Soil Vapor Extraction Work Plan
Claremont Village Shopping Center
Everett, Washington

Prepared for:
Phillips Edison and Company

December 4, 2017
PECO_2016-22

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1.0 Introduction

This document (the Plan) presents the proposed scope of work for construction, operation, and maintenance of a soil vapor extraction system (SVE) at the Claremont Village Shopping Center located at 4805 to 4933 Evergreen Way in Everett, Washington (the Site; Figure 1). The proposed system will be constructed to address elevated concentrations of tetrachloroethene (PCE) and breakdown products in subsurface soils at the Site, and protect the building spaces from vapor intrusion. The proposed remedy includes two phases of remediation: 1) at the Bella Cleaners dry cleaning facility (Tenant Space 925); and 2) the location of a historical cleaner at Tenant Space 821 (current Wild Birds Unlimited). Each location is shown on Figure 2.

This work plan does not address contamination identified at the former fueling station (now Les Schwab) located at the north end of the Site. This site will be addressed separately.

This plan has been prepared by Apex Companies, LLC (Apex) on behalf of the current Site owner, Phillips Edison and Company (Phillips Edison).

1.1 Purpose

The purpose of the work described in this Plan is to reduce the concentrations of contamination-related volatile organic compounds (VOCs) in sub-slab vapor and reduce the mass of the suspect source contaminant in soil. The scope of work includes the installation of a mobile SVE system, and continued operation and maintenance of the SVE system until remedial action objectives (RAOs) are met or another scenario where system shutdown is justified. These activities are discussed in further detail within this Work Plan.

1.2 Work Plan Organization

This Work Plan is divided into the following main sections:

- Site Background – A description of the Facility; including geology, hydrogeology, a summary of past environmental work, and current environmental conditions at the Facility;
- SVE Pilot Test Results – Results of the SVE Pilot Test, which provide the basis for the proposed system design;
- SVE System Design, Installation, and Maintenance – The approach and scope of the proposed field work, procedures for completing the well and system installations, design analysis of the proposed system, the analytical program, and monitoring plan;
- Reporting – A description of the reporting to be completed to document the installation of the SVE remedial system; and
- Schedule – A schedule for system installation, startup, and reporting.

2.0 Site Background

2.1 Site Location and Description

According to the USGS 7.5–minute topographic map of the area (Everett WA 2014), the Site is located at an average elevation of 320 feet above mean sea level (MSL). The elevation of the Site ranges from approximately 340 feet above MSL in the southeast corner to approximately 300 feet above MSL in the northwestern corner. The Site topography was observed to slope gently to moderately across the developed area from the southeastern boundary to the northwestern property line with a steep slope upward at the southeastern corner of the property. Topographic relief at the Site and nearby properties is shown to the north and northwest. Surface water flow across the Site is directed towards catch basins connected to the municipal storm water management system.

2.2 Site Geology/Hydrogeology

2.2.1 Site Geology

The Site is situated in the Puget Lowland physiographic province of Washington State (Geologic Map of Washington, 2002). The Puget Lowland is a broad, low-lying trough located between the Cascade Range to the east and the Olympic Mountains to the northwest and the Willapa Hills to the southwest. The landscape largely results from repeated cycles of glacial scour and deposition. The Site is located within an area that has been geologically mapped as Vashon glacial till deposits, characterized as a non-sorted composite consisting of silts, sands, gravels, and boulders which were deposited below the advancing glacier. While till can contain lenses of stratified materials, the locally cemented lodgment drains poorly where weathering is limited by burial. Soils encountered in the explorations were unconsolidated silt, sand, and gravel based soils that are typical of weathered glacial till deposits.

2.2.2 Site Hydrogeology

Based on experience at other sites in the area, groundwater is estimated to be present at depths between 50 and 60 feet in the shallow aquifer at the Site and the shallow groundwater flow direction is expected to be to the north or the northeast.

2.3 Previous Work

In August 2014, a Phase I Environmental Site Assessment (ESA; Apex, 2014) conducted at the Site identified the following Recognized Environmental Conditions (RECs):

1. Current and former drycleaners. The Phase I ESA identified two dry cleaning facilities: one current dry cleaners (Bella Cleaners) and one former dry cleaners (currently occupied by Wild Birds Unlimited).

2. **Use of PCE.** Bella Cleaners continues to use tetrachloroethylene (PCE) in a closed loop dry cleaning system at the Site. PCE is a known hazardous substance that can migrate significant distances in soil and/or groundwater if released to the subsurface. The continued use of the hazardous solvent is considered an REC.

3. **Former fueling station.** The Phase I ESA identified a former gasoline fueling station located at the current location of the Les Schwab facility that had operated from approximately 1953 through the early 1970s. Four associated former underground storage tanks (USTs) of unknown size had been removed from the Site. Additionally, a closure report for a former 300-gallon waste oil UST at the former station identified the presence of residual contamination in soil above applicable Ecology Model Toxics Control Act (MTCA) cleanup levels (Ecology, 2007). Concentrations detected above the cleanup levels included oil (6,500 to 7,700 milligrams per kilogram [mg/kg]), lead (318 mg/kg) and PCE (0.08 mg/kg). This site will be managed separately from the effort described in this work plan.

Based on the Phase I ESA, Apex conducted Phase II site investigation activities in September 2014 (Apex, 2014b). Investigation activities targeted the three tenant spaces of concern and included advancing five explorations (B-1 through B-5) to depths ranging from 55 to 65 feet below ground surface (bgs) for purposes of soil and groundwater sampling, collecting three subsurface soil vapor samples (from depths of approximately 5 feet bgs), and collecting four sub-slab vapor samples. Due to difficult drilling conditions and the presence of multiple underground utilities, a groundwater sample was not obtained east of Bella Cleaners during this phase of the work. Analytical results did not show soil or groundwater concentrations of total petroleum hydrocarbons (TPH) above MTCA Method A screening levels for unrestricted land use. However, several VOCs, including PCE and trichloroethylene (TCE) were detected above MTCA Method A screening levels in subsurface soil vapor and sub-slab vapor. The elevated concentrations were detected in sub-slab vapor collected beneath the current and former dry cleaning facilities, and in sub-slab vapor near the Les Schwab facility.

In September 2015, Apex conducted a Tier II Indoor Air Assessment (Apex, 2015) within several tenant spaces at the Site. While concentrations of PCE and TCE were detected in air samples collected within every tenant space that was sampled, concentrations were below the relevant MTCA screening levels and an immediate risk to human health was not identified. While ambient indoor air samples were not collected within Bella Cleaners due to current use of PCE in business operations, sub-slab vapor samples contained concentrations above MTCA screening levels for vapor intrusion. While indoor air concentrations sitewide appear acceptable, the sub-slab concentrations suggested that a PCE release had occurred and potential for future vapor intrusion is present. Historical boring and sample locations are shown on Figure 2.

3.0 SVE Pilot Test

On May 24, 2016, Apex conducted an SVE pilot test to assist in the future SVE system design (Apex, 2016). The test consisted of operating a temporary blower under a variety of flow conditions while collecting extraction flow rate and vacuum pressure data at both the extraction and observation well. The flow and pressure data collected from SVE-1 and OBS-1 were used in an analytical model (Air2D) developed by the U.S. Geological Survey (USGS) to determine the intrinsic air permeability of the geologic formation in the vicinity of well SVE-1. The model utilizes the extraction flow rate, the system vacuum pressure at the wellhead, the induced vacuum measurements from an observation well (OBS-1), as well as other physical parameters such as screen depth and distance between the two wells. Using this derived permeability, the Air2D model was also used to assess the site-specific relationship between air flow (and the resultant vacuum pressure) and the associated radius of influence (ROI). In accordance with the U.S. Army Corps of Engineers (USACE) design guidance (USACE, 2002), the ROI is defined as the distance at which the soil vapor velocity in the pore space is at least 0.001 centimeters per second (cm/sec).

The pilot test and Air2D modeling suggest an effective ROI of at least 42-feet is feasible at the Site. While the pilot test utilized only one extraction and one observation well, lithology across the Site is generally consistent (Apex, 2015). A dedicated system blower would be able to generate a higher vacuum pressure and thereby induce a larger ROI (as defined in the system design discussed below). The details of the SVE pilot test are discussed in the *Soil Vapor Extraction Pilot Test Results* letter dated July 20, 2016 (Apex, 2016).

4.0 Design Analysis – Soil Vapor Extraction

The layout and size of SVE system components is dependent on the surface cover, soil type, depth to groundwater (the thickness of the vadose zone), and horizontal and vertical extent of the target VOCs. This section presents the design of the SVE system. In general, the design is based on the recommendations provided in the USACE *Soil Vapor Extraction Engineer Manual* (USACE, 2002). The proposed layout of the system is shown on Figures 3 and 4, a schematic of the proposed SVE system components is shown on Figure 5 , and construction details and specifications are shown on Figures 6 and 7.

After the SVE system is installed and activated, an SVE Installation Report will be prepared. The report will provide a description of the field activities, SVE system installation details, system operating parameters, monitoring program, and analytical results.

4.1 System Layout and Specifications

Chemical Profile. The target contaminants include PCE, TCE, cis-1,2-DCE, and vinyl chloride. Each of these chemicals are classified as VOCs and are suitable for removal via vapor extraction.

Soil Profile. The ground surface in the treatment area is completely covered by either the site building, asphalt concrete, or Portland Cement concrete. The underlying soil profile consists of coarse sand with silt. The intrinsic air permeability of the sand layers was determined to be about 1.88 x 10^{-7} cm^2 based on the results of the pilot testing described in Section 3.

Design Basis. Design guidance for SVE systems (USACE, 2002) recommends that pore-space air velocities be greater than 0.001 cm/sec within the target treatment zone. The pore-space air velocity is dependent upon the air permeability, the air flow rate extracted from each well, and the distance from the extraction well. The Radius of Influence (ROI) for a fixed intrinsic air permeability will increase with larger extraction rates, and the Air2D model described above is used to define the relationship between flow rate and ROI for the site conditions. An iterative evaluation of the pressure gradients and resultant flow velocities driven by various air extraction rates was completed using a spreadsheet-based solution to the equations provided in the design guidance (shown on Table 1). This evaluation was used to identify the total air extraction rate that could be economically handled with readily available equipment while minimizing the number of extraction points that would be needed to cover the target area. Based on an air permeability of 1.88 x 10^{-7} cm^2, a minimum air velocity within the treatment area of 0.001 cm/sec can be achieved at a radius of 96 feet with the following design parameters:

- Air flow rate of about 79 cfm per extraction well;
- Vacuum pressure of about 13 inches of water; and
- Well screen length of 20 feet.

The ROI induced by these conditions is estimated to be 87 feet and will cover the target treatment area, as shown on Figures 3 and 4. Additional wells may be added to the SVE system if needed based on observations made during initial operation.

Blower Selection. The Rotron EN404 is capable of providing the flow and vacuum pressure conditions noted above. The Rotron EN404 is a sealed, explosion-proof blower with a 1-horsepower (hp) motor that operates on either single-phase 120V-30A or three-phase 230V-20A power. Ancillary equipment associated with the blower will include a moisture separator (knockout drum) and intrinsic controls (such as power controls, flow meter, and knockout drum high level alarm).

Equipment Shed. The SVE blower will be housed in an insulated skid-mounted pre-engineered shed (approximately 4 feet x 6 feet) with an intrinsically explosion-proof space heater (set to maintain the shed temperature above freezing temperatures) and explosion-proof lighting. The system control panel will be housed in a weatherproof enclosure on the exterior of the shed and will be equipped with a lock to prevent unauthorized access. System piping will connect to the equipment shed with a detachable fitting (i.e., collared screw fitting or cam-lock type). The system discharge will be passed through a pair of VentSorb PE carbon drums in series – located adjacent to the equipment shed. While operating, the system should generate a noise level of no more than 60 dba at a distance of 10 feet. If noise levels exceed this threshold, additional insulation or other sound attenuation measures will be installed.

Piping Selection and Layout. Piping has been sized for ease of installation and so that the pressure drop (friction losses) through the pipe is less than 0.01 inch of water per foot of pipe. As shown on Figure 5 and Table 1, the selected piping is 6-inch diameter Schedule 80 PVC. The concentrations of vapors in the operating airflow are not expected to adversely affect the PVC material during the operating life of the system. The piping layout is conceptually shown on Figures 3 and 4; actual locations of the piping may be modified to avoid utility conflicts and other obstructions.

Each piping run will be sloped toward a well to prevent the accumulation of moisture (such as from condensation) in the piping. The piping shall be buried no shallower than 12 inches bgs (the expected frost depth for the region). Piping will be bedded such that no voids or protrusions might potentially damage the piping. Trenches in paved areas will be backfilled with compacted crushed rock (3/4-inch-minus) and trenches in unpaved areas will be backfilled with soil excavated from the trench. Trench backfill will be compacted to a visibly non-yielding state and surfaced to match the surrounding area. Surface repairs will be consistent with the surrounding pavement profile (asphalt or PCC concrete).

Vapor Discharge Layout. The proposed location of the discharge stack is shown on Figures 3 and 4 and will be attached to the adjacent site building – terminating 4 feet above the building roofline.

4.2 System Operation

System Startup. Initial startup of the system will include powering up the SVE blower and verifying proper operation of the equipment (including measurement of the induced vacuum at SVE wellhead, observation well, and at each system influent). Vacuum measurements are monitored to verify system performance (e.g., changes in vacuum pressure may indicate problems in system operation) and to verify that the blower is not overloaded (excessive input vacuums may overstress the blower). Vacuum pressures at each of the SVE wellheads will be balanced by adjusting flow control valves at each wellhead. The vacuum pressure is monitored with a Magnahelic pressure gauge and will be measured while the system is in operation.

Vacuum pressure data will be evaluated to confirm the ROI of the vapor extraction wells. Adjustments to the system will be made as appropriate (such as adjusting the air flow rate) to provide operation consistent with the design goals.

Startup Monitoring. After system construction, the system will be operated for an initial period of approximately 12 hours (or until equilibrium conditions are verified using photoionization detector [PID] measurements) to verify that the system components are operating correctly and the flow and vacuum conditions across the system are within design parameters. Following the initial startup of the system, VOCs will be measured prior to the vapor carbon drums using a PID. Samples of the treated system effluent will also be collected and analyzed for VOCs. One vapor sample will be collected at the initiation of operation and a second laboratory sample will be collected after one month of operation. The data from the startup monitoring will be used to assess the operation of the system and the mass loading rate.

Routine System Monitoring. Routine monitoring of the SVE system will be performed on Site and through remote monitoring of the control system. The control system will provide notification for alarm conditions (including pressures outside of setpoints, high knockout drum levels, and power interruptions). An alarm condition light will be visible from outside of enclosure. On-site monitoring activities will be performed on a periodic basis (initially on a monthly schedule, reducing to a quarterly schedule if warranted). The routine monthly monitoring will consist of PID and pressure monitoring at each of the monitoring points. System effluent samples will be collected on a periodic basis (initially on a quarterly schedule, reducing to an annual schedule if warranted) to corroborate the PID data.

Shutdown Criteria. System shutdown will be evaluated based on the results of the system monitoring (described above). System shutdown will be considered when SVE influent concentrations (representative of mass removal) reach an asymptotic and negligible state. When mass removal remains constant and negligible for a period of three months, the system will be turned off and sub-slab soil vapor sampling will be completed at each RAA (Bella's Cleaners and former cleaner located at the Current Wild Birds retail store). Sampling will be completed at 2 weeks and 6 weeks after initial shutdown to evaluate contaminant rebound.

5.0 Analytical Program

If unexpected site conditions are encountered, chemical analyses may be performed to assess the extent and magnitude of petroleum hydrocarbons in the subsurface and to provide data suitable for the assessment of Facility risks. Samples will be analyzed on a standard turnaround time (5 to 10 business days, depending on the analyte). The sampling and analysis plan (SAP) in Appendix B discusses the analytical program in detail.

Vapor Samples. System effluent and sub-slab soil vapor samples will be analyzed for VOCs by EPA Method TO-15. Effluent samples data will be used to assess the effectiveness of system and to calculate the mass discharge rate. Sub-slab soil vapor samples will be used to verify remediation has achieved Washington Department of Ecology Method B vapor intrusion screening levels.

5.1 Quality Assurance and Quality Control

Quality assurance/quality control (QA/QC) procedures will be used throughout this project. As presented in the SAP, this plan includes sampling and custody procedures, QA sampling analyses (such as analysis of duplicates), detection limit goals, laboratory QC, and QA reporting.

6.0 SVE Installation Report

After the SVE system is installed and activated, an SVE Installation Report will be prepared. The report will provide a description of the field activities, SVE system installation details, system operating parameters, monitoring program, and analytical results.

The report will be prepared in general accordance with the following outline:

1) Introduction;
2) Background (Site History, Setting, and Operations);
3) Geology and Hydrogeology;
4) Summary of Previous Investigations;
5) Methods and Procedures;
6) Startup and System Operation;
7) Monitoring and Performance;
8) Future Activities; and
9) References.

Information provided in appendices will include:

- Photographs of Facility activities, as applicable;
- Field methods and sampling procedures;
- Boring logs and well construction information; and
- Analytical data, including a QA review.

7.0 Schedule

It is anticipated that the SVE system construction and startup will require approximately one month to complete. Barring delays beyond the control of Apex, this work plan can be implemented within 120 days of approval. An SVE System Installation Report will be submitted within 60 days of completion of the scope of work.

<u>8.0 References</u>

Apex, 2014a. *Phase I Environmental Site Assessment, Claremont Village Shopping Center*. August 22, 2014.

Apex, 2014b. *Phase II Environmental Site Assessment, Claremont Village Shopping Center*. November 3, 2014.

Apex, 2015. *Tier II Indoor Vapor Intrusion Assessment Work Plan, Claremont Village Shopping Center*. September 1, 2015.

Apex, 2016. *Soil Vapor Extraction Pilot Test Results* letter. July 20, 2016.

U.S. Army Corps of Engineers (USACE), 2002. *Soil Vapor Extraction and Bioventing Engineering Manual (EM 1110-1-4001)*. June 2002.

Minard, J. P. (1985). *Geologic Map of the Everett 7.5 - Minute Quadrangle, Snohomish County, Washington [PDF].* Reston: United States Geological Survey.

Table 1
Blower Selection, Piping Sizing, and Radius of Influence Calculation
Everett, Washington

Soil Vapor Extraction

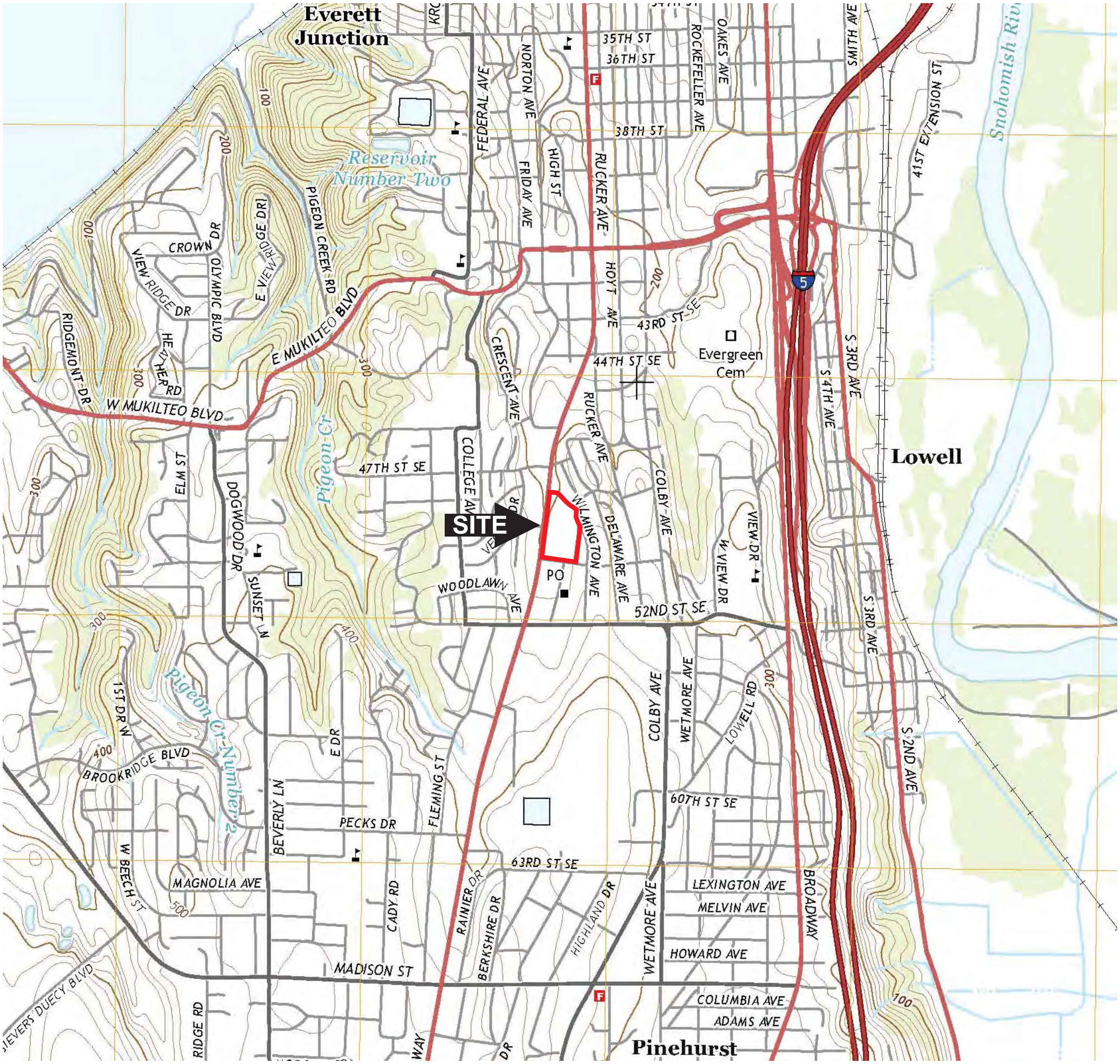
Air Flow Per Well [CFM]	Mass Flow Per Well [g/sec]	Modeled Well Vacuum [atm]	Modeled Well Vacuum ["H20]	Head Losses ["H2O], Including Fittings: Well 1.5"	Well 2"	Well 4"	Header Line 2"	Header Line 4"	Header Line 6"	Head Loss ["H2O]	Vaccum Needed at Blower ["H2O]	Design System Flow Rate [CFM]
8.82	5	0.006	2.4	0.58	0.14	0.00	0.39	0.01	0.00	0.53	2.9	8.8
13.25	7.5	0.010	4.1	1.26	0.30	0.01	0.84	0.03	0.00	1.14	5.2	13.3
17.64	10	0.014	5.7	2.16	0.51	0.02	1.45	0.05	0.01	0.56	6.3	17.6
22.16	12.5	0.017	6.9	3.34	0.79	0.02	2.24	0.08	0.01	0.87	7.8	22.2
23.45	13.25	0.018	7.3	3.72	0.88	0.03	2.50	0.09	0.01	0.97	8.3	23.5
26.46	15	0.020	8.1	4.68	1.10	0.03	3.14	0.12	0.02	1.22	9.3	26.5
35.28	20	0.026	10.6	8.08	1.91	0.06	5.42	0.20	0.03	2.11	12.7	35.3
40.15	22.5	0.030	12.2	10.33	2.44	0.08	6.93	0.26	0.04	2.69	14.9	40.2
44.09	25	0.034	13.8	12.34	2.91	0.09	8.28	0.30	0.05	3.22	17.0	44.1
49.24	27.5	0.036	14.7	15.22	3.59	0.11	10.22	0.38	0.06	3.97	18.7	49.2
52.91	30	0.040	16.3	17.44	4.12	0.13	11.71	0.43	0.07	4.55	20.8	52.9
58.40	32.5	0.044	17.9	21.04	4.96	0.15	14.13	0.52	0.08	5.48	23.4	58.4
60.07	33.75	0.046	18.7	22.20	5.24	0.16	14.91	0.55	0.08	5.79	24.5	60.1
61.73	35	0.048	19.5	23.38	5.52	0.17	15.70	0.58	0.09	6.09	25.6	61.7
70.55	40	0.054	22.0	30.13	7.11	0.22	20.24	0.75	0.11	7.85	29.9	70.6
74.96	42.5	0.057	23.2	33.81	7.98	0.25	22.71	0.84	0.13	8.81	32.0	75.0
79.37	45	0.060	24.4	37.69	8.89	0.27	25.31	0.93	0.14	9.83	34.2	79.4
88.19	50	0.068	27.7	46.05	10.86	0.33	30.92	1.14	0.17	12.00	39.7	88.2

Air Flow Per Well [CFM]	Blower: EN-101 Blower Vacuum ["H2O]	EN303 Blower Vacuum ["H2O]	EN404 Blower Vacuum ["H2O]	EN454 Blower Vacuum ["H2O]	EN513 Blower Vacuum ["H2O]	EN633 Blower Vacuum ["H2O]	EN833 Blower Vacuum ["H2O]	EN656 Blower Vacuum ["H2O]	EN6 Blower Vacuum ["H2O]	EN707 Blower Vacuum ["H2O]	EN757 Blower Vacuum ["H2O]	EN808 Blower Vacuum ["H2O]	EN858 Blower Vacuum ["H2O]	EN909 Blower Vacuum ["H2O]	EN979 Blower Vacuum ["H2O]	EN14 Blower Vacuum ["H2O]	Modeled Radius of Influence [ft]
8.82	23.3 (High)	35.9 (High)	51.7 (High)	59.6 (High)	71.0 (High)	160.0 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	16.5
13.25	20.1 (High)	34.4 (High)	51.5 (High)	59.1 (High)	68.3 (High)	160.0 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	22.4
17.64	15.7 (High)	32.7 (High)	51.2 (High)	58.5 (High)	65.3 (High)	160.0 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	27.9
22.16	9.9 (High)	30.7 (High)	50.7 (High)	57.8 (High)	61.8 (High)	154.4 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	33.1
23.45	8.2 (OK)	30.1 (High)	50.5 (High)	57.5 (High)	60.8 (High)	151.4 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	34.7
26.46	3.9 (Low)	28.6 (High)	50.1 (High)	56.9 (High)	58.2 (High)	145.4 (High)	155.0 (High)	71.0 (High)	91.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	38.3
35.28		23.5 (High)	48.0 (High)	54.8 (High)	50.0 (High)	131.5 (High)	155.0 (High)	71.0 (High)	89.8 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	48.4
40.15		20.1 (High)	46.4 (High)	53.4 (High)	45.0 (High)	124.5 (High)	155.0 (High)	71.0 (High)	88.4 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	53.3
44.09		17.2 (OK)	45.0 (High)	52.1 (High)	40.7 (High)	118.9 (High)	155.0 (High)	71.0 (High)	87.3 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	58.3
49.24		12.9 (Low)	42.7 (High)	50.4 (High)	35.0 (High)	111.4 (High)	155.0 (High)	71.0 (High)	85.8 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	63.2
52.91		9.5 (Low)	40.9 (High)	49.0 (High)	30.6 (High)	105.7 (High)	155.0 (High)	71.0 (High)	84.7 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	68.1
58.40		4.0 (Low)	37.7 (High)	46.8 (High)	24.0 (OK)	97.1 (High)	155.0 (High)	71.0 (High)	83.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	72.9
60.07		2.2 (Low)	36.7 (High)	46.0 (High)	21.9 (Low)	94.4 (High)	155.0 (High)	71.0 (High)	82.5 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	75.3
61.73		0.5 (Low)	35.7 (High)	45.3 (High)	19.9 (Low)	91.8 (High)	155.0 (High)	70.6 (High)	81.9 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	77.7
70.55			29.5 (OK)	41.1 (High)	8.6 (Low)	77.2 (High)	155.0 (High)	67.7 (High)	79.0 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	87.1
74.96			26.1 (Low)	38.8 (High)	3.0 (Low)	69.9 (High)	154.6 (High)	66.2 (High)	77.4 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	91.6
79.37			22.6 (Low)	36.4 (High)		62.6 (High)	149.6 (High)	64.7 (High)	75.8 (High)	87.0 (High)	77.0 (High)	95.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	96.1
88.19			15.3 (Low)	31.2 (Low)		48.2 (High)	138.0 (High)	61.6 (High)	72.6 (High)	85.6 (High)	77.0 (High)	92.0 (High)	98.0 (High)	112.0 (High)	89.0 (High)	106.0 (High)	104.6

Notes:
1. Mass flow calculation as derived from Air2D model.
2. Modeled pressure/radius for screened vapor well from depths of 4 to 8 feet bgs.
3. Modeled pressure from Air2D pressure output sheet for each flow rate, included in attachment
4. Head loss calculations for pipe lengths derived from layout drawing. Head loss calculated from equation for friction loss in circular duct:
   $dP = (0.109136\ Q^{1.9})/(d^{5.02})$ [inches/100 feet]
5. Blower vacuum is the sum of the calculated head loss and the modeled vacuum at the well.
6. Resultant blower flow rates read from blower curves for identified blower model
7. Radius of influence from Air2D flow output sheet for each flow rate, determined as pore space velocity of 0.001 cm/sec
8. Piping selection based on balancing differential head loss and piping size over the length of each line.
9. Highlighted head losses exceed 20 percent of blower vaccum.
10. Dashed line brackets selected operating condition.

Figure 1
Site Location Map

Claremont Village Shopping Center
4805-4933 Evergreen Way
Everett, Washington



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Everett, Washington

United States Department of the Interior
Geological Survey
7.5-Minute Series Topographic Map
Contour Interval: 20 feet
Scale: 1 inch = 24,000 feet
Date: 2014

Project: Feasibility Study

Client: Phillips Edison

Apex Job #:
PECO_2016-22

Date: November 2017

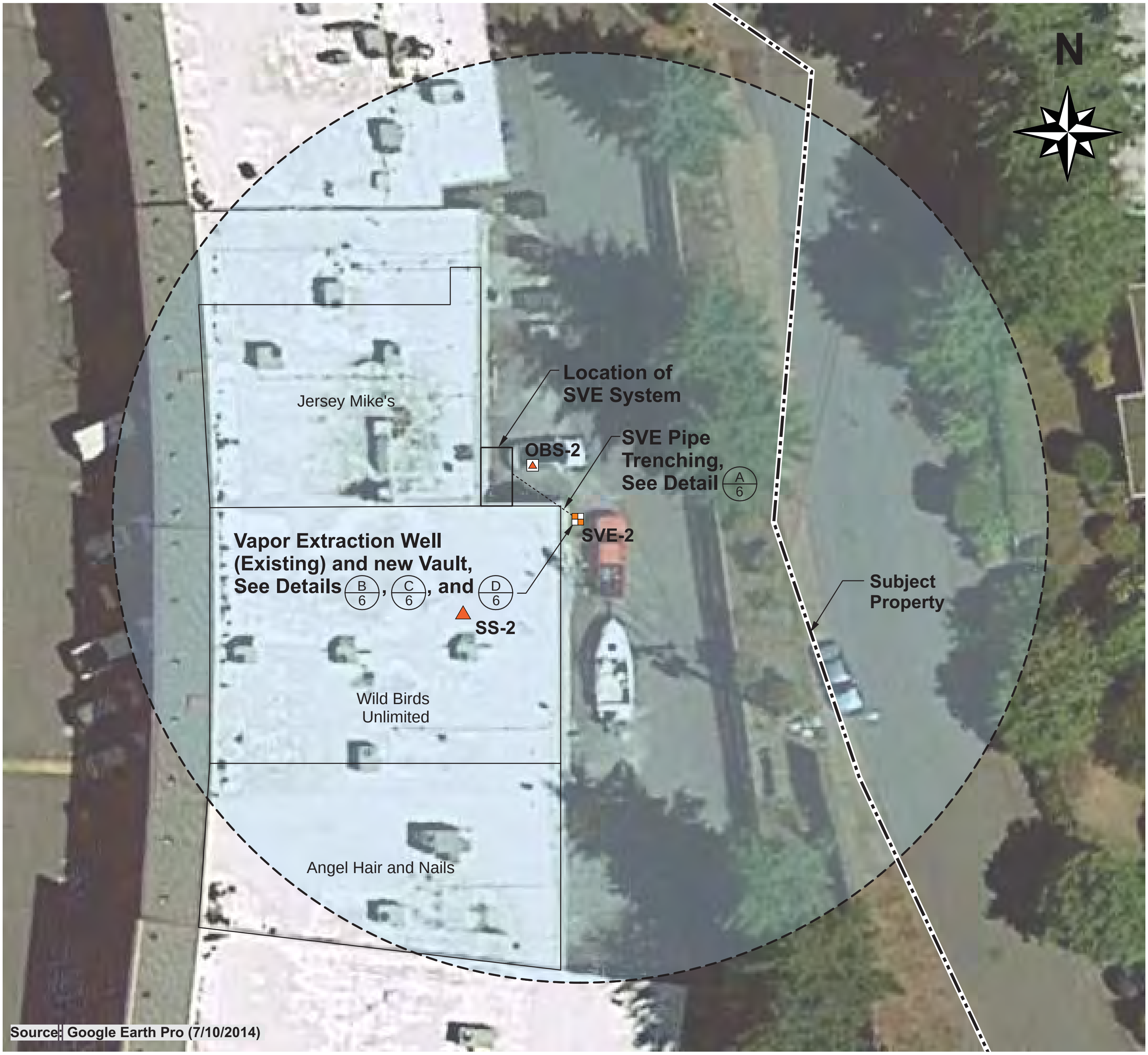
Figure 2: **Site Plan**	**Claremont Village Shopping Center** **Feasibility Study** **4805-4933 Evergreen Way** **Everett, Washington**	APEX

Legend:

- SVE Extraction Well
- SVE Pilot Test Observation Well
- Sub-Slab Soil Vapor Sampling Point
- Estimated Zone of Influence

0 40 80
Approximate Scale in Feet

Figure 3: **South - Remedial Action Area and SVE Layout**	**Claremont Village Shopping Center Feasibility Study** **4805-4933 Evergreen Way Everett, Washington**	APEX



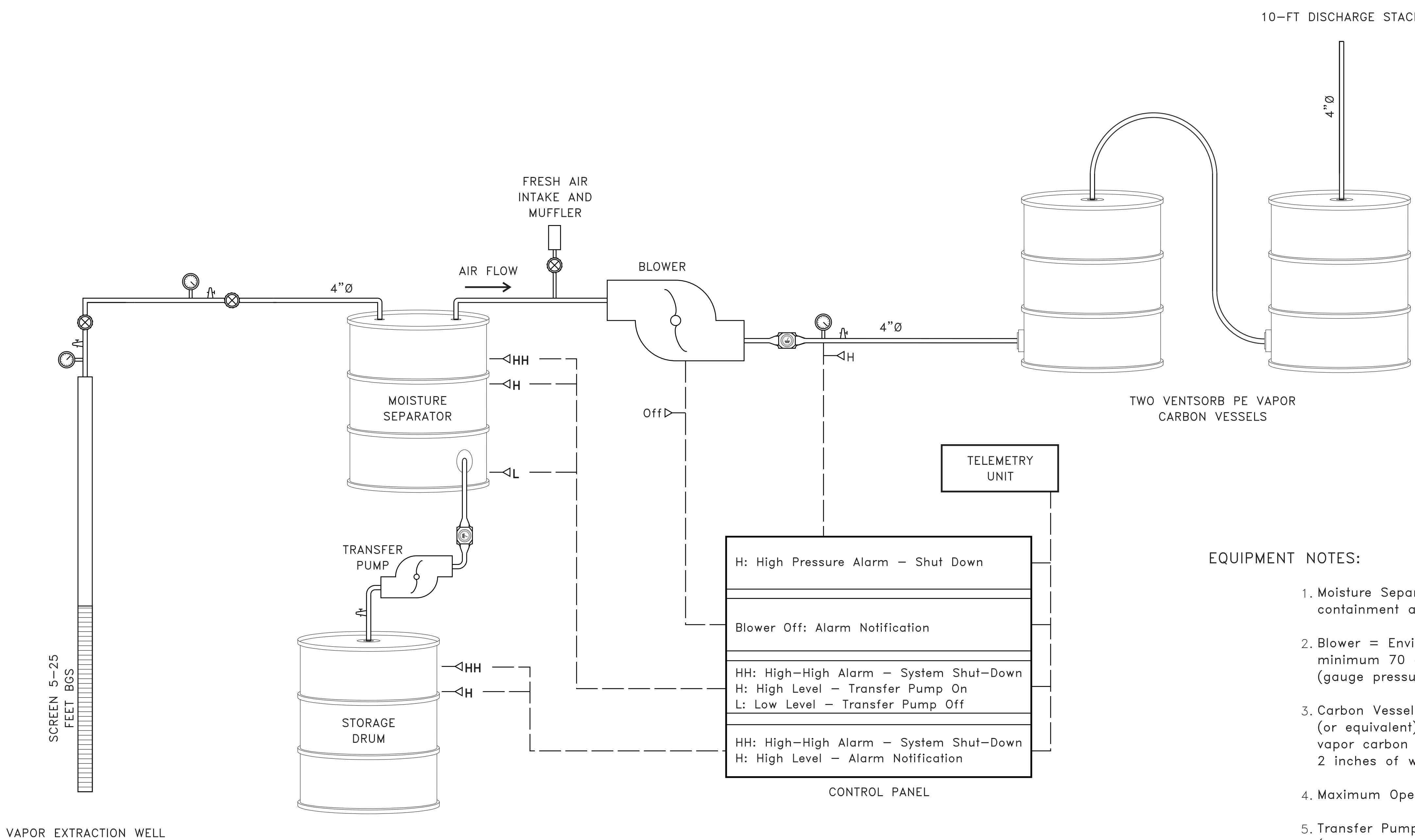
Legend:

- SVE Extraction Well
- SVE Pilot Test Observation Well
- Sub-Slab Soil Vapor Sampling Point
- Estimated Zone of Influence

0 30 60

Approximate Scale in Feet

Figure 4: **North - Remedial Action Area and SVE Layout**	**Claremont Village Shopping Center Feasibility Study** **4805-4933 Evergreen Way Everett, Washington**	APEX



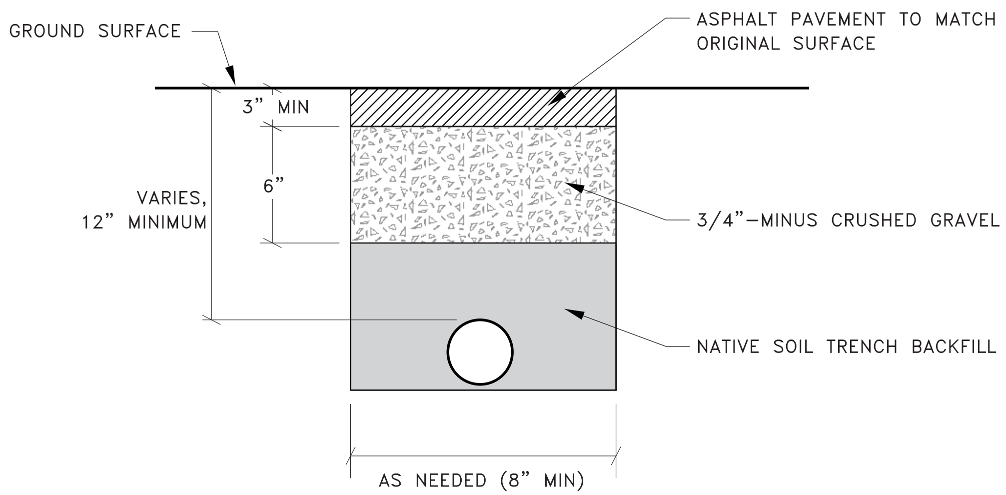
LEGEND:

- Flow Meter
- Pressure Gauge
- Sample Port
- Flow Control Valve
- System Control Input
- 4"Ø Pipe Diameter, In Inches

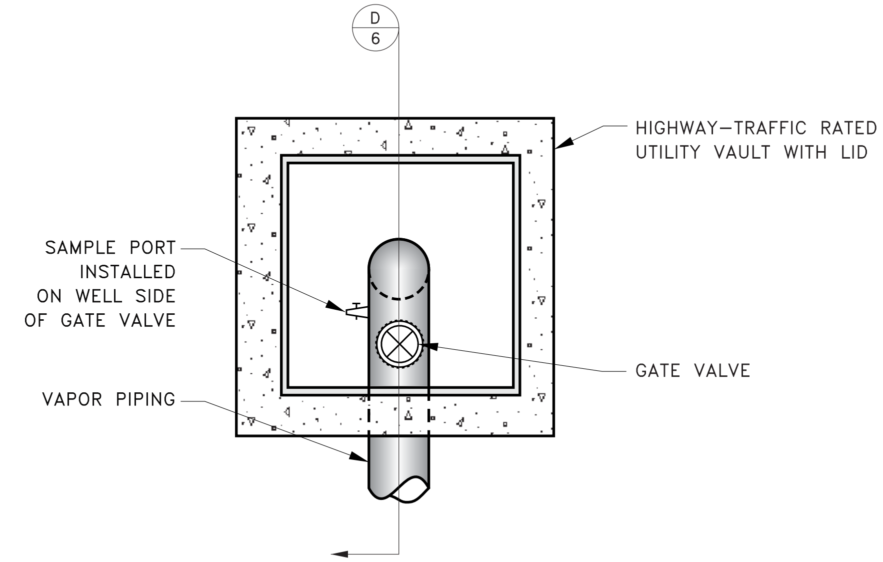
EQUIPMENT NOTES:

1. Moisture Separator = Minimum 40-gallon vessel with intrinsic secondary containment and visual indication of interstitial fluids.
2. Blower = Environmental-grade regenerative blower capable of minimum 70 cfm at vacuum pressure of 30 inches of water (gauge pressure) – Rotron EN-404 or equivalent.
3. Carbon Vessels = Two(2) 55-gallon VentSorb PE vapor carbon vessels (or equivalent) connected in series. Vessels to be specifically designed for vapor carbon treatment, with maximum per-unit head loss of 2 inches of water at air flow rate of 75 scfm.
4. Maximum Operating Noise Level = 60 dba at a distance of 10 feet.
5. Transfer Pump = Self-Priming centrifugal water pump (nominal 0.25hp, 10 gpm)
6. Storage Tank May Be Replaced With Connection to Municipal Sanitary Sewer if Permitted.
7. Telemetry Unit = Internet/Web enabled notification unit (Sensaphone WEB600 or equivalent)

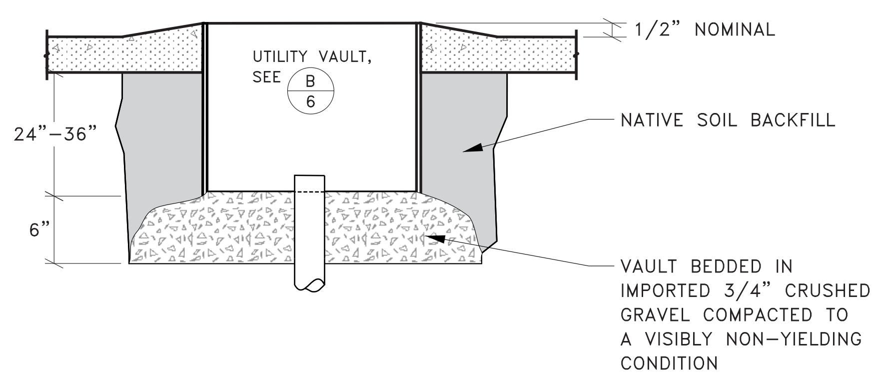
Figure 5: **SVE System Schematic**	**Claremont Village Shopping Center Feasibility Study** **4805-4933 Evergreen Way Everett, Washington**	APEX



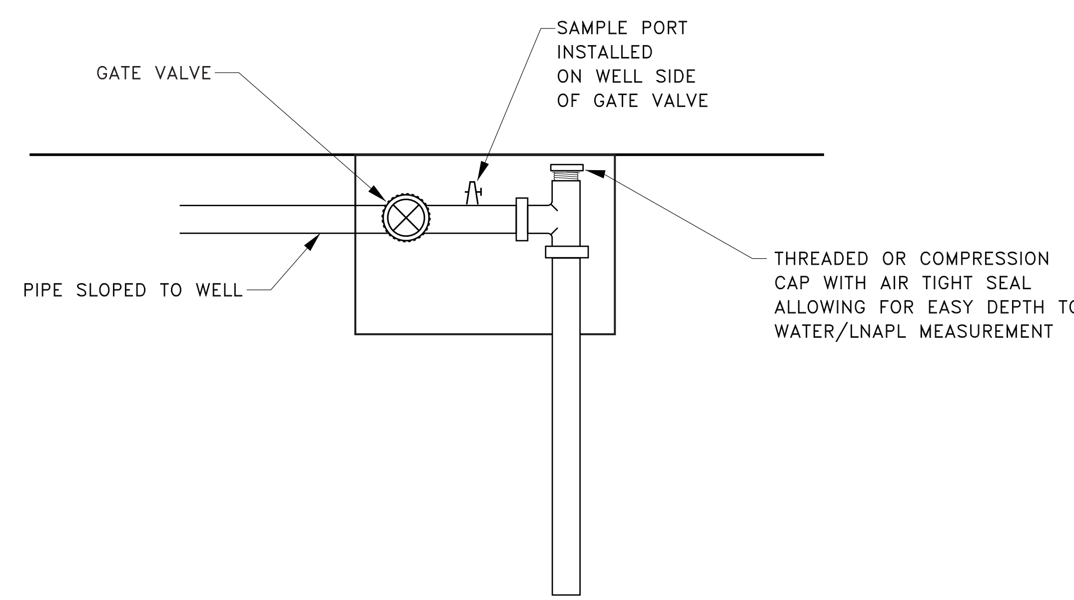
A / 6 VAPOR PIPING TRENCH DETAIL
NOT TO SCALE



B / 6 VAPOR WELL VAULT
NOT TO SCALE



C / 6 VAPOR WELL VAULT INSTALLATION DETAIL
NOT TO SCALE



D / 6 VAPOR WELL VAULT INSTALLATION DETAIL
NOT TO SCALE

Figure 6: **Construction Details**	**Claremont Village Shopping Center Feasibility Study** **4805-4933 Evergreen Way Everett, Washington**	APEX

EQUIPMENT:

1) Vapor Extraction Blower Unit: The vapor extraction blower unit shall be selected from readily available models manufactured specifically for this purpose. They shall meet the following specifications:

   a) Vapor extraction system assembly shall include blower unit, moisture knock-out tank (with a minimum usable capacity of 40 gallons), ancillary components (switches, gauges, sample ports, etc, as shown on the drawings), and any other components necessary for proper operation of the unit.

   b) Vapor extraction unit shall consist of a regenerative blower capable of a flow rate of at least 75 scfm at a vacuum pressure of 13 inches of water.

2) Pipes, couplings, and fittings shall be Schedule 80 PVC at the diameters shown on the Figures. Materials used for the installation (i.e., solvent cement) shall conform to the manufacturer's recommendations. Couplings to individual vapor extraction well casings shall be sized to match the well casing (nominally 4-inch diameter).

3) Pressure Sensors: Pressure sensors are to be installed upstream and downstream of the blower unit that meets the following criteria:

   a. Acceptable pressure range shall be compatible with vacuum range of the blower.
   b. Includes a direct-read pressure gauge.
   c. The pressure sensor shall interact with the control system to stop the system and provide an alert if the pressure is above high set point (over-pressurization) or below low set point (under-pressurization), as appropriate

4) Knockout Tank Level Sensor: Within the moisture knockout tank, a high-level float sensor shall be installed that interacts with the control system to stop the system and provide an alert if tank is full.

5) Flow Meter: An air flow meter is to be installed in the locations shown on the Drawings. The optimal range of the flow meter must be consistent with the design flow rates (nominally less than 150 scfm).

6) The control system will interact with meters and sensors as described above and provide notification for alarm conditions (including pressures outside of setpoints, high knockout drum level alarm, and power outage). Manual controls shall be provided for each operating component (i.e., blower motor). Startup of the blower motor shall be controlled by the system to not overstress the electrical supply.

7) Electrical fixtures within enclosed spaces shall be intrinsically explosion-proof. Control panel is not to be installed within enclosed spaces so as to not require explosion-proof rating (unless approved by Engineer and for no additional cost). Panel must be housed in weatherproof enclosure with lock to prevent unauthorized access. Alarm condition light to be visible from outside of enclosure.

8) Telemetry for system to include dial-out notification of alarm condition in hard-copy (i.e., fax or email), such as provided by Sensaphone Cell682 or equivalent. Notification to include type of fault, date, and time. Delivery of notification to Engineer and O&M subcontractor. Telemetry to allow dial-in inspection of system status.

9) Vapor treatment to be provided by two VentSorb PE 55-gallon drums with AP4-60 virgin grade vapor phase carbon (or approved equivalent). Drums will be connected in series with quick-disconnect flexible hoses (6-inch diameter).

CONCRETE WORK:

1) The placement of PCC and installation of any associated steel reinforcement shall conform to the placement specifications in Chapter 26 of the UBC.

SYSTEM FINISHING AND SITE CLEANUP:

1) Pavement and other property and surface structures removed or disturbed during or as a result of construction shall be restored to a condition equal in appearance and quality to that before the work began. Improved surfaces shall be of the same material and match the appearance of the removed surface.

2) The Contractor shall remove all garbage and miscellaneous debris from the site.

Figure 7:

Specifications

Claremont Village Shopping Center Feasibility Study

4805-4933 Evergreen Way
Everett, Washington

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