FARALLON
consulting

975 5th Avenue Northwest, Issaquah, Washington 98027
Tel: (425) 295-0800 Fax: (425) 295-0850
www.farallonconsulting.com

TIER 3 VAPOR INTRUSION ASSESSMENT SAMPLING AND ANALYSIS PLAN

5815 4TH AVENUE SOUTH – NORTHERN BUILDING SEATTLE, WASHINGTON

AGREED ORDER NO. DE 5348

Submitted by:
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington 98027
Farallon PN: 457-004

For:
Mr. Ron Taylor
Capital Industries, Inc.
5801 Third Avenue South
Seattle, Washington

March 21, 2011

Prepared by:

Daniel Caputo
Project Chemist

Reviewed by:

Peter Jewett, L.G., L.E.G.
Principal

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ACRONYMS AND ABBREVIATIONS

Agreed Order	Agreed Order No. DE 5348 between the Washington State Department of Ecology and Capital Industries, Inc.
Capital	Capital Industries, Inc.
CCEF	cancer cumulative exceedance factor
COPCs	constituents of potential concern
Ecology	Washington State Department of Ecology
Farallon	Farallon Consulting, L.L.C.
HVAC	heating, ventilation, and air conditioning
IPIM	Inhalation Pathway Interim Measures
IPIMALs	Inhalation Pathway Interim Measures Action Levels
NCCEF	non-cancer cumulative exceedance factor
PSC	Philip Services Corporation
SAP	Sampling and Analysis Plan
VI	vapor intrusion
VI Assessment	Vapor Intrusion Assessment

1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) has prepared this Sampling and Analysis Plan (SAP) on behalf of Capital Industries, Inc. (Capital) to describe the procedures for conducting a Tier 3 Vapor Intrusion Assessment (VI Assessment) at the northern building at 5815 4th Avenue South in Seattle, Washington (herein referred to as the Building) (Figure 1). The SAP has been prepared as part of the Remedial Investigation currently being conducted in accordance with Exhibits B and D of Agreed Order No. DE 5348, which was entered into by Capital and the Washington State Department of Ecology (Ecology) on January 24, 2008 (Agreed Order).

1.1 PURPOSE

The purpose of the SAP is to describe the procedures to be used to inspect, assess, and evaluate the potential of vapor intrusion (VI) migration of vapors with constituents of potential concern (COPCs) from groundwater to indoor air in the building. The COPCs include tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride. The inspection, assessment, and evaluation procedures are consistent with the Inhalation Pathway Interim Measures (IPIM) Work Plan prepared by Philip Services Corporation (PSC) (2002) and the Draft Interim Vapor Intrusion Plan prepared by Arrow et al. (2007), which is Exhibit D of the Agreed Order.

1.2 SAMPLING AND ANALYSIS PLAN ORGANIZATION

The SAP has been organized into the following sections: Section 1 presents the SAP purpose; Section 2 provides a site description and a summary of the IPIM approach for VI Assessment; Section 3 presents the results of the building evaluation conducted and discusses the proposed procedures to collect soil gas samples; and Section 4 discusses the report that will be prepared to describe the results of the assessment activities and anticipated schedule. The documents used in preparing the SAP are referenced in Section 5.

2.0 SITE DESCRIPTION AND IPIM APPROACH

2.1 SITE DESCRIPTION

The Building is located within the Capital Area of Investigation, east of the Capital Plant 4 (Figure 2), and is currently used for warehouse storage for Pacific Food Systems. The interior space consists of a large open warehouse area with two offices and a bathroom (Figure 1). The Building is constructed of poured concrete and corrugated steel, with a slab-on-grade foundation. Ceilings are at least 20 feet high in the warehouse area. Many chemical products and welding materials are used during operations conducted within the Building. Chemical products are stored in a large chemical cabinet in the warehouse area. A floor drain is present in bathroom that is assumed to discharge to the sewer.

2.2 IPIM APPROACH FOR VAPOR ASSESSMENT

Capital's VI Assessment Work Plan dated September 16, 2008 prepared by Farallon (2008) presents a scope of work for groundwater VI assessment at buildings within the Capital Area of Investigation that is consistent with the IPIM approach defined by PSC and adopted by Capital. The IPIM approach includes a four-tiered IPIM process that is summarized below.

- **Tier 1 and 2:** Analytical results of groundwater samples are compared to groundwater IPIM Action levels (IPIMALs) to determine whether there is a potential VI concern in nearby residential (Tier 1) or commercial (Tier 2) buildings. The groundwater data are used to calculate a cancer cumulative exceedance factor (CCEF) and a non-cancer cumulative exceedance factor (NCCEF). If either the CCEF or NCCEF exceeds a factor of 10 (which represents a carcinogenic risk greater than 1E-05 or hazard index greater than 1, respectively), the building is further evaluated under Tier 3 or may proceed directly to Tier 4.
- **Tier 3:** Building-specific sampling is conducted, potentially including indoor air, ambient air, additional groundwater, and soil gas/sub-slab soil gas sampling, to empirically determine whether installation of a VI mitigation system (under Tier 4) is warranted. This SAP outlines the results of the preliminary building inspection evaluation, and the procedures to assess the building-specific VI potential at the Building.
- **Tier 4:** A VI mitigation system is installed and operated as an interim measure to mitigate the VI pathway.

The concentrations of COPCs detected in groundwater samples collected from monitoring wells located up-gradient of the Building do not warrant a Tier 3 Assessment (Figure 2; Table 2). However, due to concentrations of COPCs detected in soil samples collected in the vicinity of the Building (Figure 2; Table 3), Ecology is requiring Capital to proceed with a Tier 3 Assessment to evaluate the potential of VI at the Building. Concentrations of COPCs in soil are presented in Table 3 and in the Remedial *Investigation Field Program First Phase Report, Capital Industries, Inc. 5801 3rd Avenue South, Seattle, Washington* dated September 18, 2009, prepared by Farallon (2009).

3.0 VAPOR INTRUSION ASSESSMENT PROCEDURES

This section summarizes the results of the preliminary building inspection and evaluation, and presents the VI Assessment and sampling procedures to be conducted by Capital at the Building.

3.1 BUILDING INSPECTION AND EVALUATION

A preliminary inspection and evaluation of the Building was conducted on January 7, 2011 to better understand the architecture, layout, and ventilation features and to identify Building features that may provide a preferential pathway for soil gas to enter the Building.

The Building is currently occupied by Pacific Food Systems that operates a warehouse during normal business hours. The Building is constructed of poured concrete and corrugated steel, with a slab-on-grade foundation. No crawl space is located under the Building. The warehouse is ventilated by a heating, ventilation, and air conditioning (HVAC) system and large roll-up doors. The floor drain in the bathroom was observed as a possible preferential pathway for soil gas. Two offices located in the southern portion of the Building are likely less affected by the HVAC system in the warehouse portion of the Building.

Many chemicals observed in the warehouse during the building inspection are potential sources of COPCs to indoor air in the Building. An inventory of the chemicals used in the Building will be conducted at the time of soil gas sampling.

Based on the Building's proximity to concentrations of COPCs in soil, the identified potential pathway for vapor intrusion, the enclosed nature of the Building, and chemicals located within the Building, two sub-slab soil gas sample will be collected inside the Building (Figure 1). The sub-slab soil gas sampling locations and procedures are presented in the following sections.

3.2 SOIL GAS SAMPLING

One sub-slab soil gas sample will be collected outside the bathroom and one will be collected in an office (Figure 1). The sub-slab soil gas samples will be collected using evacuated 1-liter Summa canisters that have been individually certified clean. Each canister will be equipped with a vacuum gauge and a flow regulator to collect a 2-hour time-integrated sample. Leak testing will be performed during sub-slab soil gas sampling. The weather forecast will be monitored, and an attempt will be made to collect samples during a period of decreasing barometric pressure, preferably during a storm-generated low. Weather conditions (i.e., temperature, wind speed, wind direction, and barometric pressure) registered at the Boeing Field weather station before, during, and at the conclusion of the sampling event will be recorded.

Upon completion of sampling, Summa canisters will be packed into their original shipping containers and sent to Air Toxics Laboratory in Folsom, California for analysis of COPCs using U.S. Environmental Protection Agency TO-14/TO-15 analytical methods. Target reporting limits will range from approximately 0.5 to 1 micrograms per cubic meter and may vary based on the concentrations of analytes detected and the pressure in the sample canister.

Sub-slab soil gas sampling will be conducted in accordance with PSC standard operating procedure (SOP) No. PSC-129 (PSC 2002) (provided in Appendix A). Based on the location and enclosed nature of the offices in the southern portion of the Building and the proximity to the concentrations of COPCs detected in soil, sub-slab soil gas samples will be collected at the back of the warehouse along the midpoint of the western wall and in the southwest corner of the most interior office.

4.0 REPORTING AND SCHEDULE

The scope of work presented in the SAP will be implemented within 30 days of review and receipt of approval from both Capital and Ecology, contingent on Building access, receipt of permission from the property owner(s) to conduct sampling, and suitable weather conditions.

The sampling results will be presented in a VI Tier 3 Assessment Report, which will contain a brief narrative of the procedures followed for the sampling activities; weather conditions at the time of sampling; and an inventory of materials observed in the Building. The VI Tier 3 Assessment Report also will discuss any issues encountered during the sampling event(s) and the analytical results for the soil gas samples collected.

The VI Tier 3 Assessment Report will include a comparison of the analytical results for the sub-slab soil gas samples to the Commercial Indoor Air IPIMALs (Table 1) and calculations of the NCCEF and CCEF. Calculation results will be used to determine whether the Building warrants Tier 4 action or no additional action is necessary. Following review and approval by Capital, the VI Tier 3 Assessment Report will be submitted to Ecology for review and comment.

5.0 REFERENCES

Arrow Environmental; Aspect Consulting; Farallon Consulting, L.L.C.; and Pacific Groundwater Group (Arrow et al.). 2007. *Draft Interim Vapor Intrusion Plan*. Prepared for the Washington State Department of Ecology. May 1.

Farallon Consulting, L.L.C. (Farallon). 2008. *Vapor Intrusion Assessment Work Plan, Capital Industries, Inc., 5801 Third Avenue South, Seattle, Washington*. Prepared for Mr. Ron Taylor, Capital Industries, Inc. September 16.

________. 2009. *Remedial Investigation Field Program First Phase Report, Capital Industries, Inc. 5801 3rd Avenue South, Seattle, Washington*. Prepared for Mr. Ron Taylor, Capital Industries, Inc. September 18.

Philip Services Corporation (PSC). 2002. *Revised Inhalation Pathway Interim Measures Work Plan*. Prepared for the Washington State Department of Ecology. August.

FIGURES

TIER 3 VAPOR INTRUSION ASSESSMENT
SAMPLING AND ANALYSIS PLAN
5815 4th Avenue South, Northern Building
Seattle, Washington

Farallon PN: 457-004

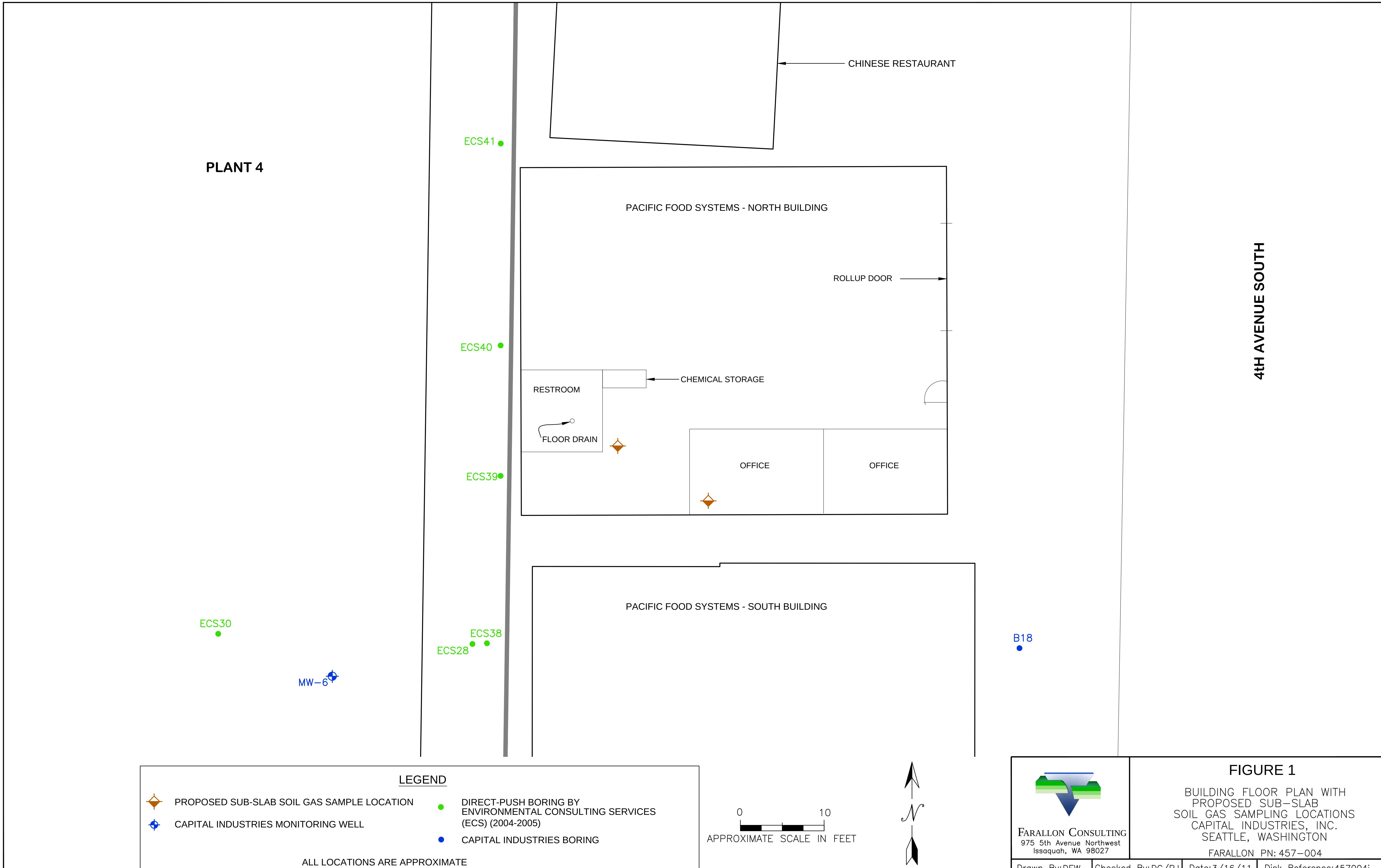

FIGURE 1

BUILDING FLOOR PLAN WITH PROPOSED SUB–SLAB SOIL GAS SAMPLING LOCATIONS
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457–004

Drawn By:DEW | Checked By:DC/PJ | Date:3/16/11 | Disk Reference:457004i

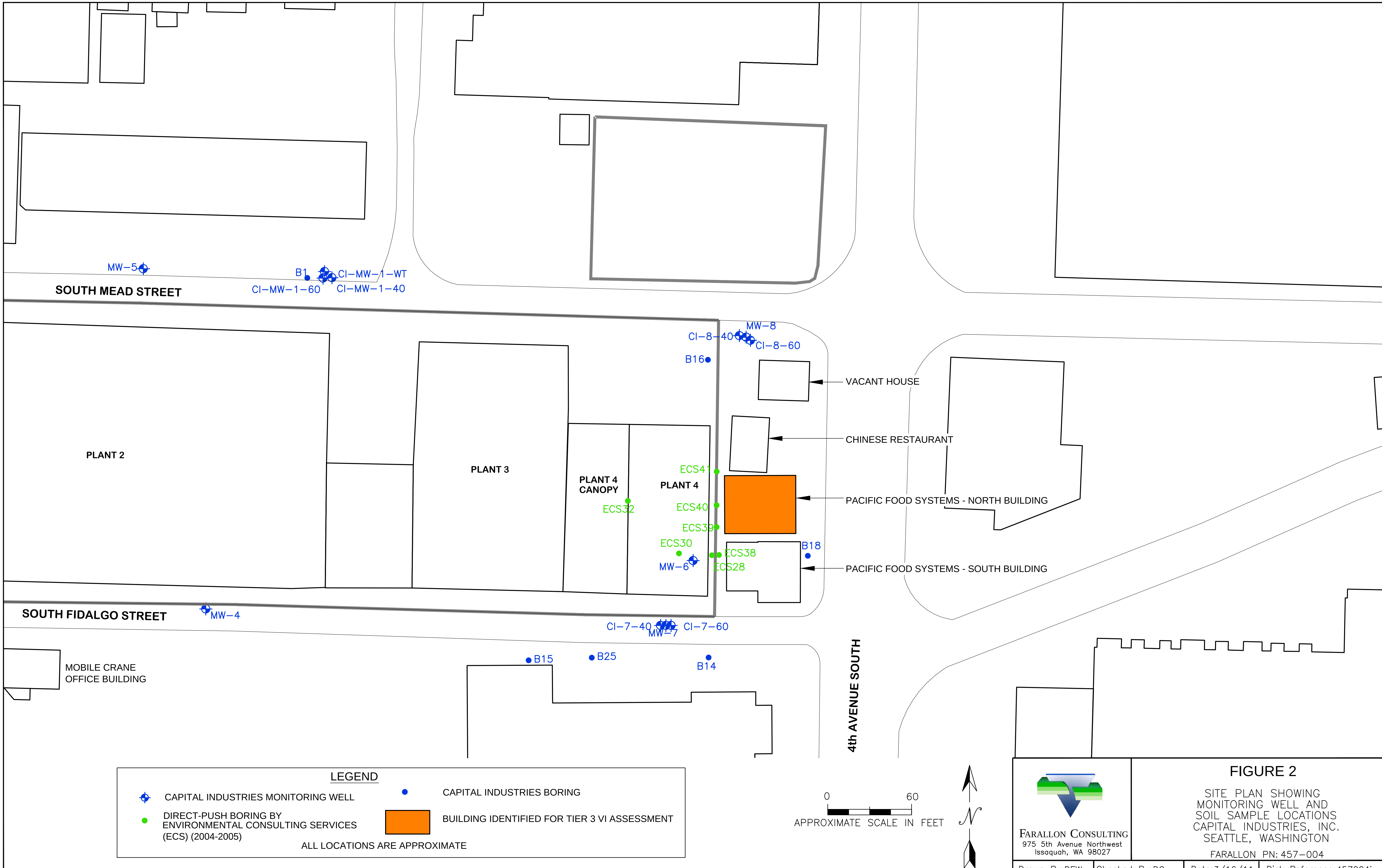

FIGURE 2
SITE PLAN SHOWING MONITORING WELL AND SOIL SAMPLE LOCATIONS
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON
FARALLON PN: 457−004

TABLES

TIER 3 VAPOR INTRUSION ASSESSMENT
SAMPLING AND ANALYSIS PLAN
5815 4th Avenue South, Northern Building
Seattle, Washington

Farallon PN: 457-004

Table 1
Indoor Air and Sub-Slab Soil Gas IPIMALs for Residential and Commercial Scenarios
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Compound	Indoor Air IPIMALs (µg/m^3)[1]				Sub-Slab Soil Gas IPIMALs (µg/m^3)[1]			
	Residential		Commercial		Residential		Commercial	
	Cancer	Non-cancer	Cancer	Non-cancer	Cancer	Non-cancer	Cancer	Non-cancer
Tetrachloroethene	0.42	27	0.97	120	4.2	270	9.7	1,200
Trichloroethene	0.098	1.6	0.23	6.8	0.98	16	2.3	68
cis-1,2 Dichloroethene	-	1.6	-	6.8	-	16	-	68
trans-1,2-Dichloroethene	-	3.2	-	14	-	32	-	140
Vinyl Chloride	0.28	4.6	0.66	19	2.8	46	6.6	190

NOTES:

- denotes no toxicity value was available. Therefore, an IPIMAL could not be calculated.

[1]The IPIMALs presented in this table were calculated by Pioneer Technologies Corporation in January 2009.

IPIMAL = Inhalation pathway interim measure action level

µg/m^3 = micrograms per cubic meter

Table 2
Summary of COPC Groundwater Analytical Results
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Sample Location	Sample Date	Analytical Results (micrograms per liter) [2]				
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride
Water Table Zone						
MW-1	02/10/06	**0.52**	**16**	**78**	1.1	<0.4
	June 2009	**0.44**	**13**	34	0.66	0.12
	6/16/2010	**0.34**	**9.5**	19	0.5	<0.20
	9/29/2010	**0.36**	**11**	22	0.68	<0.20
	12/21/2010	0.24	<0.20	16	0.5	<0.20
MW-2	02/10/06	<2	**300**	28	6.2	<2
	3/25/2010	<0.40	**73**	21	3.0	0.67
	6/17/2010	<0.40	**68**	10	3.0	<0.40
	9/30/2010	<0.40	**77**	52	7.5	**3.4**
	12/15/2010	<0.40	**63**	12	5.5	0.56
MW-3	02/09/06	<0.2	**5.6**	49	0.23	**4**
	3/25/2010	<0.20	**4.5**	30	<0.20	0.51
	6/16/2010	<0.20	**4.6**	33	0.26	0.65
	9/29/2010	<0.20	**5.1**	39	0.3	0.65
	12/15/2010	<0.20	**4.3**	32	0.27	0.48
MW-4	02/09/06	<0.2	**3.6**	1.1	<0.2	<0.2
	3/25/2010	<0.20	**1.7**	1.1	<0.20	0.67
	6/17/2010	<0.20	**2.5**	1.2	<0.20	<0.20
	9/29/2010	<0.20	**2.4**	2	<0.20	0.34
	12/15/2010	<0.20	**4.4**	3.3	<0.20	0.36
MW-5	02/09/06	<2	**300**	**230**	3.2	**17**
	3/24/2010	<1.0	**110**	**79**	1.6	**2.6**
	6/16/2010	<1.0	**130**	**100**	2.2	**5.1**
	9/29/2010	<1.0	**120**	**130**	2	**4.2**
	12/16/2010	<1.0	**110**	**95**	1.9	**2.5**
MW-6	02/10/06	**16**	**19**	22	<0.2	<0.2
	3/24/2010	**11**	**7**	1.3	<0.20	<0.20
	6/17/2010	**5.5**	**6.8**	3.9	<0.20	<0.20
	9/28/2010	**10**	**5.3**	0.28	<0.20	<0.20
	12/162010	**11**	**6.8**	2.7	<0.20	<0.20
MW-7	02/09/06	**46**	**38**	6.7	<0.2	<0.2
	3/24/2010	**22**	**17**	5.9	1.9	<0.20
	6/17/2010	**9.4**	**8.1**	5.8	<0.20	0.43
	9/30/2010	**17**	**9.7**	3.8	<0.20	0.44
	12/14/2010	**2.4**	**6.5**	4.3	<0.20	0.57
MW-8	02/09/06	<0.2	<0.2	0.41	<0.2	<0.2
	3/24/2010	<0.20	<0.20	0.26	<0.20	<0.20
	6/16/2010	<0.20	<0.20	0.3	<0.20	<0.20
	9/30/2010	<0.20	<0.20	0.63	<0.20	<0.20
	12/16/2010	<0.20	0.21	0.75	<0.20	<0.20
CI-9-WT	6/16/2010	**1.8**	**26**	3.8	<0.20	<0.20
	9/29/2010	**2.7**	**36**	4.6	<0.20	<0.20
	12/14/2010	**3.2**	**34**	4.3	<0.20	<0.20
CI-10-WT	3/24/2010	<0.20	**32**	7.5	0.39	<0.20
	6/17/2010	<0.20	**39**	17	0.79	<0.20
	9/29/2010	<0.40	**51**	19	0.78	<0.40
	12/14/2010	<0.40	**87**	35	1.9	<0.40
CI-11-WT	6/15/2010	<0.20	<0.20	0.32	<0.20	**2.0**
	9/27/2010	<0.20	<0.20	0.23	<0.20	**1.4**
	12/14/2010	<0.20	<0.20	0.29	<0.20	**1.4**
Screening Levels[3]		**0.17**	**0.404**	**72.7**	**65.3**	**1.28**

Table 2
Summary of COPC Groundwater Analytical Results
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Sample Location	Sample Date	Analytical Results (micrograms per liter) [2]				
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride
CI-12-WT	3/23/2010	<0.20	0.38	<0.20	<0.20	0.59
	6/15/2010	<0.20	0.33	<0.20	<0.20	0.31
	9/28/2010	<0.20	0.21	<0.20	<0.20	<0.20
	12/15/2010	<0.20	<0.20	<0.20	<0.20	<0.20
CI-13-WT	6/17/2010	<0.20	<0.20	0.26	<0.20	<0.20
	9/28/2010	<0.20	<0.20	<0.20	<0.20	<0.20
	12/15/2010	<0.20	<0.20	<0.20	<0.20	<0.20
CI-14-WT	6/16/2010	<0.20	1.2	3	0.22	<0.20
	9/28/2010	<0.20	1.7	3	0.25	<0.20
	12/15/2010	<0.40	0.46	48	<0.40	1.5
CG-137-WT	3/25/2010	<0.40	**98**	49	9.8	**3.3**
	6/18/2010	<0.40	**98**	50	7.7	0.92
	9/30/2010	<0.40	**92**	50	9.7	**1.4**
	12/15/2010	<1.0	**93**	48	9.4	**4.2**
CG-141-WT	3/23/2010	<0.20	<0.20	<0.20	<0.20	<0.20
	6/15/2010	<0.20	<0.20	<0.20	<0.20	<0.20
	9/29/2010	<0.20	<0.20	<0.20	<0.20	<0.20
	12/16/2010	<0.20	<0.20	<0.20	<0.20	<0.20
Screening Levels[3]		**0.17**	**0.404**	**72.7**	**65.3**	**1.28**

NOTES:

Results in **bold** denote concentrations above applicable screening levels.

< denotes analyte not detected at or above the reporting limit listed.

[1]Depth in feet below ground surface.

[2]Analyzed using U.S. Environmental Protection Agency Method 8260B.

[3]Screening levels were calculated using Washington State Model Toxics Control Act Cleanup Regulation (MTCA) Modified Method B groundwater cleanup levels, modified based on Asian Pacific Island Exposure scenarios for the consumption of fish for the groundwater-to-surface-water pathway, the Federal Clean Water Act Ambient Water Quality Criteria based on human health consumption of organisms for the groundwater-to-surface-water pathway, and Residential Exposure Scenario for inhalation of indoor air exposure pathway.

COPC - contaminant of potential concern

DCE = dichloroethene

PCE = tetrachloroethene

TCE = trichloroethene

Water Table Zone = denotes interval from the top of water table to 20 feet below ground surface (bgs).

Table 3
Summary of COPC Soil Analytical Results
Capital Industries
Seattle, Washington
Farallon PN: 457-004

Sample Location	Sample Identification	Sample Depth[1]	Sample Date	Analytical Results (milligrams per kilogram) [2]				
				PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride
ECS28	ECS28	2.6	May-05	**0.034**	**0.027**	0.0037	<0.005	<0.005
ECS28	ECS28	6.0	May-05	**0.037**	**0.013**	0.005	<0.005	<0.005
ECS30	ECS30	2.9	May-05	**0.016**	**0.14**	0.006	<0.005	<0.005
ECS30	ECS30	6.5	May-05	**0.017**	**0.046**	**0.017**	<0.005	<0.005
ECS32	ECS32	2.1	May-05	<0.005	**0.037**	0.0046	<0.005	<0.005
ECS32	ECS32	4.5	May-05	<0.005	**0.045**	0.0048	<0.005	<0.005
ECS38	ECS38	4.2	May-05	**0.014**	**0.006**	0.0029	<0.005	<0.005
ECS38	ECS38	6.4	May-05	**0.038**	**0.0041**	0.0022	<0.005	<0.005
ECS39	ECS39	0.7	May-05	**0.006**	**0.015**	**0.017**	<0.005	<0.005
ECS39	ECS39	2.2	May-05	**0.009**	**0.013**	**0.038**	<0.005	<0.005
ECS39	ECS39	6.7	May-05	0.0024	0.0024	**0.0263**	<0.005	<0.005
ECS39	ECS39	9.5	May-05	<0.005	<0.005	0.0037	<0.005	<0.005
ECS40	ECS40	0.6	May-05	0.0015	**0.0044**	<0.005	<0.005	<0.005
ECS40	ECS40	2.4	May-05	**0.009**	**0.015**	**0.029**	<0.005	<0.005
ECS40	ECS40	7.3	May-05	**0.0045**	**0.009**	**0.01**	<0.005	<0.005
ECS41	ECS41	0.1	May-05	<0.005	<0.005	<0.005	<0.005	<0.005
ECS41	ECS41	2.5	May-05	<0.005	0.0015	<0.005	<0.005	<0.005
ECS41	ECS41	6.8	May-05	<0.005	0.0014	0.002	<0.005	<0.005
B14	B14-120408-2	2.0	12/4/2008	**0.091**	**0.024**	<0.0013	<0.0013	<0.0064
B14	B14-120408-5	5.0	12/4/2008	**0.0055**	0.0018	<0.0012	<0.0012	<0.0059
B14	B14-120408-7	7.0	12/4/2008	**0.0097**	**0.0035**	<0.0012	<0.0012	<0.0058
B15	B15-120208-2	2.0	12/2/2008	**0.0039**	<0.0012	<0.0012	<0.0012	<0.0061
B15	B15-120208-5	5.0	12/2/2008	<0.0012	<0.0012	<0.0012	<0.0012	<0.0059
B15	B15-120208-7	7.0	12/2/2008	0.0012	<0.0011	<0.0011	<0.0011	<0.0056
B18	B18-120908-2	2.0	12/9/2008	<0.0011	0.0017	<0.0011	<0.0011	<0.0055
B18	B18-120908-5	5.0	12/9/2008	**0.008**	**0.0060**	<0.0012	<0.0012	<0.0061
B18	B18-120908-7	7.0	12/9/2008	**0.021**	**0.012**	<0.0011	<0.0011	<0.0053
B25	B25-073009-2	2.0	7/30/2009	**0.021**	**0.0076**	<0.0057	<0.0057	<0.0057
B25	B25-073009-5	5.0	7/30/2009	**0.012**	**0.015**	<0.0011	<0.0011	<0.0011
B25	B25-073009-7	7.0	7/30/2009	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
B26	B26-073009-2	2.0	7/30/2009	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
B26	B26-073009-5	5.0	7/30/2009	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
B26	B26-073009-7	7.0	7/30/2009	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
Screening Levels[3]				**0.0031**	**0.0028**	**0.00993**	**0.00969**	**0.005**

Notes:

Results in **bold** denote concentrations above applicable screening levels.

< denotes analyte not detected at or above the reporting limit listed.

Samples collected by Farallon Consulting, L.L.C.

[1]Depth in feet below ground surface.

[2]Analyzed using U.S. Environmental Protection Agency Method 8260B.

[3]Screening levels were calculated using Washington State Model Toxics Control Act Cleanup Regulation (MTCA) Modified Method B groundwater cleanup levels, modified based on Asian Pacific Island Exposure scenarios for the consumption of fish for the groundwater-to-surface-water pathway, the Federal Clean Water Act Ambient Water Quality Criteria based on human health consumption of organisms for the groundwater-to-surface-water pathway, and Residential Exposure Scenario for inhalation of indoor air exposure pathway.

COPC = contaminant of potential concern

DCE = dichloroethene

PCE = tetrachloroethene

TCE = trichloroethene

APPENDIX A
STANDARD OPERATING PROCEDURES

TIER 3 VAPOR INTRUSION ASSESSMENT
SAMPLING AND ANALYSIS PLAN
5815 4th Avenue South, Northern Building
Seattle, Washington

Farallon PN: 457-004

FARALLON
consulting

975 5th Avenue Northwest, Issaquah, Washington 98027
Tel: (425) 295-0800 Fax: (425) 295-0850
www.faralloncsulting.com

STANDARD OPERATING PROCEDURES

Appendix A of the
Tier 3 Vapor Intrusion Assessment
Sampling and Analysis Plan

Submitted by:
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington 98027

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STANDARD OPERATING PROCEDURE FOR INDOOR AMBIENT AIR SAMPLING USING EPA TO-14 OR TO-15 ANALYTICAL METHOD

This standard operating procedure (SOP) is based on Philip Services Corporation (PSC) SOP No. PSC-127. It contains the following sections:

1.0 PURPOSE

The purpose of this SOP is to provide personnel with the specific information needed to collect and document consistent and representative indoor ambient air data.

2.0 APPLICATION

This SOP shall be followed by all personnel who collect indoor ambient air samples associated with the Capital Industries (CI) facility in Seattle, Washington.

3.0 REFERENCES

Air Toxics LTD. *Guide to Air Sampling and Analysis, Canisters and Tedlar Bags.* Fourth Edition. Folsom, California. www.airtoxics.com.

Massachusetts Department of Environmental Protection. 2002. *Indoor Air Sampling and Evaluation Guide.* Boston, Massachusetts. April.

Pioneer Technologies Corporation, Foster Wheeler Environmental Corporation, and Philip Services Corporation. 2002. *Revised Inhalation Pathway Interim Measures Work Plan, Philip Service Corporation, Georgetown Facility, Seattle, Washington.* Pioneer Technologies Corporation, Olympia, Washington. August.

U.S. Environmental Protection Agency (EPA). January 1999. Method TO-14A. EPA/625/R-96/010b. Cincinnati, Ohio.

———. January 1999. Method TO-15. EPA/625/R-96/010b. Cincinnati, Ohio.

4.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies are necessary to properly conduct indoor ambient air sampling:

- Sufficient number of 6-liter Summa canisters, appropriate filters, and flow controllers to collect samples required by the work plan;
- Equipment required to collect samples using 6-liter Summa canisters, including appropriate wrenches and pressure gauges;
- A photoionization detector (PID) or similar instrument and the proper calibration gases to monitor the indoor ambient air during building evaluation; and
- Shipping package for the Summa canisters.

5.0 PROCEDURES

5.1 Preparation of Buildings for Sampling

Prior to sampling a building, conduct a building evaluation to determine potential sources of contamination. The purpose of the building evaluation is to identify building construction characteristics, heating and ventilation systems, and sources of possible chemical contaminants that may influence the results of indoor sampling at each location[1]. Identify potential sources of volatile organic compounds in the building by visual observation and by using a PID or similar air monitoring device to screen the building. If possible, any chemicals found should be sealed properly or removed from the building during the test. If source materials are removed from the building, it is recommended that sampling be delayed for a minimum of 24 hours. During the evaluation, document outdoor sources of contamination and weather conditions that could influence indoor ambient air concentrations. Potential sources of volatile organic compounds in the building (and their subsequent management), outdoor sources of contamination, and weather conditions are to be recorded in the field book.

5.2 Sampling Methodology

Time-integrated indoor ambient air samples are collected using 6-Liter (L) Summa canisters prepared under negative pressure and laboratory-certified clean for the compounds of interest for the site.

The Summa canisters should be equipped with dedicated flow regulators. The most representative indoor ambient air sample using this sampling technology will use an 8-hour

[1] There are many sources of indoor air contamination from the use of everyday cleaning products, beauty products, and home maintenance materials. Carpets and wood may contain volatile chemicals such as formaldehyde, xylenes, and acetone. Paints and paint thinners contain chemicals such as acetone and toluene. Refrigerators can leak Freon. Sinks and drains may be linked to sewer systems, and gases such as methane may back up through sewer pipes into the home. Chemicals such as cleaning products (e.g., oven cleaners, degreasers, ammonia, chlorine) and beauty products (e.g., spray deodorants, hair spray, perfumes) stored in the home may emit volatile compounds into the air. Other items that also may cause volatile emissions include animal feces in litter boxes, degrading food products, dry-cleaning chemicals from clothing, and fuel in furnaces.

sample period. In such a case, the flow rate of the flow regulators should be set at a fill rate for an 8-hour period.

- Verify that the canister number engraved on the canister matches the canister number listed on the certified clean tag attached to the canister to ensure that proper decontamination of the canister was completed.
- Set up the canister in the desired sample location at approximately 3 feet above the floor.
- Verify that the canister valve is closed tightly and remove the threaded cap at the top of the canister.
- Attach the flow regulator/pressure gauge to the top of the canister, using a wrench to gently tighten it.
- Open the valve and record the pressure on the gauge as the "initial pressure" in the field notes and on the sample tag attached to the canister.
- Completely fill out the sample tag attached to the canister and record all sample information in the field book, including the following:
    - Sample identification;
    - Sample start date;
    - Sample start time;
    - Location of sample: distance from walls and floor shown on building evaluation floor plan;
    - Initial pressure of canister; and
    - Canister number.
- After sampling begins and the canister is verified to be operating correctly, leave the canister to fill.
- Return after approximately 6 to 7 hours to check the canisters to ensure that they are operating properly. It is necessary to check the canister prior to the 8-hour period because the accuracy of the flow regulators can vary slightly, causing the canisters to fill faster than expected. To check the sample progress complete the following:
    - Record the gauge pressure in the field book. **The final pressure at the end of sampling should be approximately -5 to -6 inches mercury (Hg).** If the canister has already reached this point, sampling is complete, and this pressure should be recorded as the "final pressure" on the sample tag and in the field book. If the pressure is not at this level, the canister should be left to continue filling.
    - Record all stop and start times of sample collection in the field book.
- If the sample collection was continued after 7 hours and the canister appears to be filling at the appropriate rate, sample collection will be considered complete after 8 hours have elapsed.
- At the end of sampling, record the exact pressure of the canister and the time on the sample tag for that canister and in the field book.

5.3 Post-Sample-Collection Procedures

Label all sample containers with the following information: sample identification, date and time sample was collected, the starting and ending canister pressure, the site name, and the company name. Record all of this information and the ending time of sample collection in the field book and transfer pertinent information to the chain-of-custody record. Pack all Summa canisters in the original shipping containers, seal with a custody seal, and send to the laboratory for analysis. Although the unofficial holding time for this analysis is 30 days, samples should reach the laboratory as soon as possible to allow the laboratory time to conduct re-runs, dilutions, and low-level analyses, as necessary prior to sample expiration.

5.4 Analysis

The indoor air samples should be analyzed using EPA Methods TO-14 or TO-15, and when necessary/possible, low-level analysis or Selective Ion Mode (SIM) analysis to obtain the lowest achievable detection and reporting limits. The air samples collected in the Summa canisters have a 30-day holding time. Note the desired analytical method on the Chain of Custody form.

6.0 DECONTAMINATION

Equipment used for air sampling does not require decontamination in the field. The Summa canisters will be individually cleaned and certified to 0.02 parts per billion by volume for the project-specific analyte list by the contract laboratory prior to shipment. (Note: Air Toxics has reported they can certify only to 0.1 parts per billion by volume for trans-1,2-dichloroethene.) Ensure that documentation of this certification is included on a tag attached to the canister and in the paperwork that accompanies the canister shipment from the laboratory.

7.0 DOCUMENTATION

Record all field activities, environmental and building conditions, and sample documentation in the field notebook.

STANDARD OPERATING PROCEDURE FOR OUTDOOR AMBIENT AIR SAMPLING USING EPA TO-14 OR TO-15 ANALYTICAL METHOD

This standard operating procedure (SOP) is based on Philip Services Corporation (PSC) SOP No. PSC-128. It contains the following sections:

1.0 PURPOSE

The purpose of this SOP is to provide personnel with the specific information needed to collect and document consistent and representative ambient outdoor air data.

2.0 APPLICATION

This SOP shall be followed by all personnel who collect ambient outdoor air samples in support of indoor air sampling associated with the Capital Industries (CI) facility in Seattle, Washington.

3.0 REFERENCES

Air Toxics LTD. Guide to Air Sampling and Analysis, Canisters and Tedlar Bags. Fourth Edition. Folsom, California. wwvv.airtoxics.com.

Pioneer Technologies Corporation. August 2002. Revised Inhalation Pathway Interim Measures Work Plan, Philip Service Corporation, Georgetown Facility, Seattle, Washington. Pioneer Technologies Corporation, Olympia, Washington.

U.S. Environmental Protection Agency (EPA). 1999a. Method TO-14A. EPA/625/R-96/010b. Cincinnati, Ohio. January.

———. 1999b. Method TO-15. EPA/625/R-96/010b. Cincinnati, Ohio.

40 CFR Part 58, Appendix E, Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring. January.

4.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies are necessary to properly conduct outdoor ambient air sampling:

- Sufficient number of 6-liter Summa canisters, appropriate filters, and flow controllers to collect samples required by the work plan.
- Equipment required to collect samples using 6-liter Summa canisters, including appropriate wrenches and pressure gauges.
- Shipping package for the Summa canisters.

5.0 PROCEDURES

5.1 Sampling Locations

Outdoor ambient air samples are usually collected near buildings where indoor ambient air sampling is occurring. Sample collection points should be selected so that intake occurs at least 2 meters above the ground surface and upwind of the building undergoing indoor air sampling.

5.2 Sampling Methodology

Time-integrated outdoor ambient air samples will be collected using 6-liter Summa canisters prepared under negative pressure and certified clean for the compounds of interest for the site. The Summa canisters should be equipped with dedicated flow regulators. The most representative outdoor ambient air sample using this sampling technology will use an 8-hour sample period. In such a case, the flow rate of the flow regulators should be set at a fill rate for an 8-hour period.

- Verify the canister number engraved on the canister matches the canister number listed on the certified clean tag attached to the canister to ensure proper decontamination of the canister was completed.
- Set up the canister in the desired sample location.
- Verify that the valve is closed tightly, and then remove the threaded cap at the top of the canister.
- Attach the flow regulator/pressure gauge to the top of the canister, using a wrench to gently tighten it.
- Open the valve and record the pressure on the gauge as the "initial pressure" in the field notes and on the sample tag attached to the canister.
- Completely fill out the sample tag attached to the canister and record all sample information in the field book, including the following:
    - Sample identification;
    - Sample start date;
    - Sample start time;
    - Location of sample;

- Initial pressure of canister; and
- Canister number.

- After sampling begins and the canister is verified to be operating correctly, leave the canister to fill.

- Return after approximately 6 to 7 hours to check the canisters to ensure that they are operating properly.

- It is necessary to check the canister prior to the 8-hour period because the accuracy of the flow regulators can vary slightly, causing the canisters to fill faster than expected. To check the sample progress complete the following:

    - Record the gauge pressure in the field book. **The final pressure at the end of sampling should be approximately -5 to -6 inches mercury (Hg).** If the canister has already reached this point, sampling is complete, and this pressure should be recorded as the "final pressure" on the sample tag and in the field book. If the pressure is not at this level yet, the canister should be left to continue filling.
    - Record all stop and start times of sample collection in the field book.

- If the sample collection was continued after 7 hours and the canister appears to be filling at the appropriate rate, sample collection will be considered complete after 8 hours have elapsed.

- Record the exact pressure of the canister and the time at the end of sampling on the sample tag for that canister and in the field book.

5.3 Post-Sample-Collection Procedures

Label all sample containers with the following information: sample identification, date and time sample was collected, the starting and ending canister pressure, the site name, and the company name. Include all this information in the field book plus the ending time of sample collection, and transfer pertinent information to the chain-of-custody record. Pack all Summa canisters in the original shipping containers, sealed with a custody seal, and send to the lab for analysis. Although the unofficial holding time for this analysis is 30 days, samples should reach the laboratory as soon as possible to allow laboratory time to conduct re-runs, dilutions, low-level analyses, as necessary prior to sample expiration.

5.4 Analysis

The outdoor ambient air samples should be analyzed using EPA Methods TO-14 or TO-15, and when necessary/possible, low-level analysis or Selective Ion Mode (SIM) analysis to obtain the lowest achievable detection and reporting limits. The air samples collected in the Summa canisters have a 30-day holding time. Note the desired analytical method on the Chain of Custody form.

6.0 DECONTAMINATION

Equipment used for air sampling does not require decontamination in the field. The Summa canisters will be individually cleaned and certified to 0.02 parts per billion by volume for the project-specific analyte list by the contract laboratory prior to shipment. (Note: Air Toxics has reported they can certify only to 0.1 parts per billion by volume for trans-1,2-dichloroethene.) Ensure that documentation of this certification is included on a tag attached to the canister and in the paperwork that accompanies the canister shipment from the laboratory.

7.0 DOCUMENTATION

Record all field activities, environmental and building conditions, and sample documentation in the field notebook.

STANDARD OPERATING PROCEDURE FOR SUB-SLAB SOIL GAS SAMPLING WITH LEAK TESTING

This standard operating procedure (SOP) is based on Philip Services Corporation (PSC) SOP No. PSC-129. It contains the following sections:

1. Purpose
2. Application
3. References
4. Equipment and Supplies
5. Procedures
   - 5.1 Preparation for Sampling
   - 5.2 Leak Check Test for Manifold
   - 5.3 Purging
   - 5.4 Sampling Methodology Using Tracer Gas
   - 5.5 Post-Sample Collection Procedures
   - 5.6 Analysis
6. Decontamination
7. Documentation

1.0 PURPOSE

The purpose of this SOP is to provide field personnel with specific information needed to collect and document representative sub-slab soil gas samples. The recommended sampling technique, as presented in this SOP, is based on the assumption that concentrations of chemicals detected in the sub-slab soil gas samples are representative of the same chemicals that may volatilize from the uppermost aquifer into the vadose zone or from soil contamination within the vadose zone.

2.0 APPLICATION

This SOP shall be followed by all personnel who collect sub-slab soil gas samples in support of indoor air sampling associated with the Capital Industries (CI) facility in Seattle, Washington.

3.0 REFERENCES

Advanced Radon Technologies, Inc. 2002. *Radon Mitigation and Testing.* Spokane, Washington.

Air Toxics, LTD. Undated. *Guide to Air Sampling and Analysis.*

California Environmental Protection Agency. 2010. Draft Advisory – Active Soil Gas Investigation. Department of Toxic Substances Control. March.

Commonwealth of Massachusetts Department of Environmental Protection. 2002. *Indoor Air Sampling and Evaluation Guide.* WSC Policy #02-430. Boston, Massachusetts. April.

NYSDOH. 2006. New York State Department of Health Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October.

U.S. Environmental Protection Agency (EPA). 1999. Center for Environmental Research Information, Office of Research and Development. *Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method To-14A, Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography*. January.

———. 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils.* EPA530-02-052. November.

———. 2004. Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA Method TO-15 to Support Vapor Intrusion Investigations. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Groundwater and Ecosystem Restoration Division. Ada, Oklahoma.

Washington State Department of Ecology. 2009. Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action. Review draft. October.

4.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies will be used to conduct sub-slab soil gas sampling with leak testing:

- Closed-cell, smooth-surfaced foam exercise mat, acrylic shroud (with ¼-inch access port/s) of sufficient size to cover soil gas tubing and sampling apparatus (e.g. acrylic aquarium), two concrete blocks, ultra high-pure helium, MGD 2002 dielectric helium detector (or equal), new ¼-inch outside diameter (OD) Teflon tubing; Swagelok ¼-inch OD compression fittings;
- Hand rotary hammer drill, plumber's putty or suitable substitute that does not volatile organic compounds (VOCs);
- Sufficient number of 1-liter Summa canisters each with a dedicated manifold with appropriate filters, and flow controllers to collect samples required by the work plan;
- Purge canister, pressure gauges, valves, and/or accessories as supplied by the analytical laboratory;
- Equipment required to collect samples using 1-liter Summa canisters, including appropriate wrenches and compression fittings;
- Shipping package for the Summa canister/s;
- Disposable Teflon tubing for each sample;

- Patch material to repair hole drilled to original condition; and
- Field notes to record sampling information.

5.0 SUB-SLAB SOIL GAS MONITORING PORT SAMPLING PROCEDURE

Special consideration is given to ensure leakage of ambient air into the sub-slab soil gas sample is avoided or detected. The use of tracer gas enables detection of ambient air incursion from above the slab if the soil gas probe is not completely sealed. Helium will be used as the tracer gas and is added to the list of analytical target compounds. Detections of helium during sample collection will indicate ambient air leakage.

Soil gas samples should be collected during a period of decreasing barometric pressure, preferably during a storm-generated low.

5.1 Preparation for Sampling

- Ensure that access agreements are in place and appropriate permits (if any) have been obtained. Clear the sampling locations for utilities, if appropriate.
- In preparation for sampling, the field team will use a hand drill to drill an approximately 3/8-inch hole through the concrete floor slab of the building near the ambient indoor air sample locations when possible (if applicable). New Teflon tubing will be placed down the hole to a depth just below the base of the concrete slab. Plumbers putty or a similar VOC-free substance will be applied to the hole around the tubing to seal the hole, minimizing disturbance of sub-slab concentrations and surface air intrusion.
- Cut a hole toward one end of the foam exercise mat through which to feed the tubing. Place the mat over the tubing. See accompanying photographs.
- Configure the helium supply, helium detector, and shroud for monitoring. See accompanying photographs (helium supply not shown).

  Set the manifold, purge canister, and sample canister on the mat.

5.2 Leak Check Test for Manifold

- Confirm that both the purge canister and the sampling canister valves are closed (knob should be tightened clockwise).
- Remove brass caps from both the sample canister and the purge canister (unless using certified media, there is no difference between the two canisters).
- Attach manifold to canisters. See accompanying photographs.
- Confirm that a brass cap is secured at the inlet of the manifold, creating an air tight sampling train; ensure that the manifold valve above the purge canister is open; and quickly open and close the purge canister valve; close the manifold valve above the purge canister and disconnect the purge canister to check for leaks in the manifold and connections to the Summa canisters. Observe gauge for 5 minutes. If the needle on the gauge drops indicating a loss of pressure, the sampling train is not airtight. In this case, try refitting and/or tightening the connections until the needle holds steady.

5.3 Purging

- Once the sample train is airtight, remove the brass cap from the manifold inlet, connect the tubing from the sample port using a compression fitting, and open the purge canister valve one-half turn.
- Monitor integrated purging progress periodically to ensure it is occurring at the correct rate.
  *Please note: Because the purge canister is inline *after* the flow restrictor, the line will not purge faster than 6.7 milliliters per minute (rate set by Air Toxics for a 1-liter canister used to collect a 2-hour sample).
- If sampling at multiple locations, the purge canister can be disconnected from the manifold and used to purge the next sample location without affecting the sample train.
- The sample tubing should be purged of 3-5 "internal volumes" of air. Use the following equation to calculate the volume of air to remove:

  Volume = 3.1417 X (r) squared X length of tubing (inches)

  where r = the inner diameter radius (inches) of the tubing being used.

  The result will be in cubic inches. Convert to milliliters using 1 cubic inch = 16.387 milliliters. Divide by the flow rate (6.7 milliliters/minute) to determine how many minutes to purge the tubing. Record calculations in the field notes.
- Once the desired purge volume (calculated below) is met, close both the manifold and purge canister valves by hand, tightening the knobs clockwise.
- Perform sampling using the tracer gas.

5.4 Sampling Methodology Using Tracer Gas

- Verify that the canister number engraved on the canister matches the canister number listed on the attached certified clean tag to ensure that proper decontamination of the canister was completed.
- Open the sample canister valve and record the pressure on the gauge as the "initial pressure" in the field notes and on the sample tag attached to the canister.
- Immediately place the shroud over the sampling train, pressing it into the foam mat to minimize leakage of helium. Place weight (such as a concrete block) on each end of the shroud. Introduce helium into the headspace of the shroud until the concentration reaches 10 per cent as measured by the helium detector. Record helium concentration in the field notes.
- Maintain level of helium for the duration of sampling by monitoring with the helium detector and periodically pumping helium into the enclosure as needed. Record helium concentration in the shroud at five minute intervals in the field notes.
- After sampling begins and the canister is verified to be filling at the specified rate, permit the canister to fill.

Check the canister to ensure that it is filling at the specified rate. The volume of air sampled is a linear function of the canister vacuum. For example, halfway into sampling, the canister should be half filled and the gauge should read approximately 17 in. Hg. It is necessary to check the canister prior to the 2-hour period because the accuracy of the flow regulators can vary slightly, causing the canisters to fill faster than expected. To check the sample progress, complete the following:

- Record the gauge pressure in the field notes. The final pressure at the end of sampling should be approximately -5 to -6 inches mercury (Hg). Care should be taken to ensure the final canister vacuum does not reach 0 inches Hg. If the canister has already reached -5 to -6 inches Hg, sampling is complete and this pressure should be recorded as the "final pressure" on the sample tag and in the field notes. If the pressure is not at this level, the canister should be left to continue filling.
- Record all stop and start times of sample collection in the field notes.
- If sample collection appears to be filling at the appropriate rate, sample collection will be considered complete after 2 hours have elapsed.
- Close sample canister valve, disconnect from the manifold, and replace the brass caps.
- Record the exact pressure of the canister and the time at the end of sampling on the sample tag for that canister and in the field notes.
- Abandon the boring and repair to original condition.

5.5 Post-Sample-Collection Procedures

Label the sample container (Summa canister) tag with the following information: canister number, sample identification, date and time sample was collected, the starting and ending canister pressure, the site name, and the company name. Include this information, the ending time of sample collection, and the location of the sample (distance from walls and floor shown on building evaluation floor plan) in the field notes and transfer pertinent information to the Chain-Of-Custody form. Pack the Summa canister, manifold, and associated equipment from the laboratory in the original shipping containers, seal with a custody seal, and send to the laboratory for analysis. Although the unofficial holding time for the Summa canister is 30 days, samples should reach the laboratory as soon as possible to allow laboratory time to conduct re-runs, dilutions, and low-level analyses as necessary prior to sample expiration.

5.6 Analysis

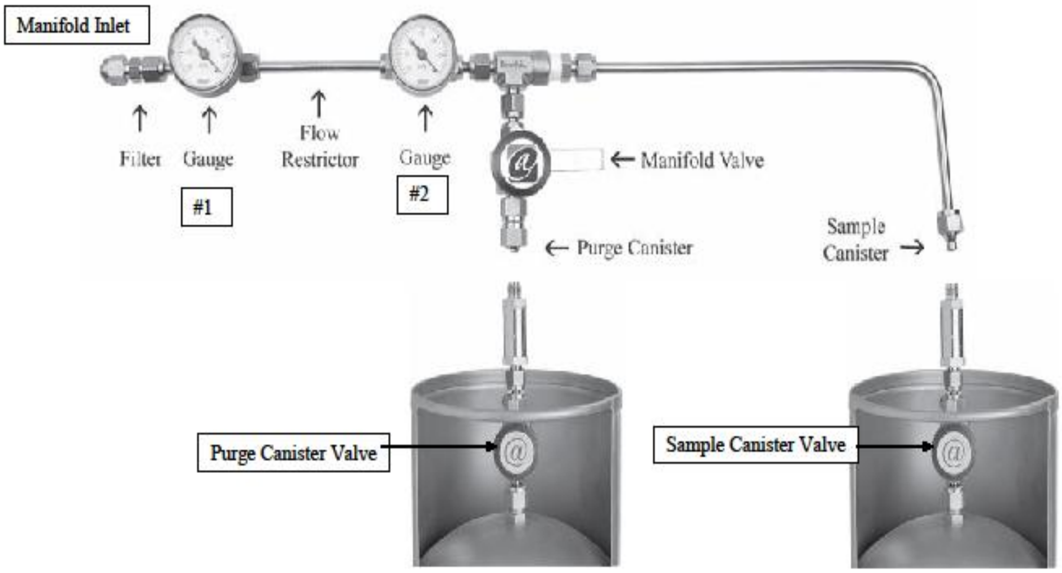
The soil gas samples should be analyzed using EPA Methods TO-14 or TO-15 and, when necessary/possible, low-level analysis or Selective Ion Mode analysis to obtain the lowest-achievable detection and reporting limits. The helium concentration in the canister is measured by modified EPA Method TO-3 following analysis of VOCs. The air samples collected in the Summa canisters have a 30-day holding time. Note the desired analytical methods on the Chain of Custody form.

6.0 DECONTAMINATION

Equipment used for soil gas sampling does not require decontamination in the field because dedicated sampling supplies and equipment are used at each location. The Summa canisters will be individually cleaned and certified to 0.02 part per billion by volume for the project-specific analyte list by the contract laboratory prior to shipment. (Note: Air Toxics has reported they can certify only to 0.1 parts per billion by volume for trans-1,2-dichloroethene.) Ensure that documentation of this certification is included on a tag attached to the canister and in the paperwork that accompanies the canister shipment from the laboratory.

7.0 DOCUMENTATION

Record all field activities, environmental and building conditions, and sample documentation in the field notes.



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LEAK TEST SCHEMATIC