as RPI's Distributor & Training Affiliate for the installation contractors. A list of the contractors can be found at RPI's website..



SECTION 1: Identification of the Substance/Mixture and of the Company/Undertaking

1.1. Product identifier

Product name : TRAP & TREAT® BOS 100®
Product form : Mixture
Product code : 11271
Synonyms : Activated carbon; Steam activated carbon

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Adsorbent

1.3. Details of the supplier of the safety data sheet

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA 15230
412-787-6700

1.4. Emergency telephone number

Emergency number : CHEMTREC (24 HRS): 1-800-424-9300

SECTION 2: Hazards Identification

2.1. Classification of the substance or mixture

GHS-US classification

Combustible Dust
Self-heating 1 H251

Not classified as a simple asphyxiant. Product does not displace oxygen in the ambient atmosphere, but slowly adsorbs oxygen from a confined space when wet. Under conditions of anticipated and recommended use, product does not pose an asphyxiation hazard.

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02

Signal word (GHS-US) :

Danger

Hazard statements (GHS-US) :

May form combustible dust concentrations in air
H251 - Self-heating: may catch fire

Precautionary statements (GHS-US) :

P235+P410 - Keep cool. Protect from sunlight
P280 - Wear eye protection, protective gloves
P407 - Maintain air gap between stacks/pallets
P413 - Store at temperatures not exceeding 140°C/284°F
P420 - Store away from other materials

2.3. Other hazards

Other hazards not contributing to the classification

Wet activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on Ingredients

3.1. Substance

Not applicable

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3.2. Mixture

Name	Product identifier	%
Activated carbon	(CAS No) 7440-44-0	≥ 68
Zero valent iron	(CAS No) 7439-89-6	≤ 32

SECTION 4: First Aid Measures

4.1. Description of first aid measures

- First-aid measures general : If exposed or concerned, get medical attention/advice. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use. Never give anything to an unconscious person.
- First-aid measures after inhalation : IF INHALED: Remove to fresh air and keep at rest in a comfortable position for breathing.
- First-aid measures after skin contact : IF ON SKIN (or clothing): Remove affected clothing and wash all exposed skin with water for at least 15 minutes.
- First-aid measures after eye contact : IF IN EYES: Immediately flush with plenty of water for at least 15 minutes. Remove contact lenses if present and easy to do so. Continue rinsing.
- First-aid measures after ingestion : IF SWALLOWED: Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center or medical professional. Get medical attention if you feel unwell.

4.2. Most important symptoms and effects, both acute and delayed

- Symptoms/injuries after inhalation : Not expected to present a significant hazard under anticipated conditions of normal use. Dust may cause irritation respiratory system.
- Symptoms/injuries after skin contact : Dust may cause irritation.
- Symptoms/injuries after eye contact : Dust may cause irritation and redness.
- Symptoms/injuries after ingestion : Not expected to present a significant hazard under anticipated conditions of normal use.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available.

SECTION 5: Firefighting Measures

5.1. Extinguishing media

- Suitable extinguishing media : Water spray. Carbon dioxide. Dry chemical. Foam. Sand.
- Unsuitable extinguishing media : None known.

5.2. Special hazards arising from the substance or mixture

- Fire hazard : Self-heating; may catch fire. Dust may be combustible under specific conditions. May be ignited by heat, sparks or flames.
- Explosion hazard : Dust may form explosive mixture in air.
- Reactivity : Zero valent iron must be kept inert or it may react exothermically.

5.3. Advice for firefighters

- Firefighting instructions : Wear NIOSH-approved self-contained breathing apparatus suitable for the surrounding fire. Use water spray or fog for cooling exposed containers. Evacuate area.

SECTION 6: Accidental Release Measures

6.1. Personal precautions, protective equipment and emergency procedures

- General measures : Evacuate area. Keep upwind. Ventilate area. Spill should be handled by trained clean-up crews properly equipped with respiratory equipment and full chemical protective gear (see Section 8).

6.1.1. For non-emergency personnel

No additional information available.

6.1.2. For emergency responders

No additional information available.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Avoid release to the environment. Product is not soluble, but can cause particulate emission if discharged into waterways. Dike all entrances to sewers and drains to avoid introducing material to waterways. Notify authorities if product enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

- For containment : Sweep or shovel spills into appropriate container for disposal. Minimize generation of dust.
- Methods for cleaning up : Sweep or shovel spills into appropriate container for disposal. Minimize generation of dust. Dispose of material in compliance with local, state, and federal regulations.

6.4. Reference to other sections

No additional information available.

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SECTION 7: Handling and Storage

7.1. Precautions for safe handling

Precautions for safe handling : Avoid dust formation. Avoid contact with skin, eyes and clothing. Do not handle until all safety precautions have been read and understood. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Keep away from sources of ignition - No smoking. Zero valent iron is highly reactive and must be kept inert or it may react exothermically.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep under inert atmosphere. Keep away from ignition sources. Store in a dry, cool and well-ventilated place. Store at temperatures not exceeding 140 °C/284 °F.

SECTION 8: Exposure Controls/Personal Protection

8.1. Control parameters

Activated carbon (7440-44-0)*

OSHA PEL (TWA) (mg/m ³)	≤ 5 (Respirable Fraction) ≤ 15 (Total Dust)
-------------------------------------	--

Zero valent iron (7439-89-6)

Remark (ACGIH)	OELs not established
Remark (OSHA)	OELs not established

*Exposure limits are for inert or nuisance dust. No specific exposure limits have been established for this activated carbon product by OSHA or ACGIH.

8.2. Exposure controls

Appropriate engineering controls : Zero valent iron must be kept inert or it may react exothermically. Provide adequate general and local exhaust ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof equipment with flammable materials. Ensure adequate ventilation, especially in confined areas. Wet activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

Personal protective equipment : Gloves. Safety glasses. Protective clothing. Under insufficient ventilation wear respiratory protection.



Hand protection : Gloves should be classified under Standard EN 374 or ASTM F1296. Suggested glove materials are: Neoprene, Nitrile/butadiene rubber, Polyethylene, Ethyl vinyl alcohol laminate, PVC or vinyl. Suitable gloves for this specific application can be recommended by the glove supplier.

Eye protection : Use eye protection suitable to the environment. Avoid direct contact with eyes.

Skin and body protection : Wear long sleeves, and chemically impervious PPE/coveralls to minimize bodily exposure.

Respiratory protection : Use NIOSH-approved dust/particulate respirator. Where vapor, mist, or dust exceed PELs or other applicable OELs, use NIOSH-approved respiratory protective equipment.

SECTION 9: Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical state	: Solid
Appearance	: Granular, powder, or pelletized substance
Color	: Black
Odor	: Odorless
Odor threshold	: No data available
pH	: No data available
Relative evaporation rate (butylacetate=1)	: Not applicable
Melting point	: Not applicable
Freezing point	: Not applicable
Boiling point	: Not applicable
Flash point	: No data available
Auto-ignition temperature	: <140°C
Decomposition temperature	: No data available

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Flammability (solid, gas)	: <140 °C
Vapor pressure	: Not applicable
Relative vapor density at 20 °C	: Not applicable
Apparent density	: 0.4 - 0.7 g/cc
Solubility	: Insoluble
Log Pow	: Not applicable
Log Kow	: Not applicable
Viscosity, kinematic	: Not applicable
Viscosity, dynamic	: Not applicable
Explosive properties	: No data available
Oxidising properties	: No data available
Explosive limits	: No data available

9.2. Other information

No additional information available.

SECTION 10: Stability and Reactivity

10.1. Reactivity

Self-heating; may catch fire. Zero valent iron must be kept inert or it may react exothermically.

10.2. Chemical stability

Stable under use and storage conditions as recommended in section 7.

10.3. Possibility of hazardous reactions

No additional information available.

10.4. Conditions to avoid

Do not allow contact with air. Avoid dust formation. Heat. Ignition sources. Exposure to high concentrations of organic compounds may cause bed temperature to rise.

10.5. Incompatible materials

Air. Alkali metals. Strong oxidizing agents.

10.6. Hazardous decomposition products

Carbon monoxide (CO), carbon dioxide (CO₂).

SECTION 11: Toxicological Information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Activated carbon (7440-44-0)

LD50 oral rat	> 2000 mg/kg
---------------	--------------

Zero valent iron (7439-89-6)

LD50 oral rat	984 mg/kg
---------------	-----------

Skin corrosion/irritation : Not classified

Serious eye damage/irritation : Not classified

Respiratory or skin sensitisation : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Silica: crystalline, quartz (14808-60-7)

IARC group	1 - Carcinogenic to humans
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The International Agency for Research on Cancer (IARC) has classified "silica dust, crystalline, in the form of quartz or cristobalite" as carcinogenic to humans (group 1). However these warnings refer to crystalline silica dusts and do not apply to solid activated carbon containing crystalline silica as a naturally occurring, bound impurity. As such, we have not classified this product as a carcinogen in accordance with the US OSHA Hazard Communication Standard (29 CFR §1910.1200) but recommend that users avoid inhalation of product in a dust form.

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

Symptoms/injuries after inhalation : Not expected to present a significant hazard under anticipated conditions of normal use. Dust may cause irritation respiratory system.

Symptoms/injuries after skin contact : Dust may cause irritation.

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Symptoms/injuries after eye contact : Dust may cause irritation and redness.
Symptoms/injuries after ingestion : Not expected to present a significant hazard under anticipated conditions of normal use.

SECTION 12: Ecological Information

12.1. Toxicity

No additional information available.

12.2. Persistence and degradability

No additional information available.

12.3. Bioaccumulative potential

No additional information available.

12.4. Mobility in soil

No additional information available.

12.5. Other adverse effects

No additional information available.

SECTION 13: Disposal Considerations

13.1. Waste treatment methods

Waste treatment and disposal methods : Vacuum or shovel material into a closed container. Dispose in a safe manner in accordance with local/national regulations. Do not allow the product to be released into the environment.
Additional information : Activated carbon is an adsorbent media; hazard classification is generally determined by the adsorbate. Consult U.S. EPA guidelines listed in 40 CFR 261.3 for more information on hazardous waste disposal.

SECTION 14: Transport Information

14.1. In accordance with DOT

Transport document description : UN3190 Self-heating solid, inorganic, n.o.s., 4.2, II
UN-No.(DOT) : 3190
DOT NA no. : UN3190
Proper Shipping Name (DOT) : Self-heating solid, inorganic, n.o.s. (Contains: Zero Valent Iron)
Department of Transportation (DOT) Hazard Classes : 4.2 - Class 4.2 - Spontaneously combustible material 49 CFR 173.124
Hazard labels (DOT) : 4.2 - Spontaneously combustible



Packing group (DOT) : II -

14.2. Transport by sea

IMO / IMDG
UN/NA Identification Number : UN3190
UN- Proper Shipping Name : Self-heating solid, inorganic, n.o.s. (Contains: Zero Valent Iron)
Transport Hazard Class : Class 4.2
Packing Group : II

14.3. Air transport

ICAO / IATA
UN/NA No : UN3190
UN- Proper Shipping Name : Self-heating solid, inorganic, n.o.s. (Contains: Zero Valent Iron).
Transport Hazard Class : Class 4.2
Packing Group : II

14.4 Other Information

Not recommended for air transport due to material self-heating when exposed to air.

TRAP & TREAT® BOS 100®

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Safety Data Sheet

SECTION 15: Regulatory Information

15.1. US Federal regulations

TRAP & TREAT® BOS 100®	
All chemical substances in this product are listed as "Active" in the EPA (Environmental Protection Agency) "TSCA Inventory Notification (Active-Inactive) Requirements Rule" ("the Final Rule"), as of February 2019 or are otherwise exempt.	
SARA Section 311/312 Hazard Classes	Fire hazard
Cobalt (7440-48-4)*	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on United States SARA Section 313	
SARA Section 313 - Emission Reporting	0.1 %


*Present below de minimis levels

15.2. International regulations

No additional information available.

15.3. US State regulations

California Proposition 65

 **WARNING:** This product can expose you to Silica: Crystalline, quartz, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Component	Carcinogenicity	Developmental toxicity	Reproductive toxicity male	Reproductive toxicity female	No significant risk level (NSRL)	Maximum allowable dose level (MADL)
Silica: crystalline, quartz(14808-60-7)	X				Not available	
Cobalt(7440-48-4)	X				Not available	
Titanium dioxide(13463-67-7)	X				Not available	

Component	State or local regulations
Aluminum oxide (1344-28-1)	U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Calcium sulfate (7778-18-9)	U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Silica: Crystalline, quartz (14808-60-7)	U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Titanium dioxide (13463-67-7)	U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Cobalt (7440-48-4)	U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Massachusetts - Right To Know List

SECTION 16: Other Information

Indication of changes : Revision 4.0
Revision Date : 07/24/2020
Other information : Author: ADK/RAK
For internal use only : PR #43

Prepared according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

NFPA health hazard : 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

TRAP & TREAT® BOS 100®

Product Code: 11271

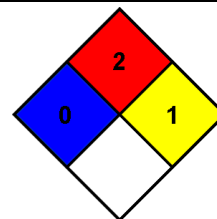
Safety Data Sheet

NFPA fire hazard

: 2 - Must be moderately heated or exposed to relatively high temperature before ignition can occur.

NFPA reactivity

: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.



HMIS III Rating

Health : 0

Flammability : 2

Physical : 1

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