20 YEARS FLOYD | SNIDER
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Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867

June 7, 2016

Mr. Steve Teel
Washington State Department of Ecology
Southwest Regional Office
300 Desmond Drive SE
Lacey, WA 98503

SUBJECT: VAPOR INTRUSION SUMMARY REPORT
Former Olympia Dry Cleaners Site
601 Union Avenue SE
Olympia, Washington

Dear Mr. Teel:

This vapor intrusion summary report for the Former Olympia Dry Cleaners Site (Site) was prepared on behalf of the Estate of Katherine Burleson and GJG, LLC, to meet the reporting requirements of Consent Decree No. 14-2-02104-3 (State of Washington 2014) and the Cleanup Action Plan (CAP; Ecology 2014). The Site is located at 606 Union Avenue SE in Olympia, Washington (Figure 1).

In September 2015, an excavation to remove accessible soil contaminated with chlorinated solvents was completed in accordance with the Remedial Action Work Plan (RAWP; Floyd Snider 2015a) and RAWP addendum (Floyd|Snider 2015b). After the remedial action was completed, a Compliance Monitoring Plan (CMP) for post-remediation monitoring was developed in coordination with the Washington State Department of Ecology (Ecology; Floyd|Snider 2016). The objective of this report is to document the results of the vapor intrusion monitoring completed in spring 2016 in accordance with the CMP.

VAPOR INTRUSION COMPLIANCE MONITORING

This section presents the results of the sub-slab monitoring conducted at the Site on March 12, 2016. The field methods used during the March 2016 monitoring event were in substantive accordance with the CMP.

Sub-Slab Vapor Point Installation

On March 12, 2016, Floyd|Snider installed three sub-slab vapor points (VP-1 through VP-3) inside the Howard's Prestige Cleaners (Howard's) building (former Olympia Dry Cleaners building): one north of the former dry cleaner machine, one east of the former dry cleaner machine, and one west of the former dry cleaner machine (Figure 2). The vapor point installation was consistent with the details provided in Appendix A of the CMP. During the vapor point installation, the

concrete slab was observed to be 12 inches thick. The vapor points were allowed to cure and stabilize for a minimum of 30 minutes before they were purged.

Sub-Slab Vapor Sample Collection

Soil vapor samples were collected on March 12, 2016, after installation, stabilization, and purging of the sub-slab vapor points. Each vapor point was purged for a minimum of 5 minutes before sample collection. Vapor sample collection and leak detection testing were performed in accordance with Appendix A of the CMP; helium was used as the tracer gas for leak detection. Leaks were evaluated in the sample train by measuring the helium content with a handheld helium detector; leaks were not detected during sample collection. One grab sample was collected from each vapor point into a 6-liter Summa canister; a field duplicate was also collected from location VP-3.

Sub-slab vapor samples were submitted to Fremont Analytical Inc., in Seattle, Washington, under chain of custody for analysis of tetrachloroethene (PCE), trichloroethene (TCE), *cis*- and *trans*-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride by U.S. Environmental Protection Agency (USEPA) Method TO-15 (selected ion monitoring [SIM]). Each sample was also analyzed for helium by gas chromatography with a thermal conductivity detector (GC/TCD).

Data Validation

Floyd|Snider performed a Compliance Screening, Tier 1 data quality review on the helium and volatile organic compound data resulting from the laboratory analysis by GC/TCD and USEPA Method TO-15 (SIM). The analytical data were validated in accordance with the National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2014).

A total of four soil vapor samples were submitted in one sample delivery group (FB1603157) to Fremont Analytical for chemical analysis. For all analyses, the analytical holding times were met, and the method blanks had no detections. The surrogate and laboratory control sample recoveries and sample/sample replicate relative percent differences all met USEPA requirements.

No qualifiers were added to the analytical results based on the data quality review. The data were determined to be of acceptable quality for use as reported by the laboratory.

COMPLIANCE MONITORING RESULTS

Analytical results for the March 2016 post-remediation sub-slab sampling event indicate that TCE was present in all three vapor points at concentrations between 25 and 31 micrograms per cubic meter ($\mu g/m^3$), which is greater than Ecology's default sub-slab screening level of 12 $\mu g/m^3$ for a residential exposure scenario. PCE was also present in samples collected from all three vapor points, but only the sample collected at VP-3 (and the duplicate sample collected from VP-3) contained PCE at concentrations greater than Ecology's default sub-slab screening level of

320 µg/m^3, with a maximum detected concentration of 588 µg/m^3. The compound *cis*-1,2-DCE was present in two out of the three vapor points; however, there is not a sub-slab screening level for *cis*-1,2-DCE. The compounds *trans*-1,2-DCE, 1,1-DCE, and vinyl chloride were not detected at concentrations greater than the laboratory detection limits in any of the samples.

Helium was not detected in the samples collected from VP-1 or VP-3. Helium was detected in the sample collected from VP-2, at a concentration of 2,070 parts per million by volume (ppmv), which is less than 1 percent and within the acceptable limits for leak detection (less than 10 percent) per the CMP.

The analytical results are summarized in Table 1. A copy of the laboratory report is included as Attachment 1.

Comparison of Results to Modified Method B Sub-Slab Screening Levels

The maximum detected sub-slab results for PCE (VP-3) and TCE (VP-2) are greater than the default Method B sub-slab screening levels (residential scenario); therefore, modified Method B sub-slab screening levels were calculated for a commercial scenario using the Ecology-approved modified Method B indoor air cleanup level for the Site and assuming a vapor attenuation factor of 0.03, which is in accordance with Ecology's draft *Guidance for Evaluating Soil Vapor Intrusion in Washington State* (Ecology 2016). The sub-slab sampling results were all less than the modified Method B (commercial scenario) screening levels, as shown in Table 1.

Johnson and Ettinger Model Summary

In accordance with Section 3.1.3 of Ecology's guidance for vapor intrusion, Floyd|Snider used the Johnson and Ettinger (J&E) Model to evaluate the potential for vapor intrusion from the sub-slab into indoor air (USEPA 2016). USEPA's on-line calculator implements the J&E simplified model to evaluate the vapor intrusion pathway into buildings. To be conservative, the maximum detected sub-slab results for PCE and TCE (the only compounds present at concentrations greater than the default sub-slab screening levels) were input into the model; the model was ran using default input parameters, with the exception of the sub-slab thickness, which is known to be 12 inches. The maximum predicted indoor air concentrations are less than both the residential and the commercial cleanup levels for indoor air. Copies of the J&E on-line model output for both PCE and TCE are included in Attachment 2.

DEVIATIONS FROM THE COMPLIANCE MONITORING PLAN

The CMP outlines a stepped approach to the vapor intrusion assessment. After receiving the sub-slab vapor monitoring results, which indicated that the maximum values for PCE and TCE were greater than Ecology's default sub-slab screening levels, Floyd|Snider initiated an assessment of the Howard's building as part of planning for indoor air sampling, following the stepped approach outlined in the CMP. After discussions with the current operator of Howard's and a review of its Material Data Safety Sheets, it was determined that there are several potential products used in

its day-to-day business, including a spot cleaner containing TCE, which could interfere with the interpretation of the results of any indoor air sampling. Therefore, in accordance with Ecology's vapor intrusion guidance, the maximum concentrations of PCE and TCE were used as input to the J&E model to evaluate the potential for vapor intrusion into indoor air. In addition, Ecology's sub-slab screening levels, which are based on a residential scenario, were modified to apply to a commercial-scenario. The results of this assessment indicate that vapor intrusion from the sub-slab into indoor air is unlikely based on both a comparison of sub-slab data to the modified Method B sub-slab screening levels and the input into the J&E model. These results were verbally discussed with Ecology and subsequently communicated to Ecology by an email message on April 8, 2016.

VAPOR INTRUSION ASSESSMENT

The results of this vapor intrusion assessment completed in accordance with Ecology's draft Vapor Intrusion Guidance indicate no significant risk of vapor intrusion into indoor air on the basis of a comparison of sub-slab sampling results to the modified Method B sub-slab screening levels and the indoor air concentration predicted by the J&E model. Therefore, the assessment of post-remediation vapor intrusion is considered complete; further assessment is unwarranted.

REFERENCES

Floyd|Snider. 2015a. *Former Olympia Dry Cleaners Site Remedial Action Work Plan*. Prepared for Washington State Department of Ecology. 15 April.

_____. 2015b. *Remedial Action Work Plan Addendum*. Memorandum from Lynn Grochala and Tom Colligan, Floyd|Snider, to Steve Teel, Washington State Department of Ecology. 22 June.

_____. 2016. *Former Olympia Dry Cleaners Site Compliance Monitoring Plan*. Prepared for Washington State Department of Ecology. 28 January.

State of Washington. 2014. *Consent Decree No. 14-2-02104-3, State of Washington, Department of Ecology v. The Estate of Katherine Burleson and GJG, LLC*. Thurston County Superior Court. 31 October.

U.S. Environmental Protection Agency (USEPA). 2014. *National Functional Guidelines for Superfund Organic Methods Data Review*. Prepared by the Office of Superfund Remediation and Technology Innovation. OSWER 9355.0-132/EPA-540-R-014-002. August.

_____. 2016. *EPA On-Line Tools for Site Assessment Calculation, Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with Two Variable/Uncertain Parameters (Source Depth, Moisture Content)*. https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite_forward.html. Accessed 6 June.

Washington State Department of Ecology (Ecology). 2014. *Former Olympia Dry Cleaners Site Cleanup Action Plan*. 29 October.

_____. 2015. CLARC Data Tables. July. https://fortress.wa.gov/ecy/clarc/CLARCDataTables.aspx. Last accessed June 6, 2016.

_____. 2016. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Draft). Publication No. 09-09-047. October 2009; revised February.

Sincerely yours,

FLOYD | SNIDER

Lynn Grochala
Senior Environmental Scientist

Encl.: Table 1 Sub-Slab Soil Vapor Sampling Results
Table 2 Sub-Slab Soil Vapor Sampling Results, Indoor Air Modeling Results, and Comparison to Cleanup Standards
Figure 1 Site Vicinity Map
Figure 2 Vapor Intrusion Monitoring Locations
Attachment 1 Laboratory Analytical Data Report
Attachment 2 J&E Model Outputs
Copies: Gary Burleson, The Estate of Katherine Burleson and GJG, LLC

Tables

Table 1
Sub-Slab Soil Vapor Sampling Results
March 12, 2016

					Sub-Slab Screening Levels[1, 2, 3]	
Chemical	**VP-1**	**VP-2**	**VP-3**	**VP-3 (duplicate)**	**Sub-Slab MTCA Method B Screening Level- Residential (µg/m^3)**	**Sub-Slab Modified MTCA Method B Screening Level- Commercial[4] (µg/m^3)**
PCE	117	186	588	558	320	1,067
TCE	30.6	31	25.8	24.9	12	67
cis- 1,2-DCE	<0.08	8.05	1.51	1.63	NA	NA
trans- 1,2-DCE	<0.024	<0.024	<0.024	<0.024	NA	NA
1,1-DCE	<0.036	<0.036	<0.036	<0.036	NA	NA
Vinyl Chloride	<0.22	<0.22	<0.22	<0.22	9	30
Helium (in ppmv)	ND (100)	2,070	ND (100)	--	NA	NA

Notes:

-- Not analyzed

1 Screening levels and cleanup levels are based on Ecology CLARC data tables (Ecology 2015) and guidance on soil vapor intrusion (Ecology 2016).

2 The residential MTCA B cleanup level will be applied only if the use of the property is converted to residential in the future.

3 The commercial MTCA B cleanup level is the appropriate cleanup level for the current commercial use of the Former Olympia Dry Cleaner building.

4 Modified Method B Screening Level was calculated by using the modified Method B Indoor Air Cleanup Level assuming an attenuation factor of 0.03. Attenuation factor used per Ecology's Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action Review Draft (Ecology 2016).

Abbreviations:

CLARC Cleanup Levels and Risk Calculation
DCE Dichloroethene
Ecology Washington State Department of Ecology
µg/m^3 Micrograms per cubic meter
MTCA Model Toxics Control Act
NA Not applicable; no value has been established
ND Not detected
PCE Tetrachloroethene
ppmv Parts per million volume
TCE Trichloroethene

Table 2

Sub-Slab Soil Vapor Sampling Results, Indoor Air Modeling Results, and Comparison to Cleanup Standards

				Sub-Slab Screening Levels[1]		Indoor Air Cleanup Levels[1]	
Chemical	Maximum Detected Sub-Slab Concentration ($\mu g/m^3$)	Predicted Low Indoor Air Concentration[2,3,4] ($\mu g/m^3$)	Predicted High Indoor Air Concentration[2,3,5] ($\mu g/m^3$)	Sub-Slab MTCA Method B Screening Level-Residential ($\mu g/m^3$)	Sub-Slab Modified MTCA Method B Screening Level-Commercial[6] ($\mu g/m^3$)	MTCA Method B Indoor Air Cleanup Level-Residential[7] ($\mu g/m^3$)	MTCA Method B Indoor Air Cleanup Level-Commercial[8] ($\mu g/m^3$)
PCE	588	2.295	2.508	320	1067	9.6	32
TCE	30	0.1233	0.1338	12	67	0.37	2
cis- 1,2-DCE	8.05	NM	NM	NA	NA	NA	NA
trans- 1,2-DCE	<0.024	NM	NM	NA	NA	27	60
1,1-DCE	<0.036	NM	NM	NA	NA	91	670
Vinyl Chloride	<0.22	NM	NM	9	30	0.28	0.9

Notes:

1 Screening levels and cleanup levels are based on Ecology CLARC data tables (Ecology 2015) and guidance on soil vapor intrusion (Ecology 2016).

2 Indoor air concentrations predicted using USEPA Johnson and Ettinger Model (USEPA 2016).

3 Selected model inputs were default (i.e., most conservative) values, except for slab thickness which is known to be 12 inches.

4 "Low Prediction" concentrations produced with highest soil moisture content and deepest depth to contamination.

5 "High Prediction" concentrations produced with lowest soil moisture content and shallowest depth to contamination.

6 Modified Method B Screening Level was calculated by using the modified Method B Indoor Air Cleanup Level assuming an attenuation factor of 0.03. Attenuation factor used per Ecology's Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action Review Draft (Ecology 2016).

7 The residential MTCA B cleanup level will be applied only if the use of the property is converted to residential in the future.

8 The commercial MTCA B cleanup level is the appropriate cleanup level for the current commercial use of the Former Olympia Dry Cleaner building.

Abbreviations:

CLARC	Cleanup Levels and Risk Calculation
DCE	Dichloroethene
Ecology	Washington State Department of Ecology
$\mu g/m^3$	Micrograms per cubic meter
MTCA	Model Toxics Control Act
NA	Not applicable; no value has been established
NM	Not modeled because the given analyte was not detected or does not have an applicable indoor air cleanup level
PCE	Tetrachloroethene
TCE	Trichloroethene
USEPA	United States Environmental Protection Agency

Figures

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Vapor Intrusion Summary Report
Former Olympia
Dry Cleaners Site
Olympia, Washington

Figure 1
Site Vicinity Map

I:\GIS\Projects\GTH-Olympia_Dry_Cleaners\MXD\VaporIntrusionSummaryReport\Figure 1 Vicinity Map.mxd
5/26/2016

Legend

- Sub-Slab Vapor Point
- Compliance Monitoring Well
- GAS — Portion of Underground Gas Main and Service Re-Routed by Puget Sound Energy

Utilities

- E — Underground Electric Line
- GAS — Underground Gas Line
- OE — Overhead Electric Line
- SW — Underground Stormwater Line
- T — Overhead Telephone Line
- W — Underground Water Line
- SS — Underground Sanitary Sewer Line

- Sidewalk
- Concrete Pad
- Building Outline
- Property Boundary
- Building Awning
- Shrubs/Trees

Boiler Room

Dry Cleaner Machine

VP-1

VP-2

VP-3

MW-09

MW-14

Howard's Prestige Cleaners Building

Cherry Street Q-Tip Trust Building

Roof Line

ARTESIAN SUPPLY WELL

N

0 5 10 20

Scale in Feet

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Vapor Intrusion Summary Report
Former Olympia Dry Cleaners Site
Olympia, Washington

Figure 2
Vapor Intrusion Monitoring Locations

I:\GIS\Projects\GTH-Olympia_Dry_Cleaners\MXD\VaporIntrusionSummaryReport\Figure 2 Indoor Air Monitoring Locations.mxd
5/31/2016

Attachment 1
Laboratory Analytical Data Report

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Floyd | Snider
Lynn Grochala
601 Union St., Suite 600
Seattle, WA 98101

RE: GTH-Olympia
Lab ID: 1603157

March 23, 2016

Attention Lynn Grochala:

Fremont Analytical, Inc. received 4 sample(s) on 3/14/2016 for the analyses presented in the following report.

Helium by GC/TCD
Volatile Organic Compounds-EPA Method TO-15 (SIM)

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
President

Date: *03/23/2016*

CLIENT: Floyd | Snider
Project: GTH-Olympia
Lab Order: 1603157

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1603157-001	VP-1-031216	03/12/2016 6:49 PM	03/14/2016 2:56 PM
1603157-002	VP-3-031216	03/12/2016 6:08 PM	03/14/2016 2:56 PM
1603157-003	VP-2-031216	03/12/2016 5:18 PM	03/14/2016 2:56 PM
1603157-004	VP-3-031216-D	03/12/2016 6:08 PM	03/14/2016 2:56 PM

Revision v1

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

Case Narrative

WO#: **1603157**
Date: **3/23/2016**

CLIENT: Floyd | Snider
Project: GTH-Olympia

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Air samples are reported in ppbv and ug/m3.

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Standard temperature and pressure assumes 24.45 = (25C and 1 atm).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

WO#: **1603157**
Date Reported: **3/23/2016**

CLIENT: Floyd | Snider
Project: GTH-Olympia

Lab ID: 1603157-001 **Collection Date:** 3/12/2016 6:49:00 PM
Client Sample ID: **VP-1-031216** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R28306		Analyst: JY
Helium	ND	100		ppmv	1	3/15/2016 4:17:00 PM

Lab ID: 1603157-002 **Collection Date:** 3/12/2016 6:08:00 PM
Client Sample ID: **VP-3-031216** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R28306		Analyst: JY
Helium	ND	100		ppmv	1	3/15/2016 4:24:00 PM

Lab ID: 1603157-003 **Collection Date:** 3/12/2016 5:18:00 PM
Client Sample ID: **VP-2-031216** **Matrix:** Air

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Helium by GC/TCD				Batch ID: R28306		Analyst: JY
Helium	2,070	100		ppmv	1	3/15/2016 4:32:00 PM

Client: **Floyd | Snider**
WorkOrder: 1603157
Project: GTH-Olympia

Client Sample ID: VP-1-031216
Lab ID: 1603157-001A
Sample Type: Summa Canister

Date Sampled: 3/12/2016
Date Received: 3/14/2016

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/17/2016	JY
cis-1,2-Dichloroethene	<0.0200	<0.0793	0.0200	0.0793		EPA-TO-15SIM	03/17/2016	JY
Tetrachloroethene (PCE)	17.3	117	0.800	5.43		EPA-TO-15SIM	03/17/2016	JY
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/17/2016	JY
Trichloroethene (TCE)	5.70	30.6	0.0170	0.0914		EPA-TO-15SIM	03/17/2016	JY
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/17/2016	JY
Surr: 4-Bromofluorobenzene	105 %Rec	--	70-130	--		EPA-TO-15SIM	03/17/2016	JY

Client: **Floyd | Snider**
WorkOrder: 1603157
Project: GTH-Olympia

Client Sample ID: VP-3-031216
Lab ID: 1603157-002A
Sample Type: Summa Canister

Date Sampled: 3/12/2016
Date Received: 3/14/2016

Analyte	Concentration		Reporting Limit		Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
	(ppbv)	**(ug/m³)**	**(ppbv)**	**(ug/m³)**				
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/17/2016	JY
cis-1,2-Dichloroethene	0.380	1.51	0.0200	0.0793		EPA-TO-15SIM	03/17/2016	JY
Tetrachloroethene (PCE)	86.7	588	0.800	5.43		EPA-TO-15SIM	03/17/2016	JY
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/17/2016	JY
Trichloroethene (TCE)	4.80	25.8	0.272	1.46		EPA-TO-15SIM	03/17/2016	JY
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/17/2016	JY
Surr: 4-Bromofluorobenzene	130 %Rec	--	70-130	--		EPA-TO-15SIM	03/17/2016	JY

Revision v1

Client: **Floyd | Snider**
WorkOrder: 1603157
Project: GTH-Olympia

Client Sample ID: VP-2-031216
Lab ID: 1603157-003A
Sample Type: Summa Canister

Date Sampled: 3/12/2016
Date Received: 3/14/2016

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
Volatile Organic Compounds-EPA Method TO-15 (SIM)								
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/17/2016	JY
cis-1,2-Dichloroethene	2.03	8.05	0.0200	0.0793		EPA-TO-15SIM	03/17/2016	JY
Tetrachloroethene (PCE)	27.4	186	0.800	5.43		EPA-TO-15SIM	03/17/2016	JY
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/17/2016	JY
Trichloroethene (TCE)	5.76	31.0	0.272	1.46		EPA-TO-15SIM	03/17/2016	JY
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/17/2016	JY
Surr: 4-Bromofluorobenzene	126 %Rec	--	70-130	--		EPA-TO-15SIM	03/17/2016	JY

Client: **Floyd | Snider**
WorkOrder: 1603157
Project: GTH-Olympia

Client Sample ID: VP-3-031216-D
Lab ID: 1603157-004A
Sample Type: Summa Canister

Date Sampled: 3/12/2016
Date Received: 3/14/2016

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Analyte	Concentration (ppbv)	Concentration (ug/m³)	Reporting Limit (ppbv)	Reporting Limit (ug/m³)	Qual	Method	Date/Analyst	
1,1-Dichloroethene (DCE)	<0.00900	<0.0357	0.00900	0.0357		EPA-TO-15SIM	03/17/2016	JY
cis-1,2-Dichloroethene	0.410	1.63	0.0200	0.0793		EPA-TO-15SIM	03/17/2016	JY
Tetrachloroethene (PCE)	82.2	558	0.800	5.43		EPA-TO-15SIM	03/17/2016	JY
trans-1,2-Dichloroethene	<0.00600	<0.0238	0.00600	0.0238		EPA-TO-15SIM	03/17/2016	JY
Trichloroethene (TCE)	4.64	24.9	0.272	1.46		EPA-TO-15SIM	03/17/2016	JY
Vinyl chloride	<0.0850	<0.217	0.0850	0.217		EPA-TO-15SIM	03/17/2016	JY
Surr: 4-Bromofluorobenzene	127 %Rec	--	70-130	--		EPA-TO-15SIM	03/17/2016	JY

Work Order: 1603157
CLIENT: Floyd | Snider
Project: GTH-Olympia

QC SUMMARY REPORT

Helium by GC/TCD

Sample ID: **LCS-R28306**	SampType: **LCS**			Units: **ppmv**		Prep Date: **3/15/2016**			RunNo: **28306**		
Client ID: **LCSW**	Batch ID: **R28306**					Analysis Date: **3/15/2016**			SeqNo: **531984**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	110,000	100	100,000	0	110	80	120				

Sample ID: **1603157-001BREP**	SampType: **REP**			Units: **ppmv**		Prep Date: **3/15/2016**			RunNo: **28306**		
Client ID: **VP-1-031216**	Batch ID: **R28306**					Analysis Date: **3/15/2016**			SeqNo: **531981**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Helium	ND	100						0		30	

Work Order: 1603157
CLIENT: Floyd | Snider
Project: GTH-Olympia

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID: **LCS-R28302** SampType: **LCS** Units: **ppbv** Prep Date: **3/17/2016** RunNo: **28302**
Client ID: **LCSW** Batch ID: **R28302** Analysis Date: **3/17/2016** SeqNo: **531970**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	2.61	0.0850	2.500	0	104	70	130				
1,1-Dichloroethene (DCE)	2.59	0.00900	2.500	0	104	70	130				
trans-1,2-Dichloroethene	2.90	0.00600	2.500	0	116	70	130				
cis-1,2-Dichloroethene	2.62	0.0200	2.500	0	105	70	130				
Trichloroethene (TCE)	2.79	0.0170	2.500	0	112	70	130				
Tetrachloroethene (PCE)	2.67	0.0500	2.500	0	107	70	130				
Surr: 4-Bromofluorobenzene	10.2		10.00		102	70	130				

Sample ID: **MB-R28302** SampType: **MBLK** Units: **ppbv** Prep Date: **3/17/2016** RunNo: **28302**
Client ID: **MBLKW** Batch ID: **R28302** Analysis Date: **3/17/2016** SeqNo: **531971**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850									
1,1-Dichloroethene (DCE)	ND	0.00900									
trans-1,2-Dichloroethene	ND	0.00600									
cis-1,2-Dichloroethene	ND	0.0200									
Trichloroethene (TCE)	ND	0.0170									
Tetrachloroethene (PCE)	ND	0.0500									
Surr: 4-Bromofluorobenzene	9.99		10.00		99.9	70	130				

Sample ID: **1603157-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/17/2016** RunNo: **28302**
Client ID: **VP-1-031216** Batch ID: **R28302** Analysis Date: **3/17/2016** SeqNo: **531962**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.0850						0		30	
1,1-Dichloroethene (DCE)	ND	0.00900						0		30	
trans-1,2-Dichloroethene	ND	0.00600						0		30	
cis-1,2-Dichloroethene	ND	0.0200						0		30	
Trichloroethene (TCE)	6.52	0.0170						5.700	13.4	30	
Tetrachloroethene (PCE)	25.3	0.0500						22.46	11.9	30	E

Work Order: 1603157
CLIENT: Floyd | Snider
Project: GTH-Olympia

QC SUMMARY REPORT

Volatile Organic Compounds-EPA Method TO-15 (SIM)

Sample ID: **1603157-001AREP** SampType: **REP** Units: **ppbv** Prep Date: **3/17/2016** RunNo: **28302**
Client ID: **VP-1-031216** Batch ID: **R28302** Analysis Date: **3/17/2016** SeqNo: **531962**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 4-Bromofluorobenzene	11.7		10.00		117	70	130		0		

Sample Log-In Check List

Client Name:	**FS**	Work Order Number:	**1603157**
Logged by:	**Erica Silva**	Date Received:	**3/14/2016 2:56:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Courier		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☑	No ☐	Not Required ☐
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C *	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☑	No ☐	NA ☐

Person Notified:	Kristen Anderson	Date:	3/14/2016
By Whom:	Erica Silva	Via:	☐ eMail ☑ Phone ☐ Fax ☐ In Person
Regarding:	Analyses and missing Tedlar Bag		
Client Instructions:	PCE + breakdown by TO-15 SIM, apply He results from VP-3 Tedlar to VP-3-DUP		

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical

Air Chain of Custody Record - Whole Air Sample

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Laboratory Project No (Internal): 1603157

Date: 3/12/16

Page: 1 of: 1

Client: Floyd Snider (see file)

Address:

City, State, Zip:

Telephone: Fax:

Project Name: GPH - Olympia

Project No: 1-9 Collected by: K A GS

Location:

Reports To (PM): Lynn Grochala

Email (PM): lynn.grochala@floydsnider.com

* Gas Matrix Codes: I = Indoor SS = Subslab L = Landfill SG = Soil Gas M = Plume Mapping Q = Fuel Gas Quality L = LEED (Consult Client Services)

** Container Codes: 6L = Six Liter Canister (Summa) TB = Tedlar Bag BV = 1 Liter Bottle Vac MC = 1 Liter MiniCan HP = High Pressure Cylinder HJ = Glass Headspace Jar

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Gas Matrix Code *	Anticipated Fill Time	Sample Volume	Container Type **	Internal: Evacuation Pressure (mtorr)	Internal: Pressure at Time of Pick-up (" Hg)	Internal: Equipment Certificaton Code	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1	VP-1-031216	15902 / —	3/12/16	SS	—	6L	Summa	10 mtorr / 3/4/16 9:30	~~30~~		30 / 1849	4 / 1853	CVOC* (+helium in tedlar bag)	03/14	-4
2	VP-3-031216	17643 / —	3/12/16	SS	—	6L	Summa	10 mtorr / 3/4/16 9:30	~~30~~ 18		30 / 1808	4 / 1822	CVOC* (+ helium in tedlar bag		-6
3	VP-2-031216	17636 / —	3/12/16	SS	—	6L	Summa	10 mtorr / 3/4/16 9:30			30 / 1718	4 / 1728	CVOC* (+ helium in tedlar)		-4
4	VP-3-031216D	17641 / —	3/12/16	SS	—	6L	Summa	10 mtorr / 3/4/16 9:30			30 / 1803	4 / 1819	CVOC* ~~(+ helium in tedlar)~~		-3
5		/ —						/			/	/			

Rental Equipment (Circle all that apply): (Manifold) Mini-Pump Fittings (Tedlar Bags) Canisters Flow Controllers Helium Cylinder Flouridated Tubing (Wrench)

Condition:

Seals Intact: Y N N/A

Turn-around times for samples received after 4:00pm will begin on the following business day.

Special Remarks: * PCE + breakdown by TO-15 SIM.

Report in ppbv and µg/m3 per K.A. 3/14/16

Relinquished	Date/Time	Received	Date/Time
x F/S	3/14/16 2:18	x	3/14/16 2:18
Relinquished	Date/Time	Received	Date/Time
x	3/14/16 2:56	x 03/14/16	2:56PM

TAT --> STD Rush (specify)

Attachment 2
J&E Model Outputs

INDOOR AIR SIMULATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Former Olympia Dry Cleaner
Report Date: Thu Apr 7 14:01:05 PDT 2016
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite_forward.htm
Type of sample: SOIL GAS Concentration = 588[µg/m^3]
Depth of soil gas sample: 1ft +/- 0.25ft
Average soil/ground water temperature: 50F

CHEMICAL PROPERTIES
Chemical of Concern: Tetrachloroethylene CAS Number: 127184
Molecular Weight: 165.83 [g/mole] Henrys Constant: 0.3362604 [unitless]
Diffusivity in Air: 7.200e-2 [cm^2/sec] Diffusivity in Water: 8.200e-6 [cm^2/sec]
Unit Risk Factor: 0.000003 [$(µg/m^3)^{-1}$] Reference Concentration: 0 [mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17 [m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 100[m^2]
Subsurface Foundation Area: 106[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.3048[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 30 [years] non-carcinogens: 30 [years]
Exposure Frequency: carcinogens 350 [days/year] non-carcinogens: 365 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 30 [years]

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficient (D_{eff}): 0.01164[cm^2/s]
Soil Gas to Indoor Air Attenuation Factor (α_{SG}) = 0.004078

[1]Low Indoor Air Prediction: 2.295 [µg/m^3] or 0.3386 [ppbv]
Cancer Risk of this concentration: 2.829e-6 Hazard Risk of this concentration: 0.

Best Estimate Indoor Air Prediction: 2.398[µg/m^3] or 0.3538 [ppbv]
Cancer Risk of this concentration: 2.957e-6 Hazard Risk of this concentration: 0.

[2]High Indoor Air Prediction: 2.508[µg/m^3] or 0.3701 [ppbv]
Cancer Risk of this concentration: 3.093e-6 Hazard Risk of this concentration: 0.

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Low Prediction" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"High Prediction" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

INDOOR AIR SIMULATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Former Olympia Dry Cleaner
Report Date: Thu Apr 7 12:12:44 PDT 2016
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite_forward.htm
Type of sample: SOIL GAS Concentration = 31[µg/m^3]
Depth of soil gas sample: 1ft +/- 0.25ft
Average soil/ground water temperature: 50F

CHEMICAL PROPERTIES
Chemical of Concern: Trichloroethylene CAS Number: 79016
Molecular Weight: 131.39 [g/mole] Henrys Constant: 0.2057688 [unitless]
Diffusivity in Air: 7.900e-2 [cm^2/sec] Diffusivity in Water: 9.100e-6 [cm^2/sec]
Unit Risk Factor: 0.00011 [(µg/m^3)$^{-1}$] Reference Concentration: 0.04 [mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17 [m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 100[m^2]
Subsurface Foundation Area: 106[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.3048[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 30 [years] non-carcinogens: 30 [years]
Exposure Frequency: carcinogens 350 [days/year] non-carcinogens: 365 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 30 [years]

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficient (D_{eff}): 0.01277[cm^2/s]
Soil Gas to Indoor Air Attenuation Factor (α_{SG}) = 0.004141

[1]Low Indoor Air Prediction: 0.1233 [µg/m^3] or 0.02295 [ppbv]
Cancer Risk of this concentration: 5.572e-6 Hazard Risk of this concentration: 0.003081

Best Estimate Indoor Air Prediction: 0.1284[µg/m^3] or 0.02390 [ppbv]
Cancer Risk of this concentration: 5.803e-6 Hazard Risk of this concentration: 0.003209

[2]High Indoor Air Prediction: 0.1338[µg/m^3] or 0.02492 [ppbv]
Cancer Risk of this concentration: 6.049e-6 Hazard Risk of this concentration: 0.003346

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Low Prediction" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.

[2]"High Prediction" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.