



May 14, 2024
Project US-El-361m136830

Mr. Steve Ferker
Project Manager
RRT Design & Construction
1 Huntington Quadrangle, Suite 301
Melville, NY 11747-4401

Subject: Technical Memorandum: Sub-slab Methane Assessment and Methane Mitigation System
Performance Evaluation
Hunt Street Facility
701 N Hunt Street
Portland, Oregon 97217

Dear Mr. Ferker:

WSP USA Environment & Infrastructure, Inc. (WSP) is pleased to provide this memorandum to RRT Design & Construction to document the results of methane testing performed at the above-referenced site. This memorandum outlines WSP's field investigation efforts and provides an assessment of the amount of methane currently being recovered by the existing system.

SITE BACKGROUND

The existing site building is constructed over a portion of a historic construction/demolition landfill. A methane mitigation system consisting of six vapor extraction lines and an extraction blower are currently operating at the site.

In May 2023, and in advance of future building expansion at the site, WSP in accordance with the Work Plan conducted an assessment of methane accumulation beneath the existing building and loading dock, and also measured the amount of methane being recovered by the existing system.

SYSTEM MONITORING AND SAMPLING

WSP's scope of work consisted of the following tasks:

- methane gas assessment beneath the existing building and loading dock,
- methane mitigation system performance evaluation.

METHANE GAS ASSESSMENT BENEATH CURRENT BUILDING AND LOADING DOCK

WSP conducted a methane gas assessment beneath the current building and loading dock on May 17, 2023. Ten temporary vapor sampling ports were installed inside the building through the concrete floor slab (in the vicinity of the current methane mitigation system), and two vapor sampling ports were installed outside the building through the asphalt in the loading dock area (see Figure 1). Vapor sampling ports were installed to a depth of 18 inches below surface of the asphalt/concrete, or to below the base of the concrete in situations where the concrete exceeded 18 inches in thickness (concrete thickness ranged from 12 to 27 inches in thickness). During installation of the vapor points, it was identified that a void was present beneath the floor in the vicinity of VP-10 and 11. Maximum depth of the void was 27.5 inches as measured from the bottom of the slab at VP-10. Helium tracer testing, using a shroud and helium detector, was conducted at each sampling port to confirm the integrity of the seals. No helium was detected in extracted vapors from any of the vapor points and all seals were



determined to be effective prior to collecting measurements. Measurements for methane, carbon dioxide, carbon monoxide, oxygen, and hydrogen sulfide were collected at each sampling port using a GEM 5000 landfill gas meter. Measurements were performed during a time of falling barometric pressure as shown in Attachment 1 – Barometric Pressure Readings. Readings were collected over a 3-minute period and recorded every 30 seconds at each sampling location. Prior to collecting readings, the methane mitigation system was shut down and sub-slab gases allowed to equilibrate for a period of 2 hours. Methane readings at all twelve sampling locations were 0.00%. Carbon Dioxide, Oxygen, Carbon Monoxide and Hydrogen Sulfide concentrations were also collected using the GEM 500 landfill gas meter, and all measurements were consistent during the sampling period after each initial reading. The highest Carbon Dioxide concentration was measured at VP-1 at 8.30% and lowest at VP-12 at 0.00%. Highest Oxygen concentrations were measured at VP-12 at 20.90%, and lowest at VP-1 at 3.20%. Carbon Monoxide and Hydrogen Sulfide concentrations were 0.00% at all vapor ports except VP-1, which had a concentration of 1.00% for both measurements. Detailed measurements are tabulated in Table 1.

METHANE MITIGATION SYSTEM PERFORMANCE EVALUATION

WSP conducted an evaluation of the current methane mitigation system performance on May 17, 2023. As a part of the evaluation, air samples, flow, and vacuum measurements were collected at each extraction line, and both upstream and downstream of the extraction blower. Air flow measurements were collected using a Velocicalc 9565 air velocity meter. Methane, carbon dioxide, carbon monoxide, oxygen, and hydrogen sulfide readings were collected using a GEM 5000 landfill gas meter. Vacuum measurements were collected at each vapor sampling port to determine the negative pressure field beneath the slab. All sampling ports displayed vacuum influence of the mitigation system, with vacuums ranging from 0.3 inches to 1.30 inches (see Figure 1). Readings collected from the methane mitigation system are detailed in Table 2.

The system components evaluated included seals at each extraction point, signage, dedicated vacuum gauge at blower, exhaust stack placement, intrinsically safe components, shutdown or low vacuum alarms, and missing or damaged components. The system had a standard control panel with “start/stop” buttons, all seals were intact, and the exhaust stack located above the blower was going outside. No vacuum gauge or vacuum alarms were observed, and no missing or damaged components were found in the system.

An air sample was collected on May 11, 2023, from the system discharge stack and submitted to Eurofins Air Toxics LLC in Folsom, California for laboratory chemical analysis of fixed gases including methane, oxygen, carbon dioxide, and carbon monoxide. Oxygen comprised 17% of the sample, Methane at 2.3% and Carbon Dioxide at 4.3%. Carbon Monoxide was not detected in the air sample. Methane from the six extraction points as well as from the blower discharge are attached in Table 1.

Extraction Point 3 (EX-3) contributed most of the methane captured by the system and was measured at 6.9% methane. It should be noted that EX-3 is located between vapor test points VP-6 and VP-7, where no methane was measured.

After completion of sampling, the vapor ports were removed, and the surface patched with asphalt or concrete to match the surrounding surface.

CONCLUSIONS

With the extraction blower off, WSP did not observe any methane accumulating beneath the floor slab over the course of a 2-hour period. The concrete floor slab is 12 to 27 inches thick with no significant cracks, indicating that if methane were to accumulate it is unlikely that significant concentrations would enter the building.

LIMITATIONS

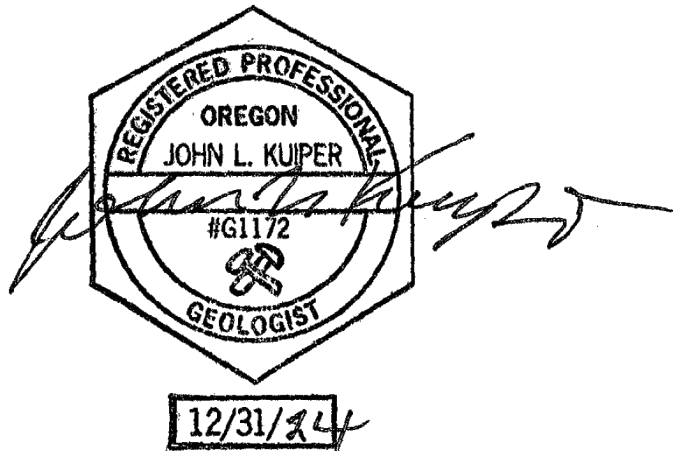
This memorandum was prepared exclusively for RRT Design & Construction by WSP. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in WSP services and based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) conditions and qualifications set forth in this proposal. This memo is intended to be used by RRT Design & Construction for the property located at 701 N Hunt Street, Portland, Oregon only, subject to terms and



conditions of its contract with WSP. Any other use of, or reliance on, this report by a third party is at that party's sole risk.

Sincerely,

WSP USA Environment & Infrastructure Inc.



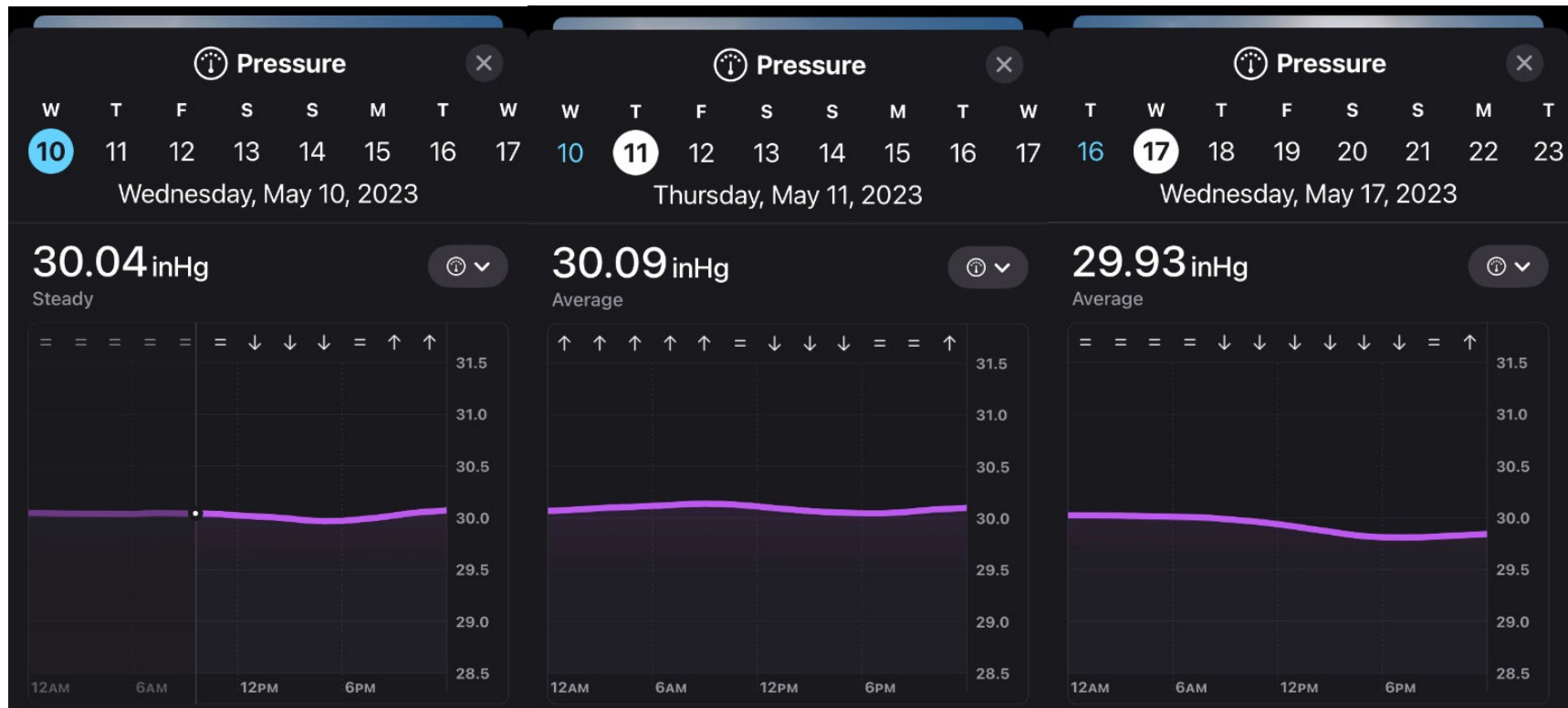
John Kuiper, RG
Principal Geologist, VP

JC/JK/KC:al

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Attachments: Barometric Pressure Readings
Laboratory Analytical Results and Chain of Custody
Figure 1 - IsoPleth Contours
Table 1 - Vapor Point Readings
Table 2 - Extraction Well Readings
Table 3 - Methane Calculations

ATTACHMENTS



Barometric Pressure Readings

5/23/2023

Mr. Daniel Duran

WSP USA Environment & Infrastructure, Inc. (formerly Wood)

15862 SW 72nd Ave

Suite 150

Portland OR 97224

Project Name: Hunt St.

Project #: 361m136830.01

Workorder #: 2305360

Dear Mr. Daniel Duran

The following report includes the data for the above referenced project for sample(s) received on 5/16/2023 at Eurofins Air Toxics LLC.

The data and associated QC analyzed by Modified ASTM D-1946 are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Eurofins Air Toxics LLC. for your air analysis needs. Eurofins Air Toxics Inc. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Monica Tran at 916-985-1000 if you have any questions regarding the data in this report.

Regards,



Monica Tran

Project Manager

WORK ORDER #: 2305360

Work Order Summary

CLIENT:	Mr. Daniel Duran WSP USA Environment & Infrastructure, Inc. (formerly Wood) 15862 SW 72nd Ave Suite 150 Portland, OR 97224 503-639-3400	BILL TO:	Mr. Daniel Duran WSP USA Environment & Infrastructure, Inc. (formerly Wood) 15862 SW 72nd Ave Suite 150
PHONE:		P.O. #	361m136830
FAX:	503-620-7892	PROJECT #	361m136830.01 Hunt St.
DATE RECEIVED:	05/16/2023	CONTACT:	Monica Tran
DATE COMPLETED:	05/23/2023		

<u>FRACTION #</u>	<u>NAME</u>	<u>TEST</u>	<u>RECEIPT VAC./PRES.</u>	<u>FINAL PRESSURE</u>
01A	EFF-20230511	Modified ASTM D-1946	5.1 "Hg	9.8 psi
02A	Lab Blank	Modified ASTM D-1946	NA	NA
03A	CCV	Modified ASTM D-1946	NA	NA
04A	LCS	Modified ASTM D-1946	NA	NA
04AA	LCSD	Modified ASTM D-1946	NA	NA

CERTIFIED BY:



Technical Director

DATE: 05/23/23

Certification numbers: AZ Licensure AZ0775, FL NELAP – E87680, LA NELAP – 02089, NH NELAP – 209222, NJ NELAP - CA016, NY NELAP - 11291, TX NELAP – T104704434-22-18, UT NELAP – CA009332022-14, VA NELAP - 12240, WA ELAP - C935

Name of Accreditation Body: NELAP/ORELAP (Oregon Environmental Laboratory Accreditation Program) CA300005-017

Eurofins Environment Testing Northern California, LLC certifies that the test results contained in this report meet all requirements of the 2016 TNI Standard.

This report shall not be reproduced, except in full, without the written approval of Eurofins Air Toxics, LLC.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630

(916) 985-1000 . (800) 985-5955 . FAX (916) 351-8279

LABORATORY NARRATIVE
Modified ASTM D-1946
WSP USA Environment & Infrastructure, Inc. (formerly Wood)
Workorder# 2305360

One 1 Liter Summa Canister sample was received on May 17, 2023. The laboratory performed analysis via Modified ASTM Method D-1946 for Methane and fixed gases in air using GC/FID or GC/TCD. The method involves direct injection of 1.0 mL of sample.

On the analytical column employed for this analysis, Oxygen coelutes with Argon. The corresponding peak is quantitated as Oxygen.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the EATL modifications.

Requirement	ASTM D-1946	ATL Modifications
Calibration	A single point calibration is performed using a reference standard closely matching the composition of the unknown.	A minimum of 5-point calibration curve is performed. Quantitation is based on average Response Factor.
Reference Standard	The composition of any reference standard must be known to within 0.01 mol % for any component.	The standards used by ATL are blended to a $\geq 95\%$ accuracy.
Sample Injection Volume	Components whose concentrations are in excess of 5 % should not be analyzed by using sample volumes greater than 0.5 mL.	The sample container is connected directly to a fixed volume sample loop of 1.0 mL on the GC. Linear range is defined by the calibration curve. Bags are loaded by vacuum.
Normalization	Normalize the mole percent values by multiplying each value by 100 and dividing by the sum of the original values. The sum of the original values should not differ from 100% by more than 1.0%.	Results are not normalized. The sum of the reported values can differ from 100% by as much as 15%, either due to analytical variability or an unusual sample matrix.
Precision	Precision requirements established at each concentration level.	Duplicates should agree within 25% RPD for detections > 5 X's the RL.

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Seven qualifiers may have been used on the data analysis sheets and indicate as follows:

B - Compound present in laboratory blank greater than reporting limit.

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the detection limit.

M - Reported value may be biased due to apparent matrix interferences.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

Summary of Detected Compounds
NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

Client Sample ID: EFF-20230511

Lab ID#: 2305360-01A

Compound	Rpt. Limit (%)	Amount (%)
Oxygen	0.20	17
Methane	0.00020	2.3
Carbon Dioxide	0.020	4.3



Air Toxics

Client Sample ID: EFF-20230511

Lab ID#: 2305360-01A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	10052226	Date of Collection: 5/11/23 12:06:00 PM
Dil. Factor:	2.01	Date of Analysis: 5/22/23 07:25 PM

Compound	Rpt. Limit (%)	Amount (%)
Oxygen	0.20	17
Carbon Monoxide	0.020	Not Detected
Methane	0.00020	2.3
Carbon Dioxide	0.020	4.3

Container Type: 1 Liter Summa Canister



Air Toxics

Client Sample ID: Lab Blank

Lab ID#: 2305360-02A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name: 10052206
Dil. Factor: 1.00

Date of Collection: NA
Date of Analysis: 5/22/23 09:21 AM

Compound	Rpt. Limit (%)	Amount (%)
Oxygen	0.10	Not Detected
Carbon Monoxide	0.010	Not Detected
Methane	0.00010	Not Detected
Carbon Dioxide	0.010	Not Detected

Container Type: NA - Not Applicable



Air Toxics

Client Sample ID: CCV

Lab ID#: 2305360-03A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name: 10052201
Dil. Factor: 1.00

Date of Collection: NA
Date of Analysis: 5/22/23 06:48 AM

Compound	%Recovery
Oxygen	98
Carbon Monoxide	101
Methane	100
Carbon Dioxide	99

Container Type: NA - Not Applicable

Client Sample ID: LCS

Lab ID#: 2305360-04A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name: 10052202

Date of Collection: NA

Dil. Factor: 1.00

Date of Analysis: 5/22/23 07:26 AM

Compound	%Recovery	Method Limits
Oxygen	99	85-115
Carbon Monoxide	100	85-115
Methane	100	85-115
Carbon Dioxide	100	85-115

Container Type: NA - Not Applicable



Air Toxics

Client Sample ID: LCSD

Lab ID#: 2305360-04AA

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name: 10052203

Date of Collection: NA

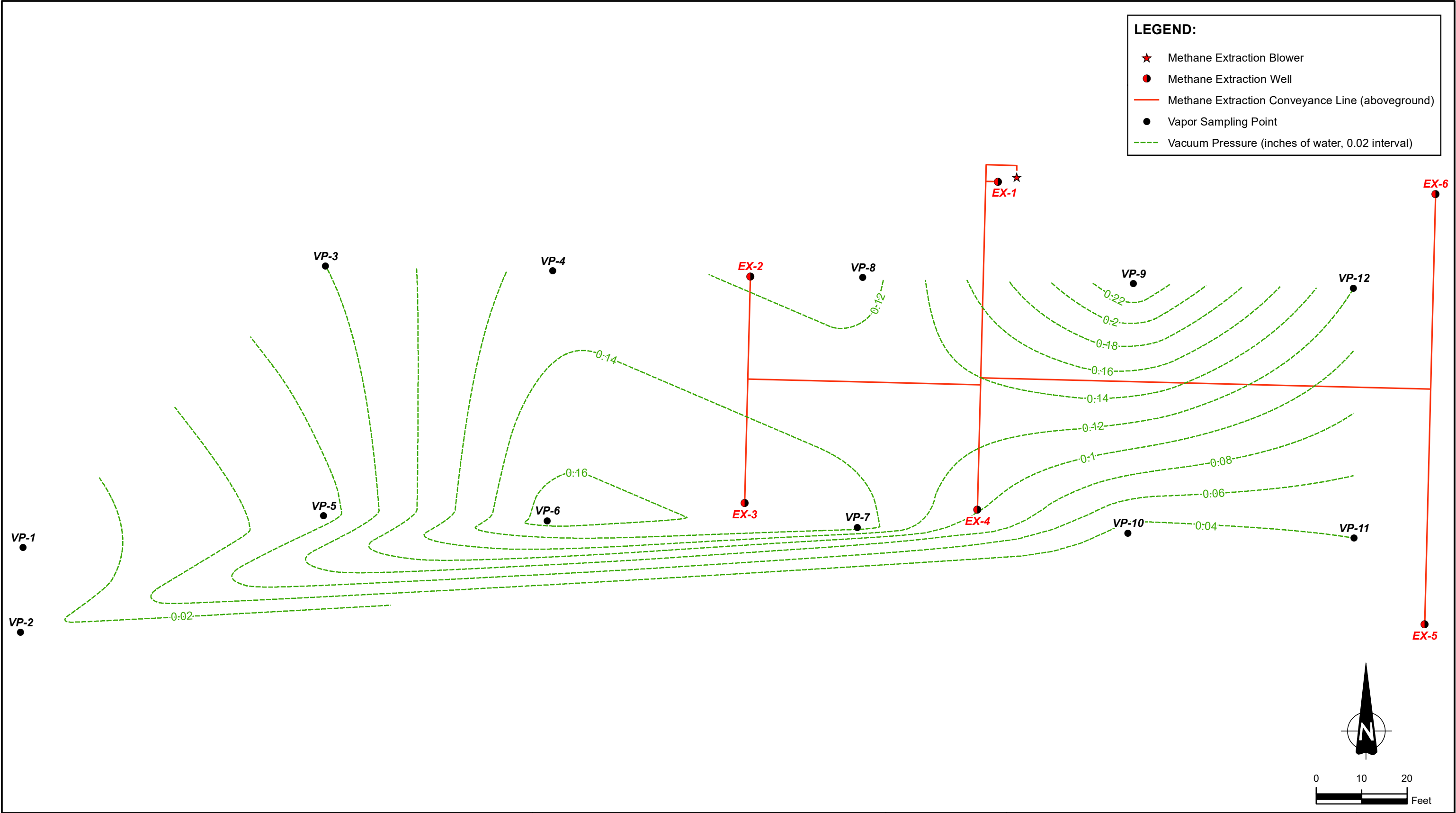
Dil. Factor: 1.00

Date of Analysis: 5/22/23 08:10 AM

Compound	%Recovery	Method Limits
Oxygen	99	85-115
Carbon Monoxide	99	85-115
Methane	101	85-115
Carbon Dioxide	100	85-115

Container Type: NA - Not Applicable

FIGURE



	WASTE MANAGEMENT, INC.			TECH MEMO 701 N HUNT STREET PORTLAND, OREGON		DATE MAY 2024
						SCALE 1 " = 20 '
	WSP USA 15862 SW 72nd Ave., Suite 150 Portland, OR 97224			ISOPLETH CONTOURS SHOWING VACUUM GRADIENT (WITH BLOWER ON)		PROJECT NO. 361M136830.01
						FIGURE 1

TABLES



Table 1. Vapor Point Readings

Project # 3-61M-136830.01

Date: 5/17/2023

Point	Helium leak test time	Purge Time	Vac with extraction system on "H2O	Extraction system off Pressure/vac	Shroud Helium Concentration	Vapor Point He concentration	METHANE %	CO2 %	O2 %	H2S (ppm)	CO (ppm)	Balance %	BAR
VP-1	9:40	na	0.00	0.00	52%	0%	na	na	na	na	na	na	29.85
VP-1	na	13:40:00	na	na	na	na	0.00	3.60	19.80	0.00	0.00	80.30	29.85
VP-1	na	13:40:30	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-1	na	13:41:00	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-1	na	13:41:30	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-1	na	13:42:00	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-1	na	13:42:30	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-1	na	13:43:00	na	na	na	na	0.00	8.20	3.20	1.00	1.00	88.60	29.85
VP-2	9:50	na	0.01	0.00	55%	0.00%	na	na	na	na	na	na	29.85
VP-2	na	13:50:00	na	na	na	na	0.00	0.90	20.03	0.00	0.00	79.30	29.85
VP-2	na	:30	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-2	na	:30	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-2	na	:30	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-2	na	:30	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-2	na	:30	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-2	na	13:53:00	na	na	na	na	0.00	2.10	16.00	0.00	0.00	81.40	29.85
VP-3	10:05	na	0.08	0.00	50%		na	na	na	na	na	na	29.85
VP-3	na	12:27:00	na	na	na	na	0.00	4.30	20.10	0.00	0.00	79.40	29.85
VP-3	na	:30	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-3	na	:30	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-3	na	:30	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-3	na	:30	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-3	na	:30	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-3	na	12:30:00	na	na	na	na	0.00	8.00	10.60	0.00	0.00	80.40	29.85
VP-4	10:31	na	0.13	0.00	51%	0.10%	na	na	na	na	na	na	29.85
VP-4	na	12:45:00	na	na	na	na	0.00	0.80	20.50	0.00	0.00	79.20	29.85
VP-4	na	:30	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-4	na	:30	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-4	na	:30	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-4	na	:30	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-4	na	:30	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-4	na	12:48:00	na	na	na	na	0.00	3.10	17.50	0.00	0.00	79.40	29.85
VP-5	10:20	na	0.05	0.00	52%	0.00%	na	na	na	na	na	na	29.85
VP-5	na	12:35:00	na	na	na	na	0.00	0.40	20.20	0.00	0.00	79.60	29.85
VP-5	na	:30	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-5	na	:30	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-5	na	:30	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-5	na	:30	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-5	na	:30	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-5	na	12:38:00	na	na	na	na	0.00	4.40	17.20	0.00	0.00	78.30	29.85
VP-6	10:42	na	0.17	0.00	50%	0.00%	na	na	na	na	na	na	29.85
VP-6	na	12:41:00	na	na	na	na	0.00	0.00	20.00	0.00	0.00	79.60	29.85
VP-6	na	:30	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-6	na	:30	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-6	na	:30	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-6	na	:30	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-6	na	:30	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-6	na	12:44:00	na	na	na	na	0.00	0.80	19.40	0.00	0.00	79.30	29.85
VP-7	10:55	na	0.15	0.00	64%	0.00%	na	na	na	na	na	na	29.85
VP-7	na	12:49:00	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.90	29.85
VP-7	na	:30	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-7	na	:30	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-7	na	:30	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-7	na	:30	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-7	na	:30	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-7	na	12:52:00	na	na	na	na	0.00	0.10	20.60	0.00	0.00	79.30	29.85
VP-8	11:17	na	0.11	0.00	59%	0.00%	na	na	na	na	na	na	29.85



Table 1. Vapor Point Readings (continued)

Project # 3-61M-136830.01

Date: 5/17/2023

Point	Helium leak test time	Purge Time	Vac with extraction system on "H2O	Extraction system off Pressure/vac	Shroud Helium Concentration	Vapor Point He concentration	METHANE %	CO2 %	O2 %	H2S (ppm)	CO (ppm)	Balance %	BAR
VP-8	na	12:54:00	na	na	na	na	0.00	0.00	21.00	0.00	0.00	79.70	29.85
VP-8	na	:30	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-8	na	:30	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-8	na	:30	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-8	na	:30	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-8	na	:30	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-8	na	12:57:00	na	na	na	na	0.00	0.30	20.00	0.00	0.00	79.80	29.85
VP-9	12:17	na	0.24	0.00	58%	0.00%	na	na	na	na	na	na	29.85
VP-9	na	13:00:00	na	na	na	na	0.00	0.00	20.60	0.00	0.00	79.60	29.85
VP-9	na	:30	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-9	na	:30	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-9	na	:30	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-9	na	:30	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-9	na	:30	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-9	na	13:03:00	na	na	na	na	0.00	0.20	19.80	0.00	0.00	80.00	29.85
VP-10	11:37	na	0.03	0.00	63%	0.50%	na	na	na	na	na	na	29.85
VP-10	na	13:10:00	na	na	na	na	0.00	1.10	18.60	0.00	0.00	80.80	29.85
VP-10	na	:30	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-10	na	:30	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-10	na	:30	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-10	na	:30	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-10	na	:30	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-10	na	13:13:00	na	na	na	na	0.00	4.00	8.40	0.00	0.00	87.50	29.85
VP-11	11:46	na	0.04	0.00	60%	0.00%	na	na	na	na	na	na	29.85
VP-11	na	13:16:00	na	na	na	na	0.00	0.00	21.00	0.00	0.00	78.60	29.85
VP-11	na	:30	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-11	na	:30	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-11	na	:30	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-11	na	:30	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-11	na	:30	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-11	na	13:19:00	na	na	na	na	0.00	0.10	20.80	0.00	0.00	79.10	29.85
VP-12	12:05	na	0.12	na	58%	0.00%	na	na	na	na	na	na	29.85
VP-12	na	13:21:00	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	:30	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	:30	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	:30	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	:30	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	:30	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
VP-12	na	13:23:00	na	na	na	na	0.00	0.00	20.90	0.00	0.00	79.10	29.85
Ambient	12:20	na	na	na	na	na	0.00	0.00	21.20	0.00	0.00	78.80	29.85



Table 2 - Extraction Well Readings

Project # 3-61M-136830.01

Date: 5/17/2023

Personel: Jason Gardner

Extraction Point	Line size	Time	Flow (fpm)	Temp	RH%	Vac ("Hg)	CH4 %	CO2 %	O2 %	H2S (ppm)	CO (ppm)	Balance %	BAR
EX-1	2"	14:05	54.50	86.90	41.70	1.15	0.10	0.10	20.80	0.00	1.00	78.90	29.85
EX-2	2"	14:30	37.00	78.30	50.50	1.30	0.20	3.40	17.20	0.00	1.00	79.20	29.85
EX-3	2"	14:56	235.20	81.80	43.10	1.05	6.90	12.50	10.00	0.00	0.00	70.50	29.85
EX-4	2"	14:44	340.40	84.20	56.20	1.03	0.00	0.10	21.30	0.00	0.00	78.60	29.85
EX-5	2"	15:10	40.80	85.60	50.30	1.15	0.10	3.60	16.30	0.00	0.00	80.00	29.85
EX-6	2"	15:30	67.80	86.30	89.20	1.14	1.70	3.40	18.00	0.00	0.00	76.90	29.85
Blower eff	4"	15:43	190.70	88.10	47.20	pos 0.3	1.70	3.50	18.10	0.00	0.00	76.70	29.85
Blower inf	4"	15:52	140.60	87.00	37.20	1.21	2.30	4.50	17.10	0.00	0.00	76.40	29.85

Table 3. Methane Calculations						
Extraction Point	Methane (% CH ₄)	Vacuum Level (Inches Hg)	Line Size (inches)	Flow Measured (fpm)	Flow Rate (cfm)	Emissions (kg/year)
EX-1	0.1	1.15	2	54.5	1.19	0.44
EX-2	0.2	1.3	2	37	0.81	0.68
EX-3	6.9	1.05	2	235.2	5.13	119.66
EX-4	0	1.03	2	340.4	7.43	0.00
EX-5	0.1	1.15	2	40.8	0.89	0.33
EX-6	1.7	1.14	2	67.8	1.48	9.23
Blower Eff	2.3	0.3	4	190.7	16.64	36.96

Constants/Conversion/Assumptions:

Molecular weight of methane (CH ₄) =	16.04 MW (g/Mol)
Average Temperature of Air on Vacuum Side =	29 Celsius (approximately 85F)
Vacuum conversion from inches Hg to hPa =	33.8638864 hPa per 1 inch Hg at 20C
Conversion from mg/L to kg/cubic feet =	0.0000283 kg/cubic foot per 1 mg/L
Conversion from minutes to days =	1440 minutes per 1 day
Conversion from kg to metric tons =	1000 kg per 1 metric ton

Flow rate (cfm) of each subsystem taken from blower manufacturer performance curve in Figure X using vacuum level vs. flow rate curve for 60 Hz power.

Formulas for Calculations;

% methane to mg/L Methane:	$\text{mg/L} = \% \text{CH}_4 \times (M/22.4) \times (273/(273+T)) \times (10) \times (P/1013)$ M = Molecular weight of CH₄ 22.4 = volume of 1 mol at 1 atm at 0 Celsius 273 = degrees Kelvin at 0 Celsius (1 degree K = 1 degree C) 273+T = degrees Kelvin of air with T = degree Celsius P = pressure of air at point of measurement in hPa (1hPa = 1 millibar)
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mg/L of Methane to kg/cubic feet:	$\text{kg/cubic feet} = \text{mg/L} \times (1 \text{ L}/0.0353 \text{ cubic feet}) \times (1 \text{ gram}/1000 \text{ mg}) \times (1 \text{ kg}/1000 \text{ grams})$
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Reference (conversion factors): Engineering Formulas: Conversions, Definitions, and Tables, Frank Sims, 1996 1st Edition

Reference: <https://www.gastec.co.jp/en/technology/knowledge/concentration/>