AGENCY REVIEW DRAFT Technical Memorandum

TO:	Erin Hobbs, Washington State Department of Ecology
CC:	Ron Taylor, Capital Industries Don Verfurth, Gordon Rees Scully Mansukhani
FROM:	Katie Gauglitz, LG, and Jennifer Wynkoop
DATE:	February 10, 2022
RE:	**Work Plan for Vapor Intrusion Mitigation System Shut Down** **5900 1st Avenue South** **Seattle, Washington** **Project No. 1933001.020.021**

Introduction and Background

Landau Associates, Inc. (LAI) has prepared this work plan on behalf of Capital Industries, Inc. (Capital) for shut down of the existing vapor intrusion mitigation system at the 5900 1st Avenue South property (5900 property)—formerly Natus Medical Building and Olympic Medical Building—in Seattle, Washington (site). The 5900 property is located within the West of 4th Cleanup Site (Cleanup Site ID 2622) within Site Unit #2 (SU2). The general site location is shown on Figure 1 and the location relative to the Capital property is shown on Figure 2.

Mitigation of vapor intrusion (VI) from volatile constituents of concern (COCs) at the 5900 property was required by the Washington State Department of Ecology (Ecology) in accordance with Agreed Order No. DE 5348, entered into by Ecology and Capital on January 24, 2008 (Agreed Order).

5900 Property Background

The 5900 property is located within a downgradient portion of a volatile organic compound (VOC) groundwater plume within SU2. According to prior site documents prepared by others (Farallon 2009), Phillips Services Corporation (PSC) initially conducted a Tier 3 VI assessment at the 5900 property building beginning in 2004; subsequently, Capital was identified as the lead business responsible for VI mitigation.

The Tier 3 assessment included sampling groundwater, sub-slab soil gas, and indoor air. In the absence of available state guidance on cleanup levels[1] and indoor air results, results were compared to site-specific Inhalation Pathway Interim Measure Action Levels (IPIMALs).[2] Calculated IPIMALs were considerably lower than current Method B VI screening levels published in Ecology's *Cleanup Level and Risk Calculation* (CLARC) tables. At the time of the Tier 3 investigation, the calculated IPIMAL for trichloroethene (TCE) in a commercial indoor air space was 0.05 micrograms per cubic meter ($\mu g/m^3$)

[1] The Tier 3 VI assessment was conducted in 2004 through 2006, prior to Washington State issuing guidance on assessment of vapor intrusion in 2009.

[2] The derivation of IPIMAL concentrations is unclear from historical documentation.

compared to the current unrestricted use indoor air cleanup level published in CLARC of 0.33 μg/m^3 and the current calculated commercial indoor air screening level of 2.1 μg/m^3.[3]

Results of the Tier 3 investigation showed TCE was the only compound found in both groundwater and indoor air. TCE concentrations in groundwater at the time ranged from 45.9 ug/L to 47.7 ug/L, sub-slab soil gas concentrations were 1.0 μg/m^3, and corrected indoor air concentrations ranged from non-detect to 4.25 μg/m^3 (PCS and PTC 2005). Subsequent sampling by GeoEngineers Inc. (GeoEngineers) in 2006 showed similar results with a maximum indoor air concentration of 1.82 μg/m^3 (GeoEngineers 2006). Exceedances of the IPIMAL occurred only in the warehouse/-manufacturing portion of the building and no other compounds besides TCE exceeded the IPIMALs. Comparison of the sub-slab soil gas concentrations to the indoor air concentrations suggested that vapor intrusion was not the source of the indoor air concentrations. However, vapor intrusion science was less advanced at the time and data was not evaluated in accordance with current standards. In addition, a building survey and chemical inventory was not completed at the 5900 property, which is standard practice in VI investigations today.

Based on the Tier 3 investigation results, a VI mitigation system was proposed by PSC for the warehouse area of the building. A sub-slab depressurization system (SSDS) was installed in the warehouse/manufacturing portion of the building by Farallon in January 2009 (Farallon 2009). The system comprises seven sub-grade extraction sumps connected to a vacuum blower unit located on the roof. The system is monitored with a series of vacuum pressure gauges and the applied vacuum range at the extraction sumps beneath the slab is approximately 8.0 to 9.0 inches of water (LAI 2021). Annual operation, maintenance, and monitoring (OM&M) consists of tracking vacuum pressure within the system, measuring system influent concentrations, and measuring indoor air concentrations.

Post installation, OM&M indoor air sampling measurements recorded TCE results as high as 25.3 μg/m^3 with the system operational. During the same sampling event when the TCE result of 25.3 μg/m^3 was recorded, sub-slab soil gas results[4] showed a TCE concentration of only 1.06 μg/m3. The maximum recorded sub-slab soil gas concentration since 2018 was 1.72 μg/m^3 with most of the recent concentrations less than 1 μg/m^3 (LAI 2021). Table 1 provides recent OM&M sampling data for the 5900 property.

Natus, the former tenant, began closing its operation and vacating the building in 2020. Prior to closure of the Natus operation, TCE was consistently detected in indoor air. Since September 2020, after Natus shut down its operation, TCE has not been detected in indoor air in three consecutive semi-annual sampling events. The discrepancy between indoor air and sub-slab soil gas results (e.g., indoor air concentrations typically higher than soil gas results) during active system operation

[3] Revised IPIMALs were calculated for SU2 in 2012 resulting in a commercial indoor air IPIMAL for TCE of 0.39 (Pioneer 2012).

[4] Measured from the soil vapor extraction system.

and the absence of TCE in indoor air upon shutdown of the Natus business operations, provides multiple lines of evidence that concentrations of TCE in indoor air were related to a background source of TCE (use of a TCE-containing product) within the building and not vapor intrusion.

Current water table groundwater monitoring results show TCE concentrations beneath the 5900 property range from 3.4 microgram per liter (µg/L) on the upgradient side of the building (closest to Capital) to 17 µg/L on the downgradient side of the building (Farallon 2021). These results suggest a possible TCE release to groundwater from the 5900 property. Despite the groundwater TCE concentrations, sub-slab soil gas results do not indicate the potential for vapor intrusion. The current soil gas screening level for TCE published in CLARC for residential properties is 11 $\mu g/m^3$ and the calculated soil gas screening level for commercial properties is 69 $\mu g/m^3$, while the soil gas concentrations beneath the 5900 property hover around 1 $\mu g/m^3$ or less.

Evaluation of current and historical TCE data from the 5900 property indicates that operation of the mitigation system is no longer warranted. Capital is requesting to discontinue system operation and conduct confirmation sampling to verify the assumption that vapor intrusion is not causing unacceptable indoor air concentrations. Capital has provided a copy of this work plan and consulted with the property owner, CenterPoint, and CenterPoint is in agreement that the system may no longer be needed, pending confirmation sampling.

Proposed Confirmation Sampling

Capital proposes to shut down the SSDS and conduct two rounds of confirmation sampling; a first sampling event at least 24-hours post shutdown and a second sampling event at least one month following the first. Results of the confirmation sampling will be evaluated to determine if the system can be shut down permanently and decommissioned.

A lease agreement with a new tenant is pending and tenant improvements to the space are proposed. The proposed new use of the space may include auto repair. Sampling will be timed around pending tenant improvements and will be conducted either before or after (not during) tenant improvements, but before occupancy, depending on the approval of this work plan.

Sampling in the winter months is considered optimal or a "worst case" testing scenario because vapor intrusion issues are generally exacerbated during cold weather. For example, cold temperatures may increase the building depressurization due to the "thermal stack effect" thus increasing the driving force of soil gas entry into the occupied building space and potential for vapor intrusion, depending on the building HVAC dynamics and the temperature differential between indoors and outdoors (EPA 2015). The building is vacant, so there is currently no risk to occupants when shutting down the system. Ecology's expedited review of this work plan is requested in order to conduct sampling in the winter months and also before pending tenant improvements begin.

Confirmation sampling will occur at seven sub-slab soil gas locations to be installed adjacent to the sumps (sumps 1 through 7; Figure 3). The sumps were constructed without an isolation valve; therefore, separate sampling ports are required. Confirmation indoor air sampling will occur at the two indoor air locations (5900-IA1 and 5900-IA3) where previous OM&M samples have been collected (Figure 3).

Sub-Slab Soil Gas Sampling Port Installation and Sampling

Sub-slab soil gas samples will be collected from permanent Cox-Colvin Vapor Pins® (vapor pins), which will be installed flush with the floor adjacent to sumps 1 through 7. Vapor pins will be installed as close to the sumps as is practicable and within 20 ft of the sump. Vapor pin installation and sub-slab soil gas sampling will be completed at least 12 hours in advance of indoor air sampling so as to not introduce soil gas into indoor air during sampling. Vapor pin installation procedures are described in Attachment 1.

Soil gas sampling will be completed following the procedures presented in Attachment 1. Laboratory analysis of TCE will be conducted in accordance with the current OM&M analytical program. Table 2 provides a confirmation sample matrix.

Indoor Air Sampling

Indoor air sampling will be conducted following sub-slab soil gas sampling. Eight-hour time-weighted average samples will be collected at each location using summa canisters. In addition, 7- to 14-day time-weighted average samples will be collected using radiello® passive samplers. The longer radiello samples will provide an understanding of whether TCE concentrations vary significantly over time and whether average concentrations in the building present an unacceptable health risk. Outdoor ambient air samples will be collected concurrently with the indoor air samples (both eight-hour time-weighted average and radiello time-weighted average at location 5900-OA2). The outdoor ambient air samples provide information on potential background sources of TCE from outside the building. If TCE is detected in outdoor air, those concentrations are subtracted from the indoor air concentrations.

Additional Work

During the September OM&M inspection LAI noted that a crack has formed between the east exterior wall and the building slab. Prior to shutdown of the SSDS, the crack will be filled with concrete crack seal.

Reporting

Results from the two confirmation sampling events will be compared to the current Modified Method B commercial screening levels for TCE (2.1 µg/m^3 for indoor air and 69 µg/m^3 for soil gas).[5] Results of the confirmation sampling, along with recommendations, will be reported to Ecology in a technical memorandum following the second sampling event.

Use of this Technical Memorandum

This Technical Memorandum has been prepared for the exclusive use of Capital Industries for specific application to the 5900 1st Avenue South property. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. LAI makes no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

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Principal Scientist

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References

EPA. 2015. *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*. OSWER 9200.2-154. US Environmental Protection Agency. June. https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf.

[5] Modified Method B Commercial Screening Levels are based on a modified exposure frequency of 0.3. All other inputs to the equations are unchanged, including the standard vapor attenuation factor of 0.3.

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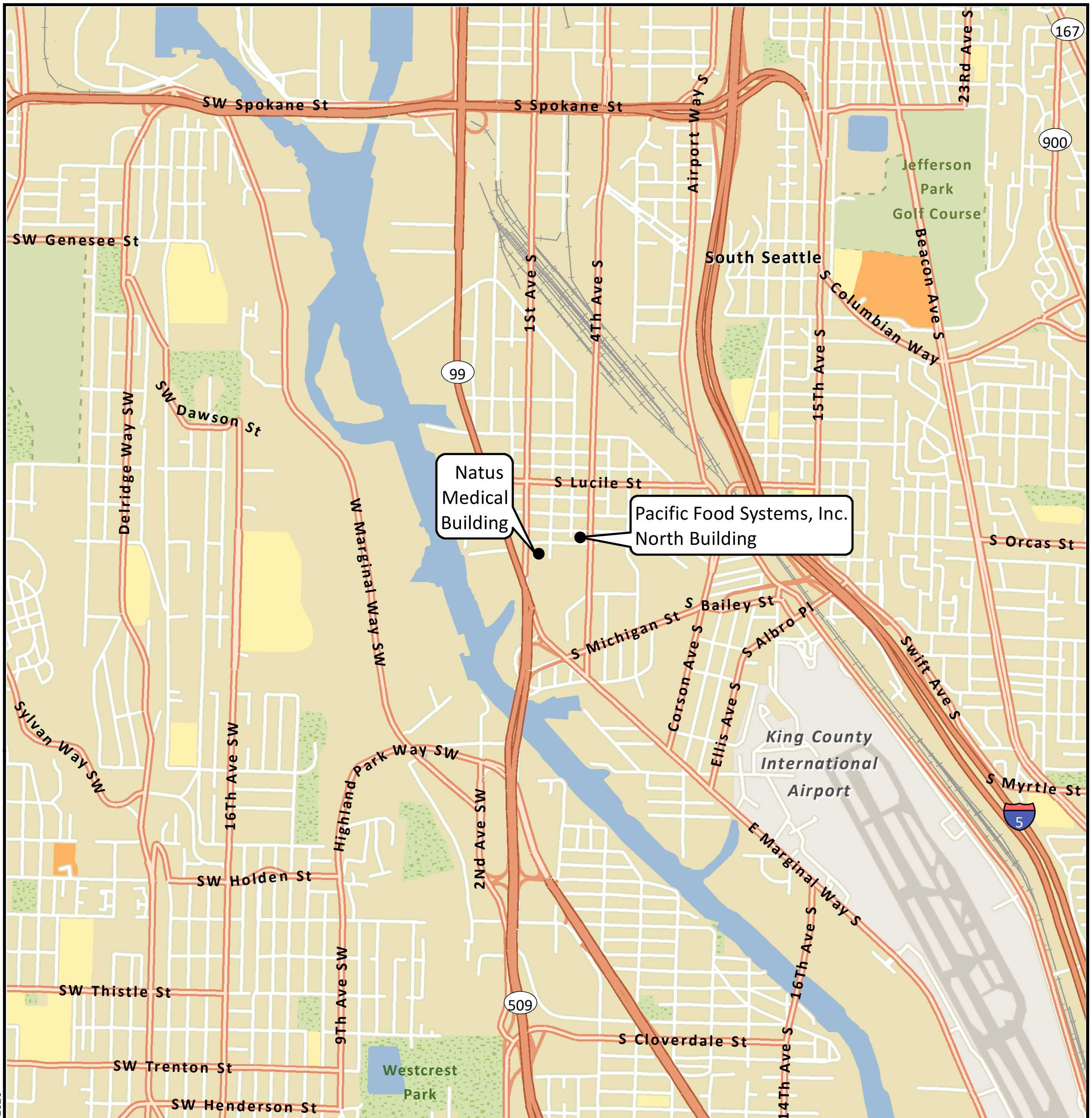
PCS and PTC. 2005. *Tier 3 Sampling Report for Inhalation Pathway Interim Measures*, 5801 Third Avenue South, Seattle, Washington. Philip Services Corporation and Pioneer Technologies Corporation. January.

Pioneer. 2012. *Updated Air and Groundwater IPIMALs/VIRLs for Residential and Commercial Scenarios for the Georgetown Site*. Prepared for the Washington State Department of Ecology by Pioneer Technologies Corporation. November 29.

Attachments



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Data Source: Esri 2012

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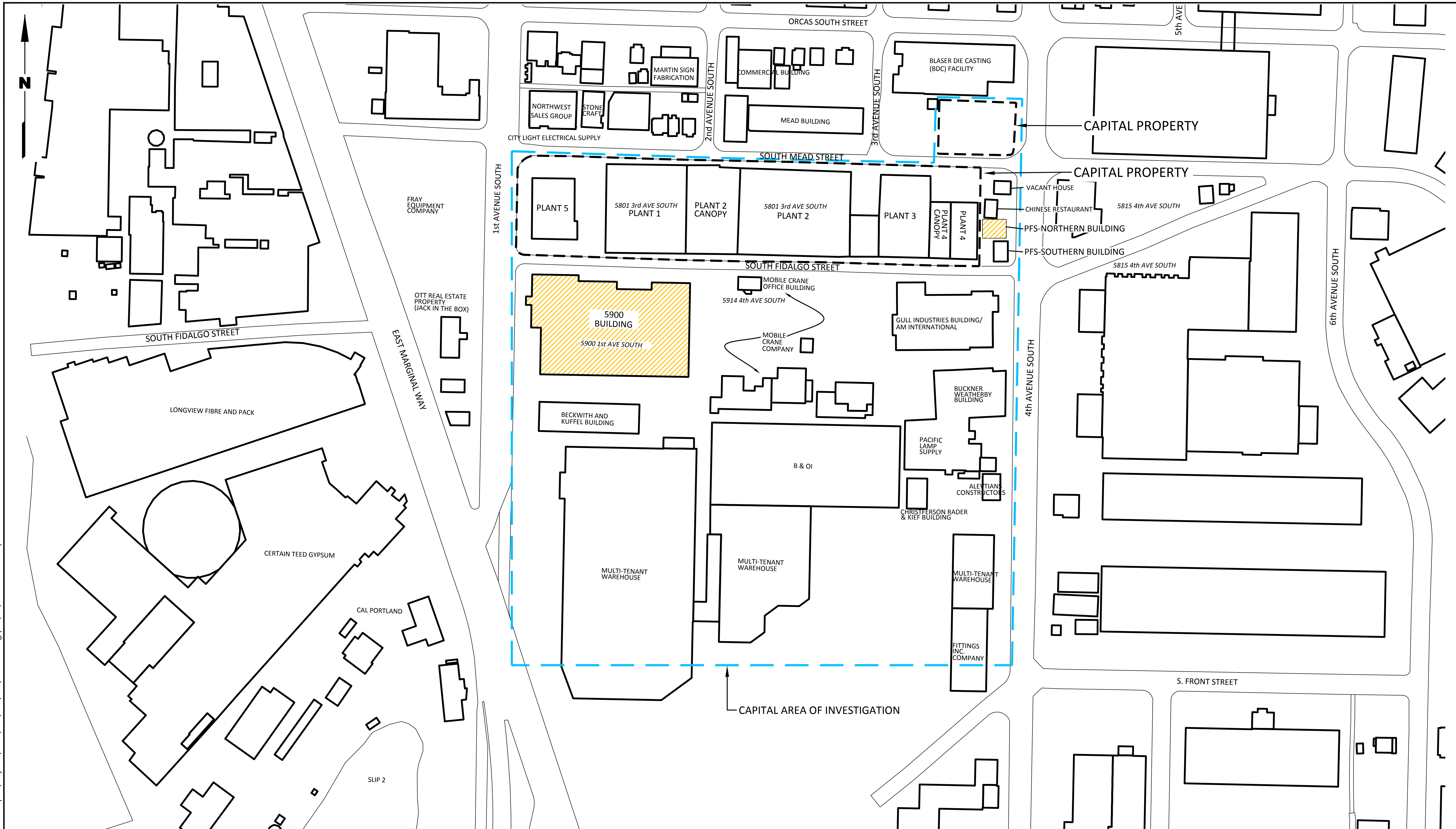
Capital Industries, Inc. Seattle, Washington	**Vicinity Map**	Figure 1



Legend

Building with Tier 4 Vapor Intrusion Intrusion Mitigation Implemented

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400

Scale in Feet

Source: Farallon Consulting, August 2017

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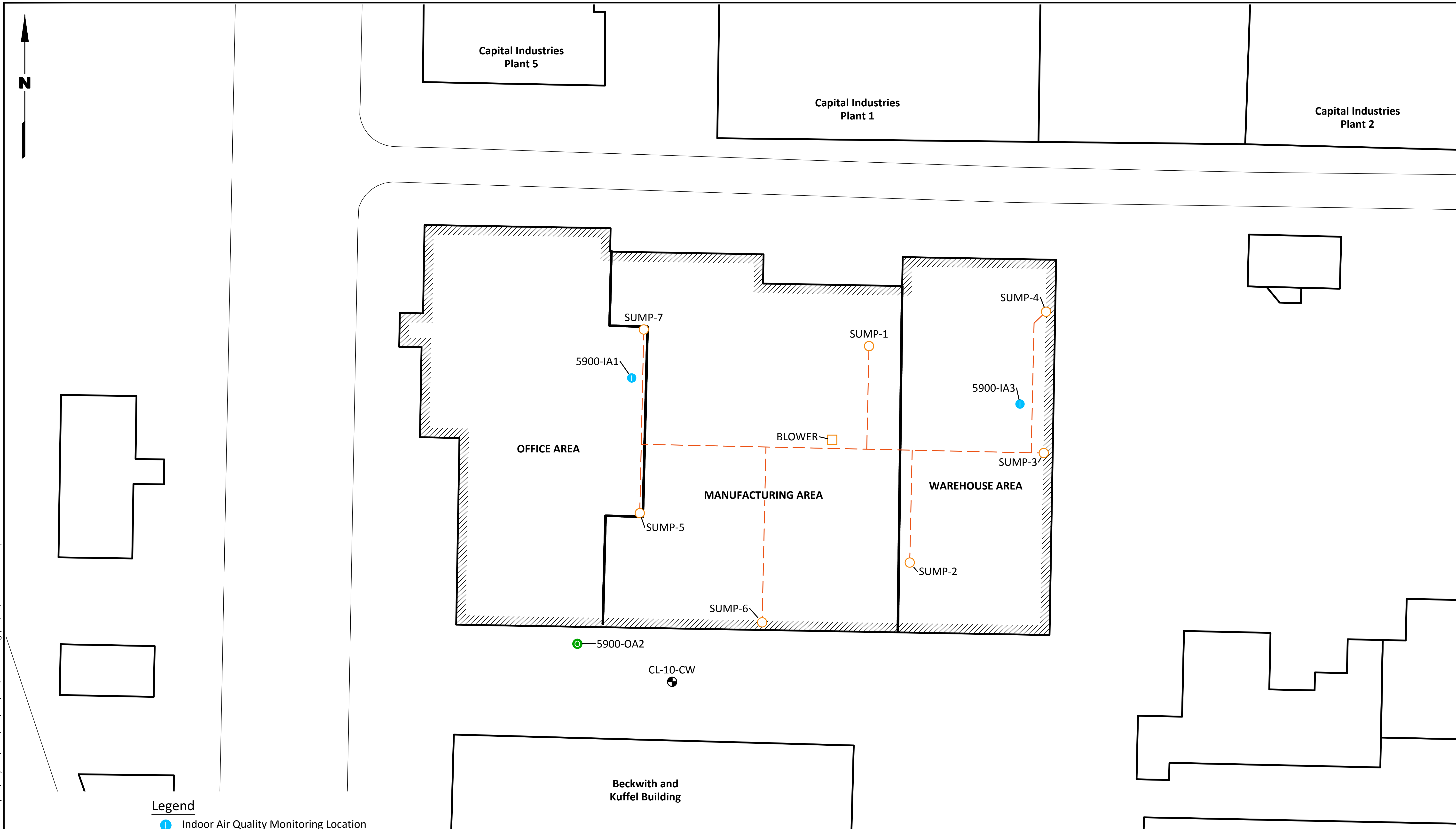
Capital Industries, Inc. Seattle, Washington	**Site Map**	Figure 2



Legend

- Indoor Air Quality Monitoring Location
- Outdoor Air Quality Monitoring Location
- Sump Location

Note

1. SSDS = Subslab Depressurization System.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 50 100

Scale in Feet

Source: Farallon Consulting, August 2017

Capital Industries, Inc. Seattle, Washington	**5900 Property Proposed Monitoring Locations**	Figure 3

Table 1
Summary of Mitigation Monitoring Analytical Results
5900 First Avenue South
Seattle, Washington

Sample Type	Location	Location Description	Sample Identification	Sample Date	Volatile Organic Compounds (µg/m³; TO-15, TO-15 SIM) PCE	TCE	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene[1]	Vinyl Chloride
Previous Commercial Indoor Air IPIMAL - Cancer					22	1.5	N/A	N/A	N/A	0.66
Previous Commercial Indoor Air IPIMAL - Non-cancer					7.5	0.39		12	39	19
Commerical Indoor Air MTCA Modified Method B Screening Level					32	2.1		130	670	0.95
Indoor Air (c)	5900-IA1	Building Main Office	IA8-33937-060215	6/2/2015	0.22 U	0.17 U	0.13 U	0.63 U	0.063 U	0.041 U
			NATUS-OFFICE-032118	3/21/2018	**0.882**	**1.11**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA1-10945-032019	3/20/2019	**1.49**	**0.238**	0.0793 U	**0.0372**	0.0357 U	0.217 U
			5900-IA-1-092719	9/27/2019	0.339 U	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA1-031920	3/19/2020	**0.411**	**0.213**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA1-20200923	9/23/2020	0.339 U	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA1-20210428	4/28/2021	**0.107**	0.0537 U	0.396 U	0.198 U	0.0397 U	0.0256 U
			5900-IA1-20210907	9/7/2021	**0.279**	0.215 U	1.59 U	0.793 U	0.159 U	0.102 U
	5900-IA2	Building Shipping Office	IA9-34348-060215	6/2/2015	0.21 U	0.17 U	0.12 U	0.62 U	0.062 U	0.040 U
	5900-IA3	Building Warehouse	NATUS-WAREHOUSE-032118	3/21/2018	**0.583**	**25.3**	0.0793 U	**0.102**	**0.117**	**0.261**
			NATUS-5900-IA3-080218	8/2/2018	0.339 U	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA3-15893-032019	3/20/2019	**2.18**	**6.08**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA3-092619	9/26/2019	**0.666**	**0.605**	0.0793 U	**0.0330**	0.0357 U	0.217 U
			5900-IA3-031920	3/19/2020	**0.734**	**0.176**	0.0793 U	**0.0268**	0.0357 U	0.217 U
			5900-IA3-20200923	9/23/2020	0.339 U	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-IA3-20210428	4/28/2021	**0.195**	0.0537 U	0.396 U	0.198 U	0.0397 U	0.0256 U
			5900-IA3-20210907	9/7/2021	**0.343**	0.215 U	1.59 U	0.793 U	0.159 U	0.102 U
Outdoor Air (d)	5900-OA1	Outside north of the Building on a telephone pole	AA4-34322-060215	6/2/2015	0.21 U	0.16 U	0.12 U	0.61 U	0.061 U	0.039 U
	5900-OA2	Outside south of the Building on west side	NATUS-UPWIND-032118	3/21/2018	**0.600**	**0.430**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			NATUS-5900-OA2-080218	8/2/2018	0.339 U	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-OA2-092619	9/26/2019	**0.368**	**4.27**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-OA2-031920	3/19/2020	**8.83**	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-OA2-20200923	9/23/2020	**3.45**	0.0914 U	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-OA2-20210428	4/28/2021	**0.107**	0.0537 U	0.396 U	0.198 U	0.0397 U	0.0256 U
			5900-OA2-20210907	9/7/2021	0.271 U	0.215 U	0.159 U	0.793 U	0.159 U	0.102 U
	5900-OA3	Ouside west of the Building moved to southwest corner of the Building	5900-OA3-15421-032019	3/20/2019	**1.36**	0.0914 U	0.0793 U	**0.0416**	0.0357 U	0.217 U

Table 1
Summary of Mitigation Monitoring Analytical Results
5900 First Avenue South
Seattle, Washington

Sample Type	Location	Location Description	Sample Identification	Sample Date	Volatile Organic Compounds (µg/m^3; TO-15, TO-15 SIM) PCE	TCE	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethene[1]	Vinyl Chloride
				Previous Commercial Soil Gas IPIMAL (b)	--	--	N/A	--	--	--
				Commerical Soil Gas MTCA Modified Method B Screening Level	1070	69		4300	22300	32
SSDS	SSDS combined Influent (representative of soil gas beneath the building)	Monitoring port on influent of SSDS exhaust blower	OLY-Influent-010517	1/5/2017	**1.49**	**9.47**	**2.21**	**0.511**	**0.0979**	0.217 U
			NATUS-INFLUENT-032118	3/21/2018	**0.675**	**1.06**	**0.118**	**0.0948**	0.0357 U	0.217 U
			NATUS-INF-15894-032019	3/20/2019	**1.46**	**0.567**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-INFLUENT-092619	9/26/2019	**0.750**	**1.72**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-INFLUENT-031920	3/19/2020	**0.596**	**0.525**	**0.177**	0.0238 U	0.0357 U	0.217 U
			5900-INFLUENT-20200923	9/23/2020	**1.41**	**0.511**	0.0793 U	0.0238 U	0.0357 U	0.217 U
			5900-INFLUENT-20210428	4/28/2021	**0.764**	**0.472**	1.59 U	0.793 U	0.159 U	0.102 U
			5900-INFLUENT-20210907	9/7/2021	**1.55**	**1.16**	3.96 U	1.98 U	0.397 U	0.256 U
	Sump 2	Manometer port	5900-SUMP-2-092619	9/26/2019	0.339 U	**0.154**	0.0793 U	0.0238 U	0.0357 U	0.217 U
	Sump 3	Manometer port	5900-SUMP-3-092619	9/26/2019	0.339 U	**0.108**	0.0793 U	0.0238 U	0.0357 U	0.217 U
	Sump 4	Manometer port	5900-SUMP-4-092619	9/26/2019	**0.372**	**1.38**	0.0793 U	0.0238 U	0.0357 U	0.217 U

Notes:

Bold text indicates detected analyte

Green shading indicates detected analyte exceeds IPIMAL

Blue shading indicates detected analytye also exceeded MTCA Modified Method B

(a) Inhalation pathway Interim measures action (IPIMAL) levels presented from Updated Air and Groundwater IPIMALS/VIRLs for Residential and Commercial Scenarios for the Georgetown Site dated October 19, 2012. Note that only compounds representing a vapor intrusion risk are listed.

(b) IPIMALs were not calculated for soil gas.

(c) Indoor air data is not corrected for outdoor air concentrations.

(d) Outdoor air data is not compared to indoor air screening levels.

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

Acronyms/Abbreviations:

IPIMAL = inhalation pathway interim measure action level

µg/m3 = micrograms per cubic meter

N/A = not applicable, used where the constituent of concern will not affect the medium of potential concern due to an incomplete pathway or no pertinent standard exists

PCE = tetrachloroethene

SIM = selected ion monitoring

SSDS = subslab depressurization system

TCE = trichloroethene

VIRLS = vapor intrusion remediation levels

Table 2
Proposed Sampling Matrix
5900 First Avenue South
Seattle, Washingon

Sample Location ID	Sample Type	Description/Location	Analysis
5900-IA1	Indoor Air 8-hr TWA	Previously sampled indoor air location; south of sump #7	TCE by TO-15
	14-day Radiello		TCE by Passive S.E. RAD130/SK
5900-IA3	Indoor Air 8-hr TWA	Previously sampled indoor air location; south-southwest of sump #4	TCE by TO-15
	14-day Radiello		TCE by Passive S.E. RAD130/SK
5900-OA2	Outdoor Air 8-hr TWA	Outdoor ambient air sampling location	TCE by TO-15
	14-day Radiello		TCE by Passive S.E. RAD130/SK
5900-S1-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 1	TCE by TO-15
5900-S2-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 2	TCE by TO-15
5900-S3-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 3	TCE by TO-15
5900-S4-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 4	TCE by TO-15
5900-S5-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 5	TCE by TO-15
5900-S6-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 6	TCE by TO-15
5900-S7-VP	Sub-Slab Soil Gas Grab Sample	Adjacent to sump 7	TCE by TO-15

Notes:
Radiello passive samplers will be deployed following collection of the TWA indoor air samples.

Abbreviations and Acronyms:
ID = identification
TCE = Trichloroethene
TWA = Time Weighted Average

ATTACHMENT 1

Vapor Pin Installation and
Sub-Slab Soil Gas Sampling Procedures

ATTACHMENT 1

VAPOR PIN INSTALLATION AND SUB-SLAB SOIL GAS SAMPLING PROCEDURES

Vapor Pin Installation

The concrete slab will be cored to allow for vapor pin installation and sample collection. Each location will be cored with an outer 1.5-inch diameter (to 1.5 inches below ground surface) and inner ⅝-inch diameter core (through the full thickness of the slab) to install a Cox-Colvin Vapor Pin® (vapor pin). If wet methods are required for coring the concrete, water application will be discontinued before penetrating the slab to prevent water from entering the subsurface environment. The vapor pin will be recessed into the floor. The drilling will be advanced through the bottom of the slab. The core hole will be sealed with a stainless-steel vapor pin and silicon sleeve (hammered into place) and immediately capped with a silicon protective cap. A flush-mount, stainless steel cover will be threaded over the top of the pin for protection and safety.

Sub-Slab Soil Gas Quality Assurance

At sub-slab soil gas sampling locations, once the seal is constructed and the tubing capped, the sampling location will be left undisturbed for a minimum of 2 hours to allow for equilibration. After this equilibration period, a helium leak test, shut-in test, and sampling train purge will be completed prior to sample collection, as detailed below.

Shut-In Test

The purpose of a shut-in test is to check the air-tightness of all connections in the sampling train prior to conducting the helium leak test. The shut-in test will be completed using the following steps:

1. After the equilibration period is complete, connect the entire sampling train—which consists of the Summa canister, flow regulator (if necessary), vacuum gauge assembly, valves, tubing, and syringe—to the soil gas implant tubing. Double-check the tightness of all connections.
2. Use a syringe to pull a vacuum on the sampling train. When both the in-line and canister vacuum gauges indicate a vacuum of at least 15 inches of mercury (in. Hg.), record the shut-in test starting vacuum pressure. Continue to watch for vacuum drops for 2 minutes. Record the shut-in test ending vacuum. If the vacuum holds steady with no observable drop for 2 minutes, this indicates that there are no leaks in the sampling train between the sampling tubing and the Summa canister.
3. If the vacuum pressure drops during the shut-in test period, a leak is present. Double-check the tightness of fittings, examine tubing and other equipment for defects or other possible leaks, and repeat the test. If the pressure continues to drop, replace the sampling train pieces in the following order: tubing, valves, canister, and repeat the test.

Helium Leak Test

The helium leak test procedure described below requires one Dielectric Helium Leak Detector MGD-2002 (or equivalent) handheld meter. A shroud of appropriate height is used at each location to fully encapsulate the aboveground portion of the sampling port. The shroud is placed over the sampling port and the sampling tubing will extend through the outlet at the top of the shroud. Hydrated bentonite or bentonite clay may be used around the base of the shroud where an uneven ground surface is present. The steps below will be followed for the helium leak test:

1. Connect the helium tank to the shroud through an inlet port and ensure that all connections are tight.
2. Turn on the helium detector and zero-out the instrument in ambient air to read a helium concentration of 0 parts per million (ppm). Insert the meter probe inside the shroud.
3. Release helium into the shroud until the helium detector indicates that the air inside the shroud contains at least 50 percent helium. Record the highest concentration of helium in ppm.
4. Install and fit the sampling train. The sampling train consists of the appropriate fittings, valves, a syringe, an in-line pressure gauge, a Tedlar® bag, and the Summa canister and flow regulator. The same syringe used in the shut-in test can also be used for the helium test.
5. Using the syringe, purge the sampling train into the Tedlar bag with 400 milliliters (mL) of soil gas. Close the Tedlar bag and remove it from the sampling train.
6. Remove the helium detector from the sampling shroud. Zero-out the instrument to read a helium concentration of 0 ppm.
7. Insert the helium detector into the Tedlar bag to measure the helium concentration in the extracted soil gas. Concentrations of helium in the sample should be zero.
8. If concentrations of helium are detected in the Tedlar bag sample, a leak may be present in the surface seal, allowing ambient air to enter the well. Double-check the surface seal, tightness of fittings, and other possibilities for leaks and repeat the test. If helium continues to be detected in the Tedlar bag, there is the potential that a gas is present in the subsurface formation that is causing interference with the helium detection meter. To check for an interfering gas, remove the helium shroud, disconnect the sampling train from the sampling tubing coming out of the ground, and check for helium directly from the sampling tubing. If helium is detected, there is likely an interfering gas present. Reconnect the sampling train, reinstall the helium shroud, rerun the shut-in test and helium leak test, collect the sample, and add analysis for helium to the chain-of-custody form for this sampling location. If helium is not detected in the formation gas, there may be a problem with the surface seal that allowed helium to get into the formation during the helium leak test. Assess the surface, look for damage or areas that could be sealed with hydrated bentonite, seal as appropriate, and rerun the helium leak test. If helium is still present, discuss the next steps with the project manager.

After completion of the shut-in-test and helium leak test, the entire sampling train has been tested for leaks.

Purge

Each sampling train will be purged of in-line gases prior to sample collection. The syringe will be used to purge 3 volumes from the sampling train (approximately 6 mL per foot of ¼-inch sampling tubing). The process will be repeated if the required purge volume was greater than the capacity of the syringe. Purge volumes will be recorded on the sample collection form.

Sample Collection

Each sub-slab soil gas sample will be collected by following the steps below:

1. Open the Summa canister valve to begin collecting the sample. Record the time the canister was opened and the initial volume of the canister. The sample collection rate should be 200 mL per minute or less.

Once the vacuum gauge on the Summa canister reaches 5 in. Hg., close the valve on the Summa canister. Ensure the Summa canister valve is closed prior to disconnecting it from the well to prevent accidental entrance of remnant low-level helium from the shroud into the Summa canister.